

Product Catalog

Mobile Hydraulics

Part 4: Mobile Electronics, Accumulators, Filters



The complete Mobile Hydraulics Catalog from Bosch Rexroth at a glance:

Part 1	Pumps	Axial Piston Pumps, External Gear Pumps, Electrohydraulic Pumps, Gerotor Pumps	RE 90010-01
Part 2	Motors, Gears	Axial Piston Motors, External Gear Motors, Radial Piston Motors, Gears	RE 90010-02
Part 3	Mobile Controls	Control Blocks, Valve Modules, Pilot Control Devices, Power Brake Valves	RE 90010-03
Part 4	Mobile Electronics, Accumulators, Filters	Controllers, Application Software, Tools, Sensors, Displays, Video Cameras, Accumulators, Filters, Oil Measurement Technology	RE 90010-04
Part 5	Compact Hydraulics	Mechanical, Solenoid and Proportional Cartridge Valves, Integrated Circuits	RE 90010-05
Part 6	Compact Hydraulics	Load Holding/Motion Control Valves, Compact Directional Valves, Compact Power Modules	RE 90010-06

For the latest product information from Bosch Rexroth, please visit our website:

www.boschrexroth.com/mobile-hydraulics

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Should you require further technical information, please contact the Rexroth sales partner in your area.

www.boschrexroth.com/addresses

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Mobile Electronics

Controllers, application software and amplifiers

Designation	Type	Data sheet	Page
BODAS Controllers			
BODAS Controller	RC4-5/30	95205	9
BODAS Controller	RC10-10/31	95206	31
BODAS Controller	RC28-14/30, RC20-10/30, RC12-10/30	95204	57
BODAS Application software			
Application software Fan Control	AFC30	95362	81
Application software BODAS-drive	DRC	95323	97
Amplifier			
Analog amplifier	RA2-1	95230	133

BODAS controller

RC4-5 series 30

RE 95205

Edition: 11.2013

1



- ▶ For the closed and open loop control of hydraulic components

Features

- ▶ High performance thanks to ultra-modern 32-bit TriCore technology with 80 MHz
- ▶ Component of BODAS system for mobile applications
- ▶ Robust and compact design meeting specifications for mobile applications
- ▶ High Electromagnetic Compatibility (EMC)
- ▶ Inputs and outputs with fault detection
- ▶ Central output deactivation
- ▶ Pulse-Width-Modulated (PWM) solenoid currents for minimum hysteresis
- ▶ Closed-loop control of solenoid currents, i.e. not dependent on supply voltage and temperature

Main components

- ▶ Nine power outputs, 4 of which current-controlled
- ▶ Program sequence monitoring with watchdog
- ▶ CPU-internal flash memory with ECC fault recognition technique
- ▶ Four independent sensor voltage supplies
- ▶ Two independent CAN bus interfaces

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Ordering code

01	02	03
RC	4-5	/ 30

Type

01	BODAS controller	RC
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Version

02	1. Position: Number of proportional power outputs 2. Position: Number of power switching outputs	4-5
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Series

03	Series 3, index 0	30
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Notes:

- ▶ The BODAS controllers are not functional without software.
- ▶ In order to use the BODAS controllers, you also need:
 - BODAS standard software or
 - application-specific software
- ▶ If there is a sample label on the name plate, it is a prototype or sample, i.e. components not released for series production. Possible sample labels are:
 - SC: A
 - SC: B
 - SC: C
 - SC: S (prototype software)

Optional accessories

- ▶ **BODAS-design software**
The Windows-based PC software BODAS-design (see data sheet 95112) for programming the BODAS controller RC cannot be used for this controller due to the inadequate memory capacity.
- ▶ **BODAS-service software**
The windows-based PC software BODAS-service (see data sheet 95086) is used for displaying functions, errors, and system variables as well as for setting parameters via a PC.
- ▶ **C-programming interface C-API**
The programming interface C-API (see data sheet 95115) is used for programming the BODAS controllers RC in the programming language C. All required functions that are needed for the configuration and the reading of the inputs, the control of the outputs, the use of the communication interfaces and the creation of the diagnostics information for BODAS-service are available to the user in the form of a software library. Additionally, the user needs a C-compiler, with which the created program is translated into a machine code that is readable for the BODAS controller.
- ▶ **BODAS measuring adapter MA7**
The BODAS measuring adapter MA7 (see data sheet 95090) is used for measuring all electrical signals at the inputs, outputs, and interfaces of the BODAS controller. For testing purposes, it is connected in series between the controller and the vehicle or device wiring.

All products mentioned here are available from Bosch Rexroth.

Further information can be found on the Internet at:
www.boschrexroth.com/mobile-electronics

Description

The BODAS controller RC4-5/30 is designed as a universal controller for mobile working machines.

State-of-the-art 32-bit TriCore technology, a clock frequency of 80 MHz and numerous I/O functions give the controller a high power density in a very compact housing.

The controller is used for the programmable control of proportional and switching solenoids and of additional electrical switching functions. Typical applications are electrohydraulically actuated work functions, travel drives and transmission controls.

Internally the BODAS controller RC4-5 series 30 contains a powerful 32-bit TriCore microprocessor TC1724, all input and output circuitry, and a power supply unit for operation with 12 or 24 volt supply voltages.

With 9 power outputs, 6 small signal outputs, a total of 30 input channels, 4 constant voltage sources and two CAN buses for communication in the vehicle, the RC4-5/30 controllers form a powerful platform for controlling mobile working machines.

The four current-controlled, pulse-width-modulated (PWM) outputs are used in particular for controlling proportional solenoids. Current control guarantees the setpoint current even if the supply voltage or temperature of the solenoid changes, and is characterized by its minimum hysteresis. The PWM outputs match the electrical proportional control of Rexroth axial piston units and valves.

Five switching outputs can be used for switching solenoids, relays or other electrical consumers.

Of the input channels, five are used to measure frequency signals. Two of these inputs are configured for active frequency sensors. Two other frequency inputs are specified for the intelligent Rexroth DSM1-10 speed sensors with integrated diagnosis function. An inductive speed sensor can be connected at the fifth frequency input.

Four resistance inputs are used, for example, to directly connect temperature sensors.

The other inputs can be used for measuring analog voltages or as switching inputs.

The inputs are protected against overvoltage and electrical interference. The voltage inputs can be monitored to detect cable breaks or short circuits.

CAN bus interfaces are available with all BODAS controllers RC for exchanging data with other bus users or electronic systems (e.g. controller RC, CAN extension modules RCE, joystick, engine control unit, display).

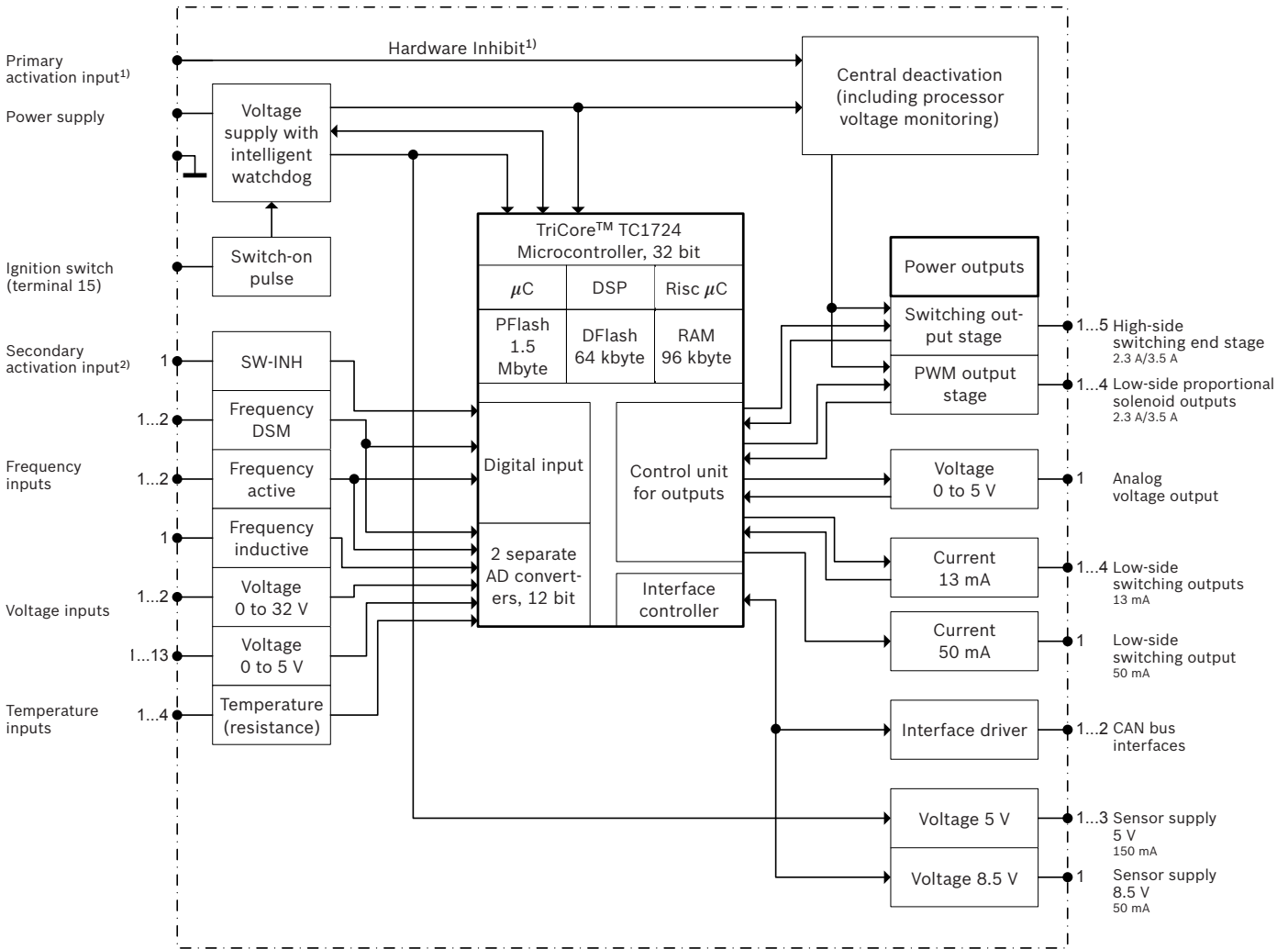
Two independent CAN bus interfaces, each of which can be operated with various protocols, are available in the RC4-5/30 BODAS controller. Communication with a service tool is also conducted via a CAN interface. The RC4-5/30 controller is supported as standard by the Rexroth tool BODAS-service.

An application interface in the form of a C-API is available for programming the controller. This allows the software developer to concentrate on the important functions of his machine without having to become immersed in the details of the TriCore technology and the hardware of the controller.

With the BODAS-service software, the programs can be quickly and simply downloaded to the controller via the Flash module. Extensive service functions, such as diagnostics, parameter setting or display of process variables are available via the graphical Windows interface of BODAS-service. This enables simple parameter setting and diagnostics in order to place the machine in service quickly and safely.

The BODAS controllers RC were developed specifically for use in mobile working machines and satisfy corresponding protection requirements regarding ambient temperatures, water and dust ingress, shock and vibration as well as Electromagnetic Compatibility (EMC). BODAS controllers RC and corresponding software in combination with pumps, motors, valves, sensors, input devices and actuators from Rexroth make for complete system solutions.

Block circuit diagram



Abbreviations

μ C	Microcontroller
DSP	Digital signal processor
RISC	Reduced instruction set computer
PFlash	Program flash
DFlash	Data flash (e.g. for parameter storage)
RAM	Random Access Memory

- 1) Input that is independent of the microcontroller, for the central enabling/deactivation of the power outputs.
2) Input for the central activation/deactivation of the power outputs.

Technical data

Nominal voltage		
Nominal	12 V DC and 24 V DC	✓
Supply voltage, permissible range	8 V DC to 32 V DC	✓
Current consumption		
Without load, in the 12 V vehicle electrical system	150 mA	✓
Without load, in the 24 V vehicle electrical system	90 mA	✓
Fuses		
Internal		–
External in supply path	max. 15 A	✓
Constant voltage source		
150 mA	5 V ±4%	3
50 mA	8.5 V ±5%	1
Analog voltage inputs, total		28
(can be used as a switching input, see alternative function)		
0 to 5 V		18
0 to 32 V		10
Digital switching inputs		1
Resistance inputs		
	10 Ω to 20 kΩ	4
Frequency inputs total		5
Active sensors	from 0 to 20 kHz,	2
DSM	from 0 to 20 kHz,	2
Inductive sensors	from 500 to 20 kHz,	1
Analog voltage output		1
	0 to 5 V	1
Proportional solenoid output, total		4
Current-controlled low-side PWM output stage	0 to 2.3 A, PWM up to 1 kHz	2
	0 to 3.5 A, PWM up to 1 kHz	2
Digital output stages total		5
Non-current-controlled low-side PWM output stage	max. 2.3 A, PWM up to 250 Hz	1
	max. 3.5 A, PWM up to 250 Hz	4
Low-side driver output		5
Low-side driver output, current-limited	to 13 mA	4
	to 50 mA	1
Interfaces		
CAN 2.0 B, ISO 11898, max. 500 kBaud		2
Fault detection in the event of cable break and short circuit		
Inputs		✓
Outputs		✓
CAN		✓
Protection against short circuits¹⁾ to supply voltage and ground		
(Requirement: controller is powered and switch-on signal at terminal 15 is on High)		
Inputs		✓
Outputs ¹⁾		✓
CAN ¹⁾		–

¹⁾ The output OUT_14 and the CAN interfaces are not durably protected against short circuit to battery voltage.

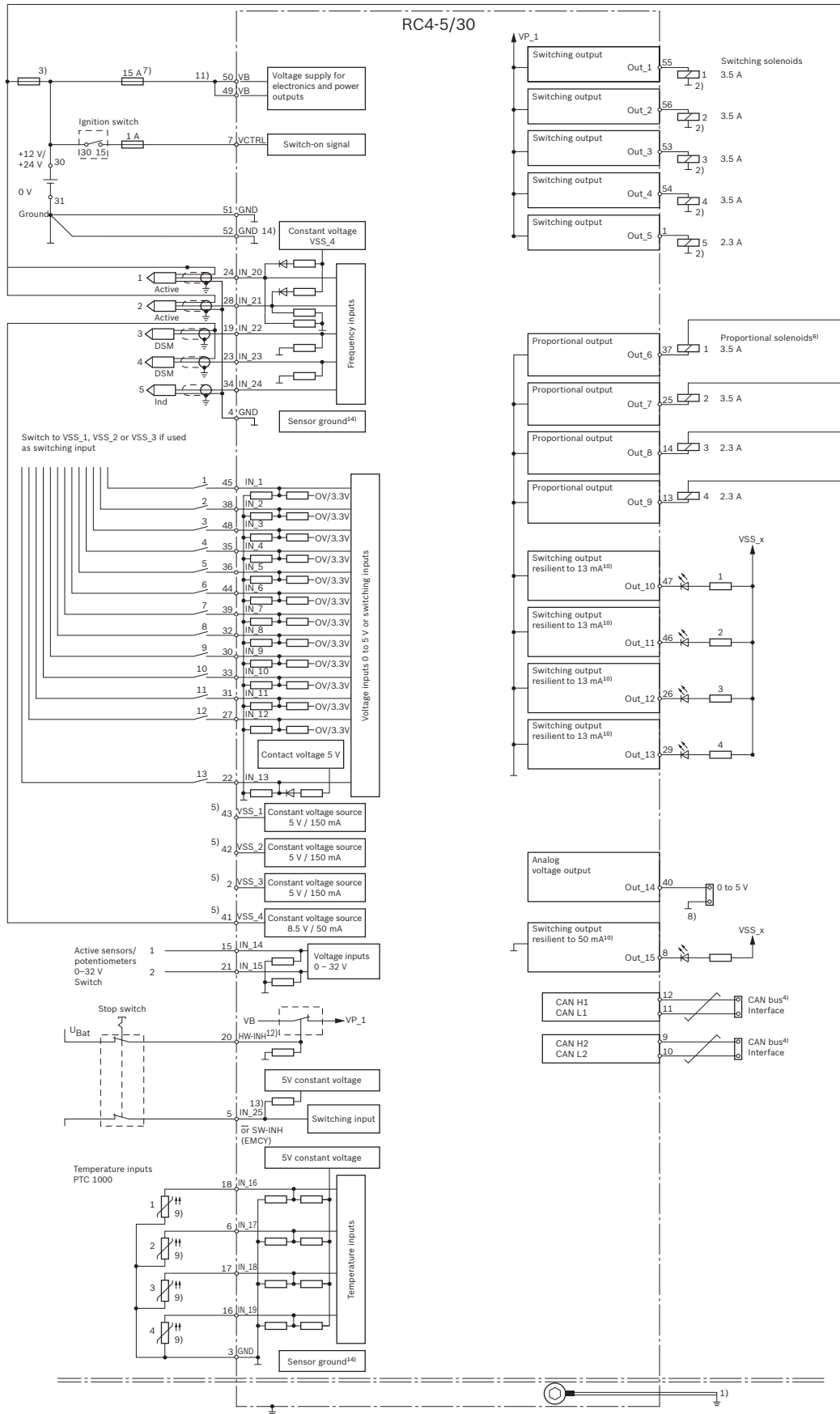
Reverse polarity protection		
Power supply / battery ¹⁾		–
Microcontroller		
		SAK-TC1724
Clock frequency		
	MHz	80
Internal memory capacity in microcontroller		
RAM	kB	96 kbyte
DFlash	kB	64 kbyte
PFlash	kB	1.5 Mbyte
Software installation		
Download in PFlash		✓
Electromagnetic compatibility		
Spurious interference (ISO 11452-2)	200 VRMS/m	✓
Spurious interference (ISO 11452-5)	BCI: 100 mA	✓
Load dump with 12 V battery voltage		✓
Load dump with 24 V battery voltage		–
Electrostatic Discharge ESD (according to ISO 10605)		
Out of service	8 kV	✓
In service	15 kV	✓
Maximum power dissipation		
Electronics	W at 32 V	approx. 3
Output stages	W at 32 V	15
Operating temperature, housing		
With mounting point on cooling surface	–40 to +85 °C (–40 to +185 °F)	✓
Storage temperature, housing		
Maximum permissible housing temperature momentary, passive:	–40 to +105 °C (–40 to +221 °F)	✓
Vibration resistance, broadband noise oscillations (ISO 16750-3)		
	57.9 m/s ² , 10 to 1000 Hz, 32 h per axis	
	10 Hz: 18 (m/s ²) ² /Hz	
	20 Hz: 36 (m/s ²) ² /Hz	✓
	30 Hz: 36 (m/s ²) ² /Hz	
	180 Hz: 1 (m/s ²) ² /Hz	
	2000 Hz: 1 (m/s ²) ² /Hz	
Shock resistance		
Transport shock (IEC 60068-2-27)	a = 30 m/s ² ; t = 11 ms per spatial axis x, y, z and in each direction (pos./neg.)	✓
Moisture resistance (IEC 60068-2-30Db; version 2)		
	90–96 % (+25 °C to +55 °C)	✓

¹⁾ Reverse polarity protection can be realized by external fusing

Spray mist humidity test (IEC 60068-2-52Kb)		
	4x 2 h	
	5% NaCl	✓
	72 h 40 °C / 93 % rF	
Salt spray resistance (DIN EN ISO 9227)		
	5 % NaCl, Ph value 6.5–7.2	✓
	144 h 35 °C	
Type of protection (DIN / EN 60529) with installed mating connector ¹⁾		
	IP66	✓
Housing material		
Cover	Deep-drawn sheet metal	✓
Base	Deep-drawn sheet metal	✓
Weight		
	approx. in kg	0.2 kg
Outer dimensions Without mating connector, with multipoint connector		
	Length (in mm)	140
	Width (in mm)	123
	Height (in mm)	43
Mating connector		
	56-pin	1 ²⁾

1) While following the installation instructions
 2) Second connector chamber not used

Connection diagram



For footnotes, see page 9

- 1) Short, low-resistance connection from a case screw to the vehicle ground.
- 2) Own ground connection to battery (chassis possible).
- 3) Separate fuse protection for sensors supplied from UBat, and solenoids switched to ground. Fuse configuration specific to application (in particular current needed and line cross section).
- 4) CAN bus: 120 Ω termination resistor and twisted line necessary.
- 5) Constant voltage sources can be used as sensor supply or switching voltage for switches/push-buttons.
- 6) The power line to consumers wired to ground must be fused, see 3).
- 7) Can be adjusted to the actual current consumption of the consumers and must be adjusted to the permissible loading of the lines and pins.
- 8) Independent ground connection of the current source to the battery, controller ground possible.
- 9) Can be used as switching inputs.
- 10) Alternatively, can be used as input.
- 11) If deactivated during operation, data will not be saved in the non-volatile memory and there will be no after run.
- 12) First deactivation channel: deactivation with level < 3.1 V; activation with level > 7.9 V.
 When deactivated, the main switch for the power supply to the high-side output stages is opened by the hardware and the low-side output stages are deactivated.
- 13) Second deactivation channel: deactivation with level > 1.3 V; activation with level < 0.9 V.
 If used as SW-INH, main switch opened and low-side output stages deactivated by the software.
- 14) Terminal 31 (ground supply) and sensor ground are joined at a star point in the controller and are connected to the housing.

Note

- ▶ To switch off the system in emergencies, the power supply to the controller must be disconnected by an emergency-stop switch.
 The emergency-stop switch must be installed in an easily accessible position for the operator.
 Safe braking must be ensured when the emergency stop function is activated.
- ▶ All GND pins are connected together on the circuit board. Maximum permissible currents depend on the contacts used (pins 51 and 52: MQS 1.5 CB; pins 3 and 4: BCB 0.6) and on the lines used.
- ▶ Lines to the controller must not be routed close to other power-conducting lines in the device.
- ▶ The proportional solenoids must not be wired with spark-suppression diodes.
 Switching solenoids at the outputs of the controller do not need to be connected to spark-suppression diodes.
 Other externally wired inductive consumers in the system must be wired with spark-suppression diodes.
- ▶ For information about mating connectors and contacts, please refer to Bosch offer drawing 1 928 A00 443.
- ▶ The fuses illustrated act as line protection.

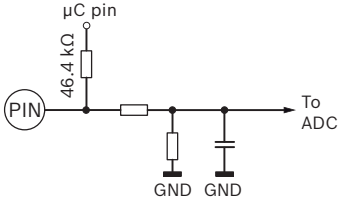
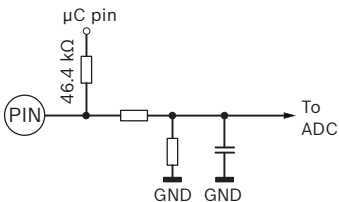
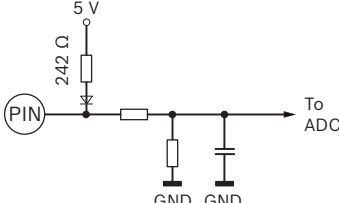
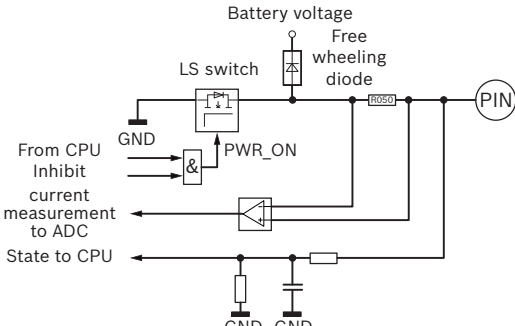
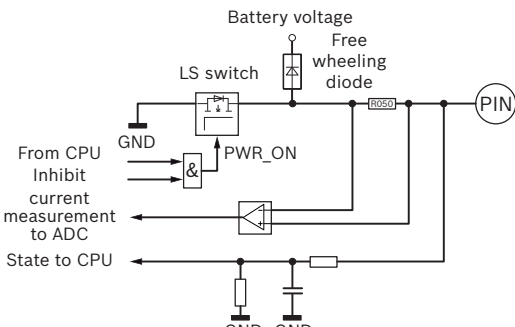
Overview of the functions

Pin ¹⁾	Description	Main function	Alternative function
49, 50	Voltage supply VB (terminal 30)	Power supply for electronics and output stages Nominal 12 V DC or 24 V DC Operating range 8 V DC to 32 V DC	
51, 52	Vehicle ground GND	Supply ground (internally connected to pins 3 and 4)	
3, 4	Vehicle ground GND	Sensor ground (internally connected to pins 51 and 52)	
20	Hardware Inhibit HW-INH	Primary activation input Hardware deactivation function for all power output stages Activation level > 7.9 V Deactivation level < 3.1 V	
5	Software Inhibit SW-INH or switching input IN_25	Secondary activation input Software deactivation function for all power output stages Activation level < 0.9 V Deactivation level > 1.3 V	Digital switching input High level > 0.9 V Low level < 1.3 V Pull-Up 10 kΩ to 5 V
7	Ignition switch VCTRL (terminal 15)	Digital input Switch on controller with level > 8 V and ≤ supply voltage VB Pull-down 10.5 kΩ	
24, 28	Active frequency input IN_20, IN_21	Frequency input for active sensors Cut-off frequency filter 22 kHz Frequency measurement up to 20 kHz Level Low < 1.35 V Level High > 3.56 V, ≤ VB Pull-up 4.64 kΩ to 8.5 V (VSS_4) Pull-down 40.42 kΩ	Analog input Measuring range: 0 to 32 V Resolution: 12 bit Digital input Level in software configurable up to 32 V Pulse counter input Pulse width measurement Measurement of pulse/pause ratio

1) Pin numbers in bold type are for MQS 1.5-CB contacts; others are for BCB 0.6 contacts

Pin ¹⁾	Description	Main function	Alternative function
19, 23	DSM frequency input IN_22, IN_23	Frequency input for Rexroth DSM sensors Cut-off frequency filter 26 kHz Frequency measurement up to 20 kHz Evaluation of additional information such as direction of rotation and fault monitoring possible Switching thresholds 7 mA / 14 mA Internal resistance 200 Ω to ground VSS_4 can be used as power supply for DSM frequency sensors.	Frequency input for active sensors wired to High, type PNP Level Low < 1.7 V Level High > 2.2 Pull-down 11.24 kΩ Analog input Measuring range: 0 to 32 V Resolution: 12 bit Digital input Level in software configurable up to 32 V Pulse counter input Pulse width measurement Measurement of pulse/pause ratio
	34	Inductive frequency input IN_24	Frequency input for inductive frequency sensors Cut-off frequency filter 22 kHz Frequency measurement from 500 to 20 kHz, Pulse counter input Pulse width measurement Measurement of pulse/pause ratio
	18, 6, 17, 16	Resistance input IN_16, IN_17, IN_18, IN_19	Temperature measurement via resistance measurement of connected temperature sensors Evaluation of passive temperature sensors with PTC measurement resistor from 10 Ω to 20 kΩ Support from Rexroth Temperature sensors TSF and TSA Pull-up 2.15 kΩ to 5 V Pull-down 117.8 kΩ
	15, 21	Analog input IN_14, IN_15	Analog input Measuring range: 0 to 32 V Resolution: 12 bit Pull-down 54.65 kΩ

1) Pin numbers in bold type are for MQS 1.5-CB contacts; others are for BCB 0.6 contacts

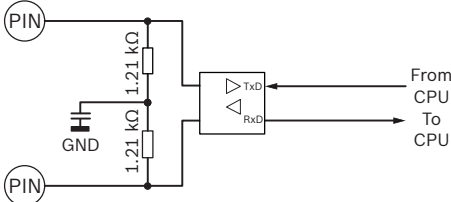
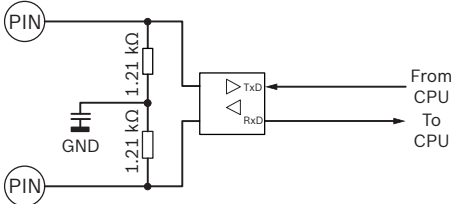
Pin ¹⁾	Description	Main function	Alternative function
45, 38, 48, 35, 36, 44	Analog input IN_1 to IN_6	Analog input Measuring range: 0 to 5 V Resolution: 12 bit	Digital input Level in software configurable up to 5 V
		If μ C pin is switched to 3.3 V: Pull-up 46.4 k Ω Pull-down 117.8 k Ω	
		If μ C pin is switched to ground: Pull-down 33.29 k Ω	
39, 32, 30, 33, 31, 27	Analog input IN_7 to IN_12	Analog input Measuring range: 0 to 5 V Resolution: 12 bit	Digital input Level in software configurable up to 5 V
		If μ C pin is switched to 3.3 V: Pull-up 46.4 k Ω Pull-down 249.8 k Ω	
		If μ C pin is switched to ground: Pull-down 39.13 k Ω	
22	Analog input IN_13	Analog input Measuring range: 0 to 5 V Resolution: 12 bit	Digital input Level in software configurable to 5 V
		Pull-up 242 Ω via diode to 5 V Pull-down 232.8 k Ω	
37, 25	PWM output stage OUT_6, OUT_7	Closed-loop current controlled Low side PWM output stage	Digital input Level in software configurable to 5 V
		Pulse frequency in software adjustable in defined steps of 50 Hz to 1 kHz	
		Duty cycle 0% to 100%	
		Max. current 3.5 A	
		Can only be operated when the master switch VP_1 is activated	
14, 13	PWM output stage OUT_8, OUT_9	Closed-loop current controlled Low side PWM output stage	Digital input Level in software configurable to 5 V
		Pulse frequency in software adjustable in defined steps of 50 Hz to 1 kHz	
		Duty cycle 0% to 100%	
		Max. current 2.3 A	
		Can only be operated when the master switch VP_1 is activated	

1) Pin numbers in bold type are for MQS 1.5-CB contacts; others are for BCB 0.6 contacts

Pin ¹⁾	Description	Main function	Alternative function
55, 56, 53, 54	Switching end stage OUT_1, OUT_2, OUT_3, OUT_4	High-side switching output stage with current sensing max. 3.5 A Central power supply via VP_1	Open-loop controlled PWM output stage with current sensing Duty cycle 0% to 100% Pulse frequency in software adjustable in defined steps up to 250 kHz max. 3.5 A Central power supply via VP_1
1	Switching end stage OUT_5	High-side switching output stage with current sensing max. 2.3 A Central power supply via VP_1	Open-loop controlled PWM output stage with current sensing Duty cycle 0% to 100% Pulse frequency in software adjustable in defined steps up to 250 kHz max. 2.3 A Central power supply via VP_1
47, 46, 26, 29	Small signal switching output OUT_10, OUT_11 OUT_12, OUT_13	Low-side driver output Limited to 13 mA (current limitation in case of overload) e.g. for LED with external resistor	Analog input (when driver output is deactivated) Measuring range: 0 to 32 V Resolution: 12 bit Pull-down 30.74 kΩ
8	Small signal switching output OUT_15	Low-side driver output Limited to 50 mA (current limitation in case of overload) e.g. for LED with external resistor	
40	Analog output OUT_14	Analog voltage output Output signal 0 to 5 V 1 kΩ external load required	Analog input (when driver output is deactivated) Measuring range: 0 to 5 V Resolution: 12 bit Pull-down 20 kΩ

1) Pin numbers in bold type are for MQS 1.5-CB contacts; others are for BCB 0.6 contacts

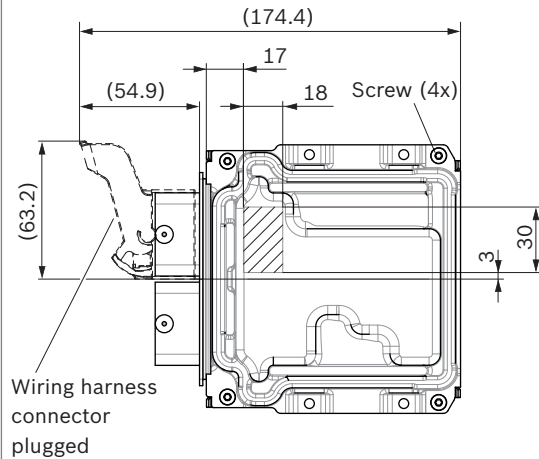
14 **RC4-5 series 30** | BODAS controller
Overview of the functions

Pin ¹⁾	Description	Main function	Alternative function
43, 42, 2	Sensor supply VSS_1, VSS_2, VSS_3	Power supply for external sensors Output voltage: 5.0 V Accuracy ±4% Load capacity: 150 mA	
		These pins must not be bridged!	
41	Sensor supply VSS_4	Power supply for external sensors Output voltage: 8.5 V Accuracy ±5% Load capacity: 50 mA	
		In particular used as power supply for DSM frequency sensors	
12, 11	CAN interface CAN1_H, CAN1_L	CAN interface CAN 2.0 B, up to 500 kBaud	
		Termination resistor 120 Ω externally required	
		Standard diagnosis interface with 250 kBaud factory setting	
			
9, 10	CAN interface CAN2_H, CAN2_L	CAN interface CAN 2.0 B, up to 500 kBaud	
		Termination resistor 120 Ω externally required	
			

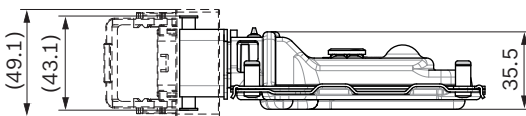
1) Pin numbers in bold type are for MQS 1.5-CB contacts; others are for BCB 0.6 contacts

Dimensions

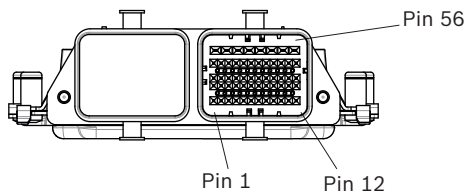
View from below



Long-side side view



Side view of connector side with pulled connector



Plan view

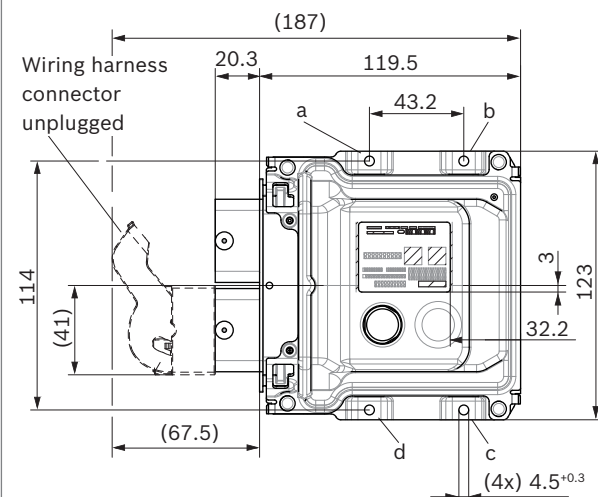


Illustration not to scale

Mounting

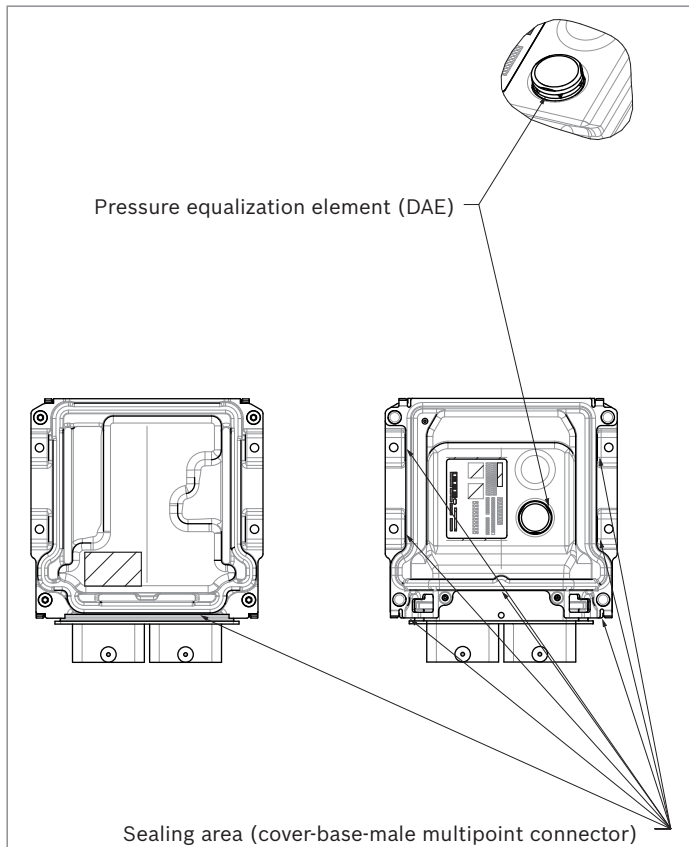
- ▶ The BODAS controller must be fastened at 4 points (a, b, c and d).
- ▶ The 4 mounting points must have an evenness of 0.5 mm.
- ▶ The upper limit for surface pressure on the screwing areas of the controller is 140 N/mm².
- ▶ It must be ensured that the screw fitting cannot come loose unexpectedly.
- ▶ The wiring harness should be fixed mechanically in the area in which the controller is installed (spacing < 100 mm).
- ▶ The wiring harness should be fixed so that in-phase excitation with the controller occurs.
- ▶ The wiring harness connector is not included in the scope of supply.
- ▶ Bosch Rexroth's consent is required if fixing is different from above.

Installation position

The installation position must be chosen such that no standing or continuously flowing water can occur in the area of the pressure equalization element (DAE) and the sealings.

The pressure equalization element (DAE) and the sealing area must not be immersed in water.

The controller must not bounce in the mounting position (case of installation).



Mating connector

A 56-pin module from Bosch is used as wiring harness connector. The 1928xxx numbers stated below are Bosch designations. Technical details about these document and part numbers are available at www.bosch-connectors.com.

Installation specification	1928 A01 41M
Technical customer documentation	1928 A01 40T
Offer drawing (assembly)	1928 A00 443

The following parts are required for assembling a wiring harness connector:

Designation	Version	Part number	Manufacturer	Number
Contact carrier, code 13	Wire outlet left	1928 405 161	Bosch	1
	Wire outlet right	1928 405 217	Bosch	
Cover	Outlet up	1928 405 164	Bosch	1
	Outlet straight	1928 405 163	Bosch	
Secondary lock		1928 405 165	Bosch	1
Holding plate		1928 405 162	Bosch	1
Wire tie		1928 401 713	Bosch	1
Contact BCB 0.6	Line cross section in mm ² 0.35 mm ² – 0.5 mm ² Insulation diameter in mm 1.2 – 1.6 (FLR-B)	1928 492 555	Bosch	up to 48 ¹⁾
	Line cross section in mm ² 0.75 Insulation diameter in mm 1.7 – 1.9 (FLR-B)	1928 492 556	Bosch	
Contact MQS 1.5-CB	Line cross section in mm ² 0.75 – 1.5 Insulation diameter in mm 1.7 – 2.4 (FLR)	1241608-1	TE connectivity (www.te.com)	up to 8 ¹⁾
Dummy contact BCB 0.6 blue		1928 405 239	Bosch	1)
Dummy contact MQS 1.5-CB green		1928 405 240	Bosch	1)

For part numbers of tools (crimping tongs, contact removal tools, etc.), see Bosch offer drawing.

1) Free contact chambers are to be sealed with dummy contacts to ensure water-tightness.

18 **RC4-5 series 30** | BODAS controller
Mating connector

Mating connector sets with the following content are available under Rexroth part number R917008789 for the manual assembly of wiring harness connectors for laboratory or small-series requirements:

Designation	Version	Part number	Manufacturer	Number
Contact carrier, code 13	Wire outlet right	1928 405 217	Bosch	1
Cover	Outlet straight	1928 405 163	Bosch	1
Secondary lock		1928 405 165	Bosch	1
Holding plate		1928 405 162	Bosch	1
Contact BCB 0.6	Line cross section in mm ² 0.35 – 0.5 Insulation diameter in mm 1.2 – 1.6 (FLR-B)	1928 492 555	Bosch	48
Contact MQS 1.5-CB	Line cross section in mm ² 0.75 – 1.5 Insulation diameter in mm 1.7 – 2.4 (FLR)	1241608-1	TE connectivity (www.te.com)	8
Dummy contact BCB 0.6 blue		1928 405 239	Bosch	30
Dummy contact MQS 1.5-CB green		1928 405 240	Bosch	4

Delivered loose in a PE bag. Not suitable for processing by a machine.

Safety instructions

General instructions

- ▶ External measures in the vehicle are required to implement commonly used safety standards for mobile working machines with the RC4-5/30 controller. If necessary, please contact Bosch Rexroth in this regard.
- ▶ Reliable operation cannot be guaranteed if samples or prototypes are used in series production machines.
- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ Incorrect connections could cause unexpected signals at the outputs of the controller.
- ▶ Incorrect programming or parameter settings on the controller may create potential dangers while the machine is in operation. It is the responsibility of the machine manufacturer to determine dangers of this type in a danger analysis and to bring them to the attention of the end user. Bosch Rexroth shall assume no liability for dangers of this kind.
- ▶ The component firmware/software must be installed and removed by Bosch Rexroth or by the authorized partner concerned in order to uphold the warranty.
- ▶ It is not permissible to open the controller or to modify or repair the controller. Modification or repairs to the wiring could result in dangerous malfunctions. Repairs to the controller may only be performed by Bosch Rexroth or by an authorized partner.
- ▶ A stop switch can be used for deactivation of the controller (refer to the connection diagram).
- ▶ When the electronics is not energized no pins must be connected to a voltage source. Thus, when the current supply is switched off, the supply for the electronics, the output stages and the external sensor supply have to be switched off together.
- ▶ Make sure that the controller's configuration does not lead to safety-critical malfunctions of the complete system in the event of failure or malfunction. This type of system behavior may lead to danger to life and/or cause much damage to property.
- ▶ System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- ▶ While commissioning and maintenance the controller (with BODAS Tools) the machine may pose unforeseen dangers. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.

- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.
- ▶ Controller used to develop software may only be installed in series production machines if it can be guaranteed that these controller have not been flash-programmed with new software more than 500 times. Controllers that have been programmed more than 1000 times are not to be installed in series production machines.

Notes on the installation location and position

- ▶ Do not install the controller close to parts that generate considerable heat (e.g. exhaust).
- ▶ Radio equipment and mobile telephones must not be used in the driver's cab without a suitable antenna or near the control electronics.
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ All connectors must be unplugged from the electronics during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.
- ▶ The controller must not be electrostatically charged, e.g. during painting operations.
- ▶ The controller will heat up beyond normal ambient temperature during operation. To avoid danger caused by high temperatures, it should be protected against contact.
- ▶ Install the controller in such a way that the connector is pointing downwards. This ensures that any condensation water that may form can flow out.
- ▶ Standing and permanently running water are not permitted anywhere near the circumferential sealing (cover/base/connector) or the pressure equalizing element (DAE).
- ▶ The housing must be wired to vehicle ground in order to comply with EMC guidelines. Metallic screws must be used to create a connection to vehicle ground.

Notes on transport and storage

- ▶ If it is dropped, the controller must not be used any longer as invisible damage could have a negative impact on reliability.
- ▶ Controllers must be stored at a temperature between -40 °C and +40 °C. Up to 1000 hrs are permissible between +40 °C and +85 °C. Up to 200 hrs are permissible between +85 °C and +105 °C. Air humidity up to 96% at 55 °C.
- ▶ After a storage time of more than 5 years, the controller must be examined by the manufacturer.

Notes on wiring and circuitry

- ▶ The electronics and the power outputs of a controller must be fed from the same power source.
- ▶ Lines to the speed sensors must be designed as short as possible and be shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The controller may only be wired when it is de-energized.
- ▶ Lines to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The wiring harness should be fixated mechanically in the area in which the controller is installed (spacing < 100 mm). The wiring harness should be fixated so that in-phase excitation with the controller occurs (e.g. at the controller mounting points).
- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.
- ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.

- ▶ PWM outputs (OUT_6 to OUT_9) must not be connected to each other or bridged. No lights are to be operated at these outputs.
- ▶ None of the sensor supplies VSS_x is to be connected to one or more sensor supply VSS_x.
- ▶ The sensor supplies VSS_x can be "pulled up" by external connection, e.g. the application of a higher voltage, because they operate only as a voltage source but not as a voltage sink. Pulling up a sensor supply may result in unexpected malfunctions and damage of the controller in lasting operation.
- ▶ The "high side" (OUT_1 to OUT_5) outputs may not be externally connected to battery.

Note on proportional and switching solenoids and other wired inductive consumers

- ▶ The proportional solenoids must not be wired with spark-suppression diodes.
- ▶ Switching solenoids at the outputs of the controller do not need to be connected to spark-suppression diodes.
- ▶ The electronics may only be tested with the proportional solenoids connected.
- ▶ Other inductive loads that are in the system but not connected to the controller must be connected to spark-suppression diodes. The same applies to relays if these have the same power supply as the controller.

Intended use

- ▶ The controller is designed for use in mobile working machines provided no limitations / restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the controller must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, current, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the controller other than that described in chapter "Intended use" is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, interference in the component not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ The customer is responsible for performing a risk analysis of the mobile working machine and determining the possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.).
 For example, a suitable assignment of input values (e.g. by connecting the acceleration pedal signal to two independent analog inputs) can be used to detect faults and to activate specially programmed reactions. Special measures may be initiated if the plausibility check shows deviations between the setpoint values and the values read back by the microcontroller.
- ▶ Please consult Bosch Rexroth if you require product data for a safety assessment of the machine.
 - Notes about all controllers in the API description (manual) must be observed.

Safety features in the BODAS controller

- ▶ Faults in the voltage supply are detected by internal monitoring.
- ▶ All output signals can be monitored by the microcontroller with the appropriate software.
- ▶ For service purposes, the controllers can be operated with all power outputs de-energized.
- ▶ The internal watchdog module centrally switches off the power supply of all proportional and switching outputs in the event of disturbances to the program execution.

Further information

- ▶ In addition, the application-specific documents (connection diagrams, software descriptions, etc.) are to be observed.
- ▶ Further information about the BODAS controllers can be found at www.boschrexroth.com/mobile-electronics

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BODAS Controller

RC10-10 Series 31

RE 95206

Edition: 06.2016

Replaces: 05.2016

1



- ▶ For closed- and open-loop control of hydraulic components

Features

- ▶ High performance thanks to 32-bit TriCore technology with 270 MHz
- ▶ Component of the BODAS system for mobile applications
- ▶ Robust and compact design meeting specifications for mobile applications
- ▶ High Electromagnetic Compatibility (EMC)
- ▶ Inputs and outputs with fault detection
- ▶ Central output deactivation
- ▶ Pulse-Width-Modulated (PWM) solenoid currents for minimal hysteresis
- ▶ Closed-loop control of solenoid currents, i.e. not dependent on supply voltage and temperature

Main components

- ▶ 20 power outputs, 10 of which current-controlled
- ▶ 9 low power signal outputs
- ▶ 46 multi-functional input pins
- ▶ Program sequence monitoring with watchdog
- ▶ Two independent sensor voltage supplies
- ▶ Four independent CAN bus interfaces (one of which useable for ISOBUS and one with wake-up function)
- ▶ One LIN interface

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Ordering code

01	02	/	03
RC	10-10	/	31

Type

01	BODAS controller	RC
----	------------------	-----------

Version

02	1 st number: number of proportional power outputs ¹⁾ 2 nd number: number of power switching outputs	10-10
----	---	--------------

Series

03	Series 3, index 1	31
----	-------------------	-----------

Notes:

- ▶ The BODAS controllers are not functional without software.
- ▶ In order to use the BODAS controllers, you also need:
 - BODAS standard software or
 - application-specific software
- ▶ If there is a sample label on the name plate, it is a prototype or sample, i.e., components not released for series production.

Possible sample labels are:

- SC: A
- SC: B
- SC: C
- SC: S (prototype software)

Optional accessories

▶ BODAS-design software

The windows-based PC software BODAS-design (see data sheet 95112) can be used for programming this BODAS RC controller. All graphical and textual programming languages specified according to IEC 61131-3 are available. Restrictions regarding the languages apply for safety related applications (see safety-relevant project planning instruction).

▶ BODAS-service software

The windows-based PC software BODAS-service (see data sheet 95086) is used for displaying functions, errors and system variables as well as for setting parameters via a PC. It is also used for flashing programs from a PC onto the controller.

▶ C programming interface C-API

The programming interface C-API (see data sheet 95115) can be used for programming this BODAS RC controller in the programming language C. All required functions that are needed for the configuration and the reading of the inputs, the control of the outputs, the use of the communication interfaces and the creation of the diagnostics information for BODAS-service are available to the user in the form of a software library.

Additionally, the user needs a C Compiler, with which the created program is translated into a machine code that is readable for the BODAS controller.

▶ BODAS measuring adapter MA8

The BODAS measuring adapter MA8 (see data sheet 95090) facilitates measuring all electrical signals at the inputs, outputs and interfaces of the BODAS controller. For testing purposes, it is connected in series between the RC controller and the vehicle or device wiring.

▶ BODAS TB3 test box

The BODAS test box TB3 is used for simulation of vehicle and device functions for development and testing purposes with BODAS controllers. The BODAS TB3 test box is connected to the controller via an adapter cable. A stencil provides channel designations specific for this controller. For details see data sheet 95092.

All products mentioned here are available from Bosch Rexroth.

Further information can be found on the internet at:
www.boschrexroth.com/mobile-electronics

¹⁾ Includes Low-side proportional outputs that must be used in combination with High-side outputs.

Description

The BODAS controller RC10-10/31 is designed as a universal controller for mobile working machines. State-of-the-art 32-bit TriCore technology, a clock frequency of 270 MHz and numerous I/O functions account for a controller with high power density in a compact housing. The controller is used for the programmable control of proportional and switching solenoids as well as additional electrical switching functions. Typical applications are electrohydraulically actuated work functions, travel drives and transmission controls.

Internally the BODAS controller RC10-10 series 31 contains a powerful 32-bit TriCore microprocessor TC1793, all input and output circuitry and a power supply unit for operation with 12 or 24 volt nominal supply voltages.

With 20 power outputs, 9 small signal outputs, a total of 51 input channels, two constant voltage sources and four CAN buses for communication in the vehicle, the RC10-10/31 controllers form a powerful platform for controlling mobile working machines.

The ten current-controlled, pulse-width-modulated (PWM) outputs are used in particular for controlling proportional solenoids. Current control guarantees the set-point current even if the supply voltage or the temperature of the solenoid changes and it is characterized by minimal hysteresis. The PWM outputs match the electrical proportional control of Rexroth axial piston units and valves. 10 switching outputs can be used for switching solenoids, relays or other electrical consumers.

Up to 12 inputs may be used to measure frequency signals. Eight of these inputs are configured for active frequency sensors and six of these can read in Rexroth DSM1-10 speed sensors with integrated diagnosis function.

Four resistance inputs are used, for example, to directly connect temperature sensors and may be used to acquire frequency signals alternatively.

Eight inputs can be used for connecting sensor via the SAE J2716 SENT interface.

The other inputs can be used for measuring analog voltages or as switching inputs.

The inputs are protected against overvoltage and electrical interference. The voltage inputs can be monitored to detect cable breaks or short circuits.

CAN bus interfaces are available with all BODAS controllers RC for exchanging data with other bus users or electronic systems (e.g. controller RC, I/O extension module, joystick, engine control unit, display).

Four independent CAN bus interfaces, each of which can be operated with various protocols, are available in the RC10-10/31 BODAS controller. One of these CAN interfaces can be used to wake up the controller. Another one features ISOBUS termination. Communication with a service tool is also conducted via a CAN interface. The RC10-10/31 controller is supported as standard by the Rexroth tool BODAS-service.

An application interface in the form of a C-API is available for programming the controller in high level language C. This allows the software developer to concentrate on the important functions of the machine without having to become immersed in the details of the TriCore technology and the hardware of the controller.

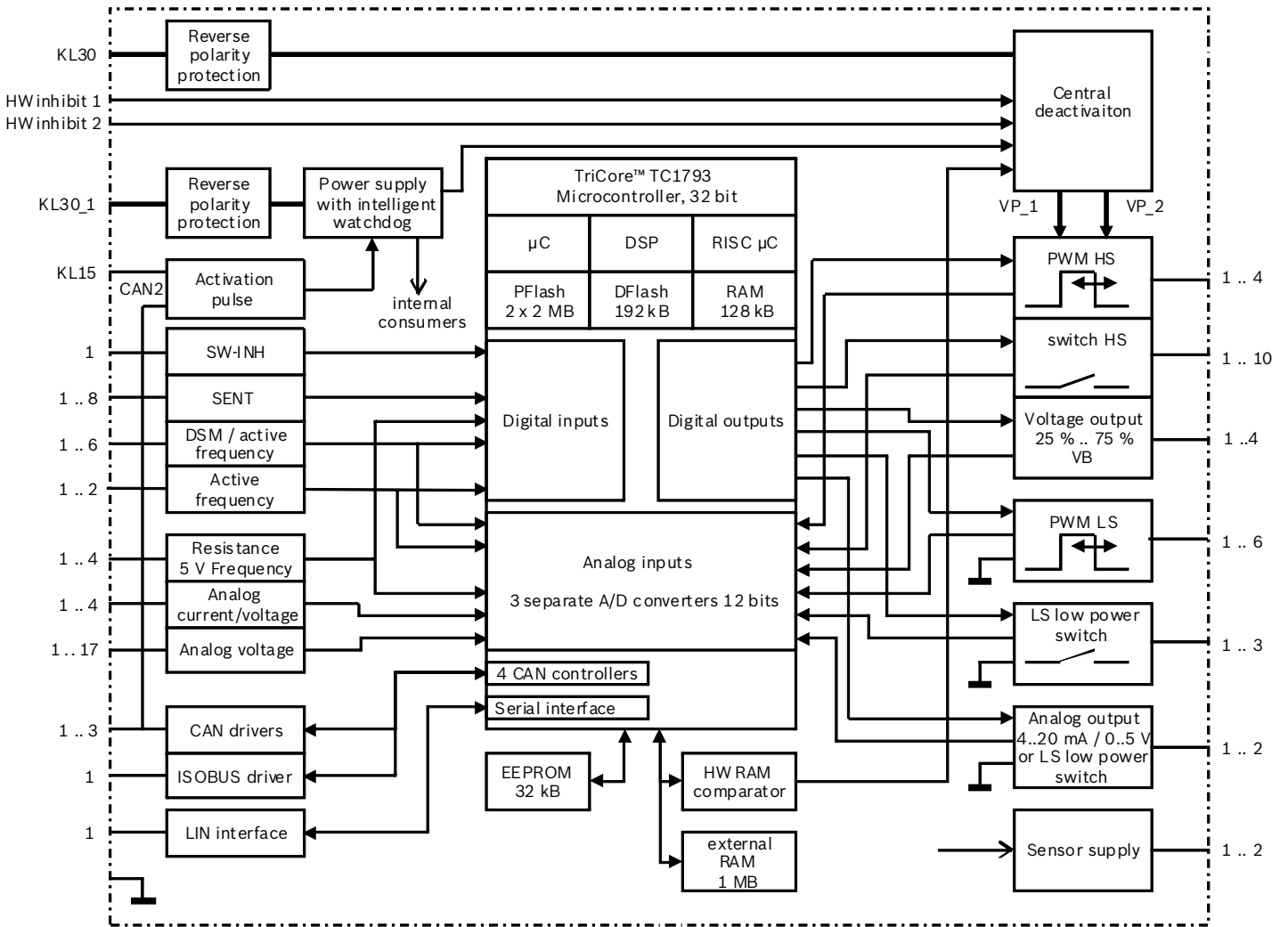
Simple and flexible programming of the BODAS controller according to the industry standard IEC 61131-3, which enables a very convenient and rapid introduction to the programming of the RC10-10/31, is possible with the BODAS-design software. Comprehensive and complex applications can be conveniently developed and clearly represented with BODAS-design.

With the BODAS-service software, the programs can be quickly and simply downloaded to the controller via the Flash module. Extensive service functions, such as diagnostics, parameter setting or display of process variables are available via the graphical Windows interface of BODAS-service. This enables simple parameter setting and diagnostics in order to place the machine in service rapidly and safely.

The BODAS controllers RC were developed specifically for use in mobile working machines and satisfy corresponding protection requirements regarding ambient temperatures, water and dust ingression, shock and vibration as well as electromagnetic compatibility (EMC). BODAS controllers RC and corresponding software in combination with pumps, motors, valves, sensors, input devices and actuators from Rexroth make for complete system solutions.

The RC10-10/31 controller can be used for safety functions according to ISO 25119 or EN ISO 13849. Safety-relevant project planning instructions have to be observed if such safety functions shall be implemented or the two-channel stop function shall be used. These instructions are available on request.

Block circuit diagram



Abbreviations	
μC	Microcontroller
DSP	Digital signal processor
RISC	Reduced instruction set computer
PFlash	program flash
DFlash	Data flash
RAM	Random Access Memory

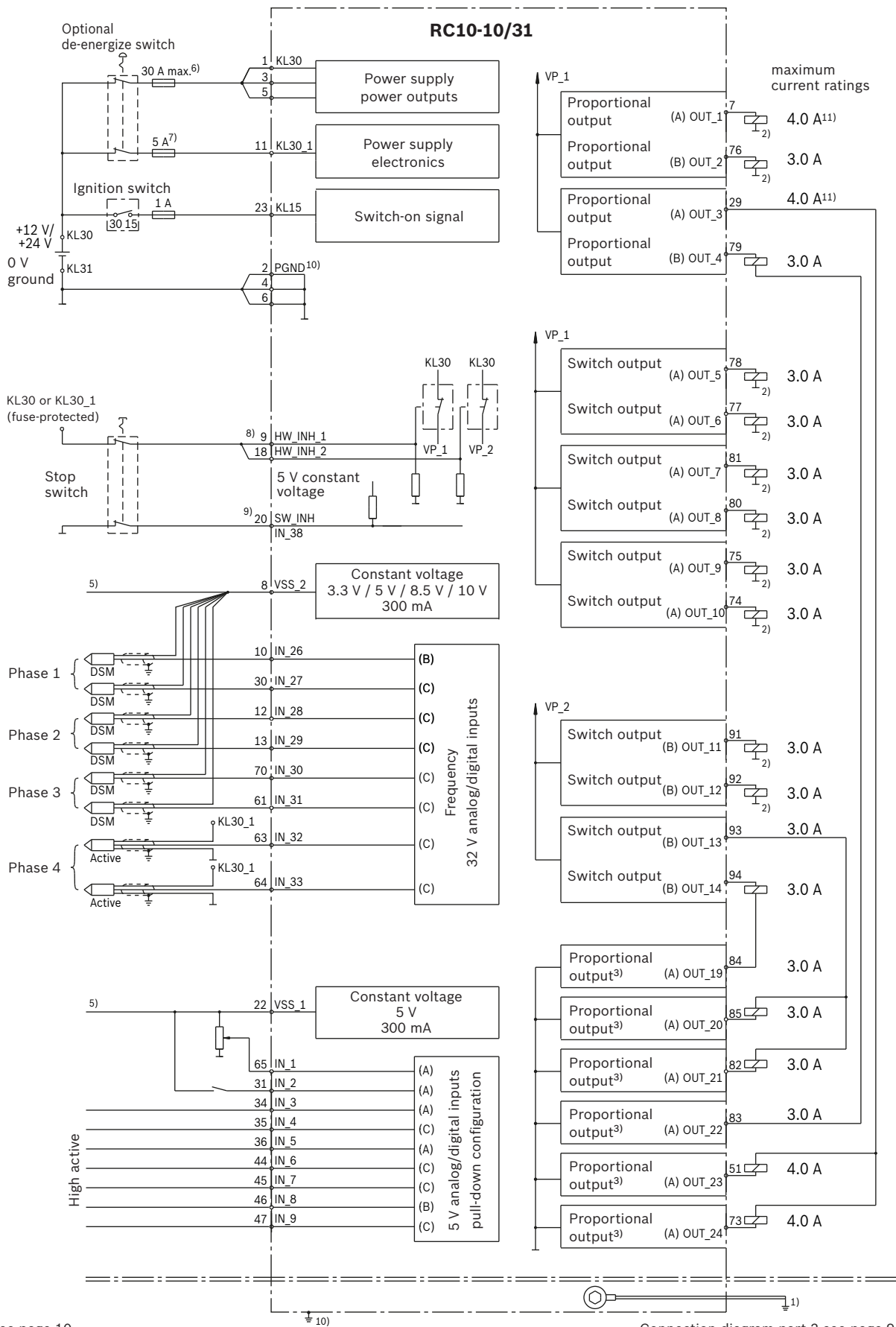
Technical data

BODAS Controller		RC10-10 Series 31
Supply voltage		
Nominal		12 V DC and 24 V DC
Permissible range		8 V DC to 32 V DC
Current consumption		
Standby current		<1 mA at 32 V
Without load, in the 12 V vehicle electrical system, approx.		280 mA
Without load, in the 24 V vehicle electrical system, approx.		210 mA
Fuses		
Internal		-
External in supply path for power outputs		max. 30 A
External in supply path for internal electronics		5 A
Constant voltage sources, total		2
300 mA	5 V ± 2.5 %	1
300 mA	3.3 V, 5 V, 8.5 V, 10 V ±10 %	1
Analog voltage inputs, total (can be used as digital inputs, partially provided as alternative function)		42
0 to 5 V		23
0 to 10 V		2
0 to 32 V		17
Digital voltage inputs, total (alternative function of other inputs)		51
Analog input with digital evaluation in software (see above)		42
SENT inputs used as digital inputs		8
Software inhibit input used as digital input		1
Resistance inputs		
Measurable resistance range	0 Ω to 50 kΩ	4
Frequency inputs, total		12
Active sensors	typical 0 Hz .. 20 kHz	2
DSM (can be used as active speed sensor input alternatively)	typical 0 Hz .. 20 kHz	6
5 V frequency inputs (alternative function of resistance inputs)	typical 0 Hz .. 20 kHz	4
Analog outputs, total		6
0 .. 5 V or 4 .. 20 mA		2
25 % .. 75 % V _{bat}		4
Digital sensor interfaces		
SAE J2716 SENT		8
Low current switch outputs (typically used for LED), total		5
Low side switch output (up to 20 mA)		3
Low side switch output as alternative function of 5 V / 20 mA analog outputs (see above)		2
Proportional solenoid output, total		10
Current-controlled high-side PWM output stage	0 .. 3 A, PWM up to 250 Hz	2
	0 .. 4 A, PWM up to 250 Hz	2
Current-controlled low-side PWM output stage	0 .. 3 A, PWM up to 1 kHz	4
Use with loads powered from high-side outputs	0 .. 4 A, PWM up to 1 kHz	2
Digital power output stages		
Switch output stage	max. 3 A	10
Can be used to power loads with current control on the low-side		

BODAS Controller	RC10-10 Series 31
Communication interfaces, total	5
CAN 2.0 B	3
ISOBUS	1
LIN	1
Fault detection in the event of cable break and short circuit	
Inputs (dependent on pull-up / pull-down resistor)	●
Outputs	●
LIN	●
CAN	●
Protection against short circuits to supply voltage and ground (Requirement: controller is powered and running, i.e. KL_30, KL30_1 and KL15 connected to VB, ground pins connected to vehicle ground, processor runs valid software)	
Inputs	●
Outputs	●
LIN	●
CAN	●
Reverse polarity protection	
Power supply power outputs	●
Power supply electronics	●
Microcontroller	SAK-TC1793
Clock frequency	
Processor clock	270 MHz
Internal memory capacity in microcontroller	
SRAM	128 kB
DFlash	192 kB
PFlash with ECC Check C-API or BODAS-design manual for the use of the 2 nd PFlash area	organized in two separate address areas 2 x 2 MB
External memory capacity in RC controller	
RAM with CRC	1 MB
EEPROM	32 kB
Software installation	
Download in PFlash	●

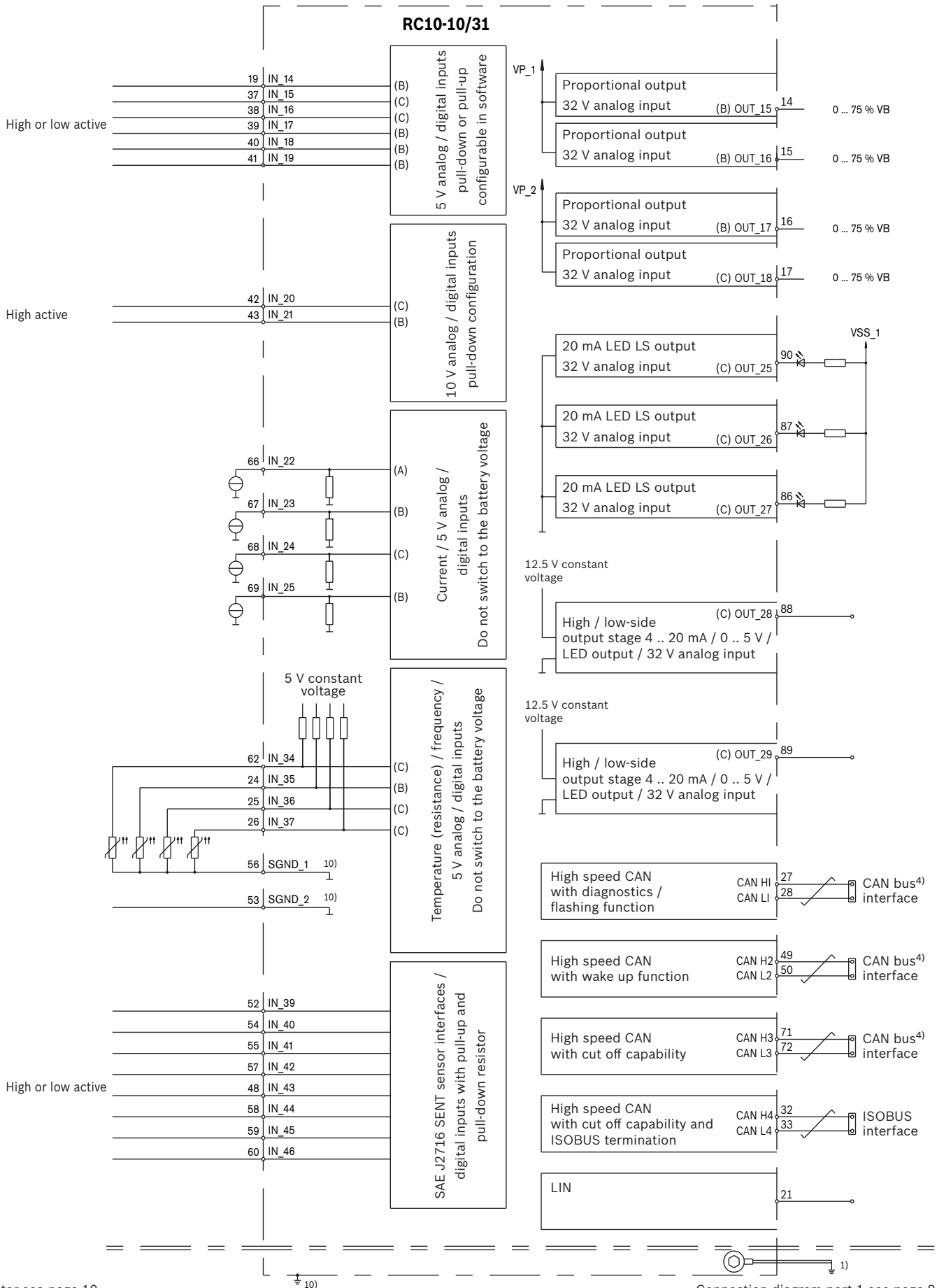
BODAS Controller		RC10-10 Series 31
Durability testing		
Simulated field use of 10 years with 10,000 operating hours		●
Electromagnetic compatibility		
Spurious interference (ISO 11452-2)		150 V _{RMS} /m
Spurious interference (ISO 11452-4)		BCI: 100 mA
Load dump with 12 V battery voltage		●
Load dump with 24 V battery voltage		●
Electrostatic Discharge ESD (according to ISO 10605)		
Direct contact unpowered / powered up		8 kV / 8 kV
Air discharge unpowered / powered up		15 kV / 15 kV
Maximum power dissipation		
Internal Electronics		4 W to 6 W
Output stages		45 W (32 V, 30 A)
Operating temperature, housing		
With mounting point on cooling surface		-40 to +85 °C (-40 to +185 °F)
Temperature of cooling surface		+60 °C (140 °F)
Storage temperature, housing		
Maximum permissible housing temperature momentary, passive:		-40 to +105 °C (-40 to +221 °F)
Vibration resistance, broadband noise oscillations (ISO 16750-3)		
57.9 m/s ² , 10 to 1000 Hz, 32 h per axis		●
10 Hz: 18 (m/s ²) ² /Hz		●
20 Hz: 36 (m/s ²) ² /Hz		●
30 Hz: 36 (m/s ²) ² /Hz		●
180 Hz: 1 (m/s ²) ² /Hz		●
2000 Hz: 1 (m/s ²) ² /Hz		●
Shock resistance		
Transport shock (IEC 60068-2-27)		a = 30 m/s ² ; t = 18 ms 1000 times per spatial axis x, y, z and in each direction (pos./neg.)
Moisture resistance (IEC 60068-2-11 Db version 2)		
90–96 % (+25 °C to +55 °C)		●
Salt spray resistance (DIN EN 60068-2-11 Ka)		
NaCl 5%		●
pH value 6.5 – 7.2		●
144 h 35 °C		●
Type of protection (ISO 20653)		
With installed mating connector including wire seals and dummy plugs		IP65
Housing material		
Cover		Die-cast aluminium
Base		Deep-drawn sheet metal
Weight		
		640 g ±5%
Outer dimensions		
Without mating connector		Length
		203 ±1 mm
		Width
		167.3 mm
		Height
		37.9 mm
Mating connector		
One connector chamber		94 male pins

Connection diagram



Footer see page 10

Connection diagram part 2 see page 9



Footnotes for the connection diagram

-
- 1) Short, low-resistance connection from a case screw to the vehicle ground.
 - 2) Own ground connection to battery (chassis possible).
 - 3) Loads connected to low side outputs must be powered from high side outputs of the same controller. Stand-alone operation of low side outputs is not permissible.
Deviations from that rule require additional measures. Please contact Bosch Rexroth.
Combinations between high side and low side outputs different from the ones shown are possible. These are examples only. For more information see safout() function in the API manual.
 - 4) CAN bus: 120 Ω termination resistor and twisted line necessary.
 - 5) Constant voltage sources can be used as sensor supply or switching voltage for switches/push-buttons.
 - 6) Can be adjusted to the actual current consumption of the consumers and must be adjusted to the permissible loading of the lines and pins.
 - 7) If deactivated during operation, data will not be saved in the non-volatile memory and there will be no after run.
 - 8) First deactivation channel: deactivation with level < 4 V (open / cable break); activation with level > 7 V (switch to terminal 30 or 30_1). When deactivated the respective main switch VP_x is off.
The main switches can be deactivated together (as shown) or separately.
 - 9) Second deactivation channel: deactivation with level > 3 V (open / cable break); activation with level < 0.4 V (switch to ground). The second deactivation channel shuts of output stage control via the processor's emergency stop function.
For more information on deactivation channels please see the respective programming manual and safety-relevant project planning instructions.
 - 10) Terminal 31 (PGND) and sensor grounds (SGND_x) are joined at a star point in the controller and are connected to the housing.
SGND_1 shall be used for the ground connection of analog sensors and SGND_2 shall be used for the ground connection of digital sensors.
 - 11) The total current out of OUT_1 and OUT_2 must not exceed 6 A.
The total current out of OUT_3 and OUT_4 must not exceed 6 A.
- The designations (A), (B), (C) indicate the respective ADC channel used for this input or current feedback.

Overview of functions

Pin	Description	Main function	Alternative functions
1, 3, 5	Voltage supply VB (terminal 30)	Power supply for output stages Nominal 12 V DC or 24 V DC Operating range 8 V DC to 32 V DC	
11	Voltage supply VB (terminal 30_1)	Power supply for internal electronics Nominal 12 V DC or 24 V DC Operating range 8 V DC to 32 V DC A wire with 0.75 mm ² cross section must be used for this pin	
23	Ignition key (terminal 15)	Switch-on signal power up with VB	
2, 4, 6	Power ground PGND	Power supply ground Internally connected to each other and to pins 56 and 53	
56	Sensor ground SGND_1	Sensor ground for analog sensors	
53	Sensor ground SGND_2	Sensor ground for digital sensors	
9	Hardware Inhibit HW_INH_1 Pull-Down resistor 261 kΩ to GND	Primary activation input for VP_1¹⁾ main switch Activation level > 7 V (switch to terminal 30 or 30_1) Deactivation level < 4 V (open / cable break)	
18	Hardware Inhibit HW_INH_2 Pull-Down resistor 261 kΩ to GND	Primary activation input for VP_2¹⁾ main switch Activation level > 7 V (switch to terminal 30 or 30_1) Deactivation level < 4 V (open / cable break)	
20	SW_INH / IN_38 Pull-up resistor 10 kΩ to 5 V	Secondary activation input SW_INH Activation level < 0.4 V (switch to ground) Deactivation level > 3 V (open / cable break)	Digital input IN_38 Active low
65, 31, 34, 35, 36, 44, 45, 46, 47	IN_1 to IN_9 Pull-Down resistor 118 kΩ to GND	Analog voltage input Measuring range nominal 0 to 5 V Resolution 12 bits Resolution 1.44 mV / bit Accuracy ± 3 % at 5 V Filter limit frequency 224 Hz	Digital input Switching threshold configurable in software (max. 5 V)

Pin	Description	Main function	Alternative functions
19, 37, 38, 39, 40, 41	IN_14 to IN_19 Pull-down configuration: 6.9 kΩ pull-down to GND (default after reset) Pull-up configuration: 118 kΩ pull-down to GND and 7.4 kΩ pull-up to 5 V Open pin voltage 4.7 V	Analog voltage input Measuring range nominal 0 to 5 V Resolution 12 bits ▶ in pull-down configuration 1.40 mV/bit ▶ in pull-up configuration 1.44 mV/bit Accuracy ± 3 % at 5 V Filter limit frequency: ▶ in pull-down configuration 264 Hz ▶ in pull-up configuration 224 Hz	Digital input Switching threshold configurable in software (max. 5 V)
42, 43	IN_20, IN_21 Pull-Down resistor 78 kΩ to GND	Analog voltage input Measuring range nominal 0 to 10 V Resolution 12 bits Resolution 3.01 mV / bit Accuracy ± 5 % at 10 V Filter limit frequency 180 Hz	Digital input Switching threshold configurable in software (max. 10 V)
66, 67, 68, 69	IN_22 to IN_25 Pull-Down resistor 14.4 kΩ to GND if used as analog voltage input Do not switch to battery voltage!	Analog current input Measuring range nominal 4 to 20 mA Accuracy ± 6.5 % at 20 mA Load in current measurement mode 244 Ω	Analog voltage input Measuring range nominal 0 to 5 V Resolution 12 bits Resolution 1.44 mV / bit Accuracy ± 3 % at 5 V Filter limit frequency 224 Hz Digital input Switching threshold configurable in software (max. 5 V)
62, 24, 25, 26	IN_34 to IN_37 Pull-down resistor 29 kΩ to GND and Pull-up resistor 1.2 kΩ to 5 V Open pin voltage 4.8 V Do not switch to battery voltage!	Resistance input Measuring range 0 .. 50 kΩ Temperature input Measuring range -50 .. 150 °C Can be used with Bosch Rexroth TSA or TSF (PTC) temperature sensors or Bosch NTC temperature sensors. For details see API manual.	Analog voltage input Measuring range nominal 0 to 5 V Resolution 12 bits Resolution 1.44 mV / bit Accuracy ± 3 % at 5 V Filter limit frequency 1647 kHz Digital input Switching threshold configurable in software (max. 5 V) Frequency input For frequency sensors that switch between typically 0 V and 5 V (e.g. Bosch DG23i) Low level < 1.7 V / high level > 3.5 V Measurable range up to 20 kHz ▶ minimal pulse length 25 μs ▶ the lower frequency limit depends on the period used in software for the frequency acquisition Do not use for active frequency sensors that switch or pull-up to battery voltage!

Pin	Description	Main function	Alternative functions
52, 54, 55, 57, 48, 58, 59, 60	IN_39 to IN_46 50 kΩ pull-down to GND and 15 kΩ pull-up to 5 V Open pin voltage 3.9 V Input capacitance typical 168 pF	SAE J2716 SENT (Single Edge Nibble Transmission) sensor signal input For sensor supply use VSS_x with 5 V For sensor ground use SGND_2 Filter limit frequency 140.8 kHz Check API manual for SENT signal evaluation.	Digital input Low Level < 1.6 V High Level > 3 V (max. 5 V)
10, 30, 12, 13, 70, 61	IN_26 to IN_31 Only in DSM configuration: Pull down resistor 196 Ω to GND Active frequency sensor input or analog input configuration: Pull-down resistor 11.2 kΩ to GND	Frequency input for Bosch Rexroth DSM speed sensors The DSM signal includes frequency, direction and diagnosis information Low Level < 8.4 mA High Level > 11.2 mA Measurable range 0 .. 10 kHz (relates to 5 kHz tooth frequency due to duplication of frequency by DSM) DSM standstill detection can be used Filter limit frequency 26.2 kHz	Frequency input for active speed sensors that switch to high level Low Level < 1.7 V High Level > 2 V Measurable range up to 20 kHz ▶ minimal pulse length 25 μs ▶ the lower frequency limit depends on the period used in software for the frequency acquisition Filter limit frequency 26.2 kHz The phase between two frequency inputs can be used to acquire the direction Phase 1: IN_26 / IN_27 Phase 2: IN_28 / IN_29 Phase 3: IN_30 / IN_31 Analog voltage input Measuring range nominal 0 to 32 V Resolution 12 bits Resolution 8.78 mV / bit Accuracy ± 6 % at 32 V Filter limit frequency 700 Hz Digital input Switching threshold configurable in software (max. 32 V)
63, 64	IN_32 to IN_33 Pull-down resistor 40 kΩ to GND and Pull-up resistor 6.8 kΩ to 5 V Open pin voltage 3.6 V	Frequency input for active speed sensors that switch to high level Low Level < 1.3 V High Level > 3.5 V Filter limit frequency 28.5 kHz Measurable range up to 20 kHz ▶ minimal pulse length 25 μs ▶ the lower frequency limit depends on the period used in software for the frequency acquisition The phase between these two frequency inputs can be used to acquire the direction Phase 4: IN_32 / IN_33	Analog voltage input Measuring range nominal 0 to 32 V Resolution 12 bits Resolution 8.78 mV / bit Accuracy ± 6 % at 32 V Filter limit frequency 700 Hz Digital input Switching threshold configurable in software (max. 32 V)

Pin	Description	Main function	Alternative functions
7, 29	<p>OUT_1, OUT_3</p> <p>Pull-up resistor 21.5 kΩ to supply voltage Free-wheeling diode included for inductive loads Power supply centrally switchable via VP_1 Open pin voltage 7.5 V with $V_{bat} = 12\text{ V}$</p> <p>The total current out of OUT_1 and OUT_2 must not exceed 6 A. The total current out of OUT_3 and OUT_4 must not exceed 6 A.</p>	<p>Proportional high-side output stage Maximum current 4 A</p> <p>Current control range 0.1 .. 4 A PWM frequency 50 .. 250 Hz Closed loop current control with current measurement over shunt resistor Software controllable duty cycle for open loop current control</p>	<p>Switching high-side output stage Maximum current 4 A</p> <p>100 % duty cycle</p>
76, 79	<p>OUT_2, OUT_4</p> <p>Pull-up resistor 21.5 kΩ to supply voltage Free-wheeling diode included for inductive loads Power supply centrally switchable via VP_1 Open pin voltage 7.5 V with $V_{bat} = 12\text{ V}$</p> <p>The total current out of OUT_1 and OUT_2 must not exceed 6 A. The total current out of OUT_3 and OUT_4 must not exceed 6 A.</p>	<p>Proportional high-side output stage Maximum current 3 A</p> <p>Current control range 0.1 .. 3 A PWM frequency 50 .. 250 Hz Closed loop current control with current measurement over shunt resistor Software controllable duty cycle for open loop current control</p>	<p>Switching high-side output stage Maximum current 3 A</p> <p>100 % duty cycle</p>
78, 77, 81, 80, 75, 74,	<p>OUT_5 to OUT_10</p> <p>Pull-up resistor 21.5 kΩ to supply voltage Free-wheeling diode included for inductive loads Power supply centrally switchable via VP_1 Open pin voltage 7.5 V with $V_{bat} = 12\text{ V}$</p>	<p>Switching high-side output stage Maximum current 3 A</p> <p>100 % duty cycle</p>	
91, 92, 93, 94	<p>OUT_11 to OUT_14</p> <p>Pull-up resistor 21.5 kΩ to supply voltage Free-wheeling diode included for inductive loads Power supply centrally switchable via VP_2 Open pin voltage 7.5 V with $V_{bat} = 12\text{ V}$</p>	<p>Switching high-side output stage Maximum current 3 A</p> <p>100 % duty cycle</p>	

Pin	Description	Main function	Alternative functions
84, 85, 82, 83	OUT_19 to OUT_22 Pull-down resistor 146 kΩ to GND Free-wheeling diode included for inductive loads	Proportional low-side output stage Maximum current 3 A Current control range 0.1 .. 3 A PWM frequency 100 .. 1000 Hz Closed loop current control with current measurement over shunt resistor Software controllable duty cycle for open loop current control	Switching low-side output stage Maximum current 3 A 100 % duty cycle
51, 73	OUT_23, OUT_24 Pull-down resistor 146 kΩ to GND Free-wheeling diode included for inductive loads	Proportional low-side output stage Maximum current 4 A Current control range 0.1 .. 4 A PWM frequency 100 .. 1000 Hz Closed loop current control with current measurement over shunt resistor Software controllable duty cycle for open loop current control	Switching low-side output stage Maximum current 4 A 100 % duty cycle
14, 15	OUT_15, OUT_16 Pull-down resistor 55 kΩ to GND Power supply centrally switchable via VP_1	PWM control signal output Output voltage 0 % .. 75 % VB Output resistance 3.6 kΩ Minimal external capacitor 100 μF Maximum PWM frequency 5 kHz	Analog voltage input Measuring range nominal 0 to 32 V Resolution 12 bits Resolution 8.09 mV / bit Accuracy ± 6 % at 32 V Filter limit frequency 483 kHz Digital input Switching threshold configurable in software (max. 32 V)
16, 17	OUT_17, OUT_18 Pull-down resistor 55 kΩ to GND Power supply centrally switchable via VP_2	PWM control signal output Output voltage 0 % .. 75 % VB Output resistance 3.6 kΩ Minimal external capacitor 100 μF Maximum PWM frequency 5 kHz	Analog voltage input Measuring range nominal 0 to 32 V Resolution 12 bits Resolution 8.09 mV / bit Accuracy ± 6 % at 32 V Filter limit frequency 483 kHz Digital input Switching threshold configurable in software (max. 32 V)
90, 87, 86	OUT_25 to OUT_27 Pull-down resistor 55 kΩ to GND	Low-side switch Maximum permissible nominal current 20 mA For LED output use serial resistor Maximum voltage at connector pin 5 V if used as Low-side switch	Analog voltage input Measuring range nominal 0 to 32 V Resolution 12 bits Resolution 8.09 mV / bit Accuracy ± 6 % at 32 V Filter limit frequency 483 kHz Digital input Switching threshold configurable in software (max. 32 V)

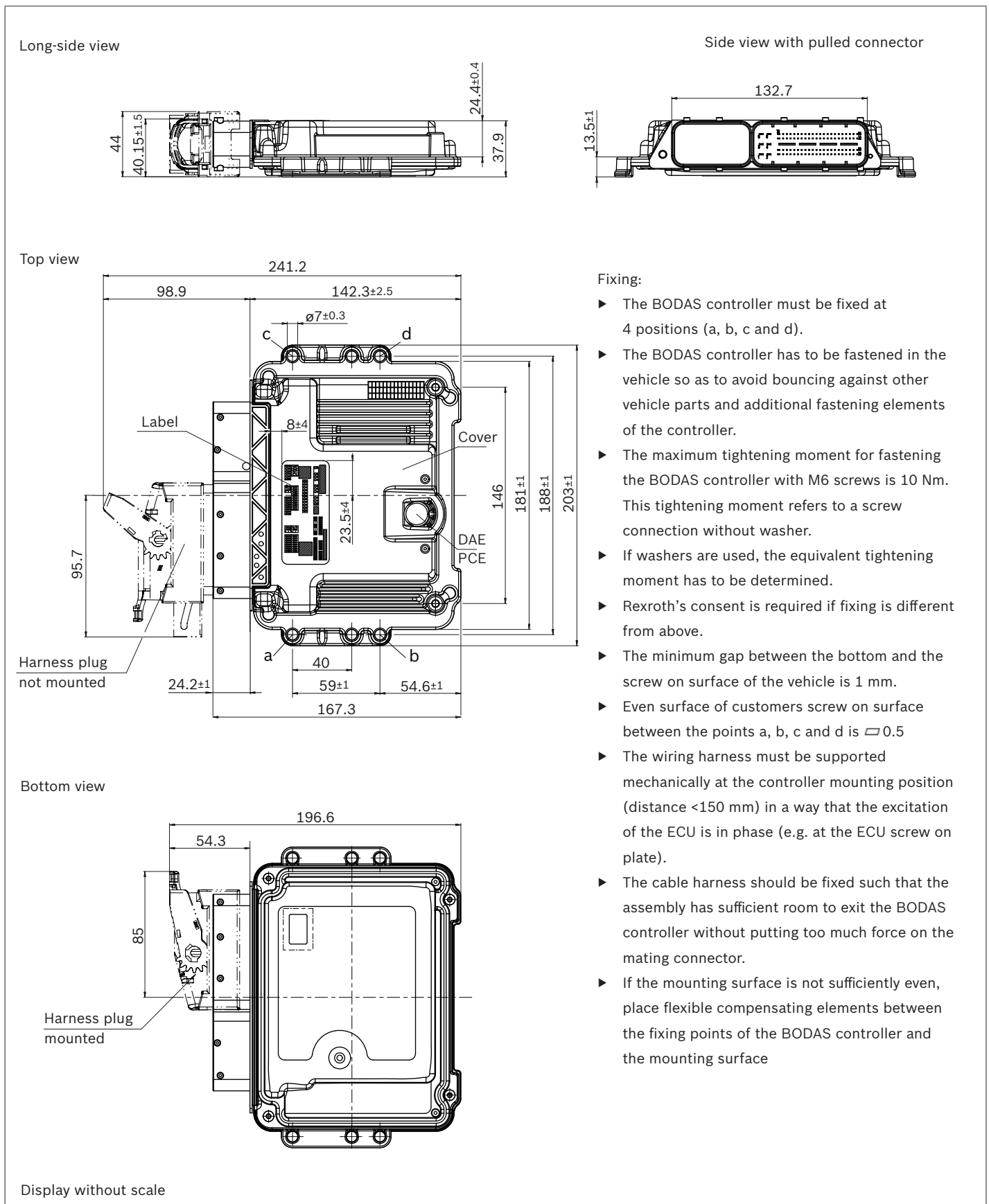
Pin	Description	Main function	Alternative functions
88, 89	OUT_28 to OUT_29 Pull-down resistor 37 kΩ to GND	High-side switch for analog output Current output 4 .. 20 mA Accuracy in steady state: ± 3 % at 20 mA Voltage output 0 .. 5 V Accuracy in steady state: ± 3 % at 5 V with 200 Ω external ohmic resistance	Low-side switch Maximum permissible nominal current 20 mA. For LED output use serial resistor Maximum voltage at connector pin 5 V if used as Low-side switch Analog voltage input Measuring range nominal 0 to 32 V Resolution 12 bits Resolution 8.09 mV / bit Accuracy ± 6 % at 32 V Filter limit frequency 483 Hz Digital input Switching threshold configurable in software (max. 32 V)
22	VSS_1	Sensor supply output voltage Nominal on-voltage 5 V Accuracy ± 2.5 % Voltage off < 0.5 V Maximum output current 300 mA Maximum external capacity 100 μF Output voltage ratiometric to ADC reference voltage	
8	VSS_2 Do not switch on VSS_2 in software if no load is connected. A minimal current of 5 mA / μF is required if a load is connected to VSS_2 to avoid diagnosis errors.	Sensor supply output voltage Nominal on-voltage software configurable as 3.3 V, 5 V, 8.5 V, 10 V Accuracy ± 10 % Voltage off < 0.5 V Maximum output current 300 mA Maximum external capacity 100 μF	
21	LIN Pull-up resistor 1 kΩ to V _{bat}	Local Interconnect Network (LIN) Single wire bus interface Physical layer according to ISO 9141 Maximum transfer rate 20 kBaud	
27, 28	CAN1_H, CAN1_L	CAN interface 2.0 B high speed CAN interface according to ISO 11898 Maximum transfer rate 500 kBaud for vehicle use (1 MBaud selectable with limited EMC characteristic, e.g. for flashing)	Diagnosis interface Flashing interface
49, 50	CAN2_H, CAN2_L	CAN interface 2.0 B high speed CAN interface according to ISO 11898 Maximum transfer rate 500 kBaud for vehicle use (1 MBaud selectable with limited EMC characteristic)	Wake-up Any CAN traffic can wake up the RC in silence mode Shut off capability CAN transceiver can be switched off

Pin	Description	Main function	Alternative functions
71, 72	CAN3_H, CAN3_L¹⁾	CAN interface 2.0 B high speed CAN interface according to ISO 11898 Maximum transfer rate 500 kBaud for vehicle use (1 MBaud selectable with limited EMC characteristic)	Shut off capability CAN transceiver can be switched off
32, 33	CAN4_H, CAN4_L¹⁾	CAN interface 2.0 B high speed CAN interface according to ISO 11898 Maximum transfer rate 500 kBaud for vehicle use (1 MBaud selectable with limited EMC characteristic) Due to the ISOBUS termination CAN_4 can only be used as the first or last device on a CAN bus. External 120 Ω termination must not be applied.	ISOBUS interface Active bus termination to 2.5 V based on ISO 11783 standard (full compliance not claimed) Termination supply derived from RC power supply Resistance approx. 2 kΩ between CAN4_H and CAN4_L Analog voltage input Measuring range nominal 0 to 32 V for CAN_4 diagnosis only. 55 kΩ Pull-Down resistor included. Do not use as analog input. Shut off capability CAN transceiver can be switched off

Pin numbers in **bold** are for contact type BDK 2.8
 Pin numbers in *italic* are for contact type MQS 1.5 CB
 All other pins are for contact type BCB 0.6

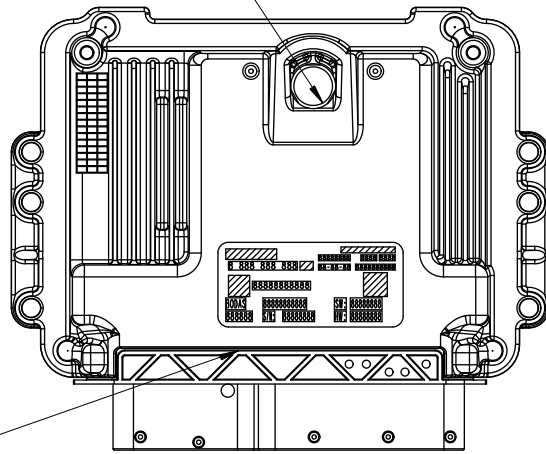
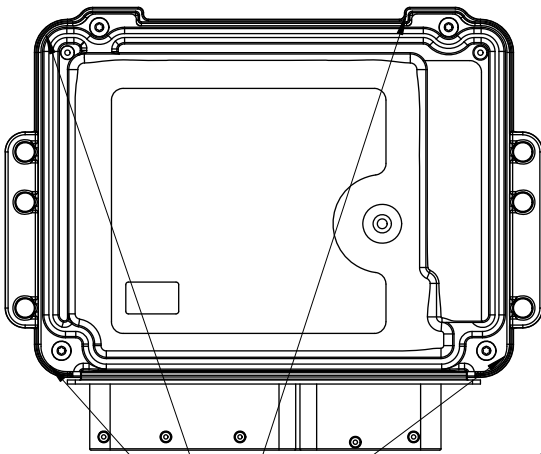
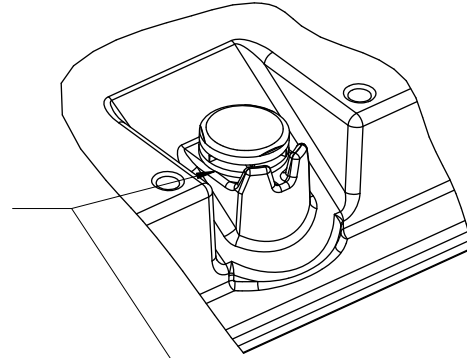
1) The activation of a main switch requires the testing of switch off paths within the RC control unit. During this test both main switches, CAN_3 and CAN_4 are switched off shortly several times even if one main switch has been activated already. Please take note of this behavior especially if the main switches are not activated at the same point in time.

Dimensions



Installation position

No standing or permanently running water allowed in the sealing area of the pressure equalizing element. Install accordingly.



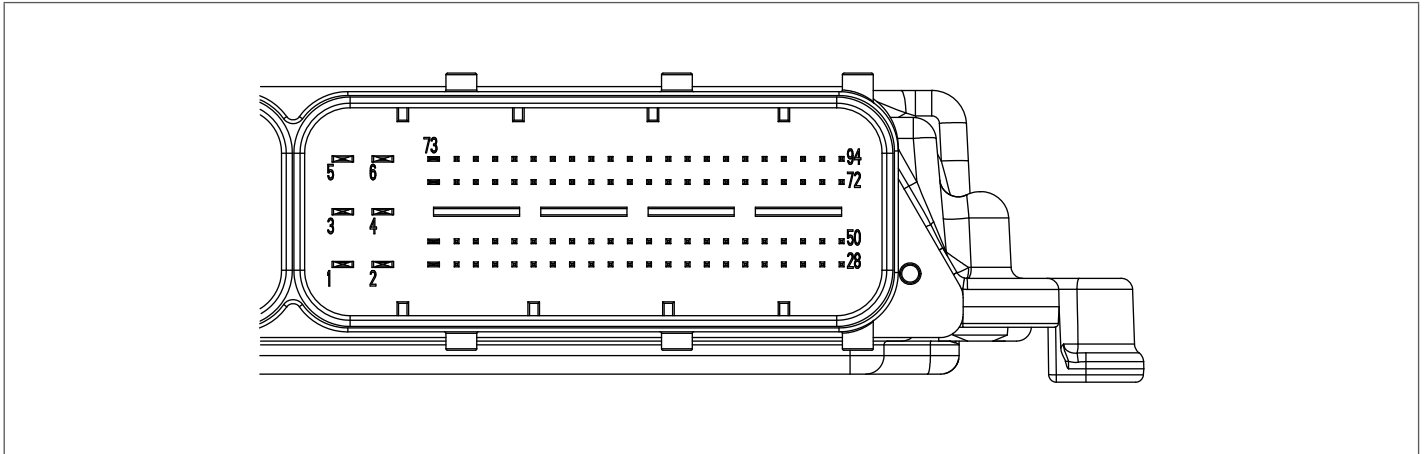
No standing or permanently running water allowed in the revolving groove area (cover-bottom-connector). Install accordingly

Mating connector

The 154-way plug connector is divided in 2 modules (94- and 60-way). Only the 94-pin module is used. The 60-pin module is closed and unused. The 1 928 xxx numbers stated below are Bosch designations. Technical details about these documents and part numbers are available at www.bosch-connectors.com. The numbers prefixed with "TE" are designations of TE connectivity (previously Tyco Electronics). Visit www.te.com for information on these items.

Assembly instruction	1 928 A01 09M
Technical customer documentation	1 928 A01 00T
Offer drawing (assembly)	1 928 A00 325
Offer drawing (carrier)	1 928 A00 326
Final check instruction	1 928 A00 05E

View of connector strip



Terminal designation

Contact BCB 0.6	Contact MQS 1.5 CB	Contact BDK 2.8
Row 1: Pins 8 to 28	Row 1: Pin 7	Pins 1 to 6
Row 2: Pins 30 to 50	Row 2: Pin 29	
Row 3: Pins 52 to 72	Row 3: Pin 51	
Row 4: Pins 74 to 94	Row 4: Pin 73	

Tools

Contact Type	Line cross section in mm ²	Hand Crimping		Automatic crimping	Extraction tool	Process specification
		Hand Tool	Profile of insert			
BCB 0.6	0.35 to 0.5	TE 0-539635-1	TE 0-539683-2	TE 9-878 439-2	1 928 496 755	1 928 A00 70M
BCB 0.6	0.75	TE 0-539635-1	TE 0-539683-2	TE 9-878 591-2	1 928 496 755	1 928 A00 70M
MQS 1.5 CB	0.75 to 1.5	TE 539635-1	TE 539692-2	TE 541662	TE 6-1579007-0	TE 114-18286
BDK 2.8	0.5 to 1.0	1 928 498 161 (with die)		1 928 498 163	1 928 498 167	1 928 F00 025
BDK 2.8	1.5 to 2.5	1 928 498 162 (with die)		1 928 498 164	1 928 498 167	928 F00 025

Cables

Use FLKr Type "B" cables.

Connector components

The following parts are required for assembling a wiring harness connector. Alternatives are listed if applicable.

Designation	Version	Part number	Manufacturer	Number
Contact carrier, Code C		1 928 405 063	Bosch	1
Cover	Outlet up	1 928 405 247	Bosch	1
	Outlet left	1 928 405 071	Bosch	
	Outlet right	1 928 405 069	Bosch	
Secondary lock power		1 928 405 074	Bosch	1
Secondary lock signal		1 928 405 073	Bosch	1
Holding plate		1 928 405 067	Bosch	1
Fixing strap		1 928 401 713	Bosch	1
Contact BCB 0.6	Line cross section in mm ² 0.35 - 0.5 Insulation diameter in mm 1.2 - 1.6 Not allowed for pin 11 (KL30_1)	1 928 492 555	Bosch	up to 84
	Line cross section in mm ² 0.75 Insulation diameter in mm 1.7 - 1.9	1 928 492 556	Bosch	
Contact MQS 1.5 CB	Line cross section in mm ² 0.75 - 1.5 Insulation diameter in mm 1.7 - 2.4	TE 1 241 608-1	TE connectivity	up to 4
Contact BDK 2.8	Line cross section in mm ² 0.5 - 1.0 Insulation diameter in mm 1.2 - 2.1	1 928 498 056	Bosch	up to 6
	Line cross section in mm ² 1.5 - 2.5 Insulation diameter in mm 2.2 - 3.0	1 928 498 057	Bosch	
Dummy contact BCB 0.6		1 928 405 077	Bosch	1) ¹⁾
Dummy contact MQS 1.5-CB		1 928 405 076	Bosch	1) ¹⁾
Single wire seal for BDK 2.8	For insulation diameter in mm 1.2 - 2.1 (blue)	1 928 300 599	Bosch	up to 6
Single wire seal for BDK 2.8	For insulation diameter in mm 2.2 - 3.0 (white)	1 928 300 600	Bosch	up to 6
Cavity / dummy plug BDK 2.8	(clear)	1 928 300 601	Bosch	1) ¹⁾

1) Free contact chambers are to be sealed with dummy contacts to ensure water tightness.

Connector Kit

Mating connector sets with the following content are available under Rexroth part number R917010843 for the manual assembly of wiring harness connectors for laboratory or small-series requirements. Machined assembly is recommended for larger quantities.

Designation	Version	Part number	Manufacturer	Number
Contact carrier, Code C		1 928 405 063	Bosch	1
Cover	Outlet right	1 928 405 069	Bosch	1
Secondary lock power		1 928 405 074	Bosch	1
Secondary lock signal		1 928 405 073	Bosch	1
Holding plate		1 928 405 067	Bosch	1
Fixing strap		1 928 401 713	Bosch	1
Contact BCB 0.6	Line cross section in mm ² 0.75 Insulation diameter in mm 1.7 – 1.9	1 928 492 556	Bosch	84
Contact MQS 1.5 CB	Line cross section in mm ² 0.75 – 1.5 Insulation diameter in mm 1.7 – 2.4	TE 1 241 608-1	TE connectivity	6
Contact BDK 2.8	Line cross section in mm ² 1.5 – 2.5 Insulation diameter in mm 2.2 – 3.0	1 928 498 057	Bosch	8
Dummy contact BCB 0.6		1 928 405 077	Bosch	60 ¹⁾
Dummy contact MQS 1.5-CB		1 928 405 076	Bosch	6 ¹⁾
Single wire seal for BDK 2.8	For insulation diameter in mm 2.2 – 3.0 (white)	1 928 300 600	Bosch	6
Cavity / dummy plug BDK 2.8	(clear)	1 928 300 601	Bosch	4 ¹⁾

Delivered loose in a PE bag. Not suitable for processing by a machine.

1) Free contact chambers are to be sealed with dummy contacts to ensure water tightness.

Safety instructions

General instructions

- ▶ Reliable operation cannot be guaranteed if samples or prototypes are used in series production machines.
- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ Incorrect connections could cause unexpected signals at the outputs of the controller.
- ▶ Incorrect programming or parameter settings on the controller may create potential hazards while the machine is in operation. It is the responsibility of the machine manufacturer to identify hazards of this type in a hazard analysis and to bring them to the attention of the end user. Rexroth assumes no liability for dangers of this type.
- ▶ The component firmware/software must be installed and removed by Bosch Rexroth or by the authorized partner concerned in order to uphold the warranty.
- ▶ It is not permissible to open the controller or to modify or repair the controller. Modification or repairs to the wiring could result in dangerous malfunctions. Repairs to the controller may only be performed by Bosch Rexroth or by an authorized partner.
- ▶ To switch off the system in emergencies, the stop switch (two-channel stop function) or the optional de-energize switch may be used. The switch must be in an easily accessible position for the operator. The system must be designed in such a way that safe braking is ensured when the outputs are switched off.
- ▶ When the electronics is not energized no pins must be connected to a voltage source. Thus, when the current supply is switched off, the supply for the electronics, the power outputs and the external sensor supply have to be switched off together.
- ▶ Make sure that the controller's configuration does not lead to safety-critical malfunctions of the complete system in the event of failure or malfunction. This type of system behavior may lead to danger to life and/or cause much damage to property.
- ▶ System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- ▶ While commissioning and maintenance the controller (with BODAS Tools) the machine may pose unforeseen hazards. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.
- ▶ Controllers used to develop software may only be installed in series production machines if it can be guaranteed that these controllers have not been flash-programmed with new software more than 500 times. Controllers that have been programmed more than 1000 times are not to be installed in series production machines!

Notes on the installation point and position

- ▶ Do not install the controller close to parts that generate considerable heat (e.g. exhaust).
- ▶ Radio transmitting equipment and mobile telephones must not be used in the driver's cab without a suitable antenna or near the control electronics.
- ▶ A sufficiently large distance to radio transmitting systems must be maintained.
- ▶ All connectors must be unplugged from the electronics during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.
- ▶ The controller must not be electrostatically charged, e.g. during painting operations.
- ▶ The controller will heat up beyond normal ambient temperature during operation. To avoid danger caused by high temperatures, it should be protected against contact.
- ▶ Install the control unit in such a way that the electrical plug is not facing upwards. This ensures that any condensation water that may form can flow out.
- ▶ Standing and permanently running water are not permitted anywhere near the circumferential groove (lid/base connector) or the pressure balance element (DAE).
- ▶ The case must be wired to vehicle ground in order to comply with EMC guidelines. Metallic screws are used to create a connection to vehicle ground.

Notes on transport and storage

- ▶ If it is dropped, the controller must not be used any longer as invisible damage could have a negative impact on reliability.
- ▶ Control units must be stored with a mean relative humidity of 60% and at a temperature between -10 °C and +30 °C. Storage temperatures between -20 °C and +40 °C are briefly permissible, for up to 100 hours.
- ▶ After a storage time of more than 5 years, the controller must be examined by the manufacturer.

Notes on wiring and circuitry

- ▶ The electronics and the power outputs of a controller must be fed from the same power source.
- ▶ When wiring the output stages, the maximum cumulative output current for each output stage group should be noted. The cumulative output current means a permanent, simultaneous actuation of the output stages.
- ▶ Lines to the speed sensors shall be as short as possible and shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The product may only be wired when it is de-energized.
- ▶ Lines to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The wiring harness should be fixated mechanically in the area in which the controller is installed (spacing < 150 mm). The wiring harness should be fixated so that in-phase excitation with the controller occurs (e.g. at the controller bolting point).
- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.
- ▶ Lines are to be routed with sufficient spacing to hot or moving vehicle parts.
- ▶ PWM outputs must not be linked or bridged.
- ▶ PMW outputs with current measurement (OUT_1 to OUT_4 and OUT_19 to OUT_24) must not be used to power bulbs.
- ▶ The sensor supplies can be „pulled up“ by an external connection, e.g. the application of a higher voltage, because they operate only as a voltage source but not as a voltage sink. Pulling up a sensor supply may result in unexpected malfunctions and damage of the controller in lasting operation.
- ▶ The „high side“ outputs may not be externally connected to battery.

- ▶ If the stop function is used in an application, the contacts 9 and 18 (HW_INH_1, HW_INH_2) of the controller must be connected to the stop switch in the vehicle. For a dual channel switch off function the contact 20 (SW_INH) has to be connected to the stop switch, too. Refer to the connection diagram.

Note on proportional and switching solenoids and other wired inductive consumers

- ▶ The proportional solenoids must not be wired with free-wheeling diodes.
- ▶ Switching solenoids at the outputs of the control unit do not need to be connected to free-wheeling diodes.
- ▶ The electronics may only be tested with the proportional solenoids connected.
- ▶ Other inductive loads that are in the system but not connected to the controller must be connected to free-wheeling diodes. This applies to relays (e.g. for de-energizing the controller) that have the same supply as the controller, too.

Intended use

- ▶ The controller is designed for use in mobile working machines provided no limitations / restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the controller must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, current, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the controller other than that described in chapter „Intended use“ is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damage resulting from improper use and/or from unauthorized interference in the component not described in this data sheet render all warranty and liability claims void with respect to the manufacturer.

Use in functions relevant to safety

- ▶ The customer is responsible for performing a risk analysis of the mobile working machine and determining the possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.)
- ▶ For example, a suitable assignment of input variables (e.g. by connecting the acceleration pedal signal to two independent analog inputs) can be used to detect faults and to activate specially programmed reactions.
- ▶ Special measures may be initiated if the plausibility check shows deviations between the set-point values and the values read back by the microcontroller.
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.
- ▶ For all control units, the notes found in the API description, in the online help section of BODAS design and in the „safety- relevant project planning instructions“ must be observed

Safety features in the BODAS controller

- ▶ The input circuits for speed and analog signals partially feature electrically independent circuits. Faults can be detected by the microcontroller using software diagnostic functions if appropriate input pins are used.
- ▶ Faults in the supply voltage are detected by internal monitoring.
- ▶ All output signals can be monitored by the microcontroller with the appropriate software.
- ▶ The controllers can be operated with all power outputs de-energized for service purposes.
- ▶ The internal watchdog module switches off the power supply of proportional and switched outputs centrally when there are malfunctions in the program run.

Further information

- ▶ In addition, the application-specific documents (connection diagrams, software descriptions, etc.) are to be observed.
- ▶ More detailed information on BODAS controllers may be found at www.boschrexroth.com/mobile-electronics.

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BODAS Controller RC Series 30

RC28-14/30
 RC20-10/30
 RC12-10/30

RE 95204

Edition: 07.2015
 Replaces: 02.2012

1



- ▶ For closed- and open-loop control of hydraulic components

Features

- ▶ High performance thanks to ultra-modern 32-TriCore technology with 180 MHz
- ▶ Component of BODAS system for mobile applications
- ▶ Robust design meeting specifications for mobile applications
- ▶ High electromagnetic compatibility (EMC)
- ▶ Inputs and outputs with fault detection
- ▶ Central deactivation of all outputs
- ▶ Pulse-width-modulated (PWM) solenoid currents for minimum hysteresis
- ▶ Closed-loop control of solenoid currents, i.e., not dependent on voltage and temperature

Main components

- ▶ Watchdog processor for program run monitoring
- ▶ Hardware-based RAM memory supervision
- ▶ CPU-internal Flash with ECC error-correcting code
- ▶ Three independent sensor power supplies
- ▶ Four independent CAN bus interfaces
- ▶ Two-channel stop function

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Ordering code

01	02	03
RC	/	30

Type

01	BODAS controller	RC
----	------------------	-----------

Version

02	1st number: number of proportional outputs 2nd number: number of switched outputs	28-14 20-10 12-10
----	--	--

Series

03	Series 3, index 0	30
----	-------------------	-----------

Notes:

- ▶ The BODAS controllers are not functional without software.
- ▶ In order to use the BODAS controllers, you also need:
 - BODAS standard software or
 - application-specific software
- ▶ If there is a sample label on the name plate, it is a prototype or sample, i.e., components not released for serial production.
Possible sample labels are:
 - SC: A
 - SC: B
 - SC: C
 - SC: S (Software prototypes)

Optional accessories

▶ BODAS-design software

The windows-based BODAS-design PC software (data sheet 95112) is used for programming the BODAS RC controllers. All graphical and textual programming languages specified according to IEC 61131-3 are available for the programming.

▶ BODAS-service software

The windows-based BODAS-service PC software (data sheet 95086) is used for displaying functions, errors and system variables as well as for setting parameters via a PC.

▶ C programming interface C-API

The C-API (data sheet 95115) programming interface is used for programming the BODAS RC controllers in the C programming language. All required functions that are needed for the configuration and the reading of the inputs, the control of the outputs, the use of the communication interfaces and the creation of the diagnostics information for BODAS-service are available to the user.

Additionally, the user needs a C-compiler, with which the created program is translated into a machine code that is readable for the BODAS controller.

▶ BODAS MA6 measuring adapter

The BODAS MA6 measuring adapter (data sheet 95090) facilitates measuring all electrical signals at the inputs, outputs and interfaces of the BODAS controller. For testing purposes, it is connected in series between the control unit and the vehicle or device wiring.

▶ BODAS TB3 test box(2 pieces) and adapter kit (1 piece)

The BODAS TB3 test box (data sheet 95092) is used for simulation of vehicle and device functions for development and testing purposes with BODAS controllers. The BODAS TB3 test boxes are connected to the control unit via the adapter TAK4/10 .

All products mentioned here are available from Bosch Rexroth. Further information can be found on the internet at: www.boschrexroth.com/mobile-electronics

Description

These BODAS controllers RC are designed as universal central control units for complex mobile working machines. Thanks to the ultra-modern 32-bit TriCore technology, a clock frequency of 180 MHz and parallel processing, these control units push into completely new performance dimensions that were previously reserved for larger PLC systems. The fields of application extend from the programmable control of proportional solenoids and additional switching functions to travel drives and transmission control as well as coordination of highly complex control circuits in mobile working machines. With 75 input channels, up to 42 output stages, four voltage outputs ($25\% * V_{bat}$ to $75\% * V_{bat}$), an additional analog output (4 to 20 mA) as well as four CAN buses for communication in the vehicle, these control units provide a high-performance platform for all functions of mobile working machines.

Internally, the series 30 BODAS RC controllers contain a high performance 32-bit TriCore microprocessor and all input and output circuits. Analog voltages in the range from 0 to 10 V and 0 to 32 V, currents from 0 to 20 mA, frequencies from 0 to 10 kHz and switching information are processed as input signals. In addition, these control units offer special inputs for intelligent Bosch Rexroth sensors, such as the DSM1-10 speed sensor with integrated diagnostics function or resistor inputs from 10 to 2000 Ω , for example for the direct connection of temperature sensors. The inputs are protected against overvoltage and electrical interference. The voltage inputs can be monitored to detect any cable breaks or short circuits. The current-controlled proportional solenoid outputs are pulse-width-modulated (PWM) and are compensated for fluctuating temperature and voltage for high accuracy and minimum hysteresis. They are optimally harmonized with the electrical proportional control of the axial piston units and valves of Bosch Rexroth. The switching outputs are designed for direct switching of relays and switching solenoids. Moreover, the outputs have integrated voltage and current monitoring.

CAN-bus interfaces are included in all BODAS RC controllers for exchanging data with other bus users or electronic systems (e.g. RC, joystick, diesel engine injection, display). Each of the four independent CAN bus interfaces can be operated using different protocols. Communication with the BODAS-design and BODAS-service software is likewise done via CAN bus and is based on the Standard Key Word Protocol 2000 (KWP 2000).

Simple and flexible programming of the BODAS controller according to the industry standard IEC 61131-3, which enables a very convenient and rapid introduction to the programming of the controller, is possible with the BODAS-design software. Comprehensive and complex applications can be conveniently developed and clearly represented with BODAS-design.

An application interface in the form of a C-API interface is available for the development of the full performance capability of these BODAS controllers when the C programming language is used. By using the C-API, the software developer can concentrate on the important functions of his machine without having to become immersed in the details of the TriCore technology.

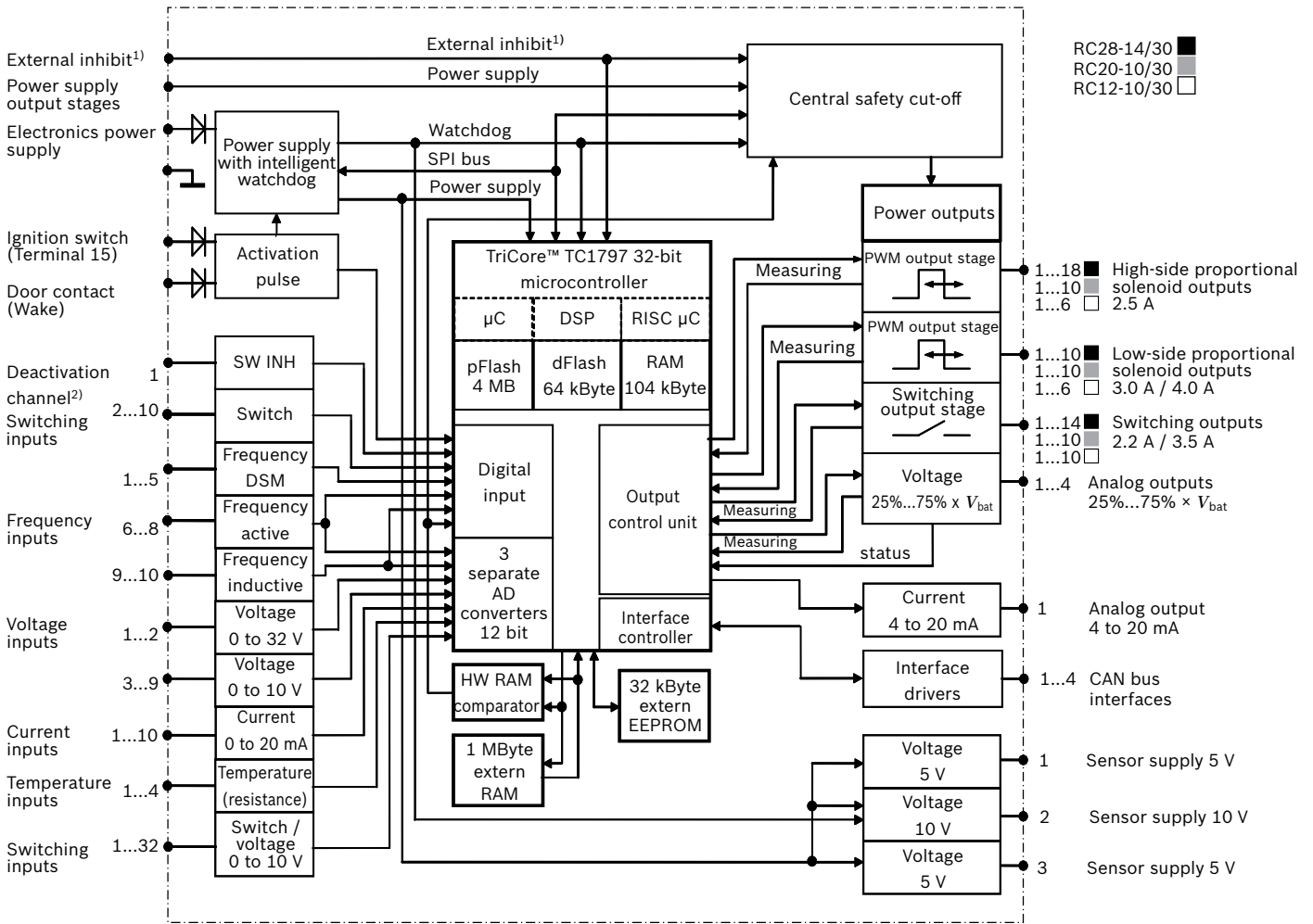
With the BODAS-service software, the programs can be quickly and easily downloaded to the control unit via the Flash module. Extensive service functions, such as diagnostics, parameter setting or display of process variables, are available via the graphical Windows interface of BODAS-service. This allows simple parameter setting and diagnostics in order to place the machine in service quickly and safely.

The BODAS RC controllers were developed specifically for use in mobile working machines and satisfy corresponding protection requirements regarding ambient temperatures, water and dust ingress, shock and vibration as well as electromagnetic compatibility (EMC).

BODAS RC controllers and corresponding software in combination with pumps, motors, valves, sensors, input devices and actuators from Bosch Rexroth make for complete system solutions.

Safety-relevant project planning instructions (95451-01-B for EN ISO 13849 and 95452-01-B for ISO 25119) have to be observed for the planning and implementation of safety functions and the two-channel stop function. These are available from Bosch Rexroth on request.

Block circuit diagram



- 1) Input that is independent of the microcontroller, for the central enabling/deactivation of the power outputs.
- 2) Input for the central enabling/deactivation of the power outputs.

Abbreviations	
μC	microcontroller
DSP	digital signal processor
RISC	reduced instruction set computer

Footnotes for page 5

- 1) Exception: GND, GND sensor, constant voltage sources and temperature inputs to battery.
- 2) Max. total current per group: 5 A
- 3) Sensor voltage inputs are raised when there is a short circuit to battery. A correct reading of sensor signals is no longer ensured. Connected sensors may be damaged.
- 4) Line protection. The wiring has to be rated according to the fuse protection.
- 5) Some functions do not comply fully with the respective specification at supply voltage < 11 V. See also overview of functions.

Technical data

Controllers RC		28-14	20-10	12-10
		■	▣	□
Nominal voltage	12 and 24 V		●	
Residual ripple (DIN 40839, part 1)	max. ±2 V		●	
Supply voltage, permissible range	8 to 32 V		(●) ⁵⁾	
Current consumption				
standby, in the 12 V vehicle electrical system	380 mA		●	
standby, in the 24 V vehicle electrical system	290 mA		●	
loaded, in the 12 V vehicle electrical system	max. 40 A		●	
loaded, in the 24 V vehicle electrical system	max. 40 A		●	
Fuses				
internal:			–	
external: in the supply path ⁴⁾	5 A (electronics), maximum 35 A (power outputs)		●	
Controllers enabling pin	Terminal 15 / Wake		●	
Constant voltage sources³⁾				
e.g. for setpoint potentiometer				
150 mA	5 V ± 150 mV		●	
250 mA	5 V ± 250 mV		●	
1000 mA	10 V ± 500 mV		●	
Digital inputs			9	
Digital voltage inputs , diagnostics capable			32	
Analog voltage inputs , pulldown	0 to 10 V		7	
	0 to 32 V		2	
Analog current inputs , diagnostics capable	0 to 20 mA		10	
Resistor inputs				
e.g. for temperature sensors resistance measuring range	10 to 2000 Ω		4	
Frequency inputs total			10	
DSM	0 to 9 kHz Level: 7 mA/14 mA		5	
Inductive sensors	0 to 10 kHz, Level: > 1 V _{RMS}		2	
Active sensors	500 Hz to 10 kHz level low: < 1 V level high: > 4 V		3	
Analog signal outputs total			5	
for 200 Ω load (ohmic resistance)	4 to 20 mA		1	
for 150 Ω load (ohmic resistance)	0 V (off), 0.1 to 5.0 V			
for 12 kΩ load (ohmic resistance)	0 V (off), 0% * V _{bat} to 90% * V _{bat} (typically 25% * V _{bat} to 75% * V _{bat})		4	
Proportional solenoid outputs (PWM) total		28	20	12
High side current range	0 to 2.5 A	18	10	6
Pulsation frequency	0; 50 to 250 Hz			
Low side current range	0 to 3.0 A	8	8	4
	0 to 4.0 A	2	2	2
Pulsation frequency	0; 50 to 250 Hz and 1000 Hz			
Digital output stages total		14	10	10
High side current range	max. 2.2 A	10	6	6
High side current range	max. 3.5 A ²⁾	4	4	4
Interfaces			4	
CAN 2.0 B, ISO 11898				
Fault detection in the event of cable break and short circuit				
Analog inputs			●	
Proportional solenoid outputs			●	
Switching solenoid outputs			●	
Short circuit resistance when energized				
to supply voltage and ground for all inputs and outputs ^{1) 3)}			(●)	

See page 4 for footnotes

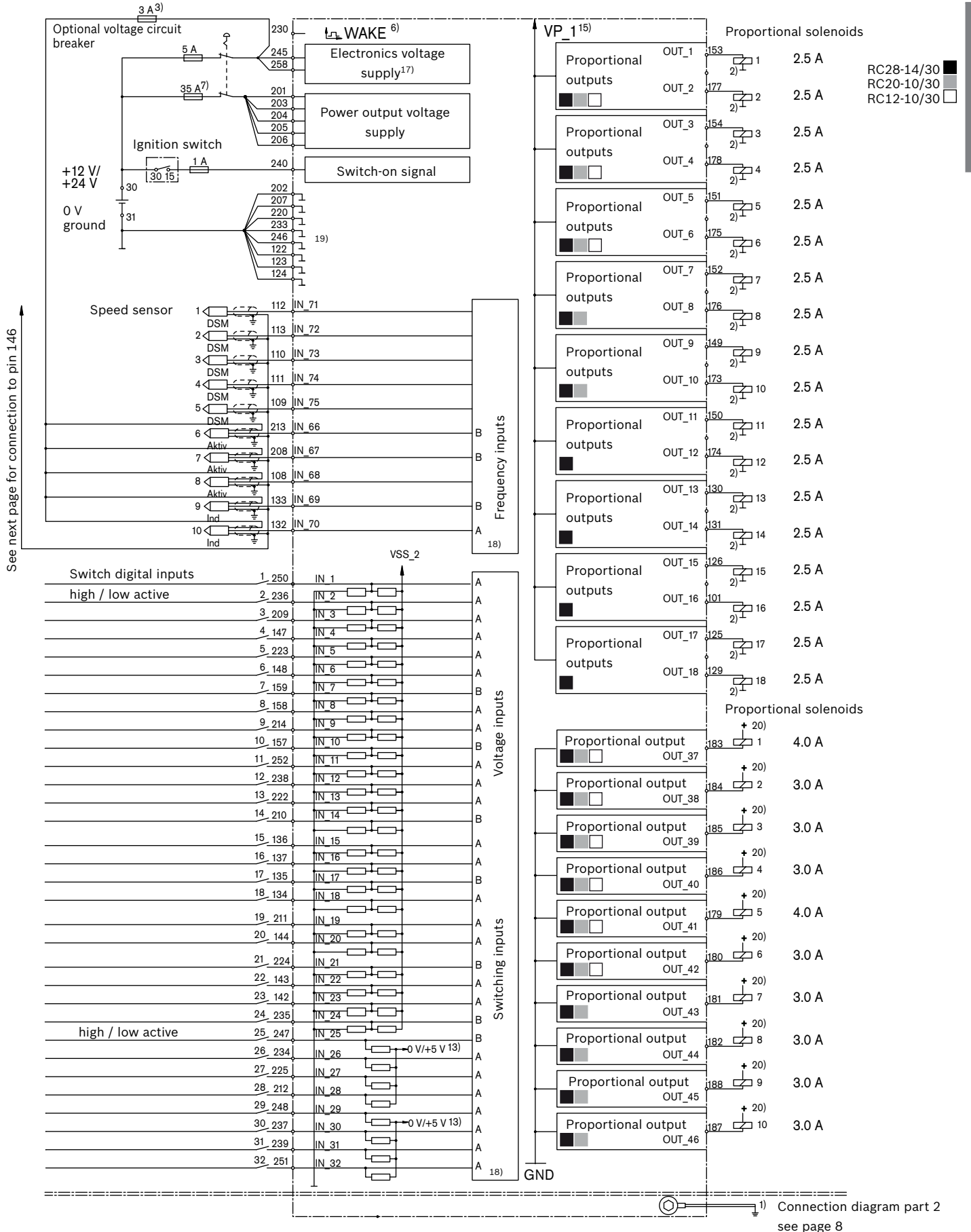
Controllers RC		28-14	20-10	12-10
		■	■	□
Reverse polarity protection¹⁾ Power supply/battery		-		
Microcontroller		SAK-TC1797		
Clock frequency	MHz	180		
Memory capacities				
RAM	MByte	1		
Flash EPROM	MByte	4		
EEPROM	kByte	32		
Software installation Download to flash memory		●		
Electromagnetic compatibility³⁾				
Spurious interference (ISO 11452-2)	200 V _{RMS} /m	●		
Spurious interference (ISO 11452-5)	100 V _{RMS} /m	●		
Electrostatic discharge ESD (according to ISO 10605)				
Out of service	8 kV	●		
In service	15 kV	●		
Max. power dissipation				
Electronics	W at 32 V	8.5		
Output stages	W at 32 V	60		
Operating temperature, housing with mounting point on cooling surface		-40 °C to +85 °C (-40 °C to +185 °F)		
Storage temperature, housing		Maximum permissible housing temperature in the short-term passive: -40 °C to +105 °C (-40 °C to +221 °F)		
Vibration resistance				
Broadband noise vibration (ISO 16750-3)	34 m/s ² , 10 to 1000 Hz, 32 h per axis 10 Hz: 18 (m/s ²) ² /Hz 20 Hz: 36 (m/s ²) ² /Hz 30 Hz: 36 (m/s ²) ² /Hz 180 Hz: 1 (m/s ²) ² /Hz 2000 Hz: 1 (m/s ²) ² /Hz	●		
Shock resistance				
Transport shock (IEC 60068-2-27)	$a = 400 \text{ m/s}^2$; $t = 6 \text{ ms}$ per spatial axis x, y, z and in each direction (pos./neg.)	●		
Moisture resistance (IEC 60068-2-30Db; variant 2)		95% (25 °C to +55 °C)		
Salt spray resistance (IEC 60068-2-52, test Kb)		4x 2 h salt spray (5% NaCl) 22 h at 40 °C/93% rF constant environment 72 h at storage room temperature		
IP rating (DIN EN 60529)²⁾ with assembled mating connector		IP65		
Housing material				
Cover:	Diecast aluminum	●		
Base:	Deep-drawing aluminum	●		
Weight		approx. kg		
Outer dimensions				
	Length (in mm)	204.5		
	Width (in mm)	203		
	Height (in mm)	40.5		
Mating connector				
	96-pin	1		
	58-pin	1		

1) The external fuse can serve as reverse polarity protection.

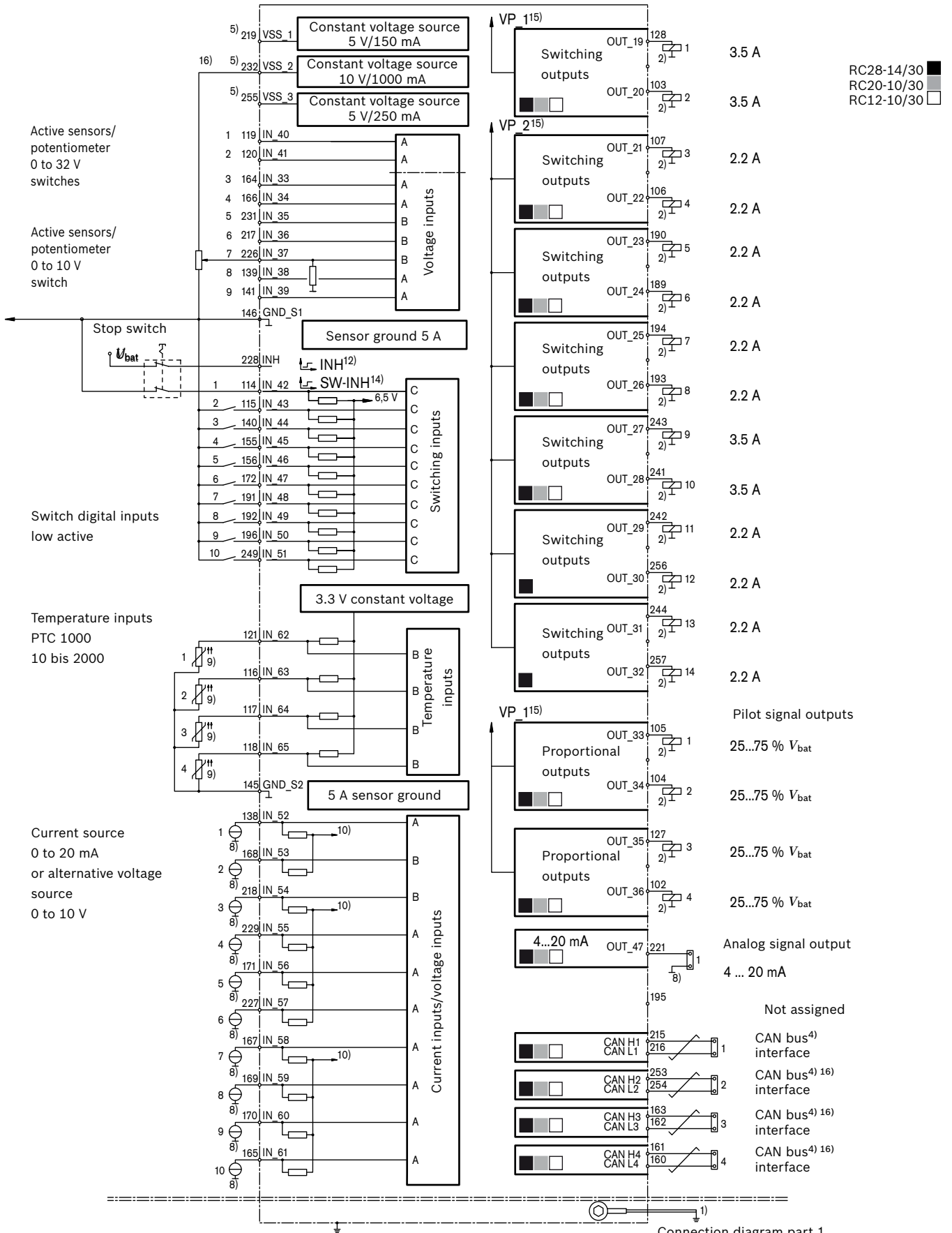
2) While following installation instructions.

3) Up to 500 kBaud when using the CAN interfaces.

Connection diagram



See page 1 for connection



Connection diagram part 1
see page 7

Footnotes for pages 7 and 8

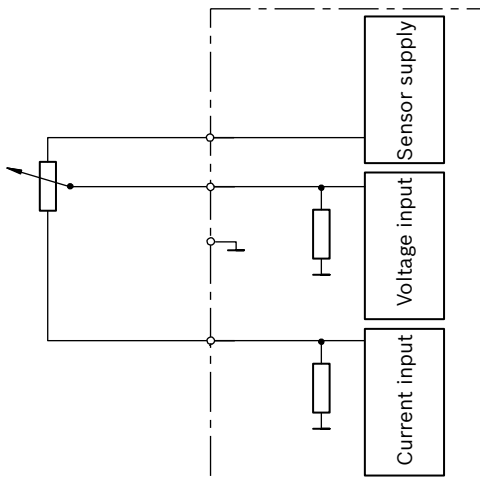
-
- 1) Short, low-resistance connection from a housing screw to the vehicle ground.
 - 2) Independent ground connection to battery (via chassis possible).
 - 3) Separate fuse required for switches and sensors. Sensor supply application specific.
 - 4) CAN bus: 120 Ω termination resistor and twisted pair wire required.
 - 5) 5 V/10 V outputs can also be used as sensor supply.
 - 6) Temporary wake up of the control unit when a signal > 8 V is applied for more than 1 sec.
 - 7) Note max. current consumption with simultaneous actuation of proportional solenoids and switching outputs.
 - 8) Separate ground connection for current source to the battery, control unit GND possible
 - 9) Can be used as switching inputs if externally switched to GND.
 - 10) For use as voltage inputs (0 to 10 V), the internal ohmic resistance can be switched by the software in groups for these inputs.
Groups: inputs 1 to 2, inputs 3 to 6, inputs 7 to 10.
 - 11) Outputs arranged in groups with 2 output stages each. Maximum permissible output current per group: 5 A
 - 12) Primary deactivation channel for proportional and switch outputs: enabling with level > 4.5 V, deactivation with level < 1 V, cable break leads to deactivation.
 - 13) Input groups may be switched to pull down or pull up in software.
 - 14) Secondary deactivation channel for proportional and switch outputs: enabling with level < 0.7 V, deactivation with level > 2 V, cable break leads to deactivation.
 - 15) Supply can be switched by the software.
 - 16) Shuts off on response from watchdog.
Temporarily interrupted for diagnostic purposes when turning on the main switch for the first time.
 - 17) If disabled during operation, data will not be saved to the non-volatile memory and there will be no after-run.
 - 18) A, B and C indicate different A/D converters which may be selected for redundancy reasons.
 - 19) Terminal 31 (supply ground) and sensor ground are bridged at a star point in the control unit and connected to the housing.
 - 20) Loads on low-side outputs should be supplied by high-side outputs so that they can also be disabled in the event of a short circuit to ground. See "Safety outputs" in the API manual. If this is not possible, the power must be routed through a relay switched via Terminal 15. In this case, the lines must be equipped with fuses. Connecting directly to Terminal 30 is not permitted.

Connection variants

Monitored potentiometer 2.5 to 5 k Ω

Fault monitoring of the potentiometer

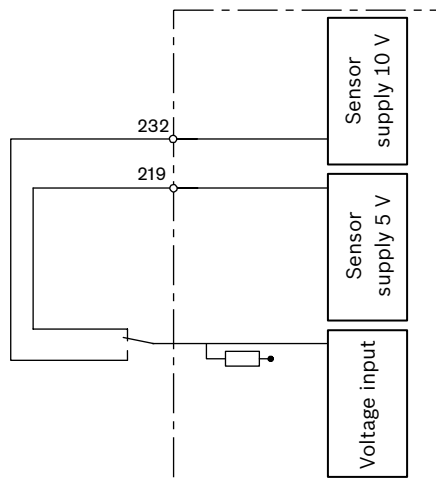
- ▶ Internal measurements of the sensor supply voltage (5 V)
- ▶ Connection of the potentiometer to a current input, via which the current of the potentiometer is checked.
- ▶ Checking the loop voltage. It must be within a valid range (software).



Switching input with fault detection

Fault monitoring of the switching inputs

- ▶ Switching of the input voltage between 10 V and 5 V
- ▶ Reading the switching level and checking the valid range (software)



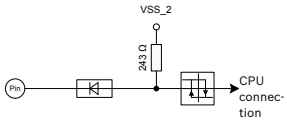
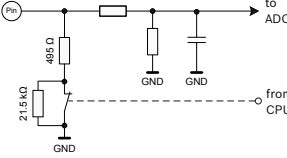
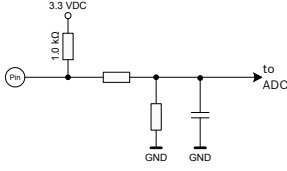
Overview of functions

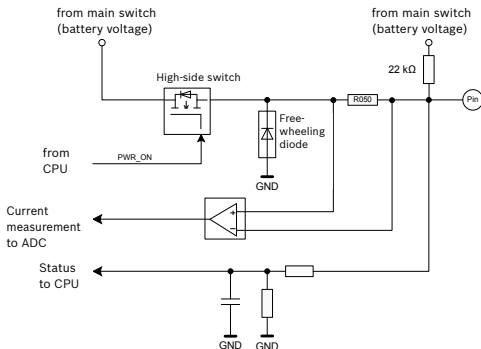
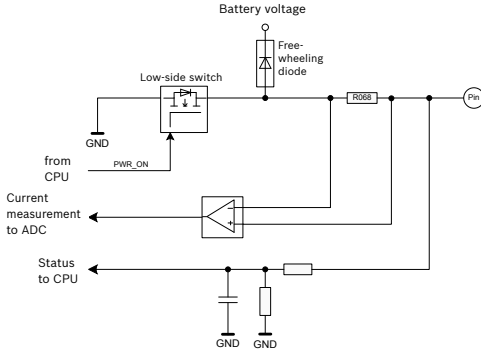
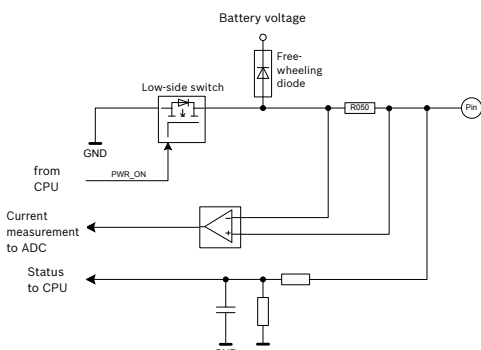
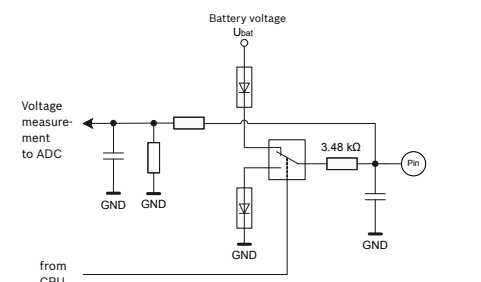
Pin	Description	Main function	Alternative functions
250, 236, 209, 147, 223, 148, 159, 158, 214, 157, 252, 238, 222, 210, 136, 137, 135, 134, 211, 144, 224, 143, 142, 235	Digital input IN_1 to IN_24 15 kΩ pull-up resistance to VSS_2 sensor supply ¹⁾ and 5.6 kΩ pull-down resistance to ground	Digital input Switching threshold configurable via software (max. 10 V) Externally switchable to GND, VSS_x or V _{bat} . If V _{bat} = 24 V then max. 10 of these inputs may be switched to 24 V simultaneously.	Analog voltage input Measuring range: 0 to 10 V Resolution: 12 bit (2.7 mV/bit) Input resistance DC to GND: 5.6 kΩ DC to VSS_2: 15.0 kΩ Filter frequency limit: 330 Hz Limited diagnostics of cable breakage due to fixed pull-up and pull-down resistance
247, 234, 225, 212, 248, 237, 239, 251	Digital input Pull-up/pull-down resistance can be switched between 5V/ground in two groups IN_25 to IN_28 IN_29 to IN_32	Digital input Switching threshold configurable via software (max. 10 V) Externally switchable to GND, VSS_x or V _{bat} . Open terminal voltage: Pull-up: 3.5 V Pull-down: 0 V (default)	Analog voltage input Input resistance with pull-up configuration: 21 kΩ to 5 V and 50 kΩ to GND Input resistance with pull-down configuration: 15 kΩ to GND Filter frequency limit: 330 Hz
164, 166, 231, 217, 226, 139, 141	Analog voltage input IN_33 to IN_39	Analog voltage input Measuring range: 0 to 10 V Resolution: 12 bit (2.71 mV/bit) Input resistance DC to GND: 15 kΩ Filter frequency limit: 330 Hz	Digital input active high Evaluation options: Switching threshold configurable via software (max. 10 V) Externally switchable to VSS_x
119, 120	Analog voltage input IN_40 to IN_41	Analog voltage input Measuring range: 0 to 32 V Resolution: 12 bit (8.8 mV/bit) Input resistance DC to GND: 15 kΩ Filter frequency limit: 800 Hz	Digital input active high Evaluation options: Switching threshold configurable via software (max. 32 V) Externally switchable to VSS_x or V _{bat}
114	Digital input IN_42 (SW INH) 21.5 kΩ pull-up resistor to 6.5 V	Secondary inhibit input Activation of output stages: Level low < 0.7 V (switch to GND with low resistance) Deactivation of output stages: Level high > 2 V, ≅ V _{bat} (switch open) Cable break leads to the deactivation of all output stages.	Digital input active low Evaluation options: Digital switching thresholds Level low < 0.7 V (switch to GND with low resistance) Level high > 2 V (switch open) Filter frequency limit: 100 Hz

1) When V_{bat} ≧ 11 V, VSS_2 = 10 V; when V_{bat} < 11 V, VSS_2 = V_{bat} - 1 V

Pin	Description	Main function	Alternative functions
115, 140, 155, 156, 172, 191, 192, 196, 249	Digital input IN_43 to IN_51 21.5 kΩ pull-up resistor to 6.5 V	Digital input active low Evaluation options: Digital switching thresholds Level low < 0.7 V (switch to GND with low resistance) Level high > 2 V (switch open) Filter frequency limit: 100 Hz	
213, 208	Active frequency input IN_66 to IN_67 6.8 kΩ pull-up resistor to VSS_2 ¹⁾ and 24 kΩ pull-down resistor to ground	Frequency input for Type NPN active sensors Frequency evaluation of active speed sensors that switch to ground. Frequency evaluation up to 10 kHz Phase measuring between IN_66 (Pin 213) and IN_67 (Pin 208) Short circuit current up to 1.4 mA	Low active digital input Evaluation options: Switching threshold configurable via software (max. 5 V) Digital switching thresholds Level low < 1 V (switch to GND with low resistance) Level high > 4 V (switch open) Open terminal voltage: > 6 V
108	Active frequency input IN_68 6.8 kΩ pull-up resistor to VSS_2 ¹⁾ and 24 kΩ pull-down resistor to ground	Frequency input for Type NPN active sensors Frequency evaluation of active speed sensors that switch to ground. Frequency evaluation up to 10 kHz Short circuit current up to 1.4 mA	
133, 132	Inductive frequency input IN_69 to IN_70 44 kΩ pull-down resistance to ground	Frequency input for Type PNP and NPN inductive and active sensors Frequency evaluation: 500 Hz to 10 kHz Min. required signal amplitude: 1 V _{RMS} (sine wave) Phase measuring between IN_69 (Pin 133) and IN_70 (Pin 132)	High active digital input Evaluation options: Switching threshold configurable via software (max. 32 V) (switch to V _{bat} with low resistance) Open terminal voltage: < 1 V Analog voltage input Measuring range: 0 to 32 V Resolution: 12 bit (7.6 mV/bit)

1) When V_{bat} ≥ 11 V, VSS_2 = 10 V; when V_{bat} < 11 V, VSS_2 = V_{bat} - 1 V

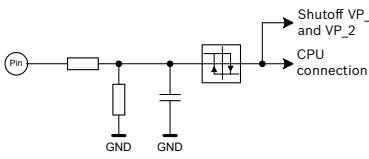
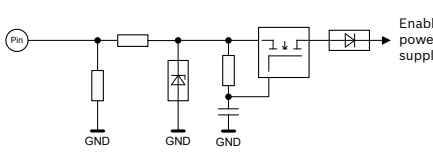
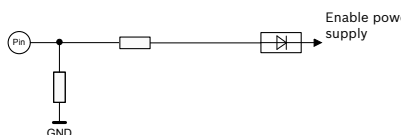
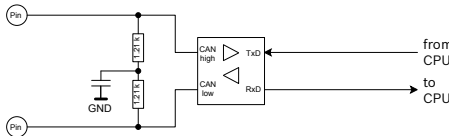
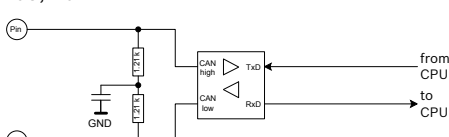
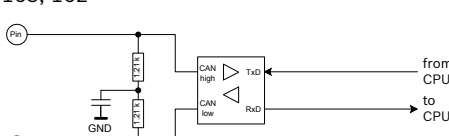
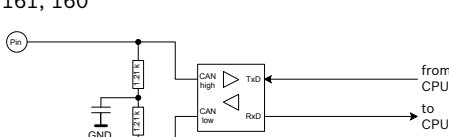
Pin	Description	Main function	Alternative functions
112, 113, 110, 111, 109	<p>DSM frequency input IN_71 to IN_75</p> <p>This input has an internal pull-up resistance of 243 Ω to VSS_2 (10 V).</p> 	<p>Frequency input for Rexroth DSM sensors</p> <p>Frequency evaluation up to 9 kHz Evaluation of additional information, such as direction of rotation and fault monitoring.</p>	<p>Frequency input for Type NPN active sensors</p> <p>Frequency evaluation of active speed sensors that switch to ground.</p> <p>Level low < 5 V (7 mA) Level high > 9 V (13 mA)</p> <p>Phase measuring between IN_71 (Pin 112) and IN_72 (Pin 113) Phase measuring between IN_73 (Pin 110) and IN_74 (Pin 111)</p> <p>Attention: Short circuit current to ground up to 40 mA.</p> <hr/> <p>Digital input switching to GND</p> <p>Evaluation options: - Digital current threshold 10 mA ± 3 mA</p>
138, 168 218, 229, 171, 227 167, 169, 170, 165	<p>Analog current input with switchable internal ohmic resistance IN_52 to IN_61</p> <p>Switchable in three groups between analog current and voltage input</p> <p>IN_52 and IN_53 IN_54 to IN_57 IN_58 to IN_61</p> 	<p>Analog current measuring input</p> <p>Measuring range: 0 to 20 mA Internal ohmic resistance: 490 Ω Resolution: 12 bit (5.5 μA/bit)</p> <p>Filter frequency limit: 330 Hz</p> <p>In 12 V applications two current inputs may be connected in parallel to halve the internal ohmic resistance.</p>	<p>Analog voltage input</p> <p>Measuring range: 0 to 10 V Resolution: 12 bit (2.71 mV/bit)</p> <p>Input resistance DC to GND: 12.38 kΩ Filter frequency limit: 330 Hz</p> <hr/> <p>Digital input active high</p> <p>Evaluation options: Switching threshold configurable via software (max. 10 V) Open terminal voltage: < 1 V</p>
121, 116, 117, 118	<p>Temperature input IN_62 to IN_65</p> <p>1 kΩ pull-up resistor to 3.3 V and 150 kΩ pull-down resistor to ground</p> <p>Not short circuit-proof to battery.</p> 	<p>Temperature measurement via resistance measurement of connected temperature sensors</p> <p>Evaluation of passive temperature sensors with PTC measuring shunts from 10 to 2000 Ω.</p> <p>Supported Bosch Rexroth sensors: TSF (RD 95180) TSA (RD 95181)</p>	<p>Digital input active low</p> <p>Evaluation options: Switching threshold configurable via software (max. 3.3 V) (switch to GND with low resistance or switch open) Open terminal voltage: > 3 V</p> <hr/> <p>Analog voltage input Measuring range: 0 to 3 V Resolution: 12 bit (0.8 mV/bit) Filter frequency limit: 230 Hz</p>

Pin	Description	Main function	Alternative functions
153, 177, 154, 178, 151, 175, 152, 176, 149, 173, 150, 174, 130, 131, 126, 101, 125, 129	PWM output stage OUT_1 to OUT_18 	PWM output stage High-side switch Clock frequency adjustable via software Integrated free-wheeling diode for switching of inductive loads Max. current: 2.5 A Duty factor: 0 to 100% Power supply centrally switchable via VP_1	Switching output stage with diagnostics duty cycle: 100%
184, 185, 186, 180, 181, 182, 188, 187	PWM output stage OUT_38 to OUT_40 and OUT_42 to OUT_46 	PWM output stage Low-side switch Clock frequency configurable via software Integrated free-wheeling diode for switching of inductive loads Max. current: 3.0 A Duty factor: 0 to 100%	Switching output stage with diagnostics Duty cycle: 100%
183, 179	PWM output stage OUT_37 and OUT_41 	PWM output stage Low-side switch Clock frequency adjustable via software Integrated free-wheeling diode for switching of inductive loads Max. current: 4.0 A Duty factor: 0 to 100% Maximum current depends on duty factor and load.	Switching output stage with diagnostics Duty cycle: 100%
105, 104, 127, 102	Analog voltage output OUT_33 to OUT_36 	PWM control voltage Output voltage: $0\% \times V_{bat}$ to $90\% \times V_{bat}$ (typically $25\% \times V_{bat}$ to $75\% \times V_{bat}$) 400 to 5000 Hz OUT_33 to OUT_36: Power supply centrally switchable via VP_1	

Pin	Description	Main function	Alternative functions
107, 106, 190, 189, 194, 193, 242, 256, 244, 257	Switching output stage with current sensing OUT_21 to OUT_26 and OUT_29 to OUT_32	High-side switch switching output stage¹⁾ Max. current 2.2 A Integrated free-wheeling diode for switching of inductive loads Power supply centrally switchable via VP_2	
128, 103, 243, 241	Switching output stage with current sensing OUT_19 to OUT_20 and OUT_27 to OUT_28	High-side switch switching output stage¹⁾ Max. current 3.5 A Integrated free-wheeling diode for switching of inductive loads OUT_19 to OUT_20: switchable via VP_1 OUT_27 to OUT_28: switchable via VP_2	
221	Analog signal output OUT_47	Analog current output Output signal with 200 Ω external ohmic resistance Output powered via VSS_2	Analog voltage output Output signal 0 V (off), 0.1 to 5.0 V 150 Ω external ohmic resistance to ground required
219	Sensor supply VSS_1	Sensor supply Output voltage 5.0 V Accuracy ±0.15 V Load capacity 150 mA	
232	Sensor supply VSS_2	Sensor supply, deactivatable Output voltage 10.0 V ²⁾ but not more than $V_{bat} - 1 V$ Accuracy ±0.50 V Load capacity: 1000 mA	
255	Sensor supply VSS_3	Sensor supply, deactivatable Output voltage 5.0 V Accuracy ±0.25 V Load capacity 250 mA	

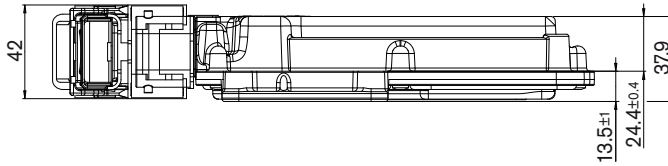
1) Software configuration as proportional output with 100% duty cycle required.

2) When $V_{bat} \geq 11 V$, $VSS_2 = 10 V$; when $V_{bat} < 11 V$, $VSS_2 = V_{bat} - 1 V$

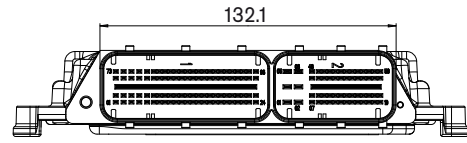
Pin	Description	Main function	Alternative functions	
228		External inhibit INH	Primary inhibit input Activation of the output stages: Level > 4.5 V, $\cong V_{bat}$ Deactivation of output stages: Level < 1 V Cable break leads to the deactivation of all output stages. Input resistance DC to GND: 34 k Ω	
230		Door contact WAKE Enables temporary power up of the control unit	Digital input Switch on control unit Level > 8 V, $\cong V_{bat}$ Input resistance DC to GND: 18.5 k Ω	
240		KL15 ignition switch Power on signal for the control unit	Digital input Controller activation Level > 8 V, $\cong V_{bat}$ Input resistance DC to GND: 10 k Ω	
215, 216		CAN interface CAN1_H, CAN1_L	CAN interface CAN 2.0 B, factory setting 250 kBaud, standard diagnostics interface up to 1 Mbaud, termination resistor in cable harness required	
253, 254		CAN interface CAN2_H, CAN2_L	CAN interface CAN 2.0 B, up to 1 Mbaud, termination resistor in cable harness required	
163, 162		CAN interface CAN3_H, CAN3_L	CAN interface CAN 2.0 B, up to 1 Mbaud, termination resistor in cable harness required	
161, 160		CAN interface CAN4_H, CAN4_L	CAN interface CAN 2.0 B, up to 1 Mbaud, termination resistor in cable harness required	

Dimensions

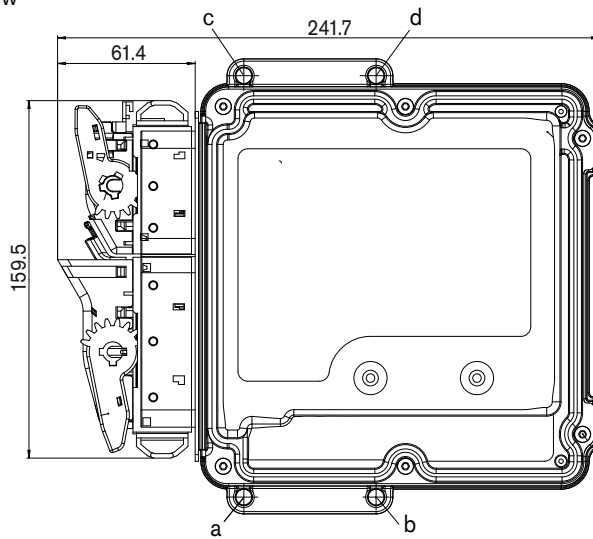
Long-side side view



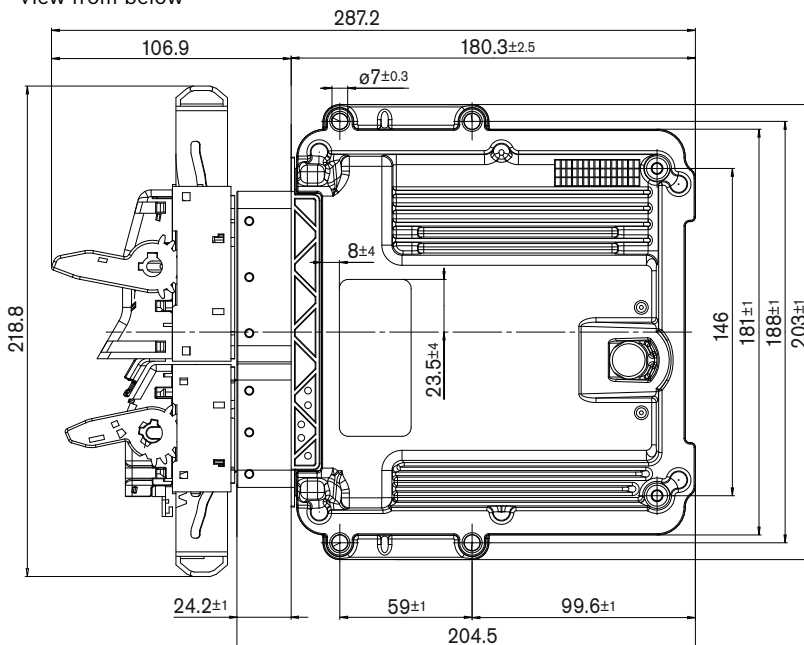
Side view of connector side with pulled connector



Plan view



View from below



Fixing:

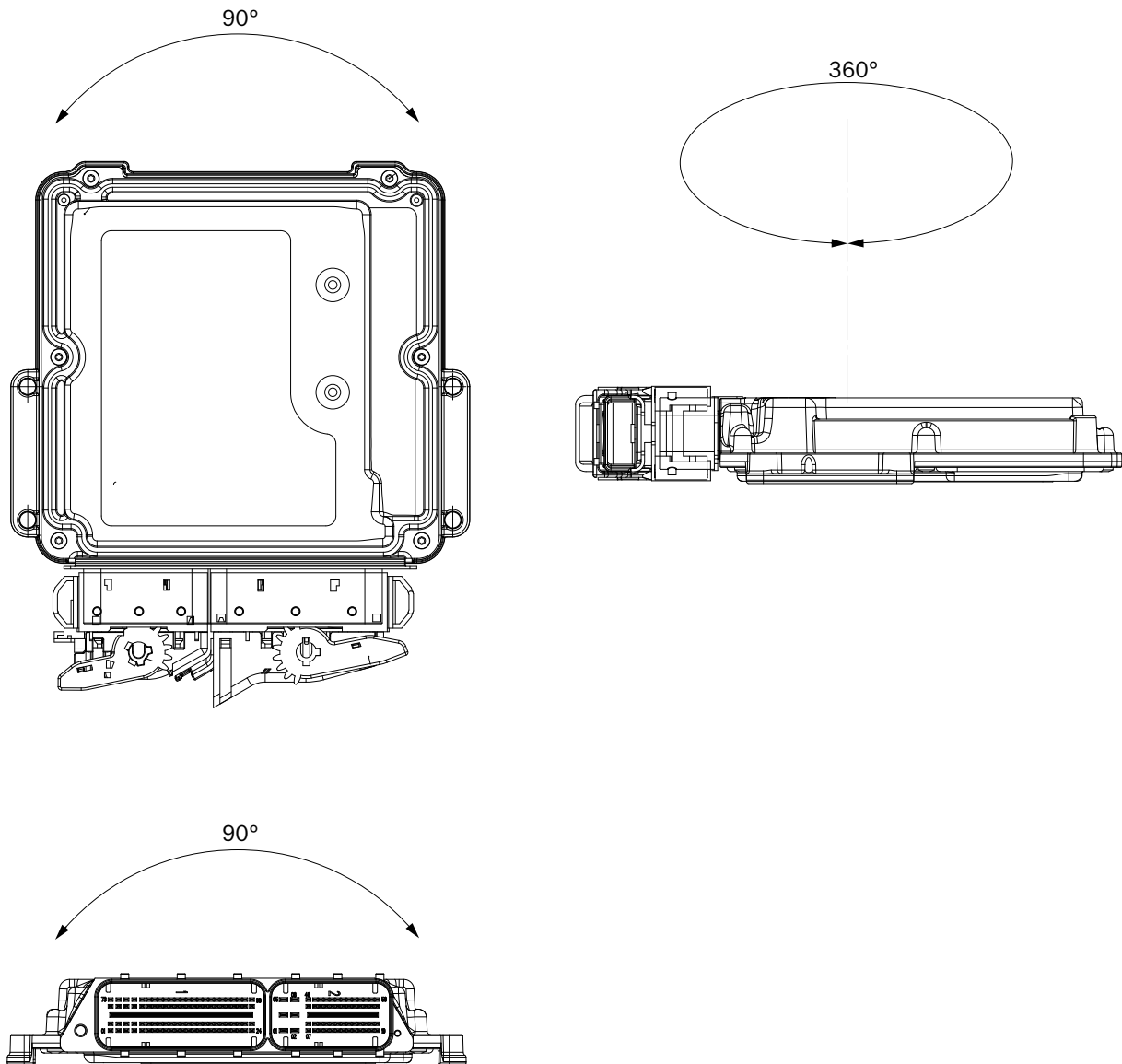
- ▶ The BODAS controller must be fixed at 4 positions (a, b, c and d).
- ▶ Tightening torque MA = 8 ± 2 Nm for mounting the BODAS control unit with M6 screws.
- ▶ Tightening torque applies for fitting without washer. The equivalent tightening torque must be calculated when using washers.
- ▶ Rexroth's consent is required if fixing is different from above.
- ▶ Installation point: flatness of the mounting surface $\square 0.5$
- ▶ The wiring harness should be mechanically fixed in the area in which the control unit is installed (spacing < 150 mm).
The wiring harness should be fixated so that in-phase excitation with the controller occurs (e.g. at the controller mounting points).

If the mounting surface is not sufficiently even, place flexible compensating elements (e.g. rubber washers) between the fixing points of the BODAS controller and the mounting surface.

- ▶ Space required for mating connector
- ▶ Space required for plugging and unplugging the mating connector

Display without scale, dimensions in mm

Installation position



Note:
Installation position only permissible with specified angular range.

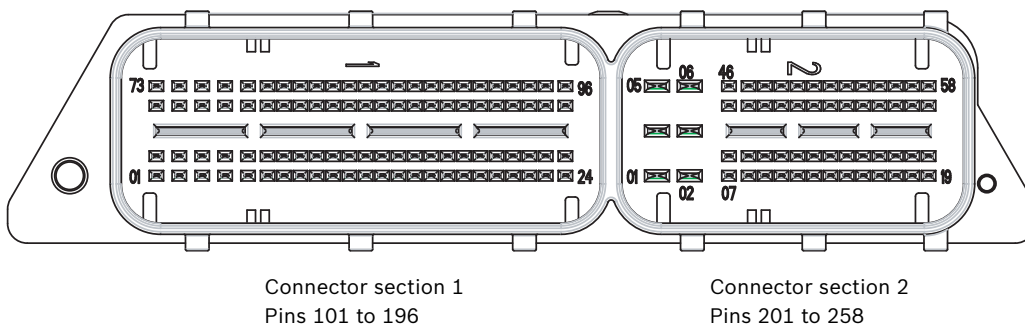
Mating connector

Order designations for the connector set with the Rexroth material number R902603622

Designation	Number	Bosch part numbers of the individual parts	
		Module 58-pin	Module 96-pin
Contact carrier code: A	1 per connector	1 928 404 780	1 928 404 781
Cover pre-installed	1 per connector	1 928 404 774	1 928 404 773
Secondary lock 1.2	1 per connector	1 928 404 760	1 928 404 762
Secondary lock 2.8	1	1 928 404 761	–
Wire tie (cable tie)	1 per connector	1 928 401 713	
Contacts BDK 2.8 contact Surface: SN Insulation cross section: 2.2 to 3.0 mm Line cross section: 1.5 to 2.5 mm	6 (8) ^{*)}	1 928 498 057	–
Matrix 1.2 contact Surface: SN Insulation cross section: 1.2 to 1.6 mm Line cross section: 0.35 to 0.5 mm	52 (55) ^{*)}	1 928 498 137	–
Matrix 1.2 contact Surface: SN Insulation cross section: 1.2 to 1.6 mm Line cross section: 0.35 to 0.5 mm	96 (100) ^{*)}	–	1 928 498 137
Individual sealing White for BDK 2.8 Cross section: 2.2 to 3.0 mm	6 (8) ^{*)}	1 928 300 600	–

^{*)} The number in the brackets indicates how many contacts or individual seals are included in the Rexroth connector set. The number without brackets indicates the requirement.

View of connector strip



The control unit connector strip can be ordered separately under Rexroth material number R917009804, e.g., for testing a wiring harness. Delivery only in quantities for lab use.

Notes regarding assembly

Please observe the assembly instructions for connectors (1 928 A00 48M) as well as the processing specifications for BDK 2.8 contacts (1 928 F00 025) and Matrix 1.2 contacts (1 928 A00 47M) when assembling the connectors. These assembly instructions are available from Bosch Rexroth upon request.

Note

Please observe the following when assembling the connector in the vehicle:
The wiring harness must be attached ≤ 150 mm from the outgoing wires and at the same vibration level as the control unit.

Recommended lines

Recommended connecting lines for contacts 201 to 206:

- ▶ Cross section 1.5 mm² to 2.5 mm²
(16 to 14 AWG, 14 AWG with thin electric insulation)
- ▶ Outer diameter: 2.2 mm to 3.0 mm

Recommended connecting lines for contacts 101-105, 124, 125-129, 148, 149-153, 172, 173-177, 196, 207, 220, 233, 246:

- ▶ Cross section 1.0 mm² to 1.5 mm² (18 to 16 AWG)
- ▶ Outer diameter: 1.9 to 2.1 mm for 1.0 mm², 2.2 to 2.4 mm for 1.5 mm²

Lines with a cross section of 0.35 mm² to 0.5 mm² can also be used for these contacts (see other contacts below).

However, the 1.0 mm² to 1.5 mm² cross sections can make it easier to insert the contacts into the connector.

Recommended connection lines for the contacts not mentioned above:

- ▶ Cross section: 0.35 mm² to 0.5 mm² (22 AWG)
- ▶ Outer diameter: 1.2 to 1.6 mm

Required tools

Bosch part numbers for tools¹⁾

Designation	Type FLK-R line cross sections			
	BDK 2.8 contacts	Matrix 1.2 contacts	1.0 mm ²	1.5 mm ²
	1.5 to 2.5 mm ²	0.35 to 0.5 mm ²		
Contact	1 928 498 057	1 928 498 137	1 928 498 138	1 928 498 139
Crimping tool with matrix	1 928 498 162	1 928 498 212	1 928 498 213	1 928 498 214
Quick-change tool	1 928 498 164	1 928 498 200	1 928 498 201	1 928 498 202
Wear parts set	1 928 498 166	1 928 498 206	1 928 498 207	1 928 498 208
Disassembly extraction tool	1 928 498 167		1 928 498 218	
10 replacement needles for the extraction tool	1 928 498 168		1 928 498 219	

Drawings and further information about Bosch connectors and tools can be found on the internet:

www.bosch-connectors.com

¹⁾ Tools can be ordered from Bosch retailers or Bosch Service (www.bosch-service.com).

Safety information

General

- ▶ Reliable operation cannot be guaranteed if samples or prototypes are used in series production machines.
- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ Incorrect connections could cause unexpected signals at the outputs of the control unit.
- ▶ Incorrect programming or parameter settings on the control unit may create potential dangers while the machine is in operation.
It is the responsibility of the machine manufacturer to identify hazards of this type in a hazard analysis and to bring them to the attention of the end user. Rexroth assumes no liability for dangers of this type.
- ▶ The component firmware/software must be installed or changed by Bosch Rexroth or by the authorized partner concerned in order to uphold the warranty.
- ▶ It is not permissible to open the control unit or to modify or repair the control unit. Modifications or repairs to the wiring could result in dangerous malfunctions. Repairs to the control unit may only be performed by Bosch Rexroth or by an authorized partner.
- ▶ To switch off the system in emergencies, the stop switch (two-channel stop function) or the optional de-energize switch may be used. The switch must be in an easily accessible position for the operator. The system must be designed in such a way that safe braking is ensured when the outputs are switched off.
- ▶ Make sure no pins are connected to a voltage source when the electronics is not powered. Thus, when the current supply is switched off, the supply for the electronics, the output stages and the external sensor supply have to be switched off together.
- ▶ Make sure that the control unit's configuration does not lead to safety-critical malfunctions of the complete system in the event of failure or malfunction. Such system behavior could result in death or serious property damage.
- ▶ System developments, installation and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with the components used and with the complete system.
- ▶ The machine may cause unforeseen hazards during control unit commissioning and maintenance (with BODAS Tools). Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.
- ▶ Controllers used to develop software may only be installed in series production machines if it can be guaranteed that these control units have not been flash-programmed with new software more than 500 times. Controllers that have been programmed more than 1000 are not to be installed in series production machines.

Notes on the installation point and position

- ▶ Do not install the control unit close to parts that generate considerable heat (e.g. exhaust).
- ▶ Radio transmitting equipment and mobile telephones must not be used in the driver's cab without a suitable antenna or near the control electronics.
- ▶ A sufficiently large distance to radio transmitting systems must be maintained.
- ▶ All connectors must be unplugged from the electronics during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.
- ▶ The control unit must not be electrostatically charged, e.g. during painting operations.
- ▶ The control unit will heat up beyond normal ambient temperature during operation. To avoid danger caused by high temperatures, it should be protected against contact.
- ▶ Install the control unit in such a way that the electrical plug is not facing upwards. This ensures that any condensation water that may form can flow out.
- ▶ Standing and permanently running water are not permitted anywhere near the circumferential groove (lid/base connector) or the pressure balance element (DAE).
- ▶ The case must be wired to vehicle ground in order to comply with EMC guidelines. Metallic screws are used to create a connection to vehicle ground.

Notes on transport and storage

- ▶ If it is dropped, the control unit must not be used any longer as invisible damage could have a negative impact on reliability.
- ▶ Store control units at an average relative humidity of 60% and at a temperature between -10 °C and 30 °C. Storage temperatures between -20 °C and +40 °C are briefly permissible, for up to 100 hours.
- ▶ After a storage time of more than 5 years, the control unit must be examined by the manufacturer.

Notes on wiring and circuitry

- ▶ The electronics and the power outputs of a controller must be fed from the same power source.
- ▶ When wiring the output stages, the maximum cumulative output current for each output stage group should be noted. The cumulative output current means a permanent, simultaneous actuation of the output stages.
- ▶ Lines to the speed sensors are to be shielded and kept as short as possible. The shield must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The product may only be wired when it is de-energized.
- ▶ Lines to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The wiring harness should be fixed mechanically in the area in which the control unit is installed (spacing < 150 mm). The wiring harness should be fixed so that in-phase excitation with the control unit occurs (e.g. at the control unit bolting point).
- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.
- ▶ Lines are to be routed with sufficient spacing to hot or moving vehicle parts.
- ▶ PWM outputs must not be linked or bridged.
- ▶ PMW outputs (OUT_1 to OUT_18 and OUT_37 to OUT_46) must not be used to power lamps.
- ▶ The sensor supplies can be “pulled up” by external connection, e.g. the application of a higher voltage, because they operate only as a voltage source but not as a voltage sink! Pulling up a sensor supply may result in unexpected malfunctions and damage the control unit in continuous operation.
- ▶ The “high side” outputs may not be externally connected to battery.

- ▶ If the stop function is used in an application, contact 228 (INH) of the control unit must be connected to the stop switch in the vehicle. For a dual channel switch off function the contact SW-INH has to be connected to the stop switch too. Refer to the connection diagram.

Notes on proportional and switching solenoids and other wired inductive consumers

- ▶ The proportional solenoids must not be wired with free-wheeling diodes.
- ▶ Switching solenoids at control unit outputs do not need to be connected to free-wheeling diodes.
- ▶ The electronics may only be tested with the proportional solenoids connected.
- ▶ Other inductive loads that are in the system but not connected to the control unit must be connected to free-wheeling diodes. This also applies to relays (e.g. for shutting off the control unit) that are powered by the same source as the control unit.

Intended use

- ▶ The control unit is designed for use in mobile working machines provided no limitations / restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the control unit must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, current, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in hazard to persons and/or cause damage to components which could result in sequential damage to the mobile working machine.

Improper use

- ▶ Any use of the control unit other than as described under “Intended use” is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damage resulting from improper use and/or from unauthorized interference in the component not described in this data sheet render all warranty and liability claims void with respect to the manufacturer.

Use in functions relevant to safety

- ▶ The customer is responsible for performing risk analysis on the mobile working machine and determining the possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures to ensure safety (sensor redundancy, plausibility check, emergency switch, etc.).
 - For example, a suitable assignment of input variables (e.g., by connecting the acceleration pedal signal to two independent analog inputs) can be used to detect faults and to trigger specially programmed reactions.
 - Special measures may be taken if the plausibility check shows deviations between the setpoint values and the values read back from the microcontroller.
- ▶ Product data that is necessary to assess the safety of the machine can be provided upon request or are listed in this data sheet.
 - For all control units, the notes found in the API description, in the online help section of BODAS design and in the “safety-relevant project planning instructions” must be observed.
 - The service life of the control unit may be reduced depending on the conditions in which it is used. See the “safety-relevant project planning instructions” for more information.

Safety features in the BODAS controller

- ▶ The input circuits for speed and analog signals partially feature circuits that are mutually electrically isolated. Through appropriate input connections, the microcontroller and, when used, the software diagnostic function can detect faults.
- ▶ Faults in the voltage supply are detected by internal monitoring.
- ▶ All output signals can be monitored by the microcontroller with the appropriate software.
- ▶ For service purposes, the control units can be operated with all power outputs de-energized.
- ▶ The internal watchdog module centrally switches off the power supply of all proportional and switched outputs when there are malfunctions in the program run.

Further information

- ▶ In addition, the application-specific documents (connection diagrams, software descriptions, etc.) are to be observed.
- ▶ More detailed information on BODAS controllers may be found at www.boschrexroth.com/mobile-electronics

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Application software

Fan Control AFC30

RE 95362

Edition: 02.2015

1



- ▶ Control solution for hydrostatic fan drives
- ▶ Version 30

Features

- ▶ The AFC30 is an easily adjustable software package for the control of one hydrostatic fan drive with setpoint specification. The setpoint is defined by up to 6 different temperature values and external fan power requests.
- ▶ AFC30 fan control is configured for variable pumps with ED electrohydraulic pressure control and a fixed motor. Alternatively a combination of a fixed pump and a fixed motor with electro-proportional pressure-relief valve is possible.
- ▶ Status-dependent fan control via digital inputs.
- ▶ Support of CAN J1939 bus communication, DM1/DM2 diagnosis as well as freely configurable CAN messages.
- ▶ Improved control quality of the fan drive for reduced fuel consumption, noise emission, and exhaust values compared to fan drive solutions without proportional control.
- ▶ Reversing function - programmable change of fan rotation direction for cleaning the cooler.
- ▶ Diagnostics and parameter settings are performed with BODAS-service PC software.
- ▶ Outputs are monitored for wire breakage and short circuits.

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Introduction

The BODAS ASrun-AFC30 is a standard software solution embedded in an RC4-5/30 Rexroth Controller to control hydrostatic fan drives with fixed or variable hydraulic pumps. The AFC30 is designed for the control of a fan drive in an open hydraulic circuit. Up to 6 temperature signals (analog/J1939) can influence the fan power request. AFC30 supports 12V and 24V systems. As the AFC30 provides cooling power on demand it will noticeably reduce the fuel consumption compared to fan drive systems without proportional control. Features such as fan standstill and reversing are additional benefits of the AFC30. The software solution supports CAN messages for inputs, outputs and diagnosis.

Documents and tools support a systematic integration of BODAS ASrun-AFC30 within the machine environment from the project planning to the start of production and beyond.

System description

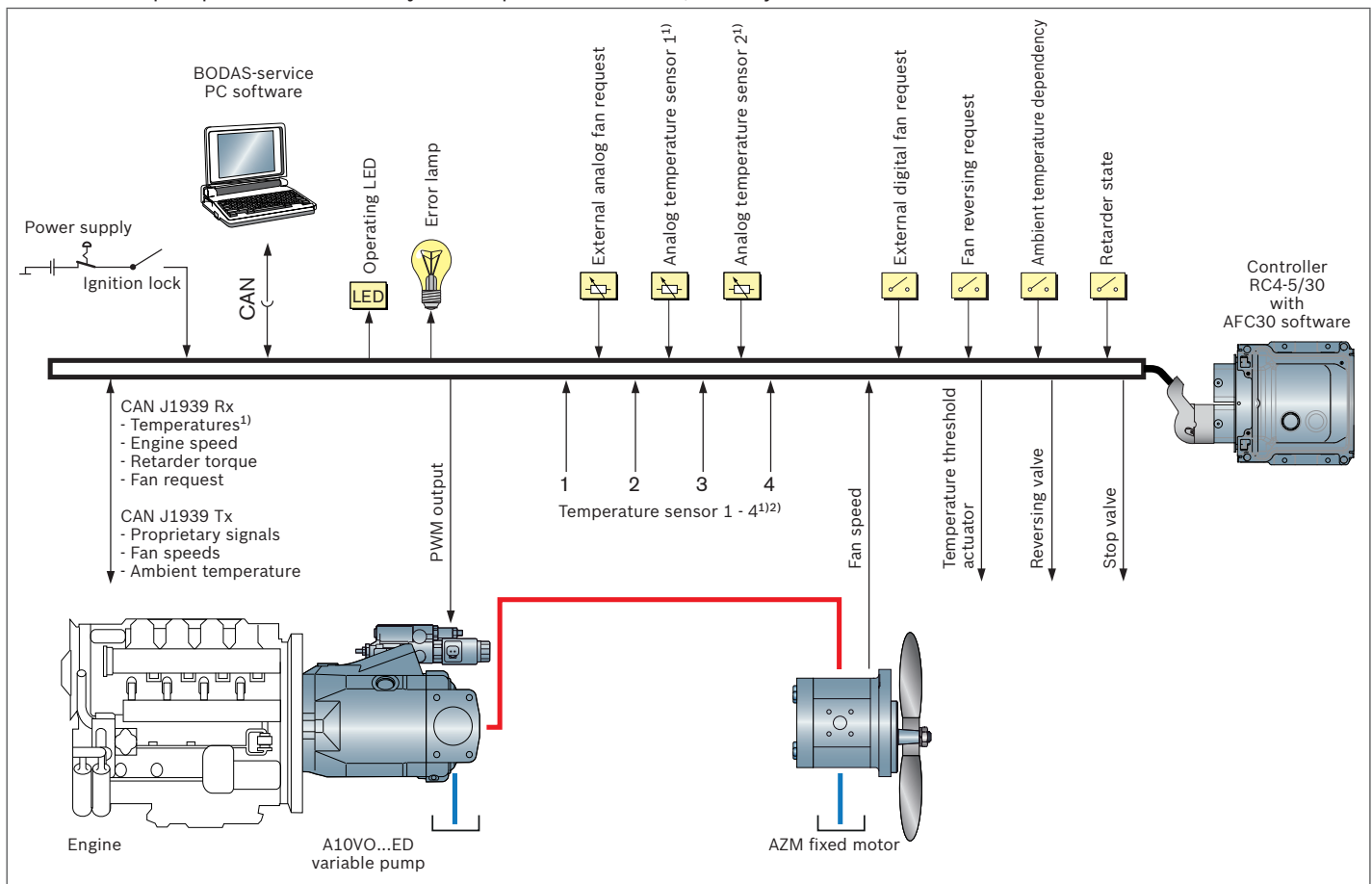
The electronic fan control is designed for controlling the following components in the open hydraulic circuit:

- ▶ Variable pump with electrohydraulic pressure control.
- or:
- ▶ Pressure-relief valve in fan drive system with a fixed pump.

The hydraulic concepts described below may be used for control purposes. The optional reversing and standstill function through the control of an additional valve are described in the chapter "Functional description"

Hydraulic concept A

One variable pump with ED electrohydraulic pressure control, in conjunction with a fixed motor

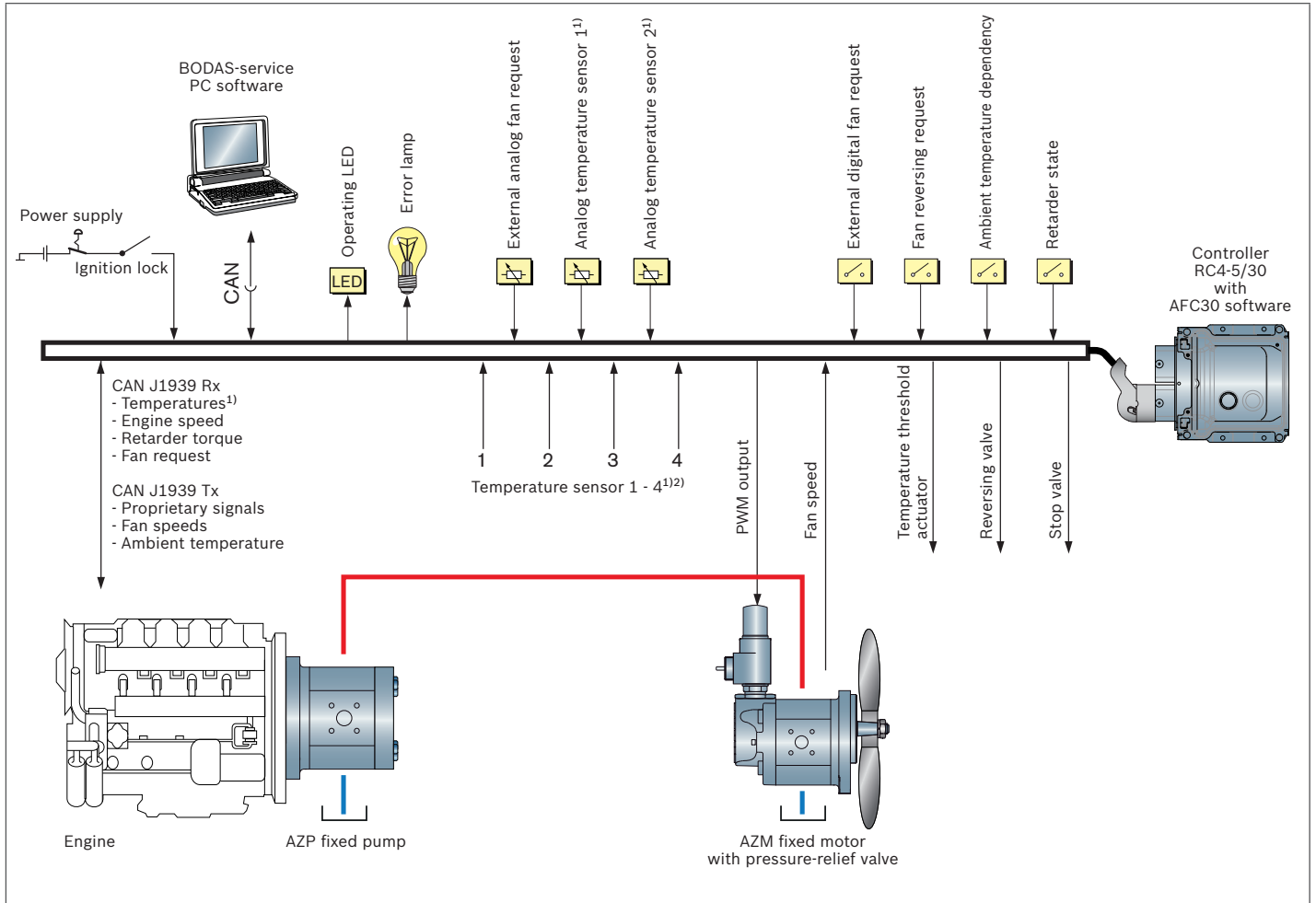


1) Up to six temperature variables can be assigned either via CAN or sensor values.

2) In total up to 4 temperature sensors (resistance) can be connected to the RC4-5/30.

Hydraulic concept B

One fixed pump, in conjunction with a fixed motor with pressure-relief valve



1) Up to six temperature variables can be assigned either via CAN or sensor values.

2) In total up to 4 temperature sensors (resistance) can be connected to the RC4-5/30.

Components

Software	BODAS ASrun-AFC30	
Controller	RC4-5/30 with 56-pin mating connector	
	Hydraulic Concept A Variable hydraulic pump	Hydraulic Concept B Fixed hydraulic pump
Hydraulic pump	Variable axial piston pump ▶ A10VO ED ▶ A10VNO ED ▶ A1VO D3C (12V)/D4C (24V) ▶ Further pumps with electro proportional pressure control	External gear pump ▶ AZP series B, F, N, G ▶ Further fixed pumps
Hydraulic motor	Fixed motor ▶ AZM series F, N, G ▶ A2FE/A2FM ▶ A10FE/A10FM ▶ Further fixed motors	Fixed motor ▶ AZMF ▶ A2FE/A2FM ▶ A10FE/A10FM ▶ Further fixed motors
Pressure-relief valve	Not necessary	KBVS (can be integrated in AZMF)

Reversing and standstill function

	Concept A				Concept B	
	ED-controlled pump				Electro proportional pressure-relief valve (KBVS.3B)	
Combined with directional valve (LF1/LF2):	4/3	4/2	4/2	2/2	4/2	4/3
Fan standstill	x	–	x	x	–	x
Reversing	x	x	–	–	x	x

Sensors and devices

- ▶ TSA PTC temperature sensor for air
- ▶ TSF PTC temperature sensor for fluids
- ▶ TF-W NTC Bosch fluid sensor (Bosch part)
- ▶ TF-L NTC Bosch air sensor (Bosch part)
- ▶ DSM1-10 Speed sensor
- ▶ HDD1 (NPN type) Speed sensor
- ▶ ID Speed sensor
- ▶ DSA1 BR12 Speed sensor
- ▶ Error lamp (not part of Bosch Rexroth product line)
- ▶ Operation lamp (not part of Bosch Rexroth product line)
- ▶ Other sensors – for the details see chapter "Electrical interfaces"

For commissioning and service

- ▶ BODAS-service PC software
- ▶ BODAS-service connection cable
- ▶ Diagnostic socket

Functional description

Setpoint specification

The fan control calculates the setpoint power of the fan considering the temperatures and fan power requests which are transmitted via sensors or CAN signals.

Up to 6 temperatures signals can be read e.g.:

- ▶ Coolant water temperature
- ▶ Charge air temperature
- ▶ Ambient air temperature
- ▶ Transmission oil temperature
- ▶ Additional analog temperatures for air or for fluid

Each temperature value is compared to a stored curve, defining the temperature to start cooling and the temperature at which the highest fan power is reached.

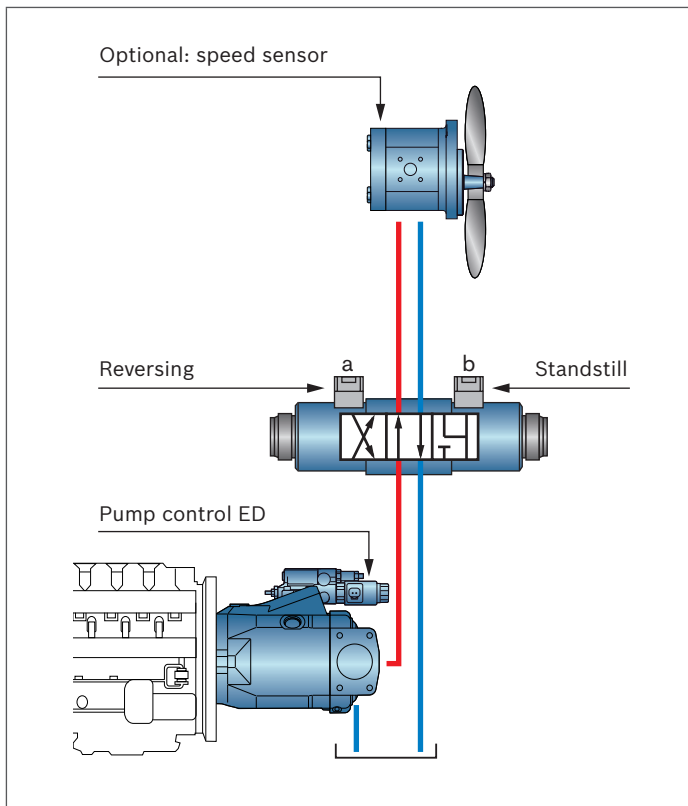
Between these two thresholds, the setpoint increases in proportion to the temperature changes.

An over-temperature can be defined.

If this value is exceeded the user will be notified by the error lamp.

▼ Variant 1

Reversing and standstill via 4/3-directional valve



The fan is controlled by the highest fan power either requested by the sensor or by CAN signal temperature curves.

Working behavior

The working behavior of the fan control is influenced by various variables:

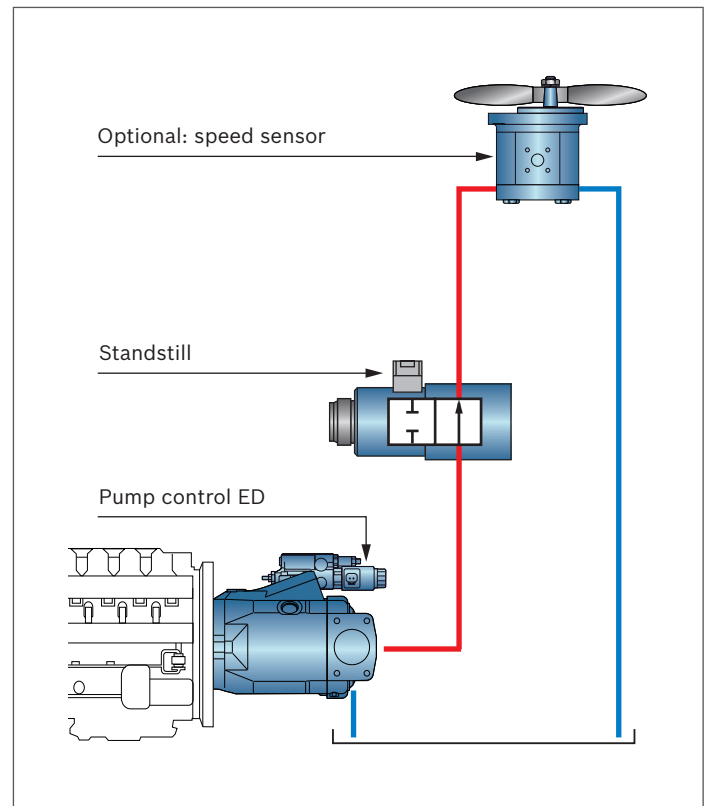
Digital and analog inputs can be used

- ▶ To set the setpoint
- ▶ To influence this setpoint
- ▶ To activate the change of the direction of the fan

Time ramps at all inputs and outputs determine how quickly the fan control is modified or how quickly the digital output changes.

▼ Variant 2

Standstill via 2/2-directional valve



Reversing function

The reversing function is activated via a digital input (switch) or an adjustable interval.

It is possible to implement the reversing function with both hydraulic concepts, fixed pump systems and variable pump systems. When used, the fan is first set to standby and if possible brought to a standstill. The flow direction of the oil is then changed for the fan motor. This is realized with the aid of a directional valve.

The minimum control current may change to a different value when the direction of rotation is reversed depending on the different dynamics of the fan blades in order to prevent overspeeding of the fan motor during reversing operation.

Temperature dependent standstill function

Fan is set to standstill if the system temperature is below a calibratable threshold and there is no fan power request. One or two independent temperature inputs can be used.

Fan speed limitation

By a sudden and fast increase of the diesel speed, a torque peak on the diesel side can occur (ED pump or bypass valve need a certain time to set the correct pressure for the requested oil flow). To avoid such behavior, a fan speed limitation could be configured.

“Shut down“ management

- ▶ After turning the ignition off, the power supply of the outputs will remain for two more seconds for a controlled slow down of the fan.
- ▶ After two seconds, the controller is switched OFF.

Monitoring functions

- ▶ Monitoring of wire breaks and short circuits for temperature input lines.
- ▶ Monitoring of wire breaks and short circuits for proportional output lines.

If a critical error occurs:

- ▶ The fan works with the maximum speed
- ▶ An associated blink code is displayed with the error lamp
- ▶ A DM1 message is sent every second on CAN bus
- ▶ An intelligent BODAS-service error message is displayed when connected with BODAS-service
- ▶ In case of overheating, an error lamp is set.
- ▶ Any faults that occur are logged in the control unit and can be read later on using PC software BODAS-service.
- ▶ A DM2 message is sent on request

Optional input: Retarder signal

- ▶ It is possible to control the fan dependent on the retarder value.
- ▶ If the retarder value is available digitally the logic can be set as low active or as high active and the required fan power is set with a parameter.
- ▶ If the retarder value is available on the CAN bus (ERC1 message), a simple function defines the required fan power.
- ▶ The fan control required by the retarder is ignored if one of the input temperatures is below a calibratable threshold.

Optional input: Ambient air temperature

- ▶ The ambient temperature can shift the temperature characteristic of the temperature input. It means that for the higher ambient temperatures the fan power starts at the higher temperature input.
- ▶ Ambient air temperature dependency can be enabled or disabled by a digital input.

External fan speed request

- ▶ Read external fan speed request from a CAN message (e.g. CM1 message). Reading procedure is always active
- ▶ The external request is included in the entirety of requests. The AFC30 chooses the maximum power of all inputs.

Blink code for error lamp

If an error is detected, the customer can identify it without using a diagnosis-tool by a blink-code of an error-lamp. A specific blink code is defined for every failure type.

Additional digital output: temperature threshold actuator

Beside the pump control, the AFC30 can also be used to control a digital output.

This is done by comparing a temperature value with thresholds.

- ▶ If the temperature value falls below the lower threshold, the digital output is set to 0.
- ▶ If the measured value exceeds the upper temperature threshold, the digital output is set to 1
- ▶ The area between the thresholds is used as the hysteresis
- ▶ The output can be low active or high active.
- ▶ Time ramps at all inputs determine how quickly the digital output responds to temperature changes.
- ▶ In comparison to "temperature dependent standstill function" this output is independent of the fan power requests

Start timer + engine speed

A start timer and minimum engine speed setting are available to keep the electronics from starting the fan until the engine is above some set speed level. This allows the fan drive hydraulics to be in a "zero" position during cranking to lessen the load on the engine.

Operating LED

The operating LED provides visual information about the AFC30 status. It has following states:

- ▶ Normal work (ON)
- ▶ Standstill or Error (OFF)
- ▶ Reversing (BLINKING)

Open-loop current control for solenoids with $I_{min} < 100$ mA

For systems with a lower I_{min} of the solenoid (50 to 100 mA) an open-loop control for lower current can be activated. Currents above 100 mA with the RC4-5/30 are current controlled in close-loop.

Electrical interfaces

CAN-Signals

▼ **Two CAN channels are supported:**

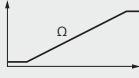
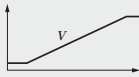
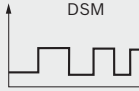

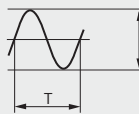
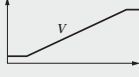
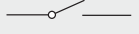
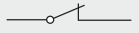
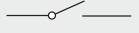

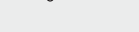
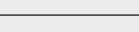
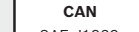
CAN 1	250 kBaud	Communication with BODAS-service
CAN 2	250 kBaud	J1939 Standard. Communication with other ECUs.

Input and output signals as well as other application specific values are sent on CAN channel 2 with a baud rate of 250 kBaud. The messages are built according to the J1939 standard.

▼ **Supported message interfaces**

CAN SAE J1939	Signal is contained in a standard J1939 message. Standard
CAN SAE J1939	Signal is contained in a proprietary J1939 message. Received J1939 messages and signals are configurable. Diagnostics is supported by DM1, DM2 and DM3 are supported. DM11 message is ignored.

Inputs

		Maximum no. AFC30	Signal type	Symbol	Remarks
Temperature	System (fluid / air / ambient)	4	Resistance		► Freely configurable ► NTC and PTC supported
		6	CAN	<div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; text-align: center;">CAN SAE J1939 Standard</div> <div style="border: 1px solid black; padding: 2px; text-align: center;">CAN SAE J1939 Proprietary</div> </div>	Standard / configurable
		2	Analog		0.5 to 4.5 V, calibratable Open input voltage: 0 V
	Ambient	1	CAN	<div style="border: 1px solid black; padding: 2px; text-align: center;">CAN SAE J1939 Standard</div>	AMB message
Speed	Fan speed	1	Frequency DSM		Speed direction signal can be normal or inverted
		1	Frequency HDD1/ DSA1BR12		
		1	Inductive		
	Engine speed	1	CAN	<div style="border: 1px solid black; padding: 2px; text-align: center;">CAN SAE J1939 Standard</div>	EEC1 message
Requests	External fan request	1	Analog		0.5 to 4.5 V, calibratable Open input voltage: 0 V
		1	Digital	 or 	Closed switch voltage: 2.5 V or 4.5 V Opened switch voltage: 4.5 V or 2.5 V Normally opened / normally closed
		1	CAN	<div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px; text-align: center;">CAN SAE J1939 Standard</div> <div style="border: 1px solid black; padding: 2px; text-align: center;">CAN SAE J1939 Proprietary</div> </div>	Standard / configurable
	Fan reversing request	1	Digital		Closed switch voltage: 2.5 V or 4.5 V Opened switch voltage: 4.5 V or 2.5 V Normally opened / normally closed
	Ambient temperature dependency	1	Digital	 or 	
	Fan rotation direction	1	Digital		
	Retarder state	1	Digital		
	Retarder torque	1	CAN	<div style="border: 1px solid black; padding: 2px; text-align: center;">CAN SAE J1939 Standard</div>	ERC1 message
DM3 request	1	CAN			

Maximum signal voltage range

Passive sensors such as potentiometers must be connected to a 5 V sensor supply (VSS_1, VSS_2 or VSS_3). Active sensors must be supplied as specified on the relevant sensor data sheet (VSS_4, U_{Ign} or U_{Bat}).

Open input voltage

Voltage measured in case of unconnected signal pin.
Voltage results from internal circuitry of RC.

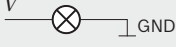
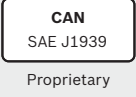
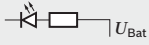
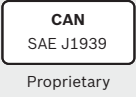

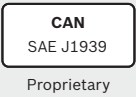

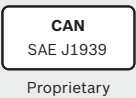

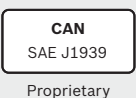
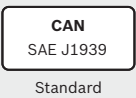
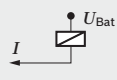
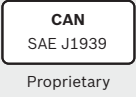
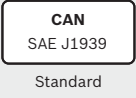
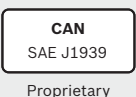
Closed switch voltage

External potential connected to RC by a closed switch.

Opened switch voltage

Potential measured at RC pin at opened switch. Voltage results from internal circuitry of RC.

Outputs

	Maximum no. AFC30	Signal type	Symbol	Remarks ¹⁾
Fault lamp	1	Switch		High / low active
	1	CAN		Proprietary message
Operating LED	1	Switch		High / low active
	1	CAN		Proprietary message
Temperature threshold actuator	1	Switch		High / low active
	1	CAN		Proprietary message
Reversing valve	1	Switch		High / low active
	1	CAN		Proprietary message
Stop valve	1	Switch		High / low active
	1	CAN		Proprietary message
Active failure codes	1	CAN		DM1 message
Saved failure codes	1	CAN		DM2 message
Fan actuator	1	PWM		Fan (pump or motor) solenoids are connected to low side switches
	1	CAN		Proprietary message
Desired fan speed	1	CAN		FD message
Actual fan speed	1	CAN		FD message
Actual ambient temperature	1	CAN		AMB message
Other application values	1	CAN		Proprietary message

1) High/low active: indicates if output logic can be inverted by parameter

Power supplies

Battery power supply

- ▶ 12 V and 24 V on-board power supplies are supported.
- ▶ Different solenoids can be used, depending of the battery voltage. Thus different load resistances are expected for error detection. These have to be calibrated.

Sensor supplies

U_{Bat}

- ▶ This potential is connected to battery voltage and is secured with a 5 A fuse.
- ▶ It is solely used for power supply of ECU electronics and the possible emergency stop switch.

U_{Ign}

- ▶ This potential is connected to the ignition switch and is secured with a 3 A fuse.
- ▶ It is used for sensors requiring battery voltage as power supply and for some switches.

VSS_1, VSS_2, VSS_3

- ▶ These potentials are connected to 5 V constant voltage sources supplied by the ECU.
- ▶ It is used for sensors requiring 5 V power supply, for potentiometers and for some switches.

Ordering code

01	02	03	04
ASrun	-	AFC	30

Type

01	Application software ready to run on RC controller	ASrun
----	--	--------------

Software

02	Fan control	AFC
----	-------------	------------

Variant

03		
----	--	--

Edition

04	Version of the released software	30
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VSS_4

- ▶ This potential is connected to a 8.5 V constant voltage source supplied by the ECU.
- ▶ It is used to supply the DSM speed sensors.

Check for maximum output currents

The maximum allowed current per output pin is individually indicated in the connection diagram.

Within the ECU one low-side output stage drives the current. The current actuators are always connected to U_{bat} . For additional information see also RC data sheet 95205.

Parameter setting and diagnostics

The parameters to be set during the commissioning of the AFC30 fan control can be easily adjusted using BODAS-service PC software.



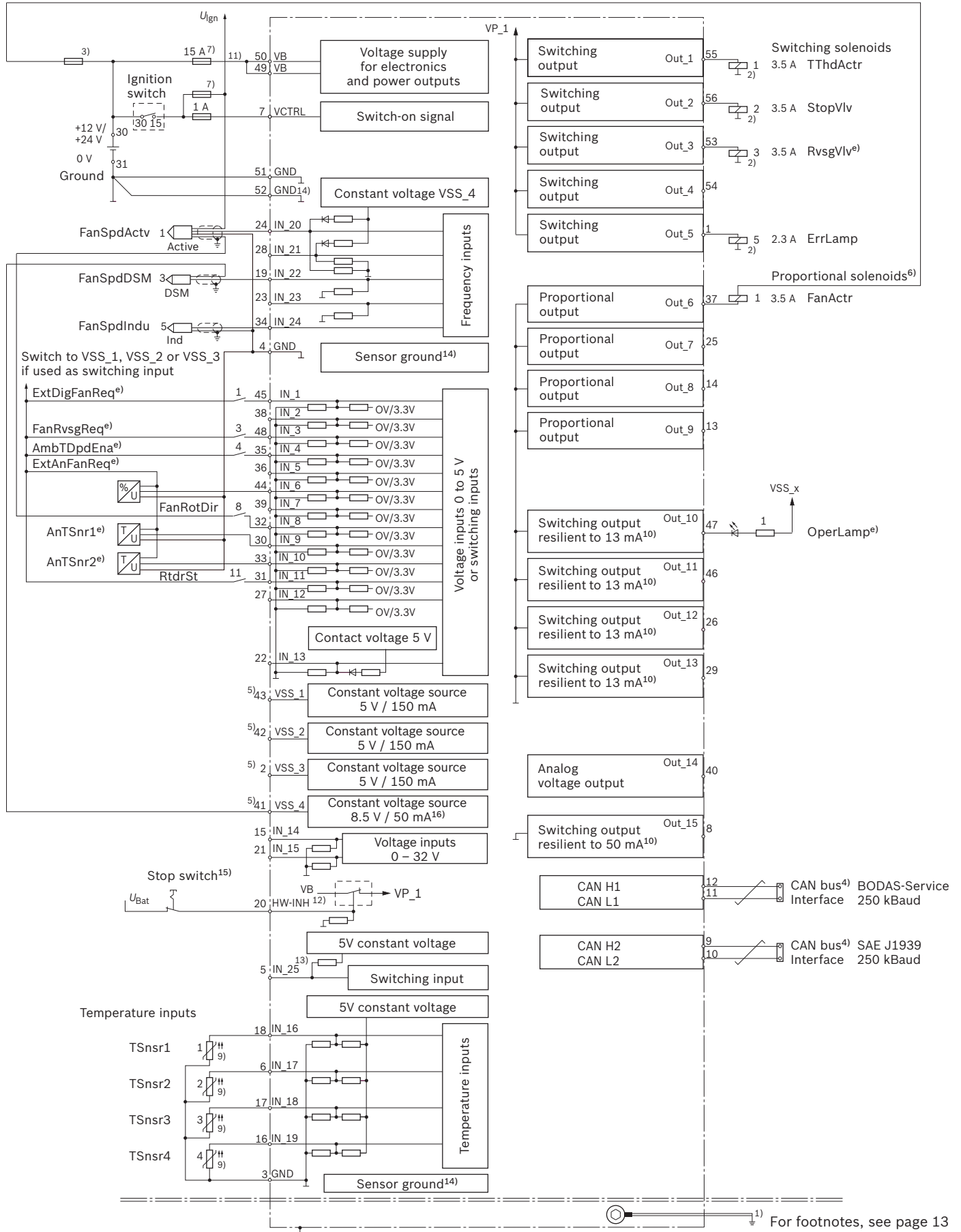
BODAS-service could be configured to display the most important process variables and the error messages for fault diagnostics and troubleshooting purposes.

ASrun-AFC30 software will be delivered readily flashed on a Rexroth Controller RC4-5/30

Order information

The AFC30 application software must only be used with the RC4-5/30 control unit and other hydraulic components. When placing an order, the hardware and software ordering codes should be linked by a "+".
Example: RC4-5/30+ASrun-AFC30

Connection diagram RC4-5/30



¹⁾ For footnotes, see page 13

StopVlv	Stop valve
RvsgVlv	Reversing valve
TThdActr	Temperature threshold actuator
ErrLamp	Error lamp
FanSpdActv	Fan speed active
FanSpdDSM	Fan speed DSM
FanSpdIndu	Fan speed inductive
FanActr	Fan actuator

ExtDigFanReq	External digital fan request
FanRvsgReq	Fan reversing request
AmbTDpdEna	Ambient temperature dependency enable
ExtAnFanReq	External analog fan request
FanRotDir	Fan rotation direction
AnTSnsr1	Analog temperature sensor 1
AnTSnsr2	Analog temperature sensor 2
RtdrSt	Retarder state

- 1) Short, low-resistance connection from a case screw to the vehicle ground.
 - 2) Separate ground connection to battery (chassis possible).
 - 3) Separate fuse protection for sensors supplied from U_{Bat}, and solenoids switched to ground. Fuse configuration specific to application (in particular current needed and line cross section).
 - 4) CAN bus: 120 Ω termination resistor and twisted line necessary.
 - 5) Constant voltage sources can be used as sensor supply or switching voltage for switches/push-buttons.
 - 6) The power line to consumers wired to ground must be fused, see 3).
 - 7) Can be adjusted to the actual current consumption of the consumers and must be adjusted to the permissible load of the lines and pins.
 - 8) Independent ground connection of the current source to the battery, controller ground possible.
 - 9) Can be used as switching inputs.
 - 10) Alternatively, can be used as input.
 - 11) If deactivated during operation, data will not be saved in the non-volatile memory and there will be no after run.
 - 12) First deactivation channel: deactivation with level < 3.1 V; activation with level > 7.9 V.
When deactivated, the main switch for the power supply to the high-side output stages is opened by the hardware and the low-side output stages are deactivated.
 - 13) Second deactivation channel: deactivation with level >1.3 V; activation with level > 7.9 V.
 - 14) Terminal 31 (ground supply) and sensor ground are joined at a star point in the controller and are connected to the housing.
 - 15) Optional, normally connected to U_{bat} / VB
 - 16) Not protected against short circuit to ground and U_{bat}.
- e) Inputs/outputs and corresponding functions are calibrateable in "Expert View" of BODAS Service. Login with password is required.

Note

- ▶ To switch the system off in case of an emergency, the power supply to the controller must be disconnected by an emergency-stop switch.
The emergency-stop switch must be installed in an easily accessible position for the operator.
- ▶ All GND pins are connected together on the circuit board. Maximum permissible currents depend on the contacts used (pins 51 and 52: MQS 1.5 CB; pins 3 and 4: BCB 0.6) and on the lines used.
- ▶ Lines to the controller must not be routed close to other power-conducting lines in the device.
- ▶ The proportional solenoids must not be wired with spark-suppression diodes.
Switching solenoids at the outputs of the controller do not need to be connected to spark-suppression diodes. Other externally wired inductive consumers in the system must be wired with spark-suppression diodes.
- ▶ For information about mating connectors and contacts, please refer to Bosch offer drawing 1 928 A01 41M.
- ▶ The fuses illustrated act as line protection.

Valid standards and separate documentation

Document	
RE 95362-B	Operating instructions AS-run AFC30 – Application guideline – Detailed functional description – Parameter description
CAN SAE J1939-71	Relevant
Rexroth data sheet 95205	BODAS Controller RC series 30, RC4-5/30
1 928 A02 41M	Assembly instruction of 112/56-way connector for RC4-5/30

▼ Compatible Rexroth products

Components	Data sheet	Relevant type code
Axial piston variable pump A10VO...ED	92703	BR52
Axial piston variable pu mp A10VNO...ED	92735	BR5x
Axial piston variable pump A1VO	92650	D3C (12V)/D4C (24V)
External gear pump AZP series B,F,N,G	10087/10089/ 10091/10093	
Fixed motor AZM series F,N,G	14026	
Fixed motor A2FE/FM	91008/91001	
Fixed motor A10FE/FM	91172	
Pressure-relief valve KBVS.3B	18139-07	
Directional valve LF1/LF2	18305-04	
BODAS temperature sensor for air TSA	95181	
BODAS temperature sensor fluid TSF	95180	
BODAS speed sensor DSM	95132	DSM1-10
BODAS controller RC series 30	95205	RC4-5/30
BODAS speed sensor HDD	95135	HDD1 (NPN type)
BODAS speed sensor ID	95130	
BODAS speed sensor DSA	95133	DSA1 BR12
BODAS-service PC software	95086	
BODAS-service connection cable	95086	
Diagnostics socket	95086	

Abbreviations

Abbreviation	Meaning
AFC	Automatic Fan Control
ED	Electro-hydraulic pressure control
BODAS	Bosch Rexroth Design and Application System
CAN	Controller Area Network
ECU	Electronic Control Unit
RC	Rexroth Controller
AS	Application Software
PWM	Pulse-Width Modulation

Safety Instructions

General instructions

- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ Incorrect connections could cause unexpected signals at the outputs of the RC
- ▶ Incorrect programming or parameter settings on the RC may create potential hazards while the machine is in operation.
- ▶ It is the responsibility of the machine manufacturer to identify hazards of this type in a hazard analysis and to bring them to the attention of the end user. Rexroth assumes no liability for dangers of this type.
- ▶ The application software must be installed and removed by Bosch Rexroth or by the authorized partner concerned in order to uphold the warranty.
- ▶ Make sure that the software configuration does not lead to safety-critical malfunctions of the complete system in the event of failure or malfunction. This type of system behavior may lead to danger to life and/or cause much damage to property.
- ▶ System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- ▶ During commissioning and maintenance the machine may pose unforeseen hazards. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.

Notes on the installation point and position

- ▶ Radio equipment and mobile telephones must not be used in the driver's cab without a suitable antenna or near the control electronics.
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ All connectors must be unplugged from the electronics during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.

Intended use

- ▶ The AFC30 is designed for use in mobile working machines provided no limitations / restrictions are made to certain application areas in this data sheet.
- ▶ Use outside of the specified and approved boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the complete system.

Improper use

- ▶ Any use of the AFC30 other than that described in chapter "Intended use" is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damage resulting from improper use (outside intended use as described above) or other improper usage and/or from unauthorized interference in the component not described in this data sheet render all warranty and liability claims void with respect to the manufacturer.

Use in functions relevant to safety

- ▶ The suitability of the software must be validated by the customer by means of risk analysis on the complete machine.
- ▶ The customer is responsible for performing risk analysis on the mobile working equipment and for defining possible safety-related functions.
- ▶ The customer is responsible for taking suitable measures in safety-related applications (sensor redundancy, plausibility check, emergency switch, etc.).

More detailed information

- ▶ Observe the operating instructions 95362-B.
- ▶ The safety measures in RC4-5/30 data sheet 95205 are to be observed.
- ▶ In addition, the application-specific documents (connection diagrams, software descriptions, etc.) are to be observed.
- ▶ More detailed information on RC4-5/30 + ASrun-AFC30 can be found at www.boschrexroth.com/mobileelektronik.
- ▶ Pay regular visits to our home page for the latest product information and information about updates.
- ▶ Copying, translation and distribution of Bosch Rexroth software is prohibited under copyright law.
- ▶ The technical specifications and safety instructions of all involved components must be considered.

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Application software

BODAS-drive DRC

RE 95323

Edition: 10.2015

1



- ▶ Control solution for hydrostatic drivetrains
- ▶ Release 41

Features

- ▶ Covering a wide range of hydrostatic drivetrain and gearbox variants of wheeled mobile machines
- ▶ Load sensitive and automotive driving for load and travel operations
- ▶ Proportional driving at fixed engine speed for work and material handling operations
- ▶ Multiple comfort functions like cruise control or velocity limitation for accurate and easy driving.
- ▶ Diesel Hydraulic Control ECOdrive and ECOwork for improved efficiency and reduced noise emissions
- ▶ Flexible interfaces – discrete or CAN J1939
- ▶ Comprehensive configuration options via BODAS-service
- ▶ Integrated safety functions in accordance with EN ISO 13849 and ISO 25119
- ▶ Modular software concept for efficient customer-specific extensions
- ▶ Supporting process documents and tools for systematic integration into the machine
- ▶ BODAS-drive DRC is part of BODAS Bosch Rexroth design and application system for mobile electronics
- ▶ Software solution on Rexroth controller RC12-10/30

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1 Introduction

BODAS-drive DRC is a software solution embedded in Rexroth controller RC12-10/30 to control hydrostatic drivetrains of wheeled vehicles. BODAS-drive covers a wide range of drivetrain types. The drivetrain is always based on an engine with CAN interface and a hydrostatic drive consisting of a pump and at least one motor. The gearbox type can vary between fixed gears, a gearbox shiftable during standstill, a shift-on-fly gearbox, a summation gearbox or radial piston motors mounted at the wheels.

The load sensitive travel behavior and features like automotive driving, hydrostatic braking and reversing provide for accurate and easy driving of the mobile machine. Proportional driving at a fixed engine speed can be the right choice for work and handling operations. The integrated Diesel Hydraulic Control DHC ECOdrive and ECOwork functions reduce fuel consumption and noise emissions. Comfort functions like cruise control, hand throttle, speed limitation and the automatic parking brake support the driver at the daily work. The comprehensive diagnostics and well-defined limp-home strategies ensure that the machine is operational.

Each input device can either be discretely connected to the RC or the signal can be received via CAN. The BODAS-drive CAN protocol is based on SAE J1939. BODAS-drive can be configured and adapted to the specific machine requirements by setting parameters with BODAS-service.

Ready-to-use safety functions developed in accordance with the standards EN ISO 13849 and ISO 25119 are part of the software.

Documents and tools support a systematic integration of BODAS-drive within the machine environment from project planning to the start of production and beyond.

The software is created with a modular design that allows for efficient customer-specific extension. For more information about customer-specific extension, please consult your Bosch Rexroth contact.

2 Typical applications and variants

BODAS-drive is designed to control the hydrostatic drivetrain of wheeled mobile machines. Thanks to the multiple functions and configuration options it can be adapted to various applications. Typical examples include wheeled loaders, telehandlers, dumpers, municipal vehicles and fork lift trucks. BODAS-drive was developed using a generic approach and represents a Safety Element out of Context (SEooC). Assumptions have been made and documented accordingly for the applicable safety functions of BODAS-drive.

Note

BODAS-drive helps to realize functionality and safety at the machine level. The machine manufacturer must thoroughly check whether the functionality of BODAS-drive can fulfil the requirements of the specific machine. If additional features are required, BODAS-drive can be extended. Please consult your Bosch Rexroth contact for an individual solution.

The BODAS-drive configuration is always based on an engine with a standard CAN J1939 interface and a Rexroth axial piston variable pump A4VG with electrical direct control type ET or electrical proportional control type EP. Depending on the secondary side of the hydrostatic drive and the gearbox type, different configurations of BODAS-drive are applicable.

BODAS-drive DRC

DRC variant	A
Engine	Communication via CAN J1939
Hydraulic drive pump	A4VG.ET or EP (pump equipped with pressure and swivel angle sensors are mandatory for prototype machines!)
Sensors	Discrete
Driver interface	Discrete or CAN J1939
BODAS controller	RC12-10/30
Safety standards	EN ISO 13849, ISO 25119

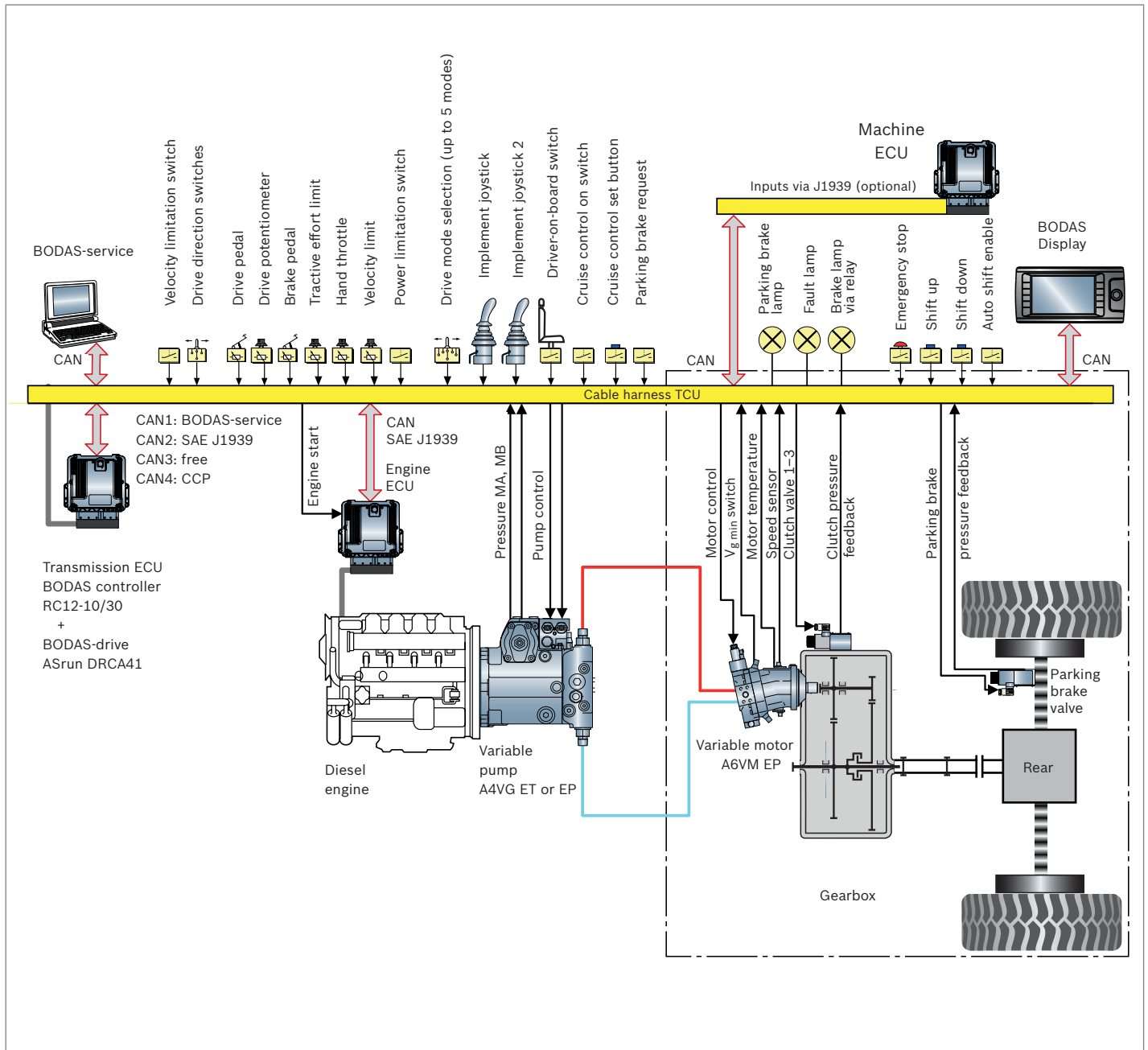
Gearbox	Hydraulic pump ET or EP	Fixed gear ratio, not shiftable	Up to 3 gear ratios, shiftable during standstill. 2 gear ratios shiftable during driving	MCR motors, displacement shiftable during standstill and during driving	Summation gearbox with one clutch interfacing 2 hydraulic motors for high torque and high speed
Hydraulic drive motor(s)	1x A6VM.EP ¹⁾ or A6VM.HA variable displacement		Hydraulic drive motor(s): up to 4 shiftable MCR radial piston motors (100% / 50% / 25% torque)		2x A6VM.EP ²⁾ variable displacement
	1x motor with fixed displacement				1x A6VM.EP ²⁾ variable displacement and 1x motor with fixed displacement
					1x A6VM.EP ²⁾ variable displacement and 1x A6VM.HA variable displacement

1) Control type EP mandatory for Shift-on-fly gearbox.
2) The motor that can be disengaged (temporary motor) must be of type A6VM.EP, positive control recommended.

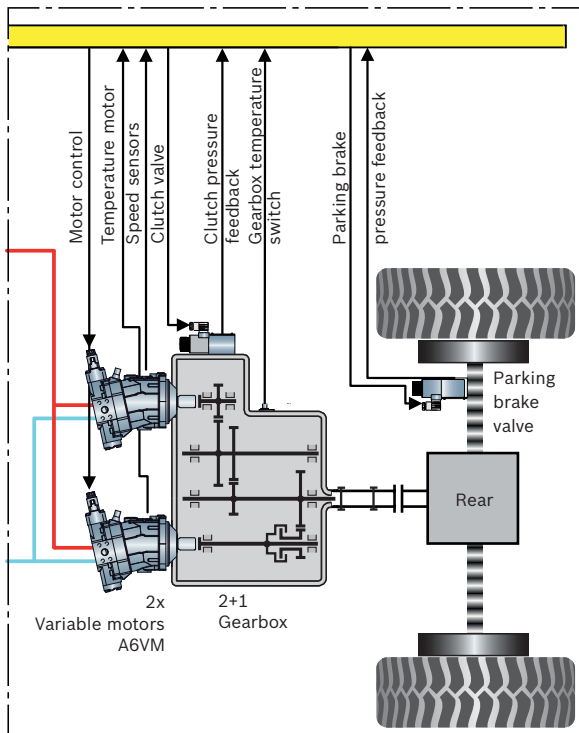
3 System description

3.1 System overview

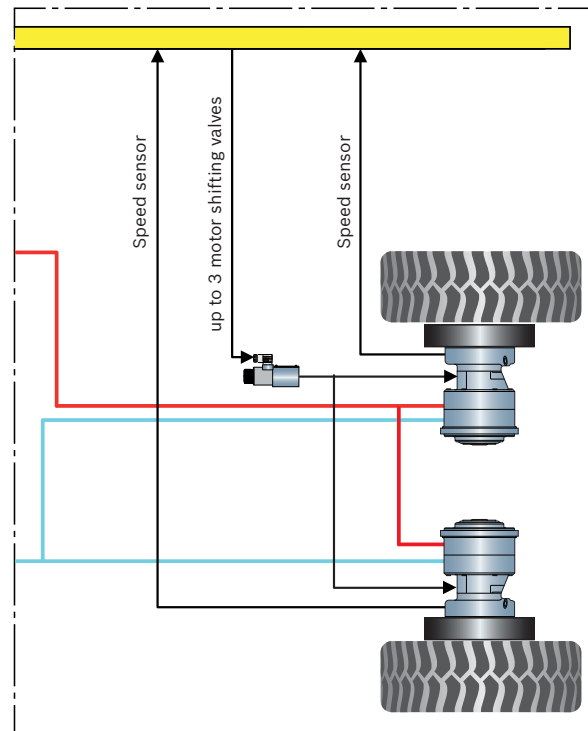
▼ System overview for a BODAS-drive DRC configuration with gearbox shifttable during standstill / shift-on-fly



▼ Part of system overview for a BODAS-drive configuration with summation gearbox



▼ Part of system overview for a BODAS-drive configuration with radial piston motors MCR



The drivetrain consists of the following main components:

- ▶ BODAS controller RC + BODAS-drive DRC
- ▶ A combustion engine with its ECU + standard J1939 CAN protocol
- ▶ A variable hydraulic pump
- ▶ At least one hydraulic motor – fixed or variable displacement
- ▶ A gearbox – design depends on the drivetrain configuration

Various driver and machine interfaces can be installed, depending on the hardware configuration and desired functions. Each input can either be discretely connected to the RC or the signal can be received via CAN. The figures above show assembly examples of the involved components. For diagnostics and commissioning BODAS-service can be connected.

See Rexroth data sheet 95086 for a detailed description of BODAS-service functions.

3.2 Drivetrain components

Engine

A precondition for BODAS-drive DRC is a diesel engine equipped with an ECU supporting CAN SAE J1939. The engine ECU performs the complete control of the engine actuators and peripherals. A target speed request is set via BODAS-drive. Actual engine values like speed or temperature are provided by the engine ECU. Important CAN messages are EEC1, ET1 and TSC1.

Drive pump

The A4VG is an axial piston pump in swashplate design with variable displacement and all components for a hydraulic closed circuit. The ET control module is a load sensitive control system.

The output flow of ET pump is infinitely variable between 0 to 100 %. Depending on the preselected current at solenoids **a** and **b** of the pressure-reducing valves, the stroke cylinder of the pump is proportionally supplied with control pressure. The pump displacement that arises at a certain control current is dependent on the speed and operating pressure of the pump. A different flow direction is associated with each pressure reducing valve.

The EP control module is a load independent control system.

The output flow of the EP pump is proportional to solenoid current and the pump speed.

For a detailed description of the pump A4VG see Rexroth datasheet 92004.

Drive motor

There is the possibility to apply fixed or variable hydraulic motors in the drivetrain. In case of a fixed motor the output speed of the hydraulic motor is proportional to the pump output flow. If the drivetrain is equipped with a variable axial piston motor A6VM with electric proportional control EP, the hydrostatic ratio can additionally be controlled by an electrically defined signal which sets the swivel angle of the motor. The closed loop EP control system ensures a constant swivel angle independent from the occurring high pressure.

For a detailed description of the motor A6VM see Rexroth datasheet 91610.

Gearbox

Depending on the drivetrain requirements, such as maximum speed and tractive effort, there are various configurations available.

- ▶ Fixed gear ratio, not shiftable
- ▶ Up to 3 different gear ratios, shiftable during standstill and up to 2 gear ratios for shift-on-fly gearbox shiftable during driving. For gear actuations up to 3 switched outputs may be used. The combination for each active gear can be individually configured.
- ▶ Summation gearbox interfacing 2 hydraulic motors for high torque and high speed.
It provides high torque at low speed using both hydraulic motors and high speed through declutching one hydraulic motor under load without interrupting traction.
- ▶ Wheel mounted radial piston motors (type MCR) shiftable during standstill and shiftable during driving. For gear actuations up to 3 switched outputs may be used. The combination for each active gear can be individually configured.

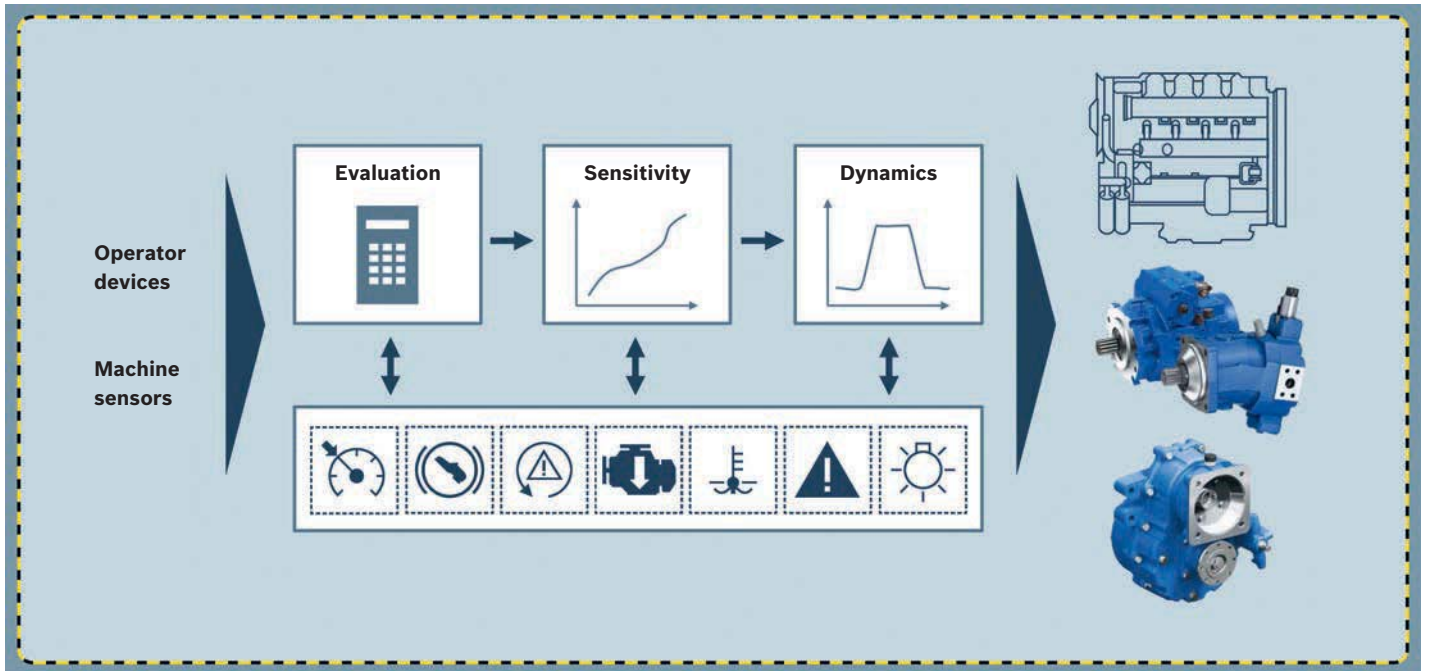
Note:

In any case the gearbox manufacturer must grant an approval for the operation of the respective gearbox type with BODAS-drive DRC.

4 Functional description

BODAS-drive evaluates the input signals coming from the connected operator devices and machine sensors. Based on this, BODAS-drive calculates the control values for the various actuators, such as the engine, hydrostatic drive and gearbox. To map the BODAS-drive functionality to a

particular machine configuration, each function can be separately activated using BODAS-service. Thus only the relevant inputs are evaluated and just the needed outputs are activated. The diagnostic routines are adapted with regard to the activated functions.



Driving functions
Automotive driving
Proportional driving
Pump control
Motor control
Engine speed control
Reversing
Service brake influence
Inching
Gearbox shifting in standstill
Gearbox shift-on-fly
Gearbox control for summation gearbox
Shift radial piston motors

Comfort functions
Velocity limitation
Cruise control
Tractive effort limitation
Hand throttle
Drive modes
Brake lamp control
Parking brake control
Diagnostics and fault lamp control
Limp-home mode

Energy efficiency and component protection functions	4EE ENERGY EFFICIENCY
DHC ECOdrive	
DHC ECOwork	
Load limiting control drive	
Engine overspeed protection	
Temperature range protection	
Power limitation	

Safety functions	SAFETY ON BOARD
Safe standstill	
Safe reversing	
Safe drive direction	
Safe speed limitation	
Safe deceleration	
Safe acceleration limit	
Safe deceleration limit	
Safe parking brake	
Safe brake light	
Safe operator detection	

For a detailed description of the safety functions, see chapter 6.3.

The minimum configuration for operating devices requires a drive direction lever (FNR) and a drive pedal. With respect to sensors, it is expected that at least one speed sensor is installed to read the hydraulic motor or gearbox speed, which enables elementary drive functionality.

For a detailed description of the relationship between desired functions and required devices, see chapter 5.

4.1 Driving functions

Automotive driving

By using the drive pedal or the drive potentiometer, the driving function increases the engine speed and the hydrostatic ratio at the same time. This function provides a comfortable driving mode so that it feels like driving a car.

Proportional driving

By using the drive pedal or the drive potentiometer the driving function increases the hydrostatic ratio independent of the engine speed. This function can typically be used for working operations.

Pump control

In order to accelerate the machine from standstill the hydraulic pump is swiveled from zero to maximum displacement. Three different guiding modes can be selected for the pump control function:

- ▶ Actual engine speed
- ▶ Desired engine speed (proportional to drive request) and actual engine speed
- ▶ Desired engine speed (proportional to drive request)

In conjunction with the electro-hydraulic pump control ET, a hydraulic pump DA (speed-controlled) function can be emulated by using the actual engine speed as guiding signal.

Motor control

In order to do the secondary acceleration phase (pump does the first), the hydraulic motor has to swivel from its maximum to its minimum displacement. Four different guiding signals can be selected:

- ▶ Actual velocity
- ▶ Desired velocity
- ▶ Actual engine speed
- ▶ Desired engine speed

In conjunction with the motor pressure control function, a hydraulic motor HA (high-pressure-controlled) or DA (speed-controlled) function can be emulated. Without motor pressure control the only reasonable guiding value is the actual machine velocity.

Motor pressure control:

The high pressure signal can be used to limit the maximum high pressure, for example, to prevent the engine from being overloaded. A further advantage is to keep the pressure below the hydraulic pump pressure cut-off limit. This function emulates hydraulic motor HA functionality.

Engine speed control

The engine provides power for the drivetrain and the implement hydraulics and, if requested, a fixed engine speed for certain working processes.

The driver has up to three different options to set the desired engine speed:

- ▶ Drive request (pedal and/or potentiometer)
- ▶ Hand throttle
- ▶ Implement request (DHC ECOwork mode)

Reversing

By using the drive direction switch or a drive pedal with direction signals the reversing function is able to decelerate and subsequently accelerate the machine in the new direction.

The reversing function works at any machine speed.

Service brake influence

Evaluation of the mechanical service brake actuation is used to control the hydraulic pump back to zero displacement more quickly in order to prevent that the mechanical brake from working against the hydrostatic drive and thus to support the mechanical braking.

Inching

Using the inch pedal, the pump control can be reduced independently from the drive pedal position and the actual engine speed. The function allows a high fine controllability during working operations. Additionally the inching function can be used with a combined braking and inching pedal instead of a separate inching pedal.

Gearbox shifting in standstill

This function can be used to select one of three mechanical gears.

Changing from one gear to another is possible only when the vehicle is at a standstill. Pressing the shift-up and shift-down buttons requests shifting from neutral up to 3rd gear and back. A shift up request shifts up one gear and a shift down request shifts down one gear. For a gearbox with 2 gears (1st and 2nd) it is possible to use a single shift button.

Gearbox shift-on-fly

This function can be used to select one from up to two mechanical gears.

Changing from one gear to the other is possible when the vehicle is at a standstill and during driving. A manual and automatic mode is available. Pressing the shift button (single shift request or shift-up / shift-down combination) requests shifting from 1st to 2nd gear and vice versa.

Shift radial piston motors

Up to three transmission ratios are supported: 100%, 50% and 25%. Changing from one ratio to another is possible during standstill and during driving. A manual and automatic mode is available. Pressing the shift button (single shift request or shift-up / shift-down combination) requests shifting from 1st up to 3rd ratio and back.

Gearbox control for summation gearbox

The summation gearbox management function provides a high torque range for working and a high velocity range for driving purposes. The transition between torque and velocity range is done fully automatically and without interruption of tractive effort.

4.2 Comfort functions**Velocity limitation**

Limitation to a maximum machine velocity is mainly used to meet country-specific speed limitation requirements.

This function also makes it possible to set different speed limits depending on drive mode, drive direction and error reaction modes.

The valid maximum limitation value is the minimum from all limitation sources (country, mode, direction, etc.).

The velocity limitation value can be reduced even more by using a proportional driver request signal. This is useful for meeting the most appropriate limitation for the current driving or working situation.

Moreover, a switch signal can be used to set a predefined velocity limitation value for safety reasons. It is useful when the velocity must be limited due to a certain action signaled by the machine. For example, if the working boom exceeds a certain limit. As soon as the position is reached, the machine automatically decelerates to the predefined limitation setting.

Cruise control

Once the cruise control switch is on, the cruise control function is activated by pressing the set button. Subsequently the machine is constantly kept at the current velocity without pressing the drive pedal.

The machine could be accelerated to a higher velocity by pressing the drive pedal. If the drive pedal is released again, the current machine target velocity is set back to the originally activated cruise control velocity.

Tractive effort limitation

For some working situations it is necessary to reduce the maximum tractive effort. With this function the driver is able to control the maximum torque at the wheels by using a proportional limitation request.

Hand throttle

For many working situations it is useful to set a fixed engine speed manually. For this purpose a proportional request signal can be used independently from using the drive pedal.

Drive modes

Up to five different drive modes are selectable. Switching from one drive mode to another is allowed during driving. For each of these drive modes the following settings are adjustable and selectable:

- ▶ Activation/deactivation of functions (e.g. ECOdrive, cruise control, etc.)
- ▶ Sensitivity (e.g. engine speed curve, pump curve, etc.)
- ▶ Dynamical behavior (e.g. acceleration and deceleration, etc.)

Example mode definition:

- ▶ Mode 1: Street (Transportation)
- ▶ Mode 2: Handling (Material handling)
- ▶ Mode 3: Loader (Working mode)

Brake lamp control

The braking lights are activated if the deceleration exceeds a defined limit. An external activation of the brake lamp e.g. by pressing the brake pedal is still required and it is not part of BODAS-drive.

Parking brake control

The parking brake function provides two modes: manual and automatic mode.

Manual mode uses either buttons or switches to engage or disengage the parking brake.

Automatic mode engages the parking brake automatically as soon as the machine reaches a standstill. The brake disengages when the driver starts accelerating the machine again. The parking brake can still be manually engaged and disengaged in automatic mode.

Diagnostics and fault lamp control

The state of the control unit as well as the connected devices are monitored during operation.

If a fault occurs:

- ▶ An appropriate error reaction is activated, such as power off, ramp stop or limp-home.
- ▶ The severity of the fault is indicated via the blinking frequency of the fault lamp.
- ▶ Active and saved errors are reported via BODAS-service.
- ▶ Active errors (DM1) and previously active errors (DM2) are reported via CAN J1939.

Limp-home mode

- ▶ Limp-home mode 1: Driving is only allowed in one direction, forward or backward.
- ▶ Limp-home mode 2: Maximum velocity limitation is set to a limp-home speed.

4.3 Energy efficiency and component protection functions

DHC ECOdrive

The intelligent DHC ECOdrive control strategy adapts the engine speed request according to the needed power for driving. During acceleration or uphill-driving phases the engine speed request is increased. If less power is needed, the engine speed request is decreased. The hydrostatic drive is controlled accordingly to achieve smooth and dynamic travel behavior.

As a result, the machine behavior is similar to a full power mode setting, but with improved fuel efficiency and reduced noise emissions.

DHC ECOwork

With this function the engine speed is kept at a low idle until a working request is detected. Subsequently the engine speed is increased depending on the DHC ECOwork request, which typically comes from the implement joystick. Increasing the engine speed only upon receiving a working request contributes to improved fuel consumption and noise emissions while working with the machine.

If this function is active during driving, the increased engine speed is automatically compensated for by the hydrostatic drive.

Load limiting control

This function provides protection against overloading and stalling of the engine. The actual and desired engine speed is monitored. If the actual engine speed drops too much, the hydrostatic ratio is reduced in order to reduce the load on the engine.

During a high load situation (e.g. digging), the hydrostatic ratio has to be reduced rather quickly. Therefore the load limiting control works on the pump and the motors independently, or also simultaneously, if necessary.

Engine overspeed protection

The diesel engine overspeed protection protects the diesel engine from damage caused by hydrostatic braking.

If the engine speed accelerates above the parameterized limit, the hydrostatic ratio is frozen and/or increased as long as the overspeed limit is exceeded.

In one option an external consumer (retarder valve) is controlled proportionally to the degree of engine overspeed.

Warning: To prevent the engine speed from increasing further and damaging the engine, the machine must be equipped with an adequate mechanical service brake which must then be actuated by the driver. It is recommended to install an additional acoustic signal to inform the driver about the overspeed situation.

Power limitation

The power limitation function limits the power consumed by the drive pump. The function can be activated by switch. The level of limitation is configurable.

Temperature range protection

The protection helps to prevent damage to the components hydraulic motor and pump caused by temperatures outside the defined range.

If the temperature gets outside the defined temperature limits, the engine/pump speed and or velocity (motor speed) is reduced.

The individual protection for these two components can be configured separately.

5 Electrical interfaces

The modular approach of BODAS-drive enables a flexible activation of the available functions.

functions and required driver and machine interfaces for inputs and outputs.

The table below describes the relationship between desired

	Inputs																	Outputs																																
	Driver interface									Machine interface								Driver		Machine interface																														
	Drive pedal	Drive potentiometer	Inch pedal	Brake pedal	Velocity limitation	Torque limitation	Cruise control	Engine hand request	Engine joystick request	Drive mode selection	Driver on board	Velocity limitation switch	Shift requests	Shift autom. / manual	Drive direction select	Parking brake request	Engine speed	Engine torque	Speed sensor 1	Speed sensor 2	Oil temperature	Pump pressure ⁵⁾	Pump swivel angle ⁵⁾	Gearbox temperature switch	Clutch pressure switch	Power limitation switch	Gear position sensor	Motor V _{min} switch	Parking brake pressure switch	Brake lamp	Fault lamp	Parking brake lamp	Status lamp	Engine speed desired	Engine start allowed	Pump	Motor	Motor temporary ¹⁾	Pump neutral valve	Clutch valve ¹⁾	Gearbox / MCR valves ²⁾	Parking brake valve	Retarder valve							
Automotive driving	o ⁶⁾	o ⁶⁾															x	x															x	x	x	x														
Brake lamp control ³⁾																			x												x																			
Cruise control	x	o	o	o			x				x								o ⁴⁾																x	x	x	x												
Diagnostics ³⁾	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	o	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x					
Drive demand	o ⁶⁾	o ⁶⁾																																	x	x	x	x												
Drive modes										x																								x		x	x	x												
ECO drive mode	o ⁶⁾	o ⁶⁾															x	x															x	x	x	x														
ECO work mode							o ⁶⁾	o ⁶⁾									x																		x															
Engine speed control	o ⁶⁾	o ⁶⁾					o ⁶⁾	o ⁶⁾									x																		x	o														
Engine overspeed protection																	x																														o			
Inch function			x														o																																	
Load limiting control	o ⁶⁾	o ⁶⁾															x																		x	x	x	x												
Motor control	o	o															x	x																o		x	x													
Motor pressure control																						x																												
Motor protection																						x																												
Parking brake control																																																		
Power limitation																																																		
Pump control	o ⁶⁾	o ⁶⁾		o													x	x																		o	x													
Pump protection																																																		
Radial piston motors (MCR)	o ⁶⁾	o ⁶⁾											x	x							o	x	x																											
Reversing function	o	o																																																
Service brake influence				x																																														
Shift-on-fly gearbox control	o ⁶⁾	o ⁶⁾																																																
Standstill gearbox control																																																		
Summation gearbox control	o ⁶⁾	o ⁶⁾																																																
Tractive effort limitation																																																		
Velocity limitation control					o							o																																						

x = mandatory for functionality
o = optional (additional enhanced functionality)

Note
The detailed hardware characteristics of the RC controller are described in Rexroth data sheet 95204. This data sheet must be taken into account before implementing BODAS-drive at the machine level.

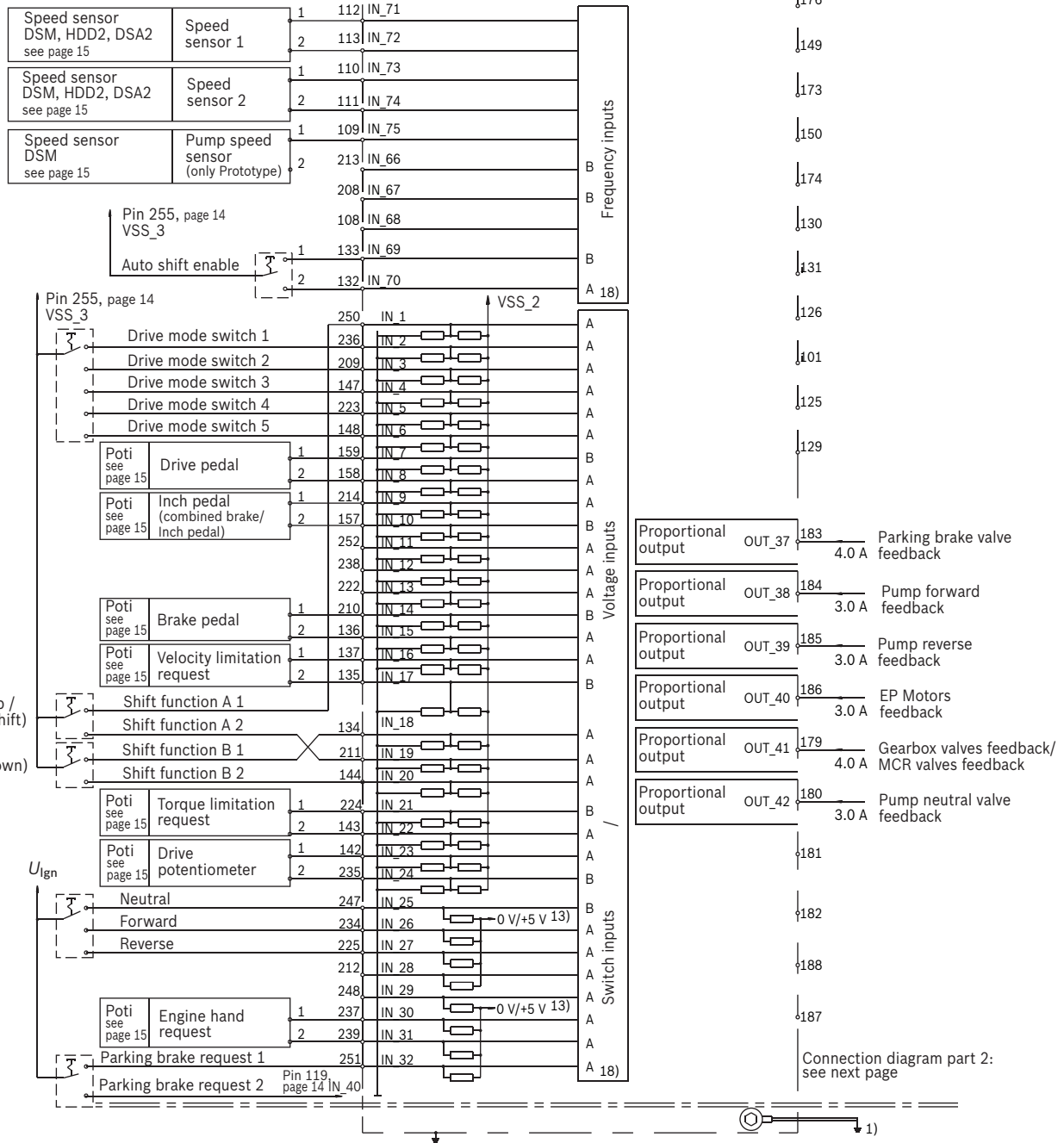
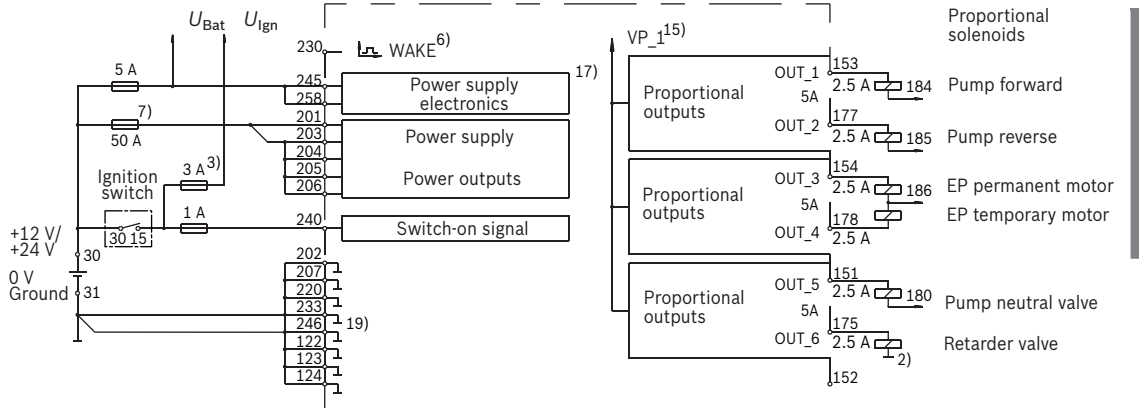
1) With summation gearbox (e.g. 2+1)
2) With standstill gearbox (up to 3 gears)
3) Diagnostics depends on enabled functionality

4) Mandatory for close loop control
5) Mandatory for prototype machines
6) One option mandatory

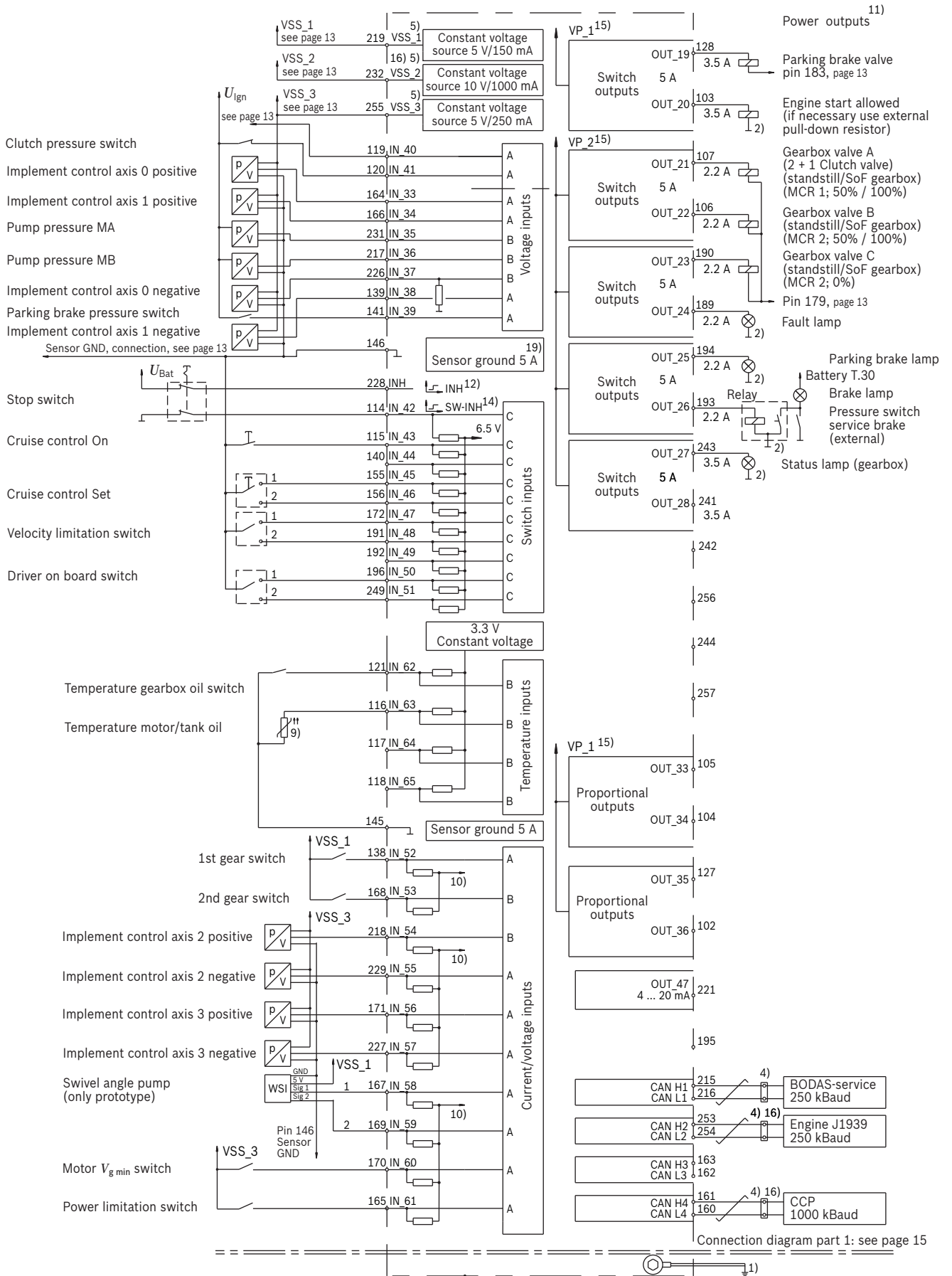
Connection diagram RC12-10/30, part 1

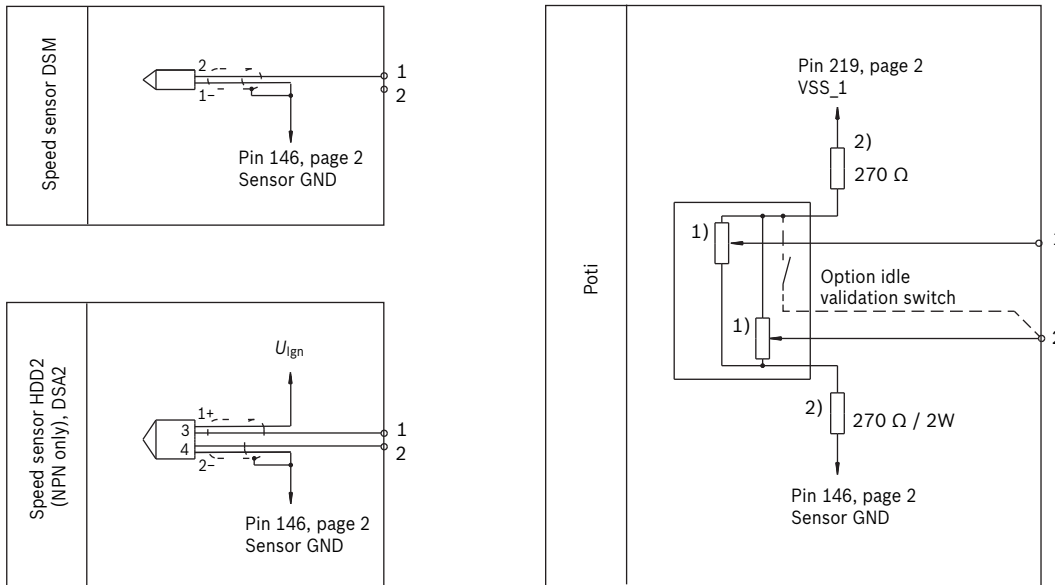
2 + 1 gearbox:
Speed sensor 1 at temporary motor
Speed sensor 2 at permanent motor

Standstill/Sof gearbox:
Speed sensor 1 at gearbox input
Speed sensor 2 at gearbox output



Connection diagram RC12-10/30, part 2





- 1) Active or passive potentiometer (1-4k)
- 2) Signal range must be 0.5 V to 4.5 V. Use additional resistances or built-in mechanical blocks to ensure the signal range

Footer from page 13 and 14

- 1) Short, low-resistance connection from a case screw to the vehicle ground.
- 2) Separate ground connection to battery (Chassis possible).
- 3) Separate fuses for switches and sensors necessary. Sensor supply application specific.
- 4) CAN-bus: termination resistor 120 Ω and twisted pair wire necessary.
- 5) Outputs 5 V / 10 V can also be used as sensor supply alternatively.
- 6) Temporary wake up of the controller when a signal >8 V is applied for more than 1 sec.
- 7) Note max. current consumption with simultaneous actuation of proportional solenoid and switched outputs.
- 8) Separate ground connection for current source to battery, controller GND possible.
- 9) Can be used as switch inputs if externally switched to GND.
- 10) For use as voltage inputs (0...10 V), the load can be stiched by the software in groups for these inputs.
Groups: inputs 1...2, inputs 3...6, inputs 7...10
- 11) Outputs arranged in groups, each with 2 output stages.
Maximum permissible output current of a group: 5 A.
- 12) Primary deactivation channel for proportional- and switch outputs: enabling with level >4.5 V, deactivation with level <1 V, cable break leads to deactivation.
- 13) Input groups may be switched to pull down or pull up in software.
- 14) Secondary deactivation channel for proportional- and switch aout-puts: enabling with level <0.8 V, deactivation with level >1.7 V, cable break leads to deactivation.
- 15) Supply can be switched by the software.
- 16) Is switched off when the watchdog triggers. Is switched off shortly for diagnosis purposes when a main switch is initially activated.
- 17) If power is disconnected during operation no data can be saved to non-volatile memory and no after-run.
- 18) A and B indicate different A/D converters which may be selected for redundancy reasons.
- 19) Terminal 31 (supply ground) and sensor ground are bridged at a star point in the control-unit and connected to the housing.

5.2 CAN signals

▼ Up to four CAN channels are supported:

CAN 1	250 kBaud	Communication with BODAS-service or BODAS-design.
CAN 2	250 kBaud	J1939 Standard. Communication with diesel engine and other ECUs.
CAN 3		Reserved.
CAN 4	1000 kBaud	Communication via CAN calibration protocol (CCP). Supporting development tools like CANape, INCA or equivalent for advanced measuring options. Caution: CCP must not be used for parameter setting or calibration.

Input and output signals for the driver and machine interface are sent on CAN channel 2 with a baud rate of 250 kBaud. The messages are built in accordance with the J1939 standard.

For details, see the CAN database, which is part of the BODAS-drive documents and tools container.

▼ Supported message interfaces

CAN SAE J1939 Standard	Signal is contained in a standard J1939 message.
CAN SAE J1939 Proprietary	Signal is contained in a proprietary J1939 message. All proprietary messages have a checksum and message counter for increased safety. All proprietary message identifiers can be commonly shifted via an offset parameter for free choice of identifier space.

5.3 Inputs

Range inputs

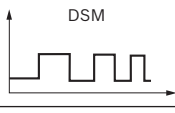
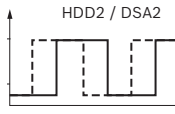
	Discrete			CAN Bus		
	Supported electrical interfaces	Maximum signal voltage range ¹⁾	Open input voltage ²⁾	Remarks	Supported CAN messages	Remarks
Drive pedal		0.5 to 4.5 V	2.7 V	<ul style="list-style-type: none"> ► Signal range of first channel can be learned via trimming functionality of BODAS-service ► Idle validation switch must be connected to 5V 	<div style="border: 1px solid black; padding: 2px; display: inline-block;">CAN SAE J1939</div> Proprietary	Proprietary messages include checksum and message counter
Drive potentiometer						
Inch pedal ³⁾						
Brake pedal						
Velocity limit						
Tractive effort limit						
Hand throttle						
Engine speed, joystick request ⁴⁾		0.5 to 4.5 V	0 V	Four channels per joystick: <ul style="list-style-type: none"> ► Positive and negative deflection of x- and y-axis ► Signal range of each channel can be learned via trimming functionality of BODAS-service 		
Pump pressure sensors M _A and M _B				–	–	–
Pump swivel angle sensor				Used for prototyping only. No functionality assigned to this sensor	<div style="border: 1px solid black; padding: 2px; display: inline-block;">CAN SAE J1939</div> Proprietary	Proprietary messages include checksum and message counter

▼ Supported electrical interfaces

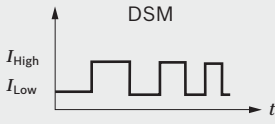
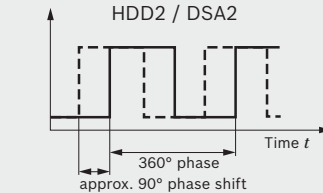
	This interface expects one analog voltage signal in the range from 0.5 V to 4.5 V. The details of the signal characteristics including start and end point as well as the allowed tolerances can be configured via parameters.
	This interface expects two opposing voltage signals in the range from 0.5 V to 4.5 V. The first signal is the leading signal and the second signal is used for plausibility check. The details of the signal characteristics including start and end point as well as the allowed tolerances can be configured via parameters.
	This interface expects two concurrent voltage signals in the range from 0.5 V to 4.5 V. The first signal is the leading signal and the second signal is used as a plausibility check. The details of the signal characteristics including start and end point as well as the allowed tolerances can be configured via parameters.
	This interface expects one voltage signal in the range from 0.5 V to 4.5 V and one on/off idle validation switch V _{IVS} signal. The voltage signal is the leading signal and the on/off signal is used as a plausibility check. The details of the signal characteristics including start and end point as well as the allowed tolerances can be configured via parameters.

1) Passive sensors such as potentiometers must be connected to a 5 V sensor supply (VSS_1 or VSS_3). Active sensors must be supplied as specified by sensor data sheet (VSS_1, VSS_2, VSS_3 or U_{Ign}).

2) Voltage measured in case of unconnected signal pin. Voltage results from internal circuitry of RC.
 3) A combined brake / inch pedal must be connected as inch pedal
 4) Such as implement pressure sensors or implement joystick
 5) x = angle α , line S or pressure p

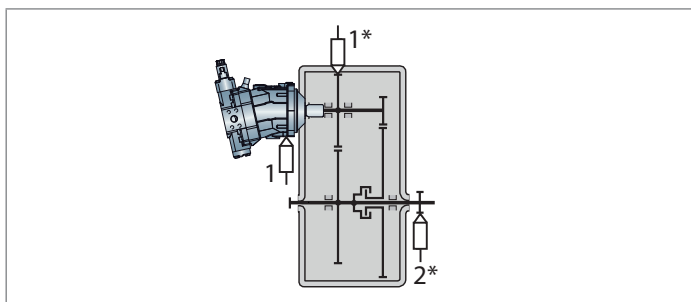
	Discrete			CAN Bus	
	Supported electrical interfaces	Sensor supply ¹⁾	Remarks	Supported CAN messages	Remarks
Gearbox speed up to two speed sensors	 DSM  HDD2 / DSA2	Signal channel of RC U_{ign}	Supported positions and combinations of speed sensors are shown below	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> CAN SAE J1939 Proprietary </div>	Proprietary messages include checksum and message counter
Engine speed	-	-	-	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> CAN SAE J1939 Standard </div>	Standard EEC1 message

▼ **Supported electrical interfaces**

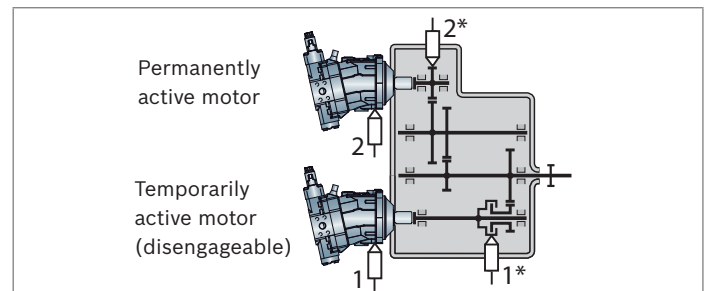
	DSM Sensor: This interface expects one frequency with coded error and direction information.
	HDD2²⁾ / DSA2 Sensor: This interface expects two frequencies with direction-dependent phase shift.

▼ **Supported positions and combinations of speed sensors**

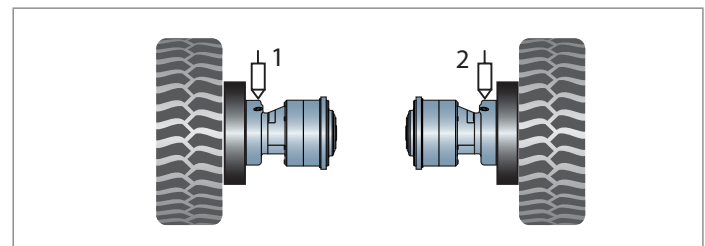
Gearboxes that can be shifted at a standstill require a speed sensor at the hydraulic motor (**1**), the gearbox input (**1***) or the gearbox output shaft (**2***), respectively. For shift-on-fly a speed sensor at the gearbox output shaft (**2***) is mandatory. The evaluation of two sensors is supported for additional diagnostics.



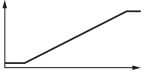
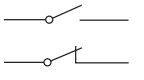
For summation gearboxes, two speed sensors are compulsory. Two combinations are supported for the sensor positions: Both speed sensors are placed either at the hydraulic motors (**1, 2**) or within the gearbox (**1*, 2***).



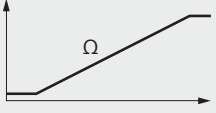
For configurations with radial piston motors (up to four wheels) two speed sensors are recommended (sensor **2** is mandatory). The sensors must be placed at different motors.



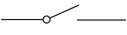
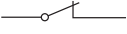
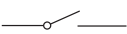
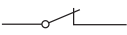
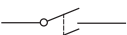

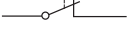

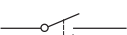
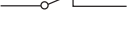



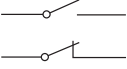

1) Sensor dependent supply voltage
2) Only NPN type supported

	Discrete		CAN Bus	
	Supported electrical interfaces	Remarks	Supported CAN messages	Remarks
Hydraulic motor oil temperature		Supported sensor: TSF, TF-W	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> CAN SAE J1939 Proprietary </div>	Proprietary messages include checksum and message counter
Gearbox oil temperature switch		Switches may be normally opened		
Engine coolant temperature	-	-	<div style="border: 1px solid black; padding: 5px; width: fit-content;"> CAN SAE J1939 Standard </div>	Standard ET1 message

▼ Supported electrical interfaces

	<p>This interface expects a temperature-dependent sensor resistance. The available measurement range of the RC is supported by the software.</p>
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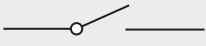
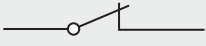
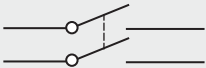
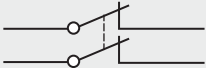
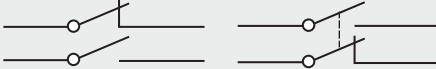
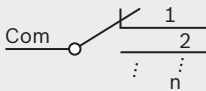
Switch inputs

	Discrete				CAN Bus	
	Supported electrical interfaces	Closed ¹⁾ switch voltage	Open ²⁾ switch voltage	Remarks	Supported CAN messages	Remarks
Cruise control on		0 V	6.5 V	Switches may be normally opened or closed	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> CAN SAE J1939 Proprietary </div>	Proprietary messages include checksum and message counter
Cruise control set						
Velocity limitation switch						
Driver-on-board switch						
Shift request shift up, shift down		5 V	2.7 V			
Auto shift enable						
Parking brake request		U_{Ign}	0 V			
Clutch pressure switch						
Parking brake pressure switch						
Motor minimum displacement switch		5 V	0 V			
Power limitation switch						
Gear position switch		U_{Ign}	0 V	Switches may be normally opened or closed		
FNR - Drive direction select three channels: neutral, forward and reverse						
Drive mode select up to five channels						
Emergency stop switch		0 V and U_{Bat}	6.5 V and 0 V	Switch must have two normally closed contacts	-	-

Supported electrical interfaces (see page 21)

- 1) External potential connected to RC by a closed switch.
- 2) Potential measured at RC pin at open switch. Voltage results from internal circuitry of RC.

▼ **Supported electrical interfaces** (from page 20)

	<p>This interface expects an on/off signal coming from a push button or switch with normally open contact.</p>
	<p>This interface expects an on/off signal coming from a push button or switch with normally closed contact.</p>
	<p>This interface expects two redundant on/off signals coming from a push button or switch with two normally open contacts.</p>
	<p>This interface expects two redundant on/off signals coming from a push button or switch with two normally closed contacts.</p>
	<p>This interface expects two redundant on/off signals coming from a push button or switch with one normally open and one normally closed contact.</p>
	<p>This interface expects exactly one of n signals in on-condition. Typical devices can be a steering column switch or any other selector switch with one common supply pin and n mechanical positions connecting the common pin with one of the n output pins.</p>

5.4 Outputs

Proportional outputs

	Discrete				CAN Bus	
	Supported electrical interfaces	Default output logic ¹⁾	Invertible ²⁾	Remarks	Supported CAN messages	Remarks
Pump solenoids		Pump swivels to V_{g0}	no	Pump forward and reverse solenoids are connected to two independent low-side switches	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> CAN SAE J1939 Proprietary </div>	Proprietary messages include checksum and message counter
Hydraulic motor solenoids		Motor swivels to V_{gmin}	yes (V_{gmax})	<ul style="list-style-type: none"> ▶ All hydraulic motor solenoids are connected to one low-side switch. ▶ Output logic is independently configurable for both motors 		
Retarder solenoid			yes	Retarder control can be proportional or digital		
Desired engine speed	-	-	-	-	<div style="border: 1px solid black; padding: 2px; display: inline-block;"> CAN SAE J1939 Standard </div> <div style="border: 1px solid black; padding: 2px; display: inline-block;"> CAN SAE J1939 Proprietary </div>	Standard TSC1 message Proprietary messages include checksum and message counter

▼ Supported electrical interfaces

	This high-side output expects a solenoid connected to ground potential. The proportional output current is generated via PWM closed-loop control. The details of the solenoid characteristics including minimum and maximum resistance can be configured via parameters.
	This high-side output expects a solenoid connected to a low-side switch. The low-side switch is an additional safety path for switching off the output in case of external short circuits. Up to four high-side switches can be connected to one low-side switch. The proportional output current is generated via PWM closed-loop control. The details of the solenoid characteristics including minimum and maximum resistance can be configured via parameters.

1) For output that is shut off (no current), expected default machine behavior for a deactivated output (no current driven by high-side output)

2) Indicates if output logic can be inverted by parameter

Switch outputs

	Supported electrical interfaces	Discrete			CAN Bus	
		Default output logic ¹⁾	Invertible ²⁾	Remarks	Supported CAN messages	Remarks
Fault lamp		Lamp is on	yes	Lamp signals from lowest to highest priority: off, on, slow flash, fast flash	<div style="border: 1px solid black; padding: 2px; display: inline-block;">CAN SAE J1939</div> Proprietary	Proprietary messages include checksum and message counter
Parking brake lamp		Lamp is on	yes	Lamp signals: off = brake disengaged, on = brake engaged, flashing = brake engagement is requested		
Status lamp (Gearbox)		Lamp is on	yes	Lamp signals: off = shifting not possible, on = shifting possible, flashing = shift up/down for fixed gear request currently not possible		
Brake lamp via relay		Lamp is on	yes	–		
Engine start allowed		Engine start is allowed	no	If engine ECU input is active low, signal must be inverted (e.g. with a normally open relay to GND)		
Gearbox valves for standstill, shift-on-fly, summation gearbox or MCR motor control		Valve is open	yes	▶ Up to three valve solenoids are connected to one low-side switch ▶ Output logic is independently configurable for all valves		
Parking brake valve		Parking brake is open	yes	Parking brake valve solenoid is connected to one low-side switch		
Pump neutral valve		No short circuit between pump X1, X2	yes	Pump neutral valve solenoid is connected to one low-side switch		

▼ **Supported electrical interfaces**

	This high-side output expects a solenoid connected to ground potential. The output voltage is switched to battery voltage or ground. The details of the solenoid characteristics including minimum and maximum resistance can be configured via parameters.
	This high-side output expects a solenoid connected to a low-side switch. The low-side switch is an additional safety path for switching off the output in case of external short circuits. Up to four high-side switches can be connected to one low-side switch. The output voltage U is switched to battery voltage or ground. The details of the solenoid characteristics including minimum and maximum resistance can be configured via parameters.
	This high-side output expects a resistance (e.g. a lamp) connected to ground potential. The output voltage is switched to battery voltage or ground. The details of the resistance characteristics including minimum and maximum resistance can be configured via parameters.

1) For output in on state (U_{Bat}), expected default machine behavior for an activated output (High-side output has battery potential).
 2) Indicates if output logic can be inverted by parameter.

5.5 Power supplies

Battery power supply

- ▶ 12 V and 24 V batteries are supported.
- ▶ Different solenoids are to be used depending on the battery voltage. Thus different load resistances are expected for error detection.

The RC controller is using an after-run functionality.

Therefore battery power supply must not be disconnected within a time period of 2 seconds after switching of ignition.

Sensor supplies

U_{Bat}

- ▶ This potential is connected to battery voltage and is protected by a 5 A fuse.
- ▶ It is solely used for power supply of ECU electronics and the emergency stop switch.

U_{Ign}

- ▶ This potential is connected to the ignition switch and is protected by a 3 A fuse.
- ▶ It is used for sensors requiring battery voltage as power supply and for some switches.
- ▶ The sensors connected to U_{Ign} don't draw current when ignition is off.

VSS_1, VSS_3

- ▶ These potentials are connected to 5 V constant voltage sources supplied by the ECU.
- ▶ It is used for sensors requiring a 5 V power supply, for potentiometers and for some switches.

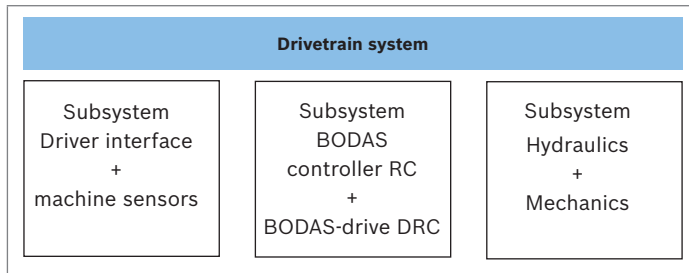
VSS_2

- ▶ This potential is connected to a 10 V constant voltage source supplied by the ECU.
- ▶ It is not used in the BODAS-drive DRC wiring harness.

6 Functional safety in accordance with EN ISO 13849 and ISO 25119

6.1 Approach

BODAS-drive uses a subsystem approach as stated in the figure below.



The machine manufacturer can use the BODAS controller RC + BODAS-drive DRC subsystem within the machine safety design to realize safety functions for the drivetrain system. The described characteristics within this data sheet refer to the BODAS controller RC + BODAS-drive DRC subsystem.

Ready-to-use safety functions developed according to the standards EN ISO 13849 and ISO 25119 are part of the software. If the performance level for the BODAS-drive subsystem is sufficient to reach the required overall performance level, BODAS-drive can be used based on the customer-specific risk assessment. In any case, the requirements of the relevant safety standard must be fulfilled at the drivetrain and machine level.

6.2 Concept

The software of the BODAS controller RC + BODAS-drive DRC subsystem utilizes an inherent safety concept. This means that all noted safety functions are realized not by dedicated monitoring software, but by a safe implementation of the safety relevant software program parts. The BODAS-drive software has been completely developed according to PL d and SRL 1. The software comes with 8 predefined safety functions, but is not limited to these. For additional safety functions, contact your Bosch Rexroth sales partner.

This inherent approach is combined with a safe diagnosis system within the BODAS-drive software, fulfilling the requirements of category 2: Detection of and appropriate reaction to hardware faults.

As BODAS-drive represents a safety element out of context (SEoC), the machine manufacturer must verify whether it is the right product for the specific application. In any case, the machine manufacturer is responsible to fulfill the overall safety requirements at the machine level.

The following approach shows how the machine manufacturer can reach the required performance level for a specific application applying BODAS-drive.

1 Risk assessment

- ▶ Performance of risk assessment
- ▶ Identification of the safety functions
- ▶ Determination of the required performance level (PLr)

2 Safety concept and category selection →

Category 2 is pre-defined for BODAS controller RC + BODAS-drive DRC subsystem

- ▶ Comparison of risk assessment results with safety functions offered within BODAS-drive
- ▶ If the safety requirements of the application cannot be fulfilled with the existing safety functions of BODAS-drive, the product must not be used. In this case, consult your Bosch Rexroth contact regarding a customized solution. Otherwise go on with the next step.
- ▶ Developing a safety concept for the complete machine and drivetrain
 - Applying BODAS-drive inherent safety approach
 - Creating block diagrams
 - Calculation of the overall performance level. The SISTEMA tool from IFA may be used. A calculation example is provided. Once the safety function groups and the characteristics of the sensors and actuators have been provided, it can directly calculate the probability of failure per hour and the performance level achieved.

3 Integration and parameterization of BODAS-drive in the machine

- ▶ Integrate BODAS-drive in the machine environment interfacing the wiring harness and devices which are selected according to the safety requirements.
- ▶ Set parameters with BODAS-service according to the application-specific requirements.

4 Validation

- ▶ Creation of an appropriate application-specific approval test specification.
 The BODAS-drive approval test specification is part of the documents and tools container and can be used as a starting point. An application-specific adaptation is required in any case.
- ▶ Performance of approval tests specific to application and project as well as documentation of the results.

Relationship between safety functions and vehicle functions

The following tables show the dependencies between safety functions and configured functionality.

The following table shows, which functionality is related to each declared safety function. For example, to know which functionality has a dependency for e.g. the safety function “Safe Reversing”, the “x” marks in the line of “Safe Reversing” show which functionality is affected. In this case, these are

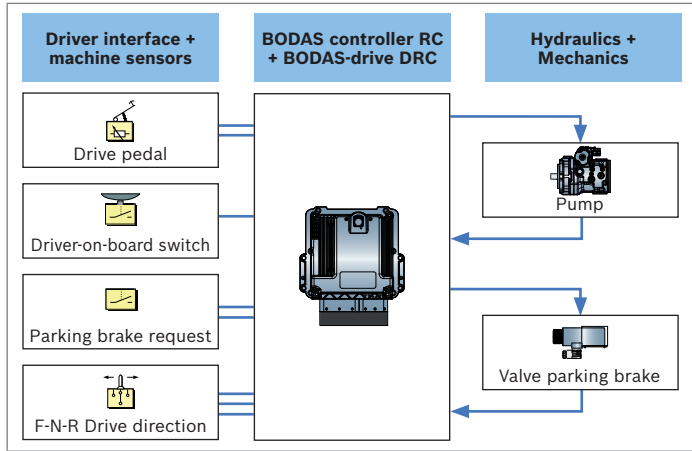
- ▶ Pump control
- ▶ Reversing Function

	Automotive driving	Brake lamp control	Cruise control	Diagnostics	Drive demand	Drive modes	ECO drive mode	ECO work mode	Engine speed control	Engine overspeed protection	Hand engine speed request	Inch function	Load limiting control	Motor control	Motor pressure control	Motor protection	Parking brake control	Power limitation	Pump control	Pump protection	Radial piston motors (MCR)	Reversing function	Service brake influence	Shift-on-fly gearbox control	Standstill gearbox control	Summation gearbox control	Tractive effort limitation	Velocity limitation control	
Safe standstill	x		x		x							x							x										
Safe parking brake																	x												
Safe direction																			x			x							
Safe acceleration and deceleration limit	x		x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Safe reversing																			x			x							
Safe brake light		x																											
Safe limited speed										x				x					x										x
Safe deceleration	x				x				x			x		x	x				x				x						
Safe operator detection																			x			x							

x = mandatory for safety function (if component is configured)

SF1: Safe standstill

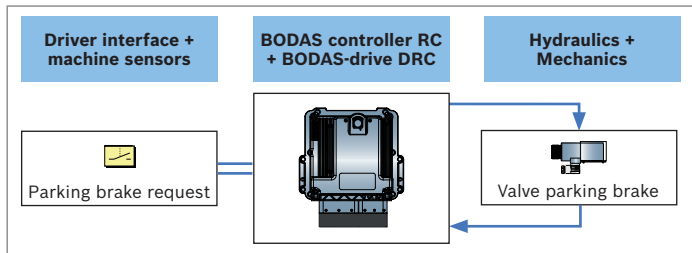
This safety function ensures no unwanted self-propelled movement of the machine caused by an unwanted torque of the hydrostatic transmission.



PFH value for the BODAS controller RC + BODAS-drive DRC subsystem for this function is about $2.6 \cdot 10^{-7}$. This value depends on the connected sensors and the type of connection (such as analog or CAN...).

SF2: Safe parking brake

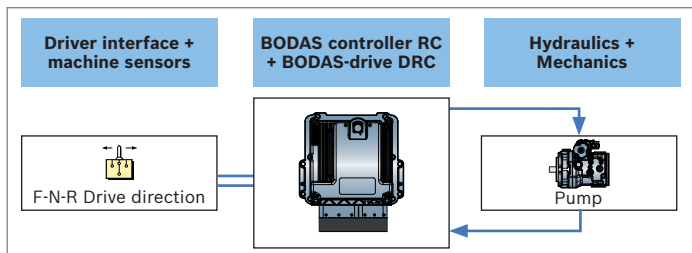
This safety function prevents the parking brake from releasing unintentionally when the vehicle is at a standstill.



PFH value for the BODAS controller RC + BODAS-drive DRC subsystem for this function is about $2.6 \cdot 10^{-7}$. This value depends on the connected sensors and the type of connection (such as analog or CAN...).

SF3: Safe direction

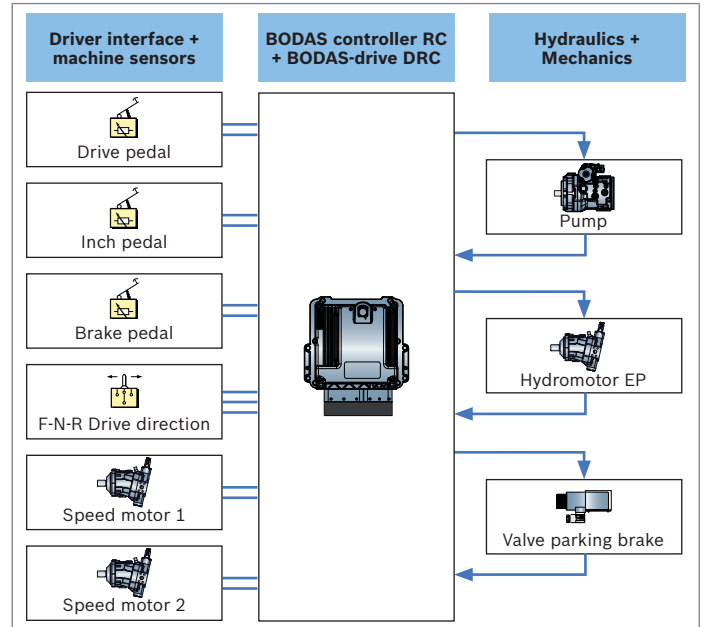
This safety function prevents the vehicle from propelling into the wrong direction. It ensures that the hydrostatic transmission issues torque in the direction the driver demands.



PFH value for the BODAS controller RC + BODAS-drive DRC subsystem for this function is about $2.6 \cdot 10^{-7}$. This value depends on the connected sensors and the type of connection (such as analog or CAN...).

SF4: Safe acceleration/deceleration limit

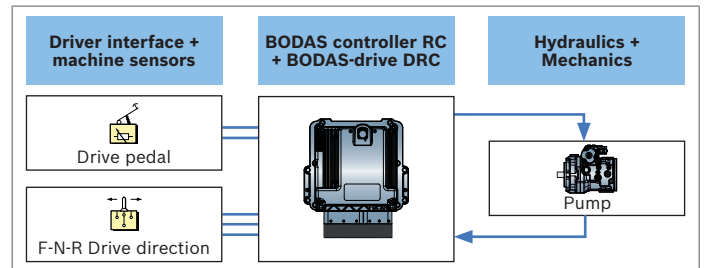
This safety function ensures that the vehicle accelerates or decelerates as the driver expects.



PFH value for the BODAS controller RC + BODAS-drive DRC subsystem for this function is about $2.6 \cdot 10^{-7}$. This value depends on the connected sensors and the type of connection (such as analog or CAN...).

SF5: Safe reversing

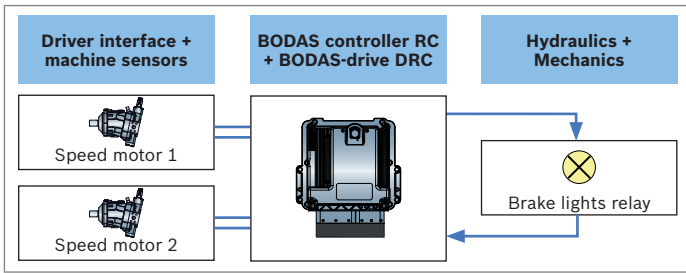
This safety function ensures the execution of a reversing action when (and only when) the driver demands it by switching the F-N-R switch.



PFH value for the BODAS controller RC + BODAS-drive DRC subsystem for this function is about $2.6 \cdot 10^{-7}$. This value depends on the connected sensors and the type of connection (such as analog or CAN...).

SF6: Safe brake light actuation

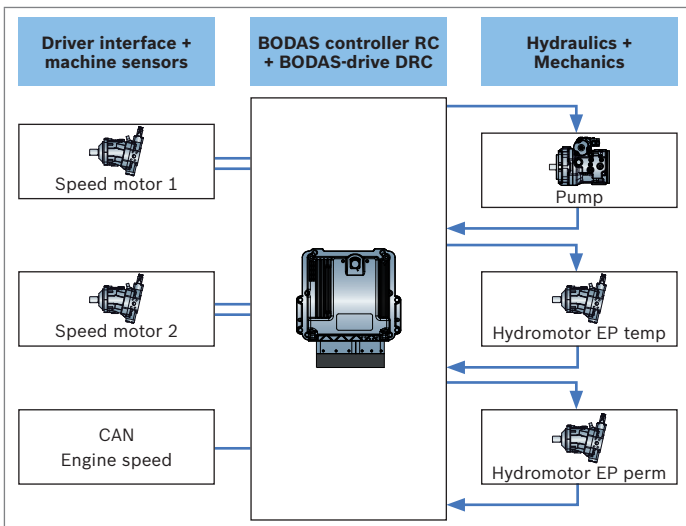
This safety function controls the brake lights depending on a calculated deceleration value.



PFH value for the BODAS controller RC + BODAS-drive DRC subsystem for this function is about $2.3 \cdot 10^{-7}$. This value depends on the connected sensors and the type of connection (such as analog or CAN...).

SF7: Safe speed limitation

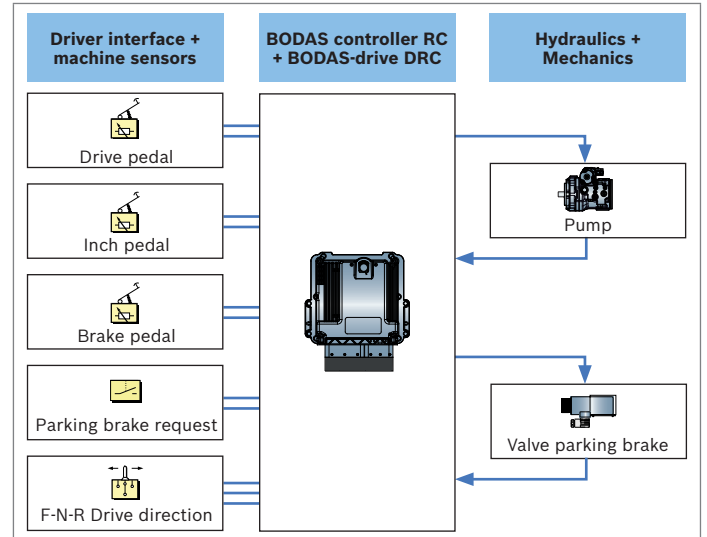
This safety function safely limits the vehicle speed. The available deceleration is limited by the available diesel drag torque. The engine overspeed protection has higher priority than this safety function.



PFH value for the BODAS controller RC + BODAS-drive DRC subsystem for this function is about $2.6 \cdot 10^{-7}$. This value depends on the connected sensors and the type of connection (such as analog or CAN...).

SF8: Safe deceleration

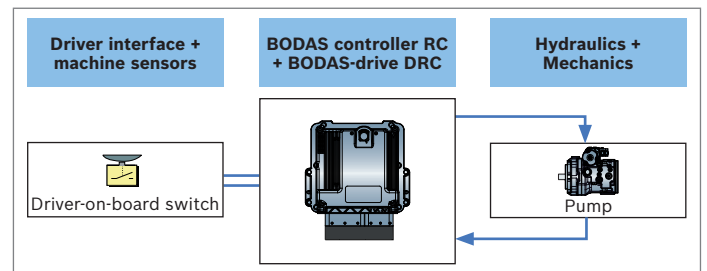
This safety function ensures that the hydrostatic transmission issues a braking torque when the driver demands it. The available braking torque is limited to the diesel drag torque. The diesel overspeed protection function has higher priority than this safety function.



PFH value for the BODAS controller RC + BODAS-drive DRC subsystem for this function is about $2.6 \cdot 10^{-7}$. This value depends on the connected sensors and the type of connection (such as analog or CAN...).

SF9: Safe operator detection

This safety function ensures that the hydrostatic transmission stops propelling the vehicle as long as the operator is not present at the operator's position.



PFH value for the BODAS controller RC + BODAS-drive DRC subsystem for this function is about $6.33 \cdot 10^{-7}$. This value depends on the connected sensors and the type of connection (such as analog or CAN...).

6.4 Example of using a BODAS-drive safety function

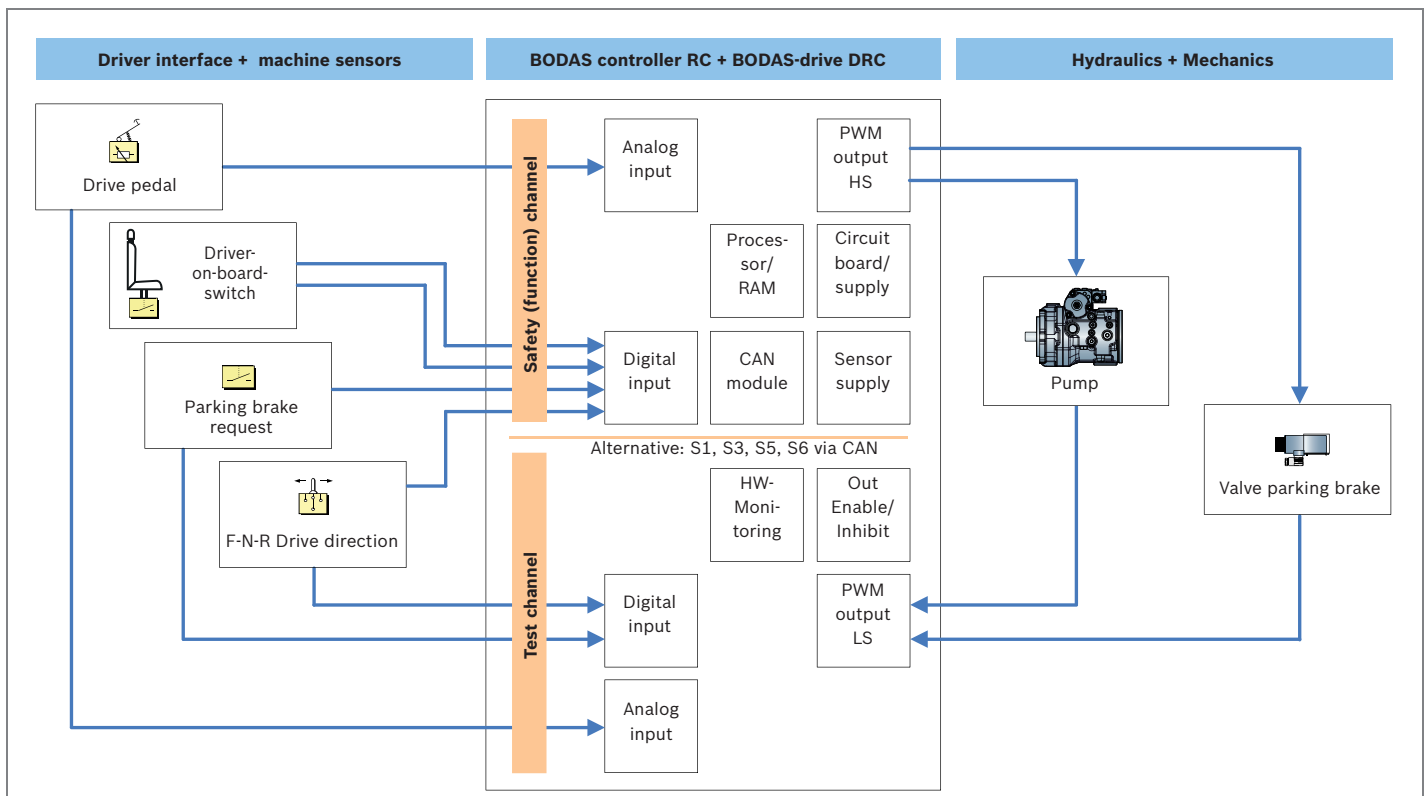
This chapter uses an example based on SF1 Safe Standstill to show how to use the standard BODAS-drive safety functions depending on the machine configuration.

First step: Develop a block diagram

Develop the block diagram based on the machine configuration and desired functionality. The usable blocks of the BODAS controller RC are defined within the safety-relevant project instructions, Rexroth datasheet 95451-01-B of the chosen ECU. The appropriate blocks of the subsystem of sensors and hydraulics have to be chosen according to the machine configuration.

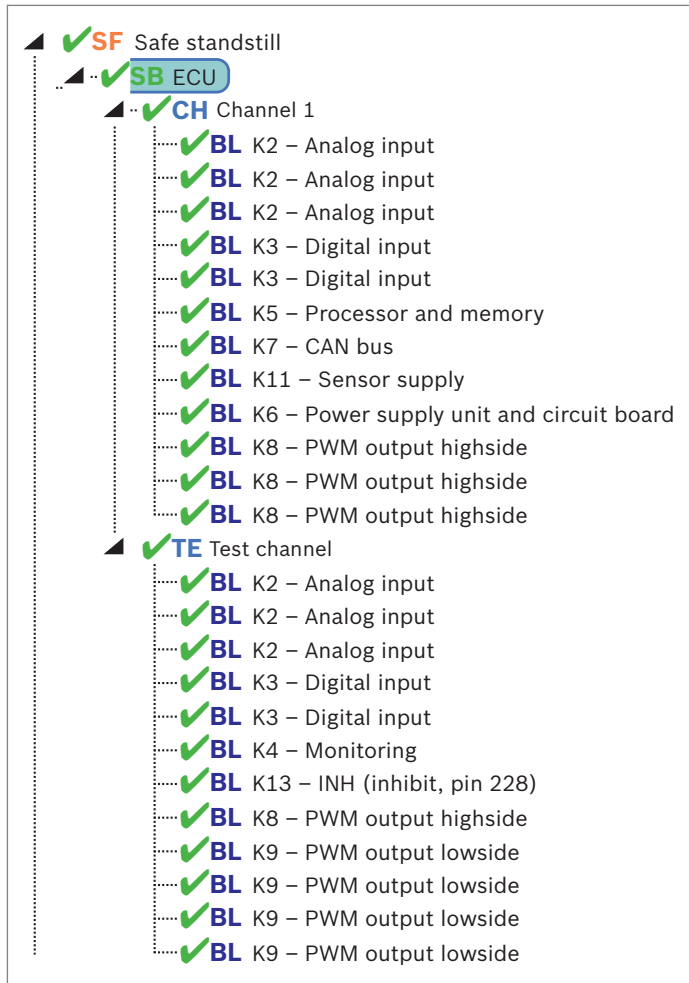
The example shows a block diagram for the safety function SF1, "Safe Standstill". It makes use of a 2-channel drive pedal, a 2-channel parking brake switch, a driver-on-board switch and a 3-position F-N-R switch on the sensor side and an electrically controlled pump and parking brake valve on the hydraulic side.

The block diagram shows the connection of all blocks relevant for this safety function. It also shows the chosen category, here category 2 with a function channel and a test channel.



Second step: Calculate metrics

The metrics of $MTTF_d$ and DC value are calculated in the second step. Bosch Rexroth recommends using the SISTEMA tool for that purpose.



Result for the BODAS controller RC + BODAS-drive DRC subsystem is:

SF Safe standstill	
PLr	d
PL	d
PFH [1/h]	6.61E-7
SB ECU	
PL	d
PFH [1/h]	3.49E-7
Cat.	2
$MTTF_d$ [a]	100 [high]
DCavg [%]	77.94 [low]
CCF	75 [fulfil]

According to the BODAS controller RC + BODAS-drive DRC subsystem, the calculation for the full system has to be done based on the respective machine. The database of the used values can be found within the safety-relevant project planning instruction for BODAS controllers RC, Rexroth datasheet 95451-01-B. Since the sensor and system structures vary, a concrete calculation has to be done within each project. Also, the machine-specific temperature profile has to be taken into account when performing the $MTTF_d$ value calculation.

7 Project engineering and ordering information

The way from machine prototyping to serial production

- ▶ The outputs of the BODAS controller RC + BODAS-drive DRC are deactivated in the initial delivery status.
- ▶ The scope of supply (as described above) must be applied and each controller has to be parameterized. Access to the parameters is password-protected. The password is part of the documents and tools container.
- ▶ The machine manufacturer must verify and validate BODAS-drive in regard to the machine-specific requirements.

Important:

- ▶ The details in chapter 6, Functional safety, must be taken into account.
 - ▶ Please take into account the Rexroth brochure „10 steps to performance level“.
- ▶ A customer-specific parameter file has to be transferred to each controller for serial production.
For a customer-specific software solution please contact your Bosch Rexroth sales partner.

Required tools

- ▶ BODAS-service V3.4.1 or higher; for the latest version see www.boschrexroth.com/mobile-electronics
- ▶ Microsoft Excel or equivalent for handling the approval test specification

Recommended tools

- ▶ Sistema, software tool for the application of the standard EN ISO 13849-1
- ▶ Vector CANalyzer Pro version 7.6 or higher – required for full functionality including virtual testbox and plant model.

7.1 Ordering code

01	02	03	04
ASrun	/	DRC	A 41

Type	
01	Application software ready to run on RC controller ASrun
Application	
02	Hydrostatic drivetrains for wheeled mobile machines DRC
Variant	
03	Hydraulic pump A4VG.ET or EP, engine with SAE J1939 CAN interface, hydraulic motor with constant displacement or A6VM.EP, fixed gear or gearbox shiftable during standstill or shift-on-fly gearbox or summation gearbox interfacing two hydraulic motors or hydraulic transmission using radial piston motors type MCR. A
Release	
04	Release number of the software 41

The software **BODAS-drive DRCA41** will be delivered already flashed on a **BODAS controller RC12-10/30**

When placing an order, the hardware and software ordering codes are to be linked by a "+".
 In this case the complete ordering code is as follows: RC12-10/30 + ASrun/DRCA41

Documents and tools container

To assist in handling the product properly, the documents and tools container has associated files and documents available, including the following contents:

- ▶ Operating instructions (Application guideline, detailed functional description and parameter description)
- ▶ User password to access the parameters via BODAS-service
- ▶ Test specification example file for approval test
- ▶ Sistema calculations, example file
- ▶ Proprietary SAE J1939 messages including code for calculation of CRC checksum and message counter for integration of other control units within the CAN network.
- ▶ Measurement, calibration and testing-tool support
- ▶ CAN database of proprietary SAE J1939 messages
- ▶ CANalyzer configuration including virtual testbox and plant model of the drivetrain (optional)

The operating instructions as well as the valid standards and separate documentation (chapter 8) must be considered before start-up of the software.

The documents and tools container is provided upon request via Info.Bodas@boschrexroth.de
 Please use the following subject for your e-mail request: "Container request: ASrun/DRCA41"

Please provide additionally the following information:

- ▶ Company name
- ▶ Contact person
- ▶ E-mail address
- ▶ Purchase order number

8 Valid standards and separate documentation

Document	
SAE J1939-21 December 2010	Data Link Layer
SAE J1939-71 May 2012	Vehicle Application Layer
Standard DIN ISO 13849-1 2006-11	Safety of machinery – Safety-related parts of control systems
Standard DIN ISO 13849-2 2012-10	Part 1: General principles for design Part 2: Validation
Standard ISO 25119 2010-06 Parts 1-4	Tractors and machinery for agriculture and forestry – Safety-related parts of control systems
95204	BODAS Controller RC series 30 RC12-10, RC20-10, RC28-14
95451-01-B	Controller RC12-10, RC20-10, RC28-14 Safety-relevant project planning instruction
08511 10	10 Steps to Performance Level

▼ Compatible Rexroth products

Components	Data sheet	Relevant type code
Axial piston variable pump A4VG...EP and ET/40	92004	EP – Electric control, proportional ET – Electric control, direct-controlled
Axial piston variable pump A4VG...EP/32	92003	EP – Electric control, proportional
Axial piston variable motor A6VM...EP/71	91610	EP – Electric control, proportional
Radial piston motor for wheel drives MCR-F	15198	
BODAS Pressure sensor PR3	95155	PR3 600MD36/10, PR3 600GS05/10
BODAS Speed sensor DSM	95132	DSM1-10
BODAS Temperature sensor fluid TSF	95180	
BODAS Speed sensor HDD	95135	HDD2L16N
BODAS Angle sensor WS1	95140	WS1T90/10
BODAS Controller RC series 30	95204	RC12-10/30
BODAS-service	95086	
BODAS measuring adapter MA6	95090	

9 Abbreviations

Abbreviation	Meaning
AgPL	Agriculture Performance Level
BODAS	Bosch Rexroth Design and Application System
CAN	Controller Area Network
CCF	Common Cause Failure
CCP	CAN Calibration Protocol
DA	Automatic control speed-related
DC	Diagnostic Coverage
DHC	Diesel Hydraulic Control
DIN	Deutsches Institut für Normung
DRC	Drive Control
ECU	Electronic control unit
EN	European Norm
EP	Proportional control electric
ET	Electric control, direct-controlled
FNR	Forward/Neutral/Reverse
HA	Automatic control high-pressure related
HS	High-Side
IFA	Institute for work protection of the German statutory accident insurance
ISO	International Organization for Standardization
IVS	Idle validation switch
LS	Low-Side
MCR	Radial piston motors
MTTF _d	Mean Time To dangerous Failure
PFH	Probability of dangerous failure per hour
PL	Performance Level
PLr	Required Performance Level
PWM	Pulse-width modulation
RC	Rexroth Controller
SAE	Society of Automotive Engineers
SEooC	Safety element out of context
SF	Safety Function
SISTEMA	Safety integrity software tool for the evaluation of machine applications, produced by IFA
SRL	Software Requirement Level

10 Safety Instructions

- ▶ BODAS-drive DRC represents a safety element out of context (SEooC). The machine manufacturer must verify whether it is the right product for the specific application.
- ▶ The machine manufacturer must perform a risk assessment.
- ▶ The required safety functions and performance levels must be fulfilled with the product in order to use BODAS-drive DRC in a specific application.
- ▶ The machine manufacturer bears responsibility for applying the valid safety standards at the machine level.
- ▶ The machine manufacturer is responsible for fulfilling all safety requirements at the drivetrain and machine level.
- ▶ The machine manufacturer is responsible for validating the machine-specific configuration of BODAS-drive DRC.
- ▶ Configurations of BODAS-drive DRC used for serial production must be validated.
- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ Incorrect connections could cause unexpected signals at the outputs of the RC.
- ▶ Incorrect programming or parameter settings may create potential hazards while the machine is in operation.
- ▶ It is the responsibility of the machine manufacturer to identify hazards of this type in a hazard analysis and to bring them to the attention of the end user. Bosch Rexroth assumes no liability for dangers of this type.
- ▶ The application software must be installed and removed only by Bosch Rexroth or an authorized partner to preserve the warranty.
- ▶ It must be ensured that the vehicle is equipped with adequately dimensioned service and parking brakes.
- ▶ Make sure that the software configuration does not lead to safety-critical malfunctions of the complete system in the event of failure or malfunction. This type of system behavior may put life in danger and/or cause great damage to property.
- ▶ System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- ▶ The machine may pose unforeseen hazards while commissioning and maintenance are carried out. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.
- ▶ The technical specifications and safety instructions of all involved components must be considered.
- ▶ The machine manufacturer must follow the valid standards and separate documentation (see chapter 8) when using the product.

Intended use

- ▶ The control unit is designed for use in mobile working machines provided no limitations / restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the control unit must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, current, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in hazard to persons and/or cause damage to components which could result in sequential damage to the mobile working machine.

Improper use

- ▶ Any use of the control unit other than as described under "Intended use" is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damage resulting from improper use and/or from unauthorized interference in the component not described in this data sheet render all warranty and liability claims void with respect to the manufacturer.

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Analog amplifier RA

RE 95230

Edition: 08.2015

Replaces: 03.2006

1



- ▶ For control of simple functions of electrohydraulic components
- ▶ Two power outputs (PWM) and one switching output
- ▶ Each output has a separately adjustable time for upwards and downwards ramps
- ▶ Each output has separately adjustable minimum and maximum currents

Features

- ▶ Optional interlock of actuation for proportional solenoids
- ▶ Supply voltage for external setpoint potentiometer
- ▶ Monitoring of setpoint potentiometer for cable breakage and short circuit
- ▶ Externally actuated switching output
- ▶ Error output
- ▶ Overload protection, overvoltage protection, conditional short-circuit protection
- ▶ Externally adjustable PWM frequency

Contents

Type code	2
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Description	2
Service options	2
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Terminal connection	6
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Installation position	8
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Safety instructions	9

Type code

01	02	03
RA	2-1	/ 10

Type

01	Analog amplifier	RA
----	------------------	-----------

Version

02	1st position: number of proportional outputs 2nd position: number of switching outputs	2-1
----	---	------------

Series

03	Series 1, index 0	10
----	-------------------	-----------

Ordering details

Type	Version	Series	Material Number
RA	2-1	/ 10	R902091800

Mating connector

Order designation for 25-pin Bosch mating connector comprising:

Designation	Material number
Handle shell, angled	Bosch 1 928 401 013
Contact carrier	Bosch 1 928 400 952
Screw for contact carrier	Bosch 1 928 491 082
Flat sealing ring for screws	Bosch 1 928 300 198
Locking piece, lilac color	Bosch 1 928 401 566
Clamping collar, large	Bosch 1 928 400 890
2 screws for the clamping collar	Bosch 1 928 491 151
Sleeve, angled, 18 mm	Bosch 1 928 300 284
Seal for contact carrier	Bosch 1 928 300 191
Clamping band for sleeve	Bosch 1 928 401 280
25 contacts	AMP 927775-3

The mating connector is not included in the scope of delivery.

It can be ordered from Bosch Rexroth under the material number R902603063.

Description

The analog amplifier activates up to two proportional solenoids. The specified control voltage is processed in the amplifier as an input variable. The analog amplifier provides a regulated electric current as an output variable for actuation of proportional solenoids.

The amplifier outputs for the proportional solenoids are activated by applying approx. 5% of the maximum setpoint voltage at the input, i.e., the minimum output current is applied. The level of this minimum output current can be adjusted separately for both proportional outputs using a trimming potentiometer. If the setpoint voltage at the input is increased, the output current for each respective proportional solenoid increases linearly.

The maximum output current can also be separately adjusted using a trimming potentiometer for the outputs.

The gradient of the output curve is influenced by this.

The analog amplifier contains time ramp functions which can be used to adjust the period in which the output current can be adapted to match a modified setpoint. The ramp time adjustment range extends from 100 ms to 10 s. The time ramp functions can be adjusted using trimming potentiometers for each solenoid.

Service options

The RA analog amplifier can be used to actuate up to two proportional solenoids in a single device (for example a toggling axial piston unit or a valve section with separate actuation of the proportional solenoids) or to actuate two devices independently of each other (for example, two individual axial piston units or valves). The use of only one proportional output is possible. A 1 A output for a switching function is also available.

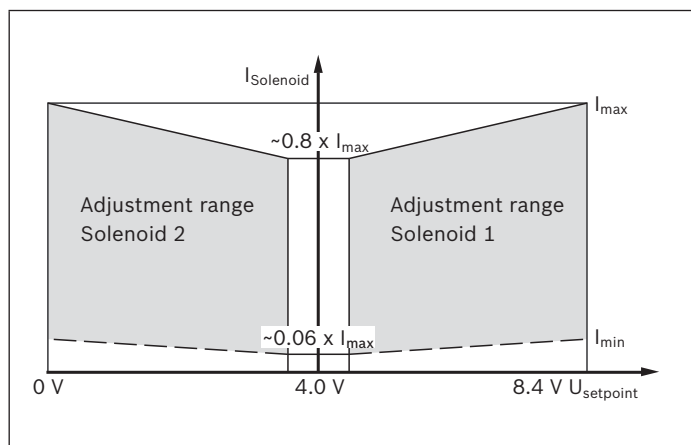
Technical data

Analog amplifier RA2-1		
Nominal voltage		12 and 24 V
Residual ripple (DIN 40839, Section 1), maximum		± 2 V
Supply voltage, perm. range		10 to 32 V
Current consumption		
without load		150 mA
with load, max.		6 A
Fuse		
internal		–
external: for switching and proportional solenoid outputs and for electronics		7.5 A T
Potentiometer supply voltage		0 V, 4.0 V
for setpoint potentiometer 2 to 5 kΩ	depending on load	7.2 V to 8.4 V
Voltage input (differential amplifier) (differential voltage)	4.0 V	2
Switch input	> 5.0 V	1
Proportional solenoid outputs (PWM)		
Current range	0 to 2.3 A	2
Pulsation frequency	100, 200 or 350 Hz	
Switch output (MOSFET)	max. 1 A	1
LED indicators		
red	Error (error display)	●
green	Power (operating state indicator)	●
yellow	I1 (PWM current channel 1)	●
yellow	I2 (PWM current channel 2)	●
Error detection		
Potentiometer: for broken wires and short circuit	Exception: wiper	●
Voltage supply: undervoltage monitoring		●
Resistance to short circuits		
To supply voltage and ground for all inputs and outputs (Exception: potentiometer supply 4.0 V to supply voltage)		●
Reverse polarity protection		
Supply/battery		●
Electromagnetic compatibility		
Spurious interference (motor vehicles directive 95/54/EC)	Details on request	100 V _{ms} /m
Line-bound interference (ISO 7637-1/-2/-3)	Values on request	●
Load dump		70 V
Max. power loss	at 32 V	4 W
Operating temperature, case		–40 to 85 °C
Storage temperature, case		–40 to 85 °C
Vibration resistance		
Sinusoidal vibration (IEC 60086-2-6)	20 cycles per axis	10g / 57 to 2000 Hz
Random vibration (IEC 60086-2-36)	30 min. per axis	0.05 g ² /Hz
Shock resistance		
Transport shock (IEC 60068-2-27)	3X in each direction (pos./neg.) and in each axis	15g / 11 ms
Continuous shock (IEC 60068-2-29)	1000X in each direction (pos./neg.) and in each axis	25g / 6 ms

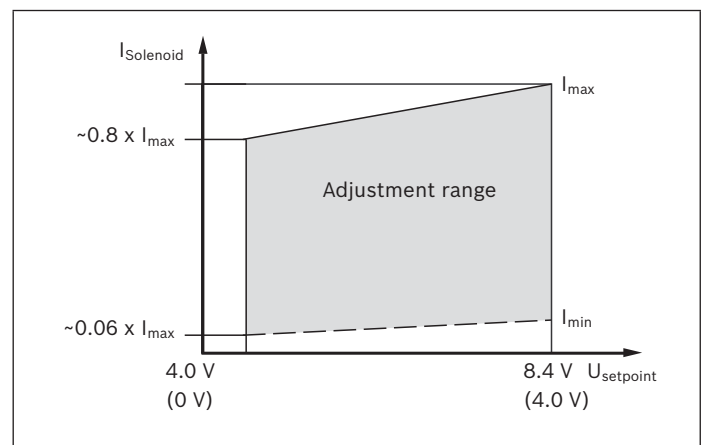
Analog amplifier RA2-1		
Resistance to moisture IEC 60068-2-30Db; version 2	90 % (+25 °C to +55 °C)	●
Resistance to salt spray IEC 60068-2-11	72 h, 35°C, 5% NaCl	●
Type of protection (DIN / EN 60529)	with installed mating connector ¹⁾	IP65
Case material	Plastic injection molding PA66 GF 35	●
Mass, approx.		0.3 kg
Outer dimensions	Length	108 mm
	Width	135 mm
	Height	42 mm

Characteristic curves

For 2 solenoids with interlocked actuation (toggling mode)

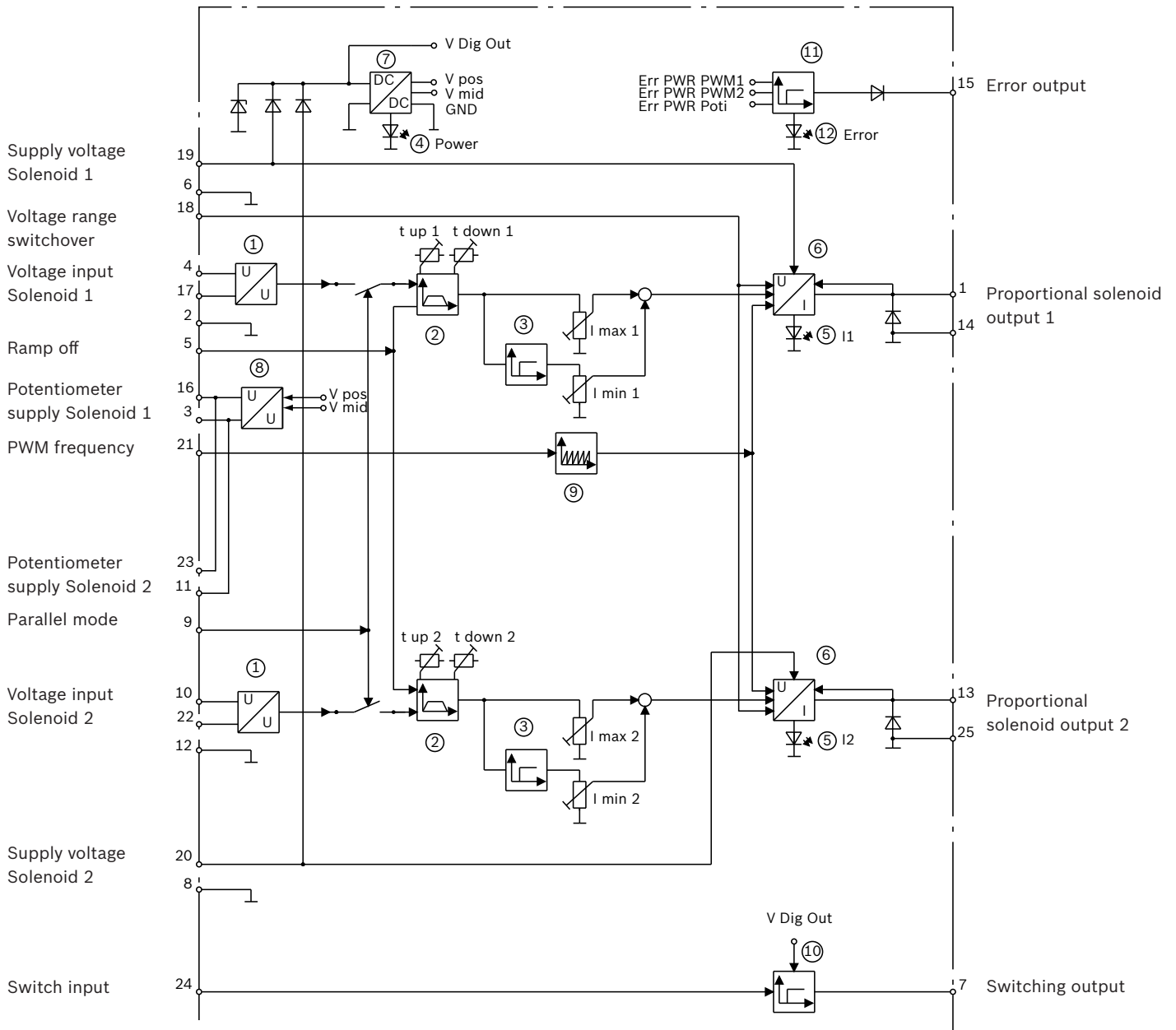


For 2 solenoids with independent actuation (parallel mode)



1) For the appropriate routing of the connection cable, see "Installation position"

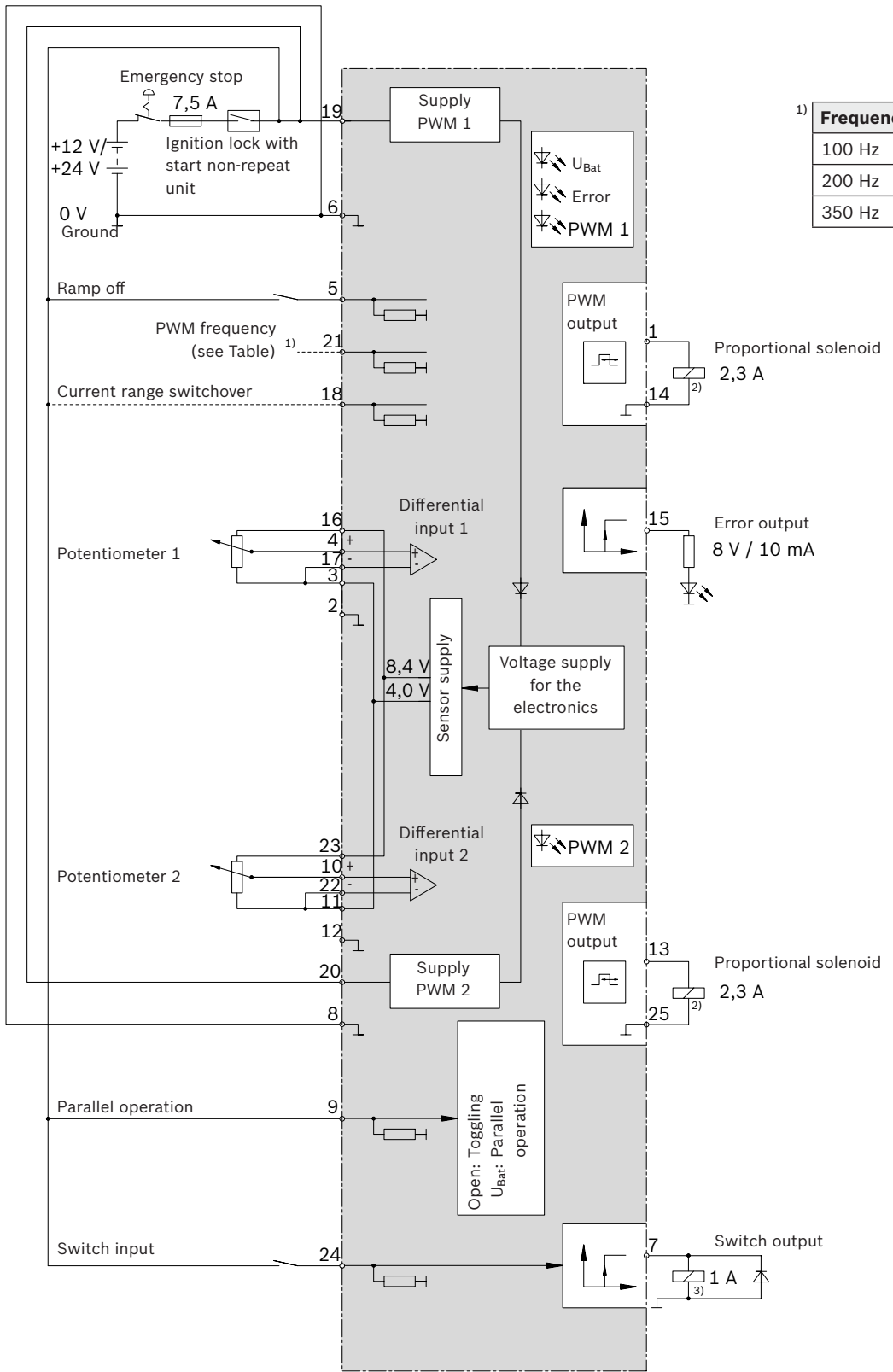
Block circuit diagram



Key	
①	Differential amplifier
②	Time ramp function
③	Reference voltage generation
④	LED operational status (Power)
⑤	LED displaying PWM current (I1 or I2)
⑥	PWM output stage

Key	
⑦	Internal voltage supply
⑧	Sensor or potentiometer supply
⑨	Clock-pulse generator
⑩	Switch output
⑩	Error detection
⑫	LED displaying error (Error)

Terminal connection



1)

Frequency	Pin 21	Bridge from 21
100 Hz	open	-
200 Hz	to GND	to 2 or 12
350 Hz	to U _{Bat}	to 19

1) 3 connection options to switch over the PWM dither frequency (see Table): 100 Hz, 200 Hz, 350 Hz if required
 2) Ground connection for solenoid return lead to the battery (or chassis) possible

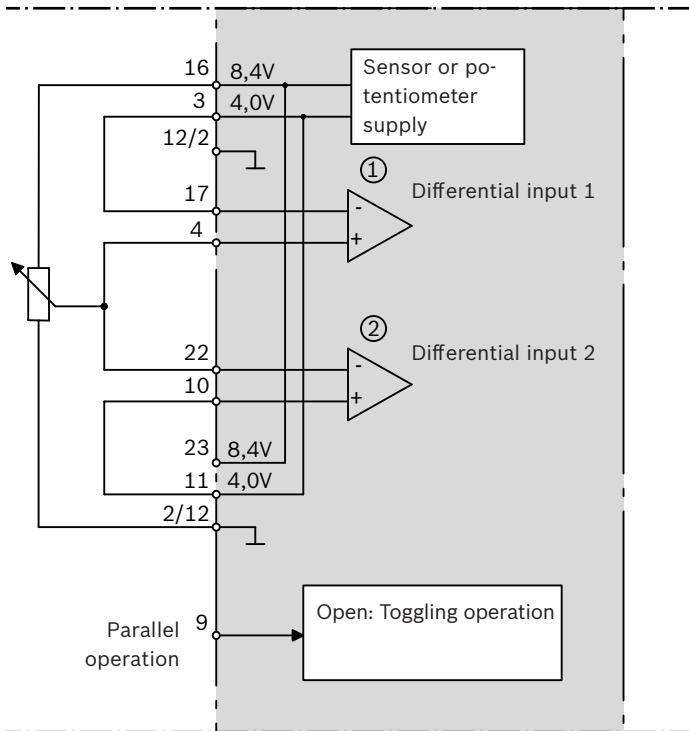
3) Separate ground connections to the battery (or chassis) required; in the case of an inductive load, a freewheeling diode must be connected

Terminal connection variant

Further terminal assignments e.g. for the control voltage or the control current specification can be found in the instruction manual 95230-B.

Toggling operation with single potentiometer

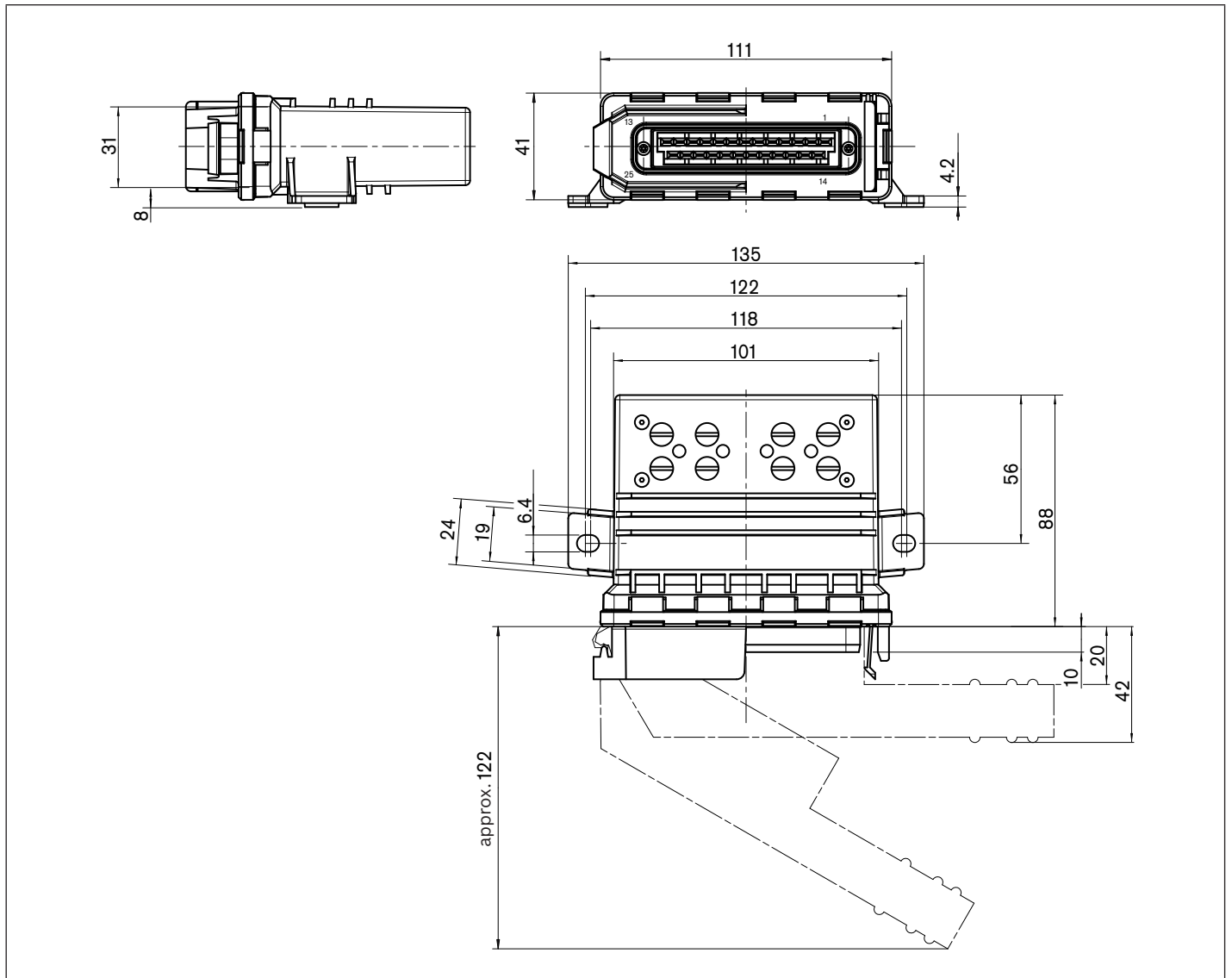
If the analog amplifier RA is used in the toggling operation with just one potentiometer, then the potentiometer must be connected as per the following section:



Key

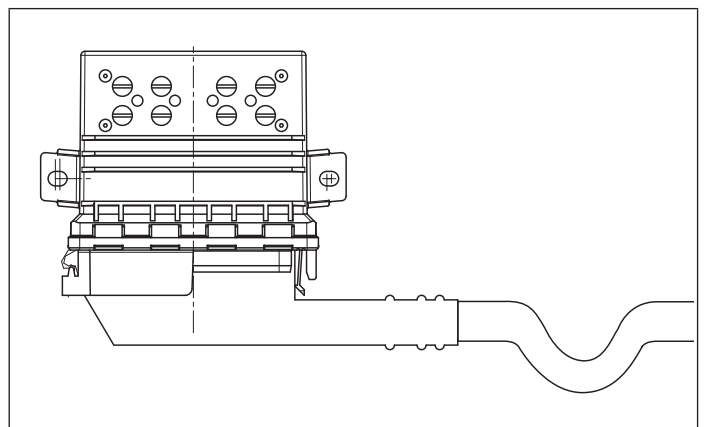
- | | |
|---|---|
| ① | Analog input 1 (4.0 V ... 8.4 V): Setpoint (U_{setpoint}) for output signal amplifier 1 (solenoid 1) |
| ② | Analog input 2 (4.0 V ... 0.0 V): Setpoint (U_{setpoint}) for output signal amplifier 2 (solenoid 2) |

Dimensions



Installation position

The permissible installation position is with the plug positioned vertically downwards. The cable must be routed such that it lies completely or partially below the amplifier connection (see illustration). The IP65 type of protection is only achieved in the shown installation position in combination with a sealing of the connector relative to the wiring harness sleeve. Any ingress of water into the analog amplifier by way of the wiring harness must be avoided by routing the wiring harness accordingly.



Project planning notes

- ▶ The instruction manual 95230-B must be observed during project planning and commissioning.
- ▶ The total of setpoints for parallel wired potentiometers must lie in a range between 2 kΩ and 5 kΩ. Potentiometers with 4.7 kΩ or 5 kΩ are recommended.
- ▶ The externally actuated switch output can be used to actuate an additional device such as, e.g. for an emergency valve or a horn.
- ▶ Do not use a freewheeling diode in the the lines to the solenoids at Pin 1 and 13.
- ▶ Other inductive consumers in the system must be equipped with freewheeling diodes.
- ▶ External switching contacts in the solenoid lines are not permissible.
- ▶ Toggling or parallel mode is applied to Pin 9:
 - Not connected: toggling mode, interlocked actuation of Solenoid 1 and Solenoid 2
 - wired with +U_{Bat} parallel mode, independent of each other actuation of Solenoid 1 and Solenoid 2
- ▶ To switch off the time ramp function, Pin 5 (ramp off) must be connected.
- ▶ The PWM frequency of the output current is set by connecting pin 21 (PWM frequency).
- ▶ The PWM output stages are supplied with voltage via Pin 19 (Solenoid 1) or Pin 20 (Solenoid 2) separately. Interruption of the supply voltage enables them to be switched off individually and independent from each other.
- ▶ Connection of Pin 24 (Dig In) activates switch output (Pin 7, Dig Out).

Safety instructions

- ▶ In contrast to digital control units analog amplifiers only allow a limited diagnosis and monitoring capability. The use of an analog amplifier in applications in which – in the event of a error – hazardous machine states may arise, is therefore not permissible without additional external protective measures.
- ▶ If an analog amplifier develops a error – i.e. unintended actuation or switching off of one or several solenoids – then malfunctions cannot be reliably prevented.
- ▶ The suggested circuits do not imply any technical liability of Bosch Rexroth for the system.
- ▶ The safety instructions in instruction manual 95230-B must be observed.
- ▶ In emergency situations or a malfunction the operating voltage is to be externally interrupted. To this end, interruption of the electronic circuit's supply voltage is to be effected using an emergency stop switch. The emergency stop switch must be installed in an easily accessible position for the operator. Safe braking must be ensured when the emergency stop function is activated.
- ▶ To avoid malfunctions the lines shielded from and to the potentiometers are to be connected on one side with low-impedance to devices or vehicle ground.
- ▶ Cables to the electronics must not be routed close to other power-conducting cables in the machine or vehicle.
- ▶ A sufficient distance to radio systems must be maintained.
- ▶ All connectors must be unplugged from the electronics during electrical welding operations.
- ▶ The analog amplifier may only be wired up when in de-energized state.
- ▶ Cable connection must have a strain relief and be attached such that vibration will not cause any corrosion to the plug contacts. Contacts must be protected against corrosion.
- ▶ If the solenoid output is overloaded (short circuit) the relevant output is not constantly switched off.
- ▶ The two PWM outputs must not be connected to each other (bridged)!
- ▶ Faulty connections could cause unexpected signals at the outputs of the analog amplifier.

- ▶ Opening, modifying or repairing the analog amplifier RA is not permissible. Modifications or repairs to the wiring could lead to dangerous malfunctions.
- ▶ Make sure no pins are energized when the analog amplifier RA is not receiving power.
- ▶ System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- ▶ No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, then repairs must be performed immediately.
- ▶ If the analog amplifier RA is dropped, continued use is not permissible because unseen damage may affect its reliability.
- ▶ Operation of the analog amplifier RA must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, current, temperature, vibration, shock and other described environmental influences.

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Mobile Electronics

BODAS Tools

Designation	Type	Data sheet	Page
BODAS Diagnostic tool for controller RC	BODAS-service 3.x	95086	145
BODAS Development tool IEC61131 for controller RC	BODAS-design 3.x	95112	153
BODAS C programming interface for controller RC	BODAS C-API	95115	161
BODAS Measuring adapter	MA	95090	165
BODAS Testbox	TB3	95092	173

BODAS-service

RE 95086/05.12 1/8
Replaces: 10.10

2

Data sheet

Version 3.x



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Features

The BODAS-service PC software tool provides a convenient and user-friendly method of executing service functions for BODAS controllers from Rexroth. Parameters could be displayed and edited, process variables displayed, and their values graphically plotted and recorded. In addition, error messages could be read out, reset as well as the application's diagnostic configuration configured. Furthermore, functions are available for reading out and writing to the controller EEPROM.

For BODAS controllers, equipped with CAN diagnosis, extensive version information on the controller is displayed. For these controllers, in the event of an emergency, full access to all process variables and parameters is possible for a single service session via an "Emergency Access" (requires only the BODAS-service DEMO version).

BODAS-service also offers an option for the loading of application software, so-called HexFiles, onto BODAS controller RC and the transfer of display configuration Files onto the BODAS Display DI3.

The respective functions are enabled by a USB hardlock (license control).

BODAS-service contains BODEM 25 and FT2 (Not available from Windows 7).

The following license versions can be selected:

- BODAS-service Diagnosis (contains BODEM25 license)
- BODAS-service Flash Tool
- BODAS-service Full Version (contains BODEM25 license)

All of the listed functions can be executed on a PC or laptop.

Ordering code

BODAS-service 3.X is available from Rexroth as follows:

License version _____	Material numbers
Diagnosis _____	R902109418
Flash Tool _____	R902109417*
Full Version _____	R902109416*

Note

Version administration of BODAS-service:

The Index X defines the Version of BODAS-service (e.g. status 09/2011 = 3.3).

The Version with the higher Index defines always the latest Version and is always backwardscompatible to the former Versions.

Maximum two Updates of BODAS-service are scheduled per year.

Updates can be downloaded under www.boschrexroth.de/mobile-electronics under the heading BODAS Tools.

Main components

- CD-ROM
- License (USB dongle)

Required components

- **Appropriate RS232 or CAN connection cable** from a serial port of the PC/Laptop (available COM port) or a connection from the interface of a CAN adapter to the CAN interface in the wiring to the controller
- **Flash Adapter FA1** for software transfer (flashing of application software) from PC via the serial interface RS232 to a BODAS controller RC series 20 and 21 and controller MC
- **CAN-USB interface** from Vector (CANcardX, CANcardXL, CANcaseXL) or Peak (PCAN-USB) to the CAN interface of the controller

This connection cable and the CAN-USB interface are not included in supply of the PC tool.

The connection cable (one cable for CAN and RS232), Flash Adapter FA1 and a CAN-USB interface can be ordered from Rexroth under the following material numbers.

– Connection cable _____	R902109422
– Flash Adapter _____	R902045960
– Interface CAN-USB _____	R902602780

Optional bundles:

The BODAS-service bundles contain the tool, the connection cable as well as a CAN-USB interface.

These bundles can be ordered from Rexroth under the following material numbers:

- BODAS-service Diag bundle _____ R902109421
- BODAS-service Flash Tool bundle _____ R902109420*
- BODAS-service Full Version bundle _____ R902109419*

* To transfer software from PC to a BODAS controller RC series 20 and 21 via the RS232 interface a flash adapter FA1 is required. This is not included in the Bundles and must be ordered separately!

System requirements

- Personal computer with 500 MHz Pentium II microprocessor (minimum)
- VGA video adapter or video adapter with a resolution of at least 1024x768 and at least 16 bit colour quality
- Minimum 512 MB main memory (RAM)
- One free serial or CAN interface (depending on selected communication interface)
- One free USB interface (for license key - USB dongle)
- Available hard disk capacity > 200 MB
- Java runtime environment (installation occurs automatically)

Operating system

- Windows 2000
- Windows XP
- Windows Vista
- Windows 7
(Only for BODAS-service. Not available for FT2 and BODEM)

Program installation from CD

Using the [Run] function in the [Start] menu, start "BODAS-service 3.xxx_Setup.exe" from the CD-ROM.

All further instructions are provided on the screen. During the installation process you will be offered the choice to install BODEM25 and FT2. These earlier versions of BODAS tools for Windows 2000, XP and Vista are intended for field service of controllers series MC.

Note

System administrator rights are required in order to install the BODAS-service software on Windows.

Updates

Current BODAS-service program updates can be found on the Internet under www.boschrexroth.com/mobile-electronics under the header "BODAS-Tools" or within the Rexroth media directory under the search criteria "Diagnosis Tool BODAS-service". It is recommended to check personally for a BODAS-service update at least every 6 months!

Start-up and operation

BODAS-service

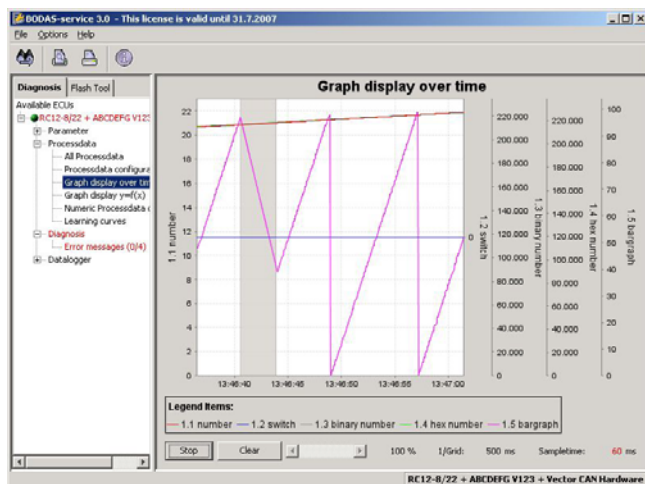
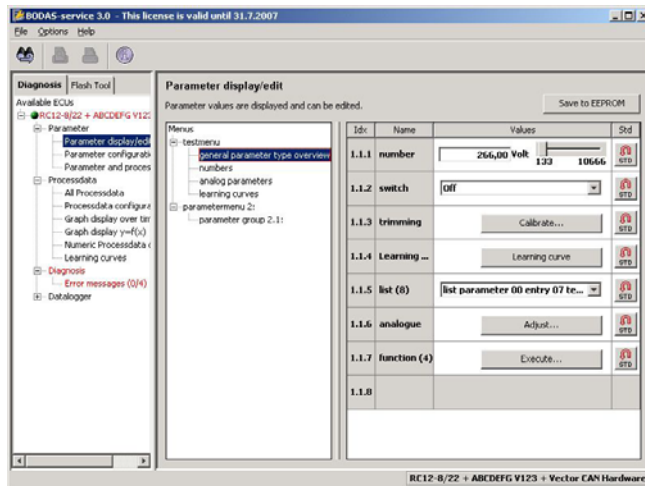
After starting the program, the last configuration (automatic query) can be loaded (note that there is start delay the first time the program is started due to loading of the Java environment. This startup delay will be not displayed (e.g. with a "sandglass"). After the initial program start a delay of 30 seconds, due to the startup of the JAVA Environment, is normal). If the last configuration is not used or if the last configuration cannot be confirmed by the connected hardware, BODAS-service Diagnosis must first scan for connected devices. This can be used for automatic scanning of the serial- and CAN interface for BODAS controllers. The serial interfaces (COM ports) to be searched must be correctly configured prior to performing the scan (with the File → Interface menu item).

With the BODAS-service Flash Tool, it is possible to scan for connected devices using the System Scan function as well as to use the interface selection to directly flash (download application software) a BODAS controller.

The BODAS-service Diagnosis Configurator can be activated and deactivated via the "Options" menu.

A detailed functional description of the tools can be found in the online help. This can be accessed after starting the program by pressing the F1 key.

Typical applications



Function/operating notes

The BODAS-service PC software tool provides a convenient and user-friendly method of executing service functions for BODAS controllers from Rexroth. Depending on the license version which is purchased, the tool is characterized by the following functions:

- Extremely user-friendly, through Windows user interface, free configurable work flow and online help
- Simultaneous display of multiple parameters for modification settings
- Simultaneous display of multiple process variables in graphical or numeric form
- Printout of all settings and process variables for documentation purposes
- Clear and easy-to-understand display of error messages
- Easy-to-use data logger: Save measured values (process variables and parameters) to the hard disk
- Selectable and expandable program language
- Adjustable device language (relevant to controller data, up to 4 languages available)
- Diagnosis Configuration for a BODAS or C application on BODAS controller RC
- Transfer software from PC to a BODAS controller RC (flashing of application software)
- Transfer of Display configuration Files onto BODAS Display DI3.
- Save the data contained in the EEPROM of a BODAS controller or transfer an EEPROM file (EPR file) to a BODAS controller
- Command line control option for various BODAS functions, e.g. flash programming or EPR file download

Additional functions for BODAS controller RC beginning with CAN diagnosis:

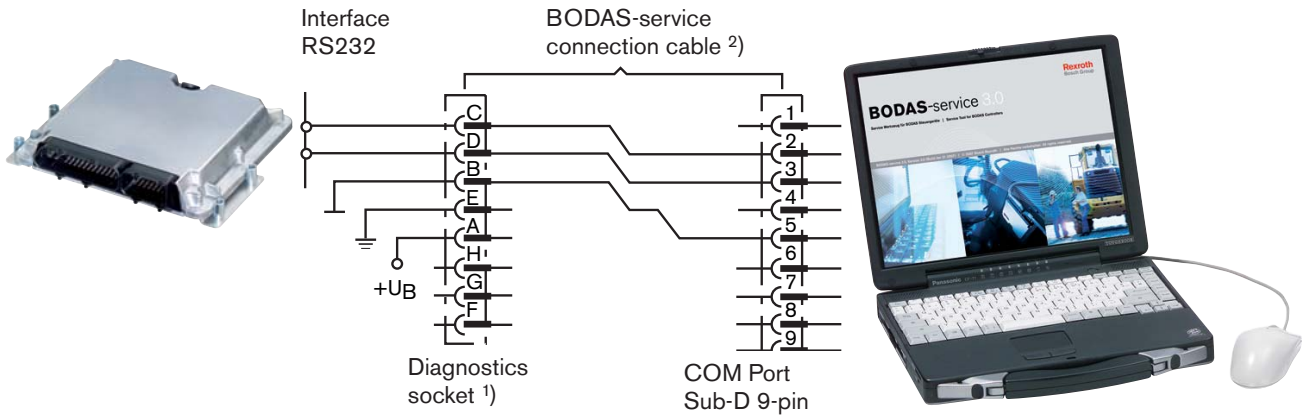
- Display of extensive version information
- Emergency release of all parameters and process variables via an "Emergency Access" (beginning with the BODAS-service DEMO version) for a one-time connection by means of the "Seed and Key" process

Note

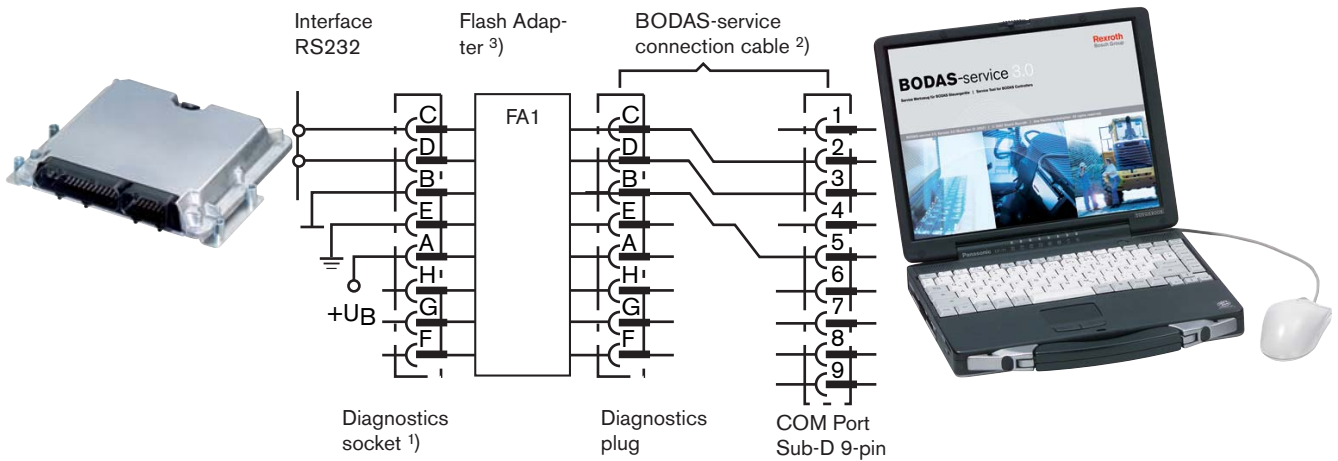
A demo version of BODAS-service 3.x – capable of displaying data only – is available as a free download on the Internet at www.boschrexroth.com/mobile-electronics under the header "BODAS-Tools" or within the Rexroth media directory at the search criteria "Diagnosis Tool BODAS-service". The demo version does not allow to modify, save or delete any parameters or data.

Connection variants

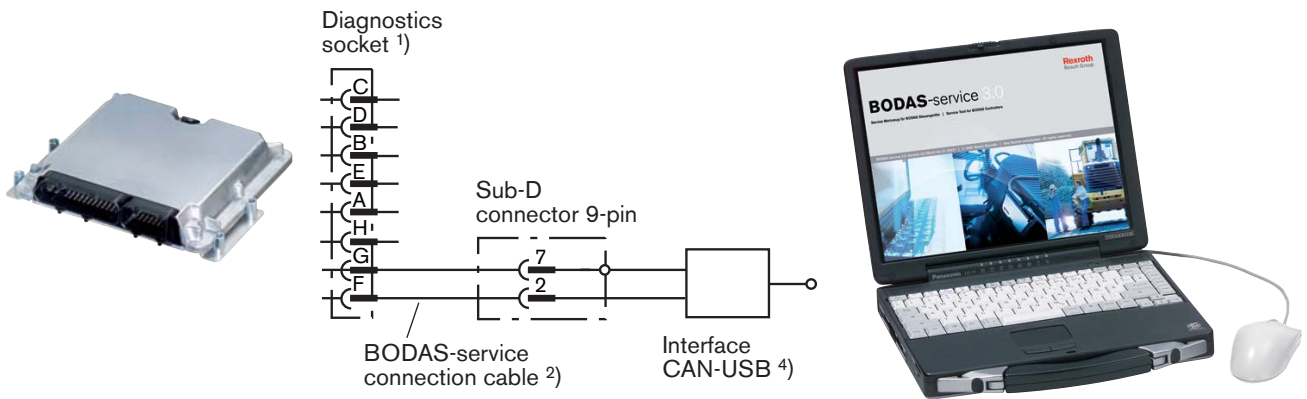
Variante 1: RS232 without flash function



Variante 2: RS232 with flash function



Variante 3: CAN with and without flash function



Connection variants

1) Ordering code for the Metallock-Bantam diagnostics socket, manufacturer: e.g. FCI

Consisting of	FCI order designation
Socket	UTG012-8S
8 connector contacts	RC16M23K
Cable clips	UTG12PG
Dust cap	UTP12DCG

The diagnostics socket is available from Rexroth under material number R909831291.

2) The BODAS-service connection cable is available from Rexroth under material number R902109422.

3) The Flash Adapter FA1 is available from Rexroth under material number R902045960.

4) The CAN USB Interface is available from Rexroth under material number R902602780.

Assembly of the BODAS-service connection cable

Material number R902109422

X1

Metallock-Bantam

for connection to the FCI Metallock-Bantam diagnostics socket R909831291

X2

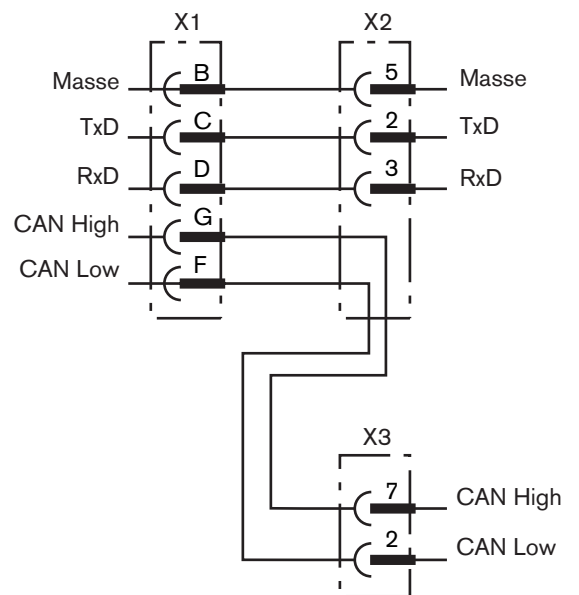
Sub-D connector, 9-pin,

for connection to RS232 Sub-D interface

X3

Sub-D connector, 9-pin,

for connection to CAN Sub-D interface



Note

1. The respective interfaces may be damaged if the RS232 cable interface is connected to a CAN-USB interface or the CAN cable interface is connected to the RS232 interface.
2. The BODAS-service connection cable offers no EMC protection through shielding or twisted pair.
3. The BODAS-service connection cable has protection class IP 20.
4. The BODAS-service connection cable is designed for operating and storage temperatures from -40°C to +70°C.

Safety notes

General instructions

- The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- The use of BODAS-service in the standard working mode of the machine is not permissible.
- Working on the PC with BODAS-service in combination with a control unit or display in a machine or vehicle is only permissible during commissioning of the machine or during service operations. Appropriate safety measures must be provided against hazards caused by unexpected operational states.
- Changing parameters or loading (flash-programming) software onto the BODAS controller RC or BODAS display may only be performed by trained and experienced specialists who are suitably familiarized with both the components used and the complete system.
- When performing flash-programming, the user is responsible for ensuring that the software to be flash-programmed is compatible with the BODAS RC or BODAS display hardware/vehicle in question.
- Incorrect parameter settings resp. programming by using BODAS-service may create potential hazards while the machine is in operation.
It is the responsibility of the machine manufacturer to identify hazards of this type in a hazard analysis and to bring them to the attention of the end user. Rexroth assumes no liability for dangers of this type.
- System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- While commissioning and maintenance of the machine with BODAS-service the machine may pose unforeseen hazards. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- Make sure that nobody is in the machine's danger zone.
- No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.

Notes on the installation point and position

- Connect the RC controller to a PC with the BODAS-service connection cable only. The BB-3 connection cable must not be used! Incorrect connection cables or wiring could cause the PC interface to be destroyed!
- The control unit and the PC must be switched off when the BODAS-service connection cable is connected or disconnected.
- When using the BODAS-service flash function, the drive unit (e.g. diesel engine) must be switched off during data transmission to the BODAS controller!

Intended use

- Operation of the BODAS-service must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the complete system.

Improper use

- Any use of the BODAS-service other than that described in chapter "Intended use" is considered to be improper.
- BODAS-service may be used on a restricted base only for development, configuration and parametrization of safety relevant applications. Details for safety relevant requirements can be provided on request by Bosch Rexroth Mobile Electronics.
- Use in explosive areas is not permissible.
- Damage resulting from improper use and/or from unauthorized interference in the component not described in this data sheet render all warranty and liability claims void with respect to the manufacturer.

Safety notes

More detailed information

- More detailed information on BODAS-service may be obtained from www.boschrexroth.com/mobile-electronics under the heading BODAS Tools.
- Pay regular visits to our home page for the latest product information and information about updates.
- Disposal of BODAS-service must be performed professionally by the customer.
- Copying, translation and distribution of Bosch Rexroth software is prohibited under copyright law.

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Subject to change.

BODAS-design

RE 95112/10.10 1/8
Replaces: 07.09

2

Data sheet

Version 3.0



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Features

The PC software BODAS-design is used for programming and for software development for BODAS controllers RC from the Rexroth product range. All graphic and text-based languages specified in the IEC 61131-3 standard are available for programming.

In addition, BODAS-design also offers convenient additional functions for software development:

- An integrated simulation environment allows software to be tested without hardware.
- Internal parameters can be displayed over time for monitoring the program, and the program run can be interrupted, e.g. for troubleshooting.
- The application program is loaded into the controller via CAN or RS232 (depending on the RC series).
- A diagnosis configuration for the specific project is drawn up using a convenient editor in BODAS-service and is linked to the BODAS-design project by a standardized interface.
- Parameter setting, the output of process variables and the display of diagnostic information are possible either by individual visualization or by using BODAS-service.
- BODAS-design contains BODAS-service Full Version (for details see RE 95086 also).

BODAS-design and BODAS-service Full Version are enabled by the BODAS-design USB hardlock.

Ordering code

BODAS-design 3.0 is available from Rexroth as follows:

License version _____ Material numbers

Design _____ R902109425

Note

Version administration of BODAS-design:

The Index X defines the Version of BODAS-design (e.g. status 06/2010 = 3..0.12).

The Version with the higher Index defines always the latest Version and is always backwardscompatible to the former Versions.

Maximum two Updates of BODAS-design are scheduled per year!

Updates may be downloaded from www.boschrexroth.de/mobile-electronics under the heading BODAS Tools.

Main components

- CD-ROM
- License (USB dongle)

Required components

- **Appropriate RS232 or CAN connection cable**
from a serial port of the PC/Laptop (available COM port) or a connection from the interface of a CAN adapter to the CAN interface in the wiring to the controller
- **CAN-USB interface**
from Vector (CANcardX, CANcardXL, CANcaseXL) or Peak (PCAN-USB) to the CAN interface of the controller

This connection cable and the CAN-USB interface are not included in supply of the PC tool.

The connection cable (one cable for CAN and RS232) and a CAN-USB interface may be ordered from Rexroth under the following material numbers.

- Connection cable _____ R902109422
- Interface CAN-USB _____ R902602780

Additional recommended

- Software Library BODAS-design Library
for extension of the functionality of the BODAS Runtime System with ramps, curves, ..., trigonometric functions.
- Software Library BODAS-design Template
for extension of the functionality of the BODAS Runtime System with ramps, curves, ..., trigonometric functions (= BODAS-design Library) and extension with various BODAS-design Templates (Software Source Codes) for use with BODAS controller RC (AFC-fan controll, SPC-speed control, DRC-pump control / drive control (DRCA), VAC-valve control (VACB))
- BODAS test box TB3
for simulating input signals, generating frequency signals (DSM, HDD simulation), displaying outputs, ... for series 20, 21, 22 and 30 BODAS controllers (for the RC36-20/30 two TB3 are necessary)
- Adapter cable TAK1
for connection series 20 and 21 BODAS controllers to the TB2 or TB3
- Adapter cable TAK2
for connection series 22 BODAS controllers to the TB3
- Adapter Kit RC36-20/30 (contains TAK4 and stencil) for connection of BODAS controller RC36-20 series 30 with two TB3

The test box, adapter kit and adapter cable are not included in the supply of the PC development environment.

The test box and adapter cable may be obtained from Rexroth under the following material numbers:

- BODAS TB3 test box _____ R902109066
- TAK1 adapter cable _____ R902076455
- TAK2 adapter cable _____ R902109508
- Adapter Kit RC36-20/30 _____ R902109578
- BODAS-design Template _____ R902109423
- BODAS-design Library _____ R902109424

System requirements

- Personal computer with 500 MHz Pentium II microprocessor (minimum)
- VGA video adapter or video adapter with a resolution of at least 1024x768 and at least 16 bit colour quality
- Minimum 512 MB main memory (RAM)
- One free serial or CAN interface (depending on selected communication interface)
- One free USB interface (for license key - USB dongle)
- Available hard disk capacity > 500 MB

Operating system

- Windows 2000
- Windows XP
- Windows Vista
- Windows 7 (release on request)

Program installation

Using the [Run] function in the [Start] menu, start „Setup_BODAS-design_3.xxx.exe" from the CD-ROM.

All further instructions are provided on the screen.

Note

System administrator rights are required in order to install the BODAS-design software under Windows.

Current drivers for the dongle, runtime system updates and program updates can be found on the Internet under www.boschrexroth.com/mobile-electronics under the BODAS Tools heading or within the Bosch Rexroth media directory under the search criteria "development suite BODAS-design"

It is recommended to update BODAS-design resp. the BODAS controller runtime systems at least every 6 months, if such an update is present!

A change history of BODAS-design and the contained BODAS runtime systems is available within the installation directory of BODAS-design under "Version Information".

Attention: After an Update of BODAS-design or of the BODAS runtime systems the corresponding used/changed Software project has to be completely retested!

With the BODAS-design product CD you will receive also BODAS-service Full Version. This version can be used to do diagnosis, flash software and create your diagnostic configuration (details see RE 95086).

For installation of BODAS-service please select the SETUP file out of the BODAS-service folder of the BODAS-design product CD and follow the instructions of the Installation assistant.

Current BODAS-service program updates may be found on the Internet at www.boschrexroth.com/mobile-electronics under the BODAS-Tools heading or within the Bosch Rexroth media directory under the search criteria "Diagnosis Tool BODAS-service". It is recommended to update BODAS-service at least every 6 months, if such an update is present!

Further information about BODAS-service and the Diagnosis-configurator may be found in the BODAS-service data sheet RE 95086 or in the help menu of BODAS-service.

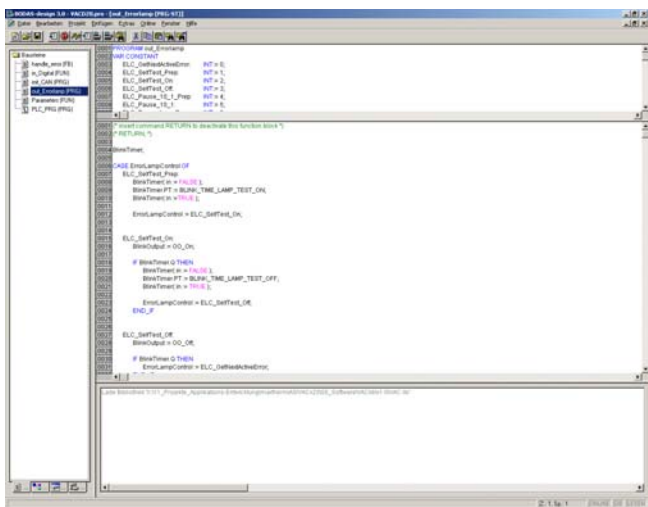
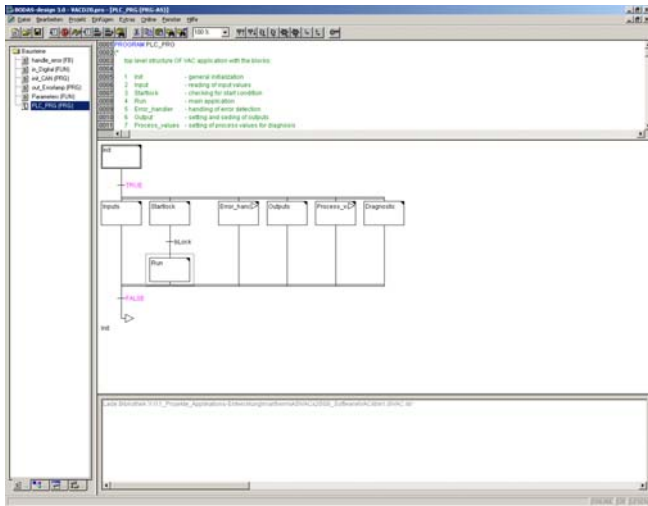
Start-up and operation

BODAS-design

After the program has been started, either an existing BODAS project can be loaded or a new one can be created. Here, the target platform (specification for BODAS controller used) must be selected.

A detailed functional description of the development environment may be found in the online help. This can be accessed after starting the program by pressing the F1 key.

Typical applications



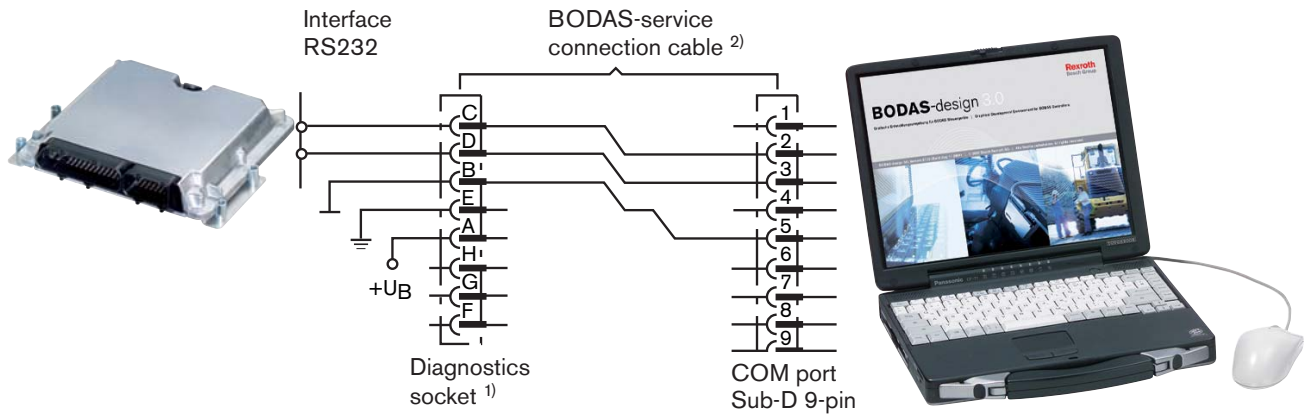
Function/operating notes

The BODAS-design PC development environment is used to create application programs for BODAS controllers RC. This is characterized by the following functions:

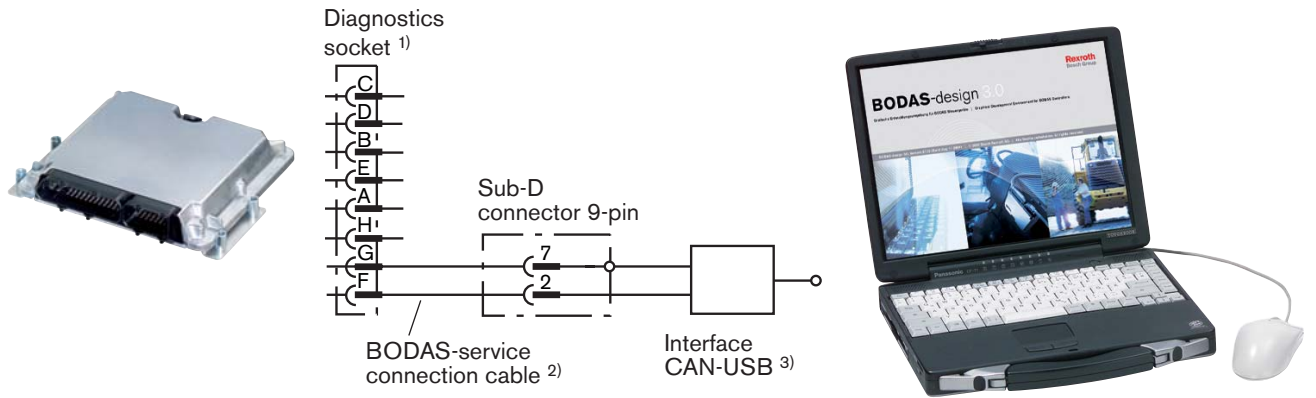
- Software development as per IEC 61131-3, i.e. based on graphic and text-based languages: CFC, SFC, ST, FUP, ...
- Convenient functions for reading-in signals and for actuating outputs based on the BODAS runtime system.
- The diagnostic configuration for BODAS-design projects is drawn up in the convenient BODAS-service diagnostic configurator.
- The diagnostic configuration from BODAS-service is incorporated via a standardized BODAS-design interface. (The diagnosis configuration must be stored in the same folder as the corresponding BODAS-design Application (.pro file). Details about the configurator you will find in the BODAS-service help.)
- Simulation mode for testing BODAS applications without hardware.
- Internal parameters can be displayed over time for monitoring the program, and the program run may be interrupted, e.g. for troubleshooting.
- Program download via CAN or RS232 (depending on RC series) onto BODAS controllers with BODAS runtime system.
- If the BODAS-design library or BODAS-design template are used (for details, please refer to RE 95113), an individual application software can be programmed in a very short time.

Connection variants

Variant 1: RS232



Variant 2: CAN



1) Ordering code for the Metalock-Bantam diagnostics socket, manufacturer: e.g. FCI

Consisting of	FCI order designation
Socket	UTG012-8S
8 connector contacts	RC16M23K
Cable clips	UTG12PG
Dust cap	UTP12DCG

The diagnostics socket is available from Rexroth under material number R909831291.

2) The BODAS-service connection cable is available from Rexroth under material number R902109422.

3) The CAN USB Interface is available from Rexroth under material number R902602780.

Assembly of the BODAS-service connection cable: see RE 95086

Safety notes

General instructions

- The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- The use of BODAS-design in the standard working mode of the machine is not permissible.
- Working on the PC with BODAS-design in combination with a control unit or display in a machine or vehicle is only permissible during commissioning of the machine or during service operations. Appropriate safety measures must be provided against hazards caused by unexpected operational states.
- Changing parameters or loading (flash-programming) software onto the BODAS controller RC or BODAS display may only be performed by trained and experienced specialists who are suitably familiarized with both the components used and the complete system.
- When performing flash-programming, the user is responsible for ensuring that the software to be flash-programmed is compatible with the BODAS RC hardware/vehicle in question.
- Incorrect parameter settings resp. incorrect programming by using BODAS-design may create potential hazards while the machine is in operation.
It is the responsibility of the machine manufacturer to identify hazards of this type in a hazard analysis and to bring them to the attention of the end user. Rexroth assumes no liability for dangers of this type.
- System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- While commissioning and programming with BODAS-design the machine may pose unforeseen hazards. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- Make sure that nobody is in the machine's danger zone.
- No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.

Notes on the installation point and position

- Connect the RC controller to a PC with the BODAS-service connection cable only. The BB-3 connection cable must not be used! Incorrect connection cables or wiring could cause the PC interface to be destroyed!
- The control unit and the PC must be switched off when the BODAS-service connection cable is connected or disconnected.
- When using the BODAS-service resp. BODAS-design flash function, the drive unit (e.g. diesel engine) must be switched off during data transmission to the BODAS controller!

Intended use

- Operation of the BODAS-design must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the complete system.

Improper use

- Any use of the BODAS-design other than that described in chapter "Intended use" is considered to be improper.
- BODAS-design may be used on a restricted base only for development of safety relevant applications. Details for safety relevant programming can be provided on request by Bosch Rexroth Mobile Electronics.
- Use in explosive areas is not permissible.
- Damage resulting from improper use and/or from unauthorized interference in the component not described in this data sheet render all warranty and liability claims void with respect to the manufacturer.

Safety notes

More detailed information

- More detailed information on BODAS-design may be found at www.boschrexroth.com/mobile_electronics under the heading BODAS Tools.
- Pay regular visits to our home page for the latest product information and information about updates.
- Disposal of BODAS-design must be performed professionally by the customer.
- Copying, translation and distribution of Bosch Rexroth software is prohibited under copyright law.

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Subject to change.

BODAS C-API

RE 95115/01.10 1/4
Replaces: 02.07

2

Data sheet

C-programming interfaces
for BODAS controllers RC of series 20, 21 and 22
and for BODAS controllers RC of series 30



Contents

Order designation	2
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Required components	2
System requirements	3
Safety instructions	4

Features

With the C-API (API = Application Programming Interface) Rexroth offers a convenient programming interface for creating applications for the BODAS controllers RC. This interface allows simple access to the control unit functions, e.g. actuation of outputs, without detailed knowledge of the hardware used being necessary.

The C-API is available in two versions. One for BODAS RC series 2x with C16x technology and one for BODAS RC3x with TriCore technology.

The user can make use of all functions needed for:

- system configuration
- configuring and reading inputs
- actuating outputs
- using the CAN, CANopen communications interfaces (RC2-2/21 does not support CANopen communication)
- diagnostic functions for BODAS service
- and others

The simplicity of the system makes it possible for the user to concentrate on his application and to use the C-API functions as a tool.

Powerful functions contain algorithms for the adjustment and learning functions, making it easier for the developer to program routine tasks.

The contents of the library are configured for optimum actuation of the Rexroth hydraulic components and allow maximum flexibility for its application.

Order designation

BODAS C-API is available from Rexroth as follows:

C-API/35

for BODAS controllers RC of series 20, 21 and 22

Material number _____ R902135575

C-API/40

for BODAS controllers RC of series 30

Material number _____ R902135575

Main components

- CD-ROM:
 - Compiled C-libraries
 - Handbook / API documentation with examples for the application of the functions
 - Basic program

Required components

- **BODAS-service 3.x full version**
Material number _____ R902109416
Data sheet _____ RE 95086
- **BODAS-service connection cable**
Material number _____ R902109422
Data sheet _____ RE 95086
- **Metalock-Bantam UTG012-8S diagnostics socket, 8-pin**
Material number _____ R909831291
Data sheet _____ RE 95086

For C-API version 35 for series 20, 21, 22

not available from Bosch Rexroth!

- Tasking C-Compiler version 8.0 r2 and higher.
Version c166v8.0r2 can be procured free of charge from Tasking /Altium when purchasing the latest C166-Compilers.
- For further information about Tasking Compiler please see <http://www.tasking.com/>

Notes when using Windows Vista:

- The Tasking Compiler must be installed directly under "C:\", not under "C:\Programs", as there could otherwise be problems with write authorization.
- Help files in *.hlp format cannot be shown as standard under Windows Vista. For this reason, use the Compiler help files in *.pdf format.

For C-API version 40 for series 30,

not available from Bosch Rexroth!

- HighTec GNU TriCore Development Suite
The Compiler version to be used can be found in the help document for the C-API. Please comply with any installation instructions given there.
- For further information about the GNU Compiler please see <http://www.hightec-rt.com>

Additional recommended components

The components listed below, apart from the C Compiler, are available from Rexroth under the following material numbers.

- **Test box TB3**
Material number _____ R902109066
Data sheet _____ RE 95092
- **Adapter cable TAK 1 for RC series 20, 21**
Material number _____ R902076455
Data sheet _____ RE 95092
- **Adapter cable TAK 2 for RC series 22**
Material number _____ R902109508
Data sheet _____ RE 95092
- **Adapter kit RC36-20/30 for RC36-20/30**
Material number _____ R902109578
Data sheet _____ RE 95092
- **Interface CAN-USB**
Material number _____ R902602780
Alternative vector
CANalyzer with optional CANopen and J1939
(see <http://www.vector-worldwide.com>)

System requirements

- IBM compatible personal computer with 500 MHz Pentium II microprocessor (minimum)
- VGA video adapter or video adapter with a resolution of at least 1024x768 and at 16 bit colors
- Minimum 512 MB main memory (RAM)
- One vacant serial or CAN interface (depending on the communications interface selected)
- Vacant hard drive capacity > 50 MB (the Compiler is not included here)

Operating system

(depends on the availability of the corresponding Compiler!)

- Windows 2000
- Windows XP
- Windows Vista

Safety instructions

- The suggested circuits do not imply any technical liability for the system on the part of Rexroth.
- Read the API documentation carefully and in full before you start working with the C-API.
- Changing parameters or loading (flashing) software onto BODAS controller RC may only be performed by trained and experienced specialists who are suitably familiarized with the used components as well as the complete system (please refer to RE 95086).
- Work on the PC with BODAS C-API in combination with a BODAS controller in a machine or vehicle may only be performed while commissioning the machine or during service work. Appropriate safety measures against dangers caused by unexpected operational states must be provided.
Make sure that nobody is in the machine's danger zone.
- To switch off the system in emergencies, the power supply to the electronics must be disconnected with a safety switch.
- The general terms for the supply of goods and services the Bosch Rexroth AG as well as the supplementary shipping terms for BODAS software are valid.
- The safety measures provided in RE 95200, RE 95201, RE 95202 and RE 95203 must be observed.
- Copying, translation and distribution of Rexroth software is prohibited under copyright law.

Intended use

- The C-API is designed for use with BODAS controllers RC in mobile working machines.
- The C-API must generally be used within the approved operating range specified in this data sheet and must take account of safety instructions.
- Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the complete system.
- Damages which result from improper use and/or from unauthorized, unintended interventions in the device not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Other notes

More detailed information about BODAS products can be found at www.boschrexroth.com/mobileelektronik under the heading "BODAS Tools".

Pay regular visits to our home page for the latest product information and information about updates.

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Subject to change.

BODAS

Measuring Adapter MA

Series 10

RE 95090

Edition: 03.2015

Replaces: 02.2011



- ▶ Break-out box for BODAS controllers RC
- ▶ Access to electrical interfaces of controllers
- ▶ To be used at the desk or at the cable harness of the machine
- ▶ Measurement and manipulation of controller's inputs and outputs

2

Features

The BODAS measuring adapter is specified for the connection of BODAS controllers with the BODAS connector system. The measuring adapter is joined up in the circuit with the BODAS RC controller. This allows individual access to the BODAS RC controller connectors at the adapter:

- ▶ Measurement of all electrical input and output signals within the context of:
 - Commissioning
 - Diagnostics
 - Service
- ▶ Feed in of external signals
- ▶ Control of consumers (e.g. solenoids), signal indicators (e.g. lamps) and sensors
- ▶ Fault simulation via disconnection and connection of contacts

Inhalt

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Description	2
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Ordering code

01	02	03
MA	/	10

Model

01	BODAS measuring adapter	MA
----	-------------------------	-----------

Version

02	154-pin	for BODAS controller RC36-20/30, RC28-14/30 family	6
	56-pin	for BODAS controller RC4-5/30	7
	94-pin	for BODAS controller RC10-10/31	8

Series

03		10
----	--	-----------

Description

The BODAS measuring adapter MA is used for measuring all electrical signals at the inputs, outputs and interfaces of the BODAS controller. It is preferably used in commissioning or troubleshooting on the vehicle or device.

The BODAS measuring adapter MA is joined up in the circuit between the BODAS controller and the vehicle or device wiring.

The measuring bushings are numbered to correspond to the connection contacts of the BODAS controller and thereby match the designations in the connection diagram (refer to corresponding RC data sheet, such as RC36-20/30 = RE95203).

To disconnect connections from the vehicle or device wiring

to the BODAS controller, individual jumper connectors can be removed at the BODAS measuring adapter. In this way, the current across a proportional solenoid can be measured, for example, with an amperemeter that is connected to the BODAS measuring adapter. A break in a connection cable can also be simulated with the removal of a jumper connector (wire break monitoring).

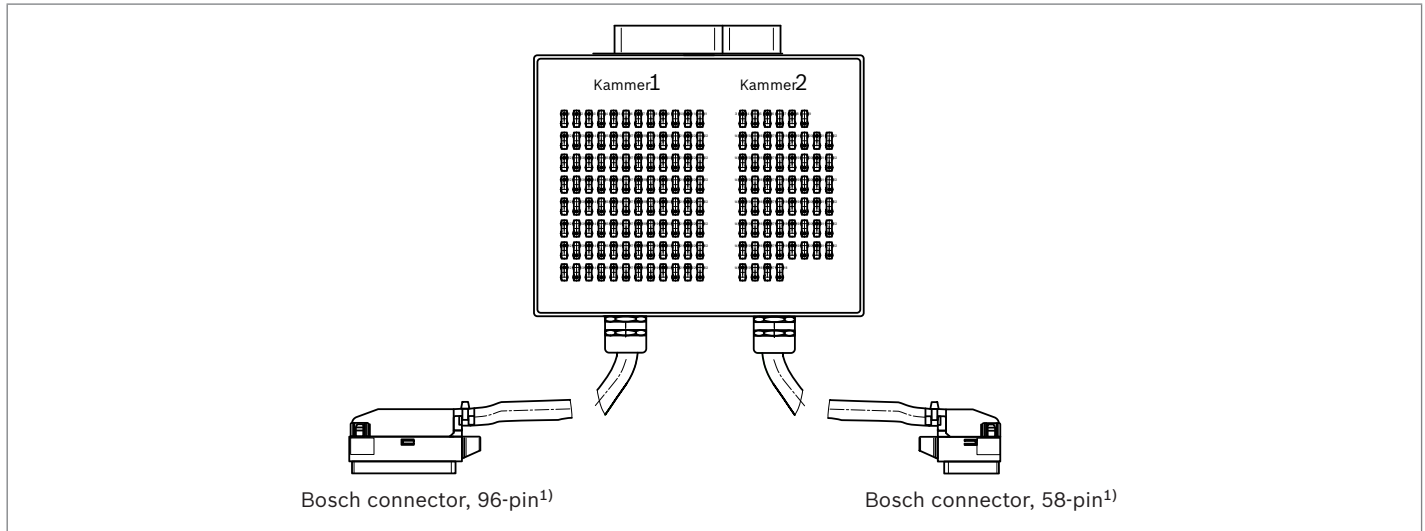
Another fault simulation can be the connection of any contacts (e.g. potentiometer monitoring). Moreover, if necessary additional signals can be coupled into the system, for example, from external control units via the BODAS measuring adapter.

Technical Data

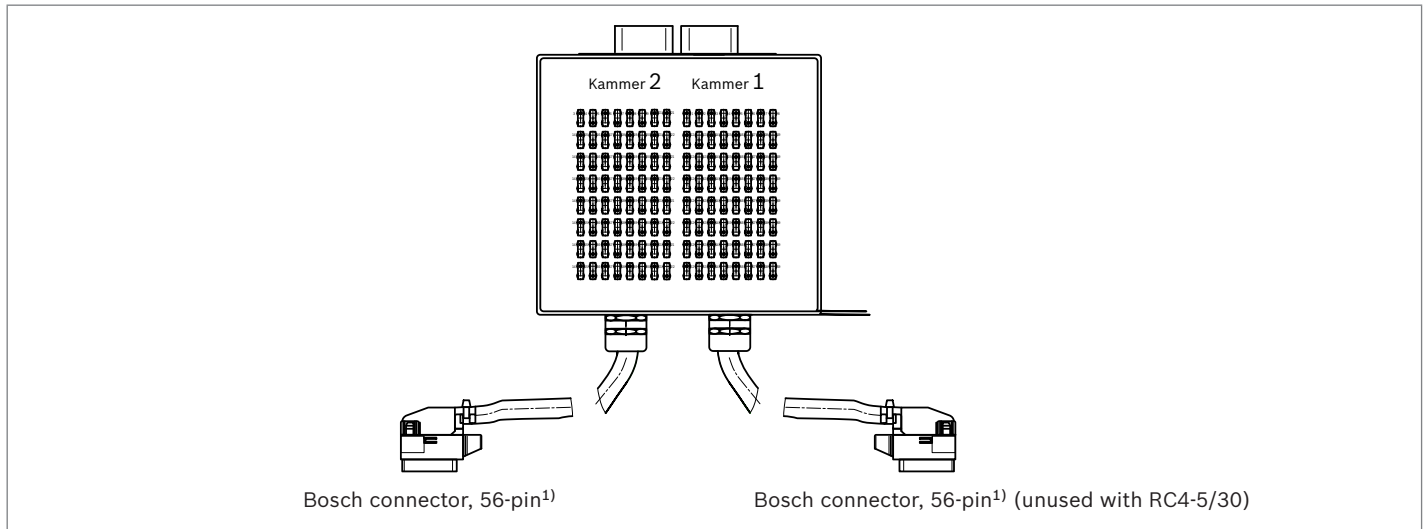
Typ		MA6	MA7	MA8	
Plug connector		BOSCH	58-pin 96-pin	56-pin / 56-pin (unused with RC4-5/30)	60-pin (unused with RC10-10/31) / 94-pin
Number of measurement points (jumper connectors)		4 mm sockets	–	–	154
		2 mm sockets	154	112	–
Operating voltage			0 to 32 V		
Maximum permissible current	Sockets 101 to 105 and 125 to 129, 148 to 153, 171 to 177, 196	A	5	–	–
	106 to 121 and 130 to 147, 154 to 170, 178 to 195, 208 to 219, 221 to 232, 234 to 244, 247 to 257		2	–	–
	201, 203 to 206, 245, 258		<10	–	–
	122 to 124, 202, 207, 220, 233, 246		3	–	–
	(201 to 248) 101 to 148		–	7	–
	(249 to 256) 149 to 156		–	19	–
	K01 to K06		–	–	20
	K07 to K94 (A01 to A60)		–	–	5
Length of the connection lines		mm	750	600	900
Dimensions (without connection lines)		mm	280×225×80	260×220×50	255×220×60
Ground		kg	3.6	3	3.6
Protection class			IP20		
EMC			no EMC protection		

Versions

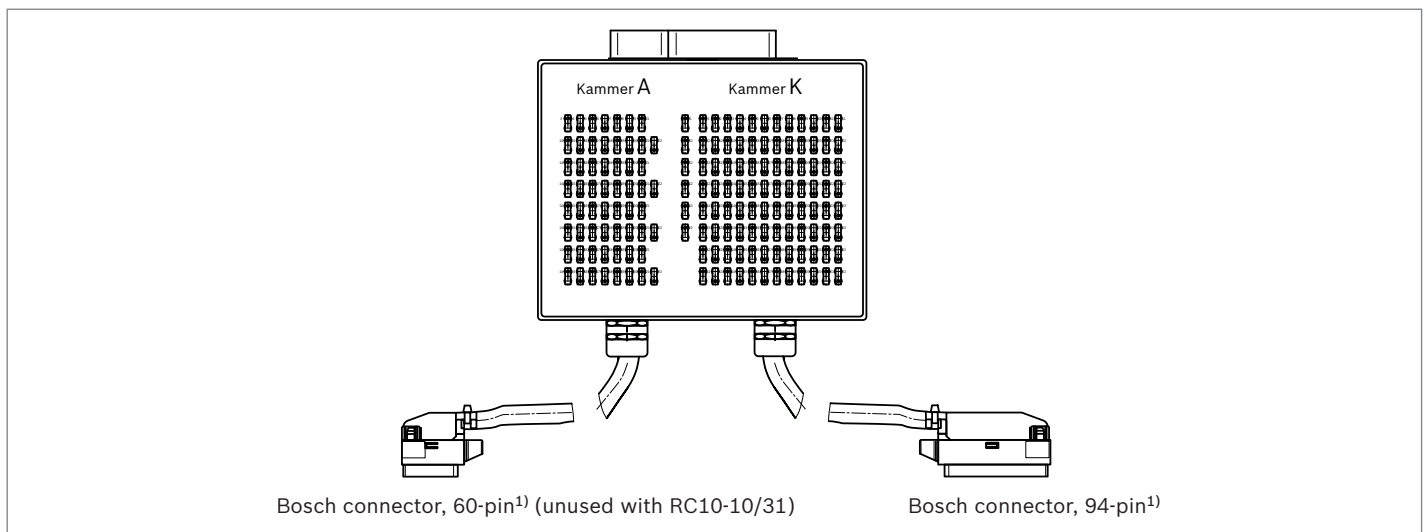
BODAS measuring adapter MA6 – 154-pin for BODAS controllers RC36-20/30 and RC28-14/30 family



BODAS measuring adapter MA7 – 56-pin for BODAS controller RC4-5/30

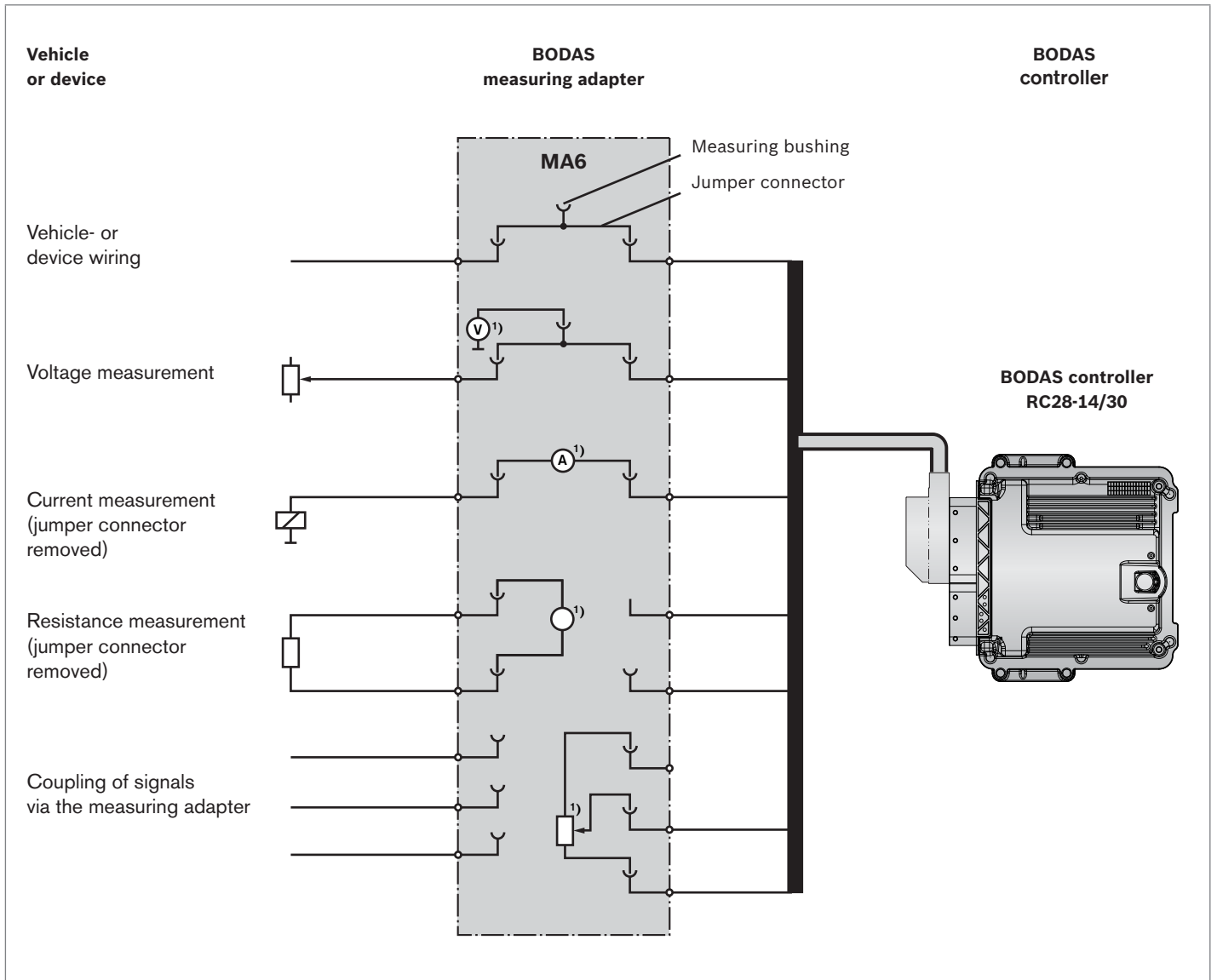


BODAS measuring adapter MA8 – 94-pin for BODAS controller RC10-10/31



¹⁾ Information about the Bosch connectors are found in the data sheet for the BODAS RC controller series 30 (e.g. RC36-20/30 RE95203).

Examples for measurements with the BODAS measuring adapter MA6



1) Measuring equipment and potentiometer are not included in the delivery contents.

Safety instructions

General instructions

- ▶ The suggested circuits do not imply any technical liability for the system on the part of Rexroth.
- ▶ The use of the BODAS measuring adapter in the standard work mode of the machine is not permissible.
- ▶ Work on the PC with BODAS measuring adapter in connection with a control unit or display in a machine or a vehicle may only be performed during commissioning of the machine were during service work.
Appropriate safety measures against dangers caused by unexpected operating conditions must be provided.
- ▶ Before switching on the BODAS controller with the BODAS measuring adapter, make sure that via control of the outputs no safety-critical situations can occur.
- ▶ Opening of the BODAS measuring adapter, modifications or repairs on the BODAS measuring adapter are prohibited. Modification or repairs to the wiring could lead to dangerous malfunctions.
Repairs on the BODAS measuring adapter mailing be carried out by Bosch Rexroth or by suitable contracting partners.
- ▶ To switch off the system in emergencies, the power supply to the electronics must be disconnected with a safety switch.
The safety switch must be installed in an easily accessible position for the operator. The system must be designed in such a way that actuating the safety switch ensures safe braking.
- ▶ During the commissioning and maintenance of the vehicle / machine with the BODAS measuring adapter (with BODAS tools), the machine may pose unforeseen hazards. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.
- ▶ The BODAS measuring adapter is suitable for mobile operation in the vehicle (only in the interior - Of the machines), in the laboratory and on the test bed.
- ▶ The BODAS measuring adapter is designed for operating and storage temperatures from -10 °C to +40 °C.

Notes on the installation location and position

- ▶ Do not install the BODAS measuring adapter close to parts that generate considerable heat (e.g. exhaust).
- ▶ The measuring adapter MAX is only suitable for use in protected areas (e.g., cab). Only use adapter in dry spaces. Avoid buildup of condensation water and water spray.
- ▶ Radio equipment and mobile telephones must not be used in the driver's cab without a suitable antenna or near the control electronics and the BODAS Tools (BODAS measuring adapter).
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ When connecting or disconnecting the BODAS measuring adapter, the controller or the vehicle (entire vehicle electrical system) must be switched off.
Connection of the measuring adapter only in the deenergized state!
Before disconnecting the plug on the vehicle side, shut off the controller power supply (terminate overtravel).
Do not touch plug contacts on the vehicle side.

Notes on transport and storage

- ▶ If it is dropped, the BODAS measuring adapter must not be used any longer as invisible damage could have a negative impact on reliability.

Intended use

- ▶ The BODAS measuring adapter is designed for the commissioning and maintenance work of mobile working machines in combination with the BODAS RC controller.
- ▶ Operation of the BODAS measuring adapter (Tools "the BODAS hardware in combination with BODAS measuring adapter") must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, current, temperature, vibration, shock and other described environmental influences.
- ▶ Only measuring equipment approved for this voltage range and signals suitable for the application and BODAS RC controller may be connected to the BODAS measuring adapter. Faulty wiring on the measuring adapter can cause damage in the vehicle electrical system and/or control unit!
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the BODAS measuring adapter other than described in chapter "Intended use" is considered to be improper.
- ▶ BODAS measuring adapter is not suitable for use in functions relevant to safety.
- ▶ The BODAS measuring adapter is not suitable for standard installation in mobile working machines.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages resulting from improper use and/or from unauthorized interference with the component not described in this data sheet render all warranty and liability claims void with respect to the manufacturer.

More detailed information

- ▶ More detailed information about the BODAS measuring adapter and BODAS tools can be found at www.boschrexroth.com/mobileelektronik under the Tools heading.
- ▶ Pay regular visits to our home page for the latest product information and information about updates.
- ▶ The BODAS measuring adapter must be disposed of professionally by the customer.

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BODAS Test box

TB3 series 10

RE 95092

Edition: 07.2013

Replaces: 02.2010



► Universal test box for BODAS RC controllers

2

Features

- Suitable for BODAS controllers RC of series 20, 21, 22 and 30
- Box housing for convenient transport with integrated lid compartment for cable and other accessories
- Integrated frequency generators and option of connecting external frequency generators
- Integrated switches and connections for external switch signals
- Integrated potentiometers and connections for external analog signals
- Option of connecting proportional solenoids
- Switching outputs and analog outputs
- Serial data interface or CAN (dependent upon the series of the RC controller) for diagnostics, parameter setting, display of process variables and programming
- CAN bus interfaces
- 2-mm bridges for individual wiring of potentiometers and analog inputs
- 4-mm laboratory connector system

Contents

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Controls and connections	6
Connection example	7
Assembly of BODAS adapter cable TAK	8
Safety instructions	9

Ordering code

01	02	03
TB	3	/ 10

Type

01	Test box	TB
----	----------	-----------

Design

02	For BODAS controllers RC of series 20, 21, 22 and 30	3
----	--	----------

Series

03	Series 1, Index 0	10
----	-------------------	-----------

Main components

Included in the standard delivery of the BODAS test box TB3/10 for controllers RC series 20, 21, 22 and 30:

- ▶ TB3/10 in a transport case
- ▶ 2 bridge connectors (4 mm)
- ▶ 51 bridge connectors (2 mm)

The BODAS test box TB3/10 is used to simulate vehicle and equipment functions for development and test purposes in conjunction with BODAS controllers RC.

The BODAS test box TB3/10 is a development complement. It is just suitable for internal use or for usage in laboratory. The BODAS test box TB3/10 is not suitable for an operational application in a machine.

The BODAS test box TB3/10 has been developed specifically for the BODAS controllers RC series 20, 21, 22 and 30.

The permissible voltages, currents and frequencies correspond to the constraints of the BODAS controllers RC (see data sheet RE 95200, RE 95201, RE 95202, RE 95203, RE 95220).

The BODAS test box TB3/10 is not intended for private purposes.

The designated use includes, that you have completely read and understood the operating instructions and especially chapter 2 "Fundamental safety instructions".

Required components

You will need the following items to use the test box TB3 with the BODAS controllers RC series 20, 21 and 22:

- ▶ one test box TB3
- ▶ power supply unit (12/24 VDC) to power the test box and controller from a central point
- ▶ TAK1 adapter cable to connect the BODAS controller RC of series 20 or 21.
- ▶ TAK2 adapter cable to connect the BODAS controller RC of series 22.
- ▶ proportional solenoids with 4-mm connectors to connect to the PWM outputs to simulate the connected load.

You will need the following items to use the test box TB3 with the BODAS controllers RC series 30, RC36-20, RC28-14, RC20-10 or RC12-10 and:

- ▶ two test boxes TB3
- ▶ power supply unit (12/24 VDC) to power the test box and controller from a central point
- ▶ adapter kit RC36-20/30 or adapter kit RC28-14/30 (comprises adapter cable TAK4 and TB3 templates) to connect with the BODAS controllers RC36-20, RC28-14, RC20-10 or RC12-10.
- ▶ proportional solenoids with 4-mm connectors to connect to the PWM outputs to simulate the connected load.

Optional accessories:

- ▶ Voltage and/or current measuring devices
- ▶ BODAS-service connecting cable to communicate with the serial interface or CAN interface of a PC or laptop

The cables listed above are available from Rexroth under the following material numbers:

TAK1 adapter cable	R902076455
TAK2 adapter cable	R902109508
Adapter kit RC36-20/30 (TAK4 and two templates)	R902109578
Adapter kit RC28-14/30, RC20-10/30, RC12-10/30 (TAK4 and two templates)	R917008171
CAN USB adapter	R902602780
BODAS-service connecting cable	R902109422
BODAS-service	see data sheet 95086)
BODAS-design	see data sheet 95112)
C-API	see data sheet 95115)

Description

The test box TB3/10 is used to simulate vehicle and equipment functions for development and test purposes in conjunction with BODAS controllers RC.

The test box TB3/10 is useful for

- ▶ software development using BODAS controllers RC,
- ▶ parameter setting of BODAS controllers RC with BODAS-design or BODAS-service
- ▶ and diagnostics.

The test box TB3/10 allows you to simulate all the conditions of the overall system and to perform far-reaching functional tests of your control outside of the vehicle.

This reduces the development time of software and increases the safety and comfort. The test box TB3/10 was developed specifically for the BODAS controllers RC. All inputs and outputs from these controllers can be configured via the test box TB3/10.

A controller RC36-20/30 needs to be connected with two BODAS test boxes TB3/10.

The permissible voltages, currents, and frequencies correspond to the constraints of the BODAS controllers. The test box TB3/10 offers interfaces for connecting proportional solenoids and all inputs of the controller. This allows for a complete simulation of the application – from the control of proportional solenoids to cable break.

The test box TB3/10 provides various input signals for the BODAS controller RC.

If necessary, you can also generate the test signals with signal generators or speed sensors and feed these into the TB3/10 test box through the sockets provided. The signals are transmitted to the BODAS controller RC.

The output signals from the BODAS RC controller can be picked up and measured at the TB3/10 test box. These are indicated by LEDs.

The diagnostics interface allows connecting a PC or laptop with the PC software BODAS-service or BODAS-design. CAN bus interfaces can be used to communicate with other bus users, e.g. with additional BODAS controllers RC or a joystick.

The power supply and switch inputs are protected against over-current.

The test box is easy to transport, because of the transport case including a space in the cap for cables and other complements.

Controls and indicators

Controls / connections	TB3 label	Number	Function	Chapter
Switch for voltage supply to controller and TB3 test box	TB3 supply	1	On / Off	7.1
Switch for ignition simulation	Ignition switch	1	On / Off	8.5.1
Switch for supplying the outputs on the controller	Supply outputs	1	On / Off	
Switches for switch inputs	Digital inputs	14	Supply voltage (+) / open / ground (-)	8.3.1
Connection for switch inputs		14	Switch signal measurement or external switch signal input	
Connection for analog inputs	Analog inputs	11	Voltage input 0 to 5 V Plug board with 2 mm bridges Voltage measurement or external voltage infeed	8.3.2
Connection for analog inputs (on RC/20 and RC/21: in part current inputs, designations explained below)		4	Voltage input 0...8 V ¹⁾ Current input 0...20 mA ³⁾ Plug board with 2 mm bridges Voltage measurement or external voltage infeed (on RC/20 and RC/21 accordingly for current)	
Potentiometer for analog inputs (5 kΩ)		15	Simulation of analog inputs	
Connection for temperature inputs	Temperature	2	Plug board with 2 mm bridges Measurement of resistance or connecting an external resistor	
Potentiometer for temperature inputs (2 kΩ)	Temperature inputs	2	Temperature sensor simulation ¹⁾ (precision potentiometer)	
Frequency generators	Frequency generator	4	Speed measuring simulation (1.7 Hz - 9.1 kHz, square-wave signal) Setting and output of internally generated or input frequency signal, optionally processable as DSM signal: direction data, error signal generation	8.1
		2	Speed measuring simulation (1.7 Hz - 4.55 kHz, square-wave signal) Setting and output of internally generated or input frequency signal, for HDD2 simulation two signals with a phase shift of ± 90° for direction of rotation detection	
Connection for frequency inputs	Frequency inputs	5	Input of an internally generated or external frequency signal (transmission via 4 mm lab measurement cables)	
Connection for current measurement input at PWM outputs	PWM Lowside	6	Current measurement inputs for PWM outputs, connection for return wire from proportional solenoids ²⁾	8.4.2
LED for current measurement inputs		6	Current measurement inputs indicator ⁴⁾	
LED and connection for switching outputs (Highside)	Digital output Highside	4	Indicator and measurement of switching outputs ^{1) 4)}	8.4.2
LED and connection for switching outputs (Lowside)	Digital output Lowside	4	Indicator and measurement of switching outputs ^{1) 4)}	
LED and connection for "Low power" switching outputs (Highside)	Digital low power	2	Indicator and measurement of "Low power" switching ^{1) 4)}	

Controls / connections	TB3 label	Number	Function	Chapter
Connection for current outputs to proportional solenoids (Highside) (on RC/20 and RC/21 as switching outputs, designations explained below)	PWM Highside	12	Output current measurement, proportional solenoid outputs	8.4.1
LED for current outputs (Highside)		12	Current outputs indicator ⁴⁾	
Connection for analog outputs (voltage)	Analog out	2	Measurement of output voltage	8.4.4
Connection for BODAS-service diagnostic cable, Cannon Trident, 8-pin	Diagnosis	1	Communication / Service / Programming (RS232 and CAN1)	-
Connection for CAN bus, SUB 9-pin	CAN1, CAN2	2	Communication Pin 7: CAN high, Pin 2: CAN low	8.5
Connection for power supply unit (12V or 24V DC)	+ 12 V/+ 24 V ECU, TB3	2	Power supply for test box and controller	8.3.2 6.2
Connection for power supply unit (ground)	GND ECU, TB3	2	Central ground	6.3 7.1
Battery voltage connection (voltage according to the supply)	Battery	4	Voltage supply of external signal transmitters, solenoids or for enabling or disabling (depending on series) the output stages (INH)	8.3.3
Ground connection	Ground	8	Reference potential for external sensor or measuring devices	
Connection for internal activation or deactivation (depending on series), Inhibit	INH	1	Internal activation / deactivation of power outputs RC/20, RC/30: level > 5V, activation of output stages RC/21, RC/22: level > 5V, deactivation of output stages	8.4.5
Circuit breaker	F2 (20 A)	1	Fuses for battery sockets 4 in connector panel	-
Glass tube fuse	F1 (10 A)	1	Fuse TB3 internal	-
Connector plug for the adapter cable to the BODAS RC controller, Harting HAN108DD	---	1	Connection for adapter cable TAK1	4.2 6.2

With reference to the connector table observe the following information:

The designations on the TB3/10 test box are matched to the inputs and outputs on a BODAS controller RC series 22. For the BODAS controllers RC series 20 and 21 these do not correspond exactly.

As to the BODAS controller RC36-20/30 and RC28-14/30, RC20-10/30 as well as RC12-10/30 the correct designations of the inputs and outputs are ensured through the existing templates in the adapter kit.

The designations, which differ from the actual assignment if connecting a controller RC series 20 and 21, can be found in the appropriate operating instructions under "Connection designation for BODAS controllers RC series 20 and 21".

- 1) BODAS controller RC series 22 only
- 2) BODAS controller RC series 21 and 22 only
- 3) BODAS controller RC series 20 and 21 only
- 4) LEDs glow dimly when the power outputs are enabled. Even if no output is actuated.

Controls and connections

Plug board for potentiometers
of analog and temperature inputs

Sockets for inputs and outputs,
ground and operating voltage

Diagnostics and CAN connections,
voltage supply

LED indicator
for outputs

Frequency generators

Switches for switch
inputs

Connector for adapter
cable TAK1 or TAK2

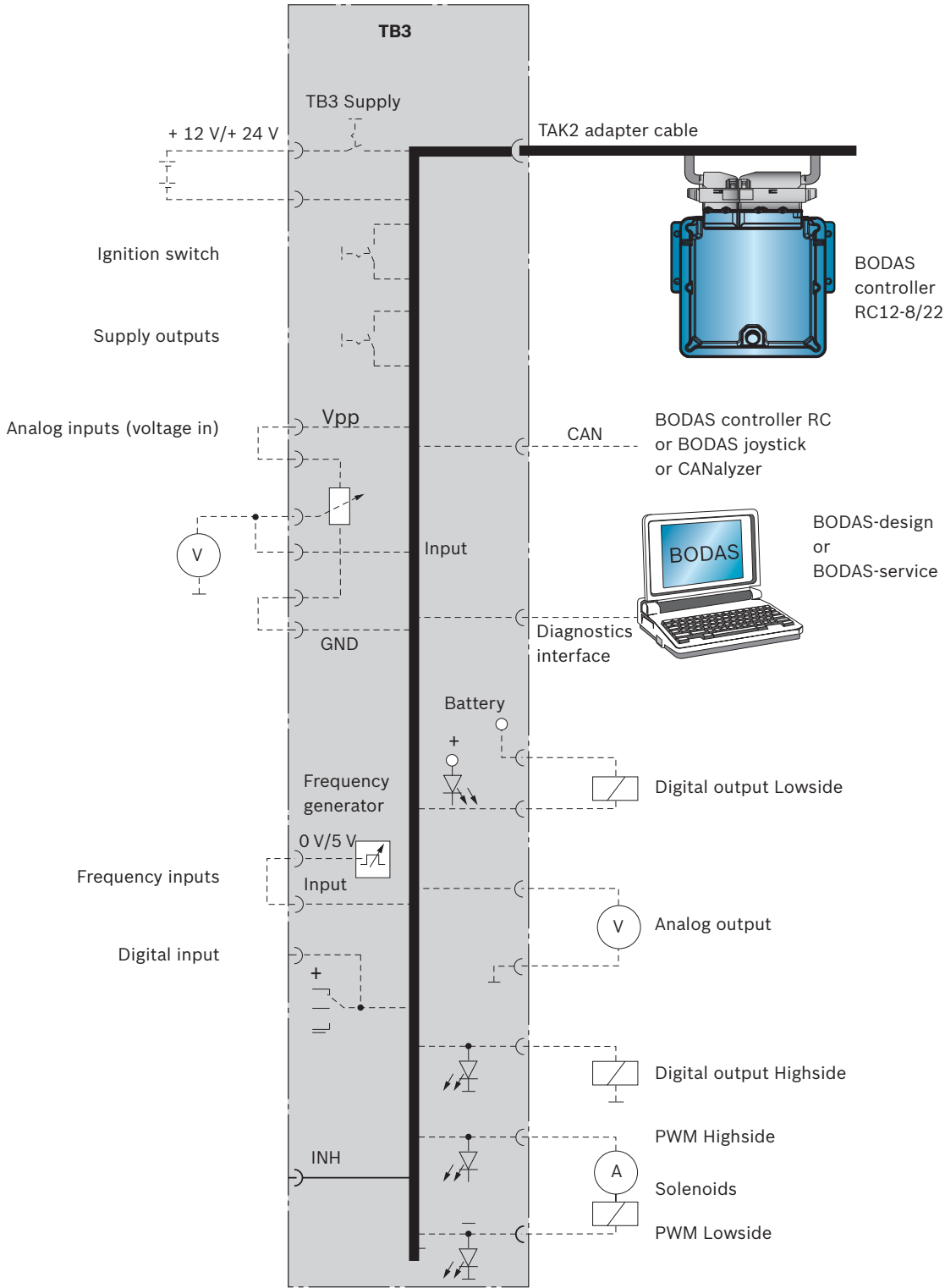
Potentiometers
for analog and
temperature inputs

Power switch,
ignition switch,
main switch, fuses



Connection example

This diagram shows an example of the connection options offered by the test box TB3.



Assembly of BODAS adapter cable TAK

Adapter cable TAK1 for connecting a BODAS controller RC series 20 and 21 with the test box TB3 (R902109508).

Adapter cable TAK2 for connecting a BODAS controller RC series 22 with the test box TB3 (R902109508).

▼ Adapter cable TAK1/TAK2



▼ Controller RC series 20 connected via TAK1 with a BODAS test box TB3/10

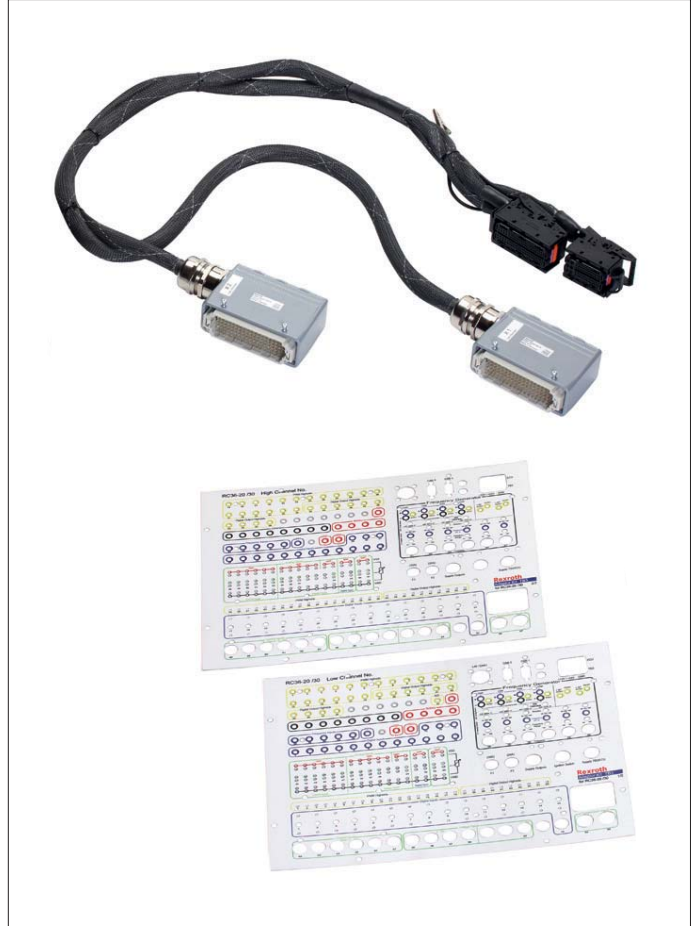


▼ Controller RC36-20/30 connected via TAK4 with two BODAS test boxes TB3/10.



Adapter kit RC36-20/30 or RC28-14/30, RC20-10/30, RC12-10/30 (TAK4 and two templates) for connecting a BODAS controller RC36-20/30, RC28-14/30, RC20-10/30 or RC12-10/30 with two test boxes TB3 R902109578

▼ Adapter kit for BODAS controller RC series 30



Indication

- ▶ The BODAS TAK1/2 resp. the adapter kit RC series 30 does not provide EMC protection via shielding or twisting.
- ▶ The BODAS TAK1/2 resp. the adapter kit RC series 30 has the protection class IP 20.
- ▶ The BODAS TAK1/2 resp. the adapter kit RC series 30 is designed for operating and storage temperatures between 0°C and +40°C.

Safety instructions

General instructions

- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ The BODAS test box TB3 must be connected while in a voltage-free state.
- ▶ Before switching on the BODAS controller with the BODAS test box TB3, ensure that no safety-critical situations could arise through control of the outputs.
- ▶ Incorrect connections could cause unexpected signals at the outputs of the BODAS test box TB3.
- ▶ It is not permissible to open the BODAS test box or to modify or repair the BODAS test box. Modifications or repairs to the wiring could result in dangerous malfunctions. Repairs to the BODAS test box TB3 may only be performed by Bosch Rexroth or by an authorized partner.
- ▶ To switch off the system in emergencies, the power supply to the electronics must be disconnected with a safety switch. The safety switch must be installed in an easily accessible position for the operator. The system must be designed in such a way that actuating the safety switch ensures safe braking.

Notes on the installation point and position

- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ All connectors must be unplugged from the electronics during electrical welding and painting operations.

Notes on transport and storage

- ▶ If it is dropped, the BODAS test box TB3 must not be used any longer as invisible damage could have a negative impact on reliability.

Further information

- ▶ Observe the operating manual 95092-B.
- ▶ Further information about the BODAS test box TB3 can be found at www.boschrexroth.com/mobile-electronics.
- ▶ Visit our web page regularly to inform about current product information and updates.
- ▶ The BODAS test box TB3 must be disposed according to the national regulations of your country.

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Mobile Electronics

BODAS Sensors

Designation	Type	Data sheet	Page
Speed sensor	DSM	95132	185
Speed sensor	HDD	95135	201
Pressure sensor	PR3	95155	215
Pressure sensor	PR4	95156	229
Angle of rotation sensor	WS1	95140	239
Angle sensor	AN2	95143	243
Angle sensor	AN3	95144	251
Inertial sensor	AC1	95175	259
Inclination sensor	INC	95166	269
Temperature sensor for fluid	TSF	95180	273
Temperature sensor for air	TSA	95181	279
Temperature switch	TS	95145	283
Contamination switch	VS	95148	287
Inductive position sensor	PO1	95160	293
Draft sensor	KMB	95170	301

For the latest information on mobile electronics, please visit our website:

www.boschrexroth.com/mobile-electronics

RE 90010-04/07.2016, **Bosch Rexroth AG**

Speed sensor DSM series 10

RE 95132

Edition: 05.2016

Replaces: 12.2015



- ▶ Hall-effect sensor for contactless speed sensing

Features

- ▶ Direction of rotation detection
- ▶ Diagnostic signals
 - Standstill recognition
 - Critical air gap
 - Critical installation position
- ▶ Detects even low speeds
- ▶ Specially developed for the tough requirements of mobile applications
- ▶ Automotive quality
- ▶ Simple installation without adjustment work
- ▶ Current interface
- ▶ Type of protection IP69K

Inhalt

Ordering code	2
Description	2
Technical data	3
Output signals	4
Application on controllers	7
Dimensions	8
Connector	9
Notes on installation	10
Gear specifications	11
Standard gear	12
Manufacturer confirmation of DSM MTTF _d -values	13
Safety instructions	15

Ordering code

01	02	03
DSM	1	- 10

Type

01	Hall-effect speed sensor (for mobile applications)	DSM
----	--	------------

Version

02		1
----	--	----------

Series

03		10
----	--	-----------

Available variants

Type	Material number
DSM1-10	R917000301

Description

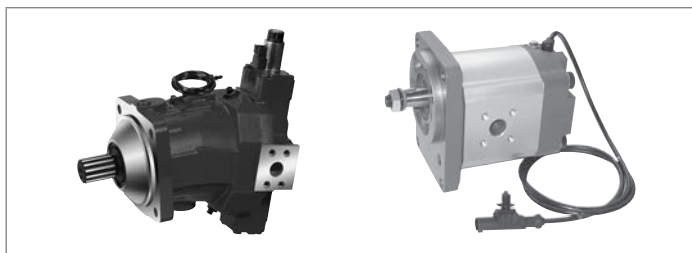
The DSM1-10 Hall-effect speed sensor was specially developed for tough use in mobile working machines. The sensor detects the speed signal of ferromagnetic gear wheels or cut panels. In this process, as an active sensor it supplies a signal with constant amplitude independent of the rotational speed. The sensor excels not just in its ability to detect the direction of rotation, but also through additional diagnostic functions, such as:

- ▶ Standstill recognition
- ▶ Critical air gap
- ▶ Critical installation position

Example applications

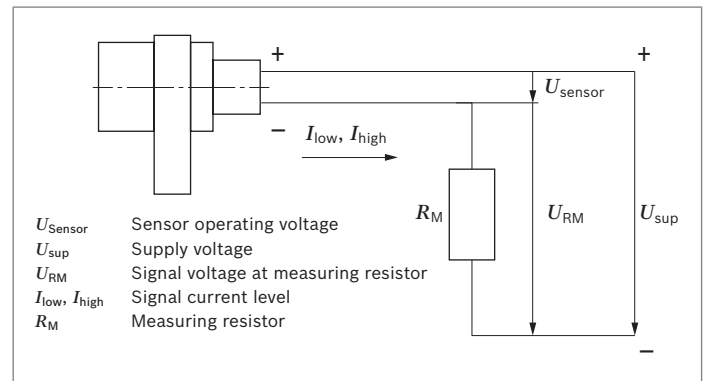
Due to its compact, sturdy design, the sensor is suitable for the following applications, among others:

- ▶ In Rexroth external gear and axial piston motors (examples)



- ▶ In the wheel bearing for measuring the wheel speed
- ▶ In gearboxes or gearbox stages
- ▶ In fan drives for buses, trucks and construction machinery (from 7 to 20 kW)
- ▶ In vibration drives for road rollers and construction machinery

Block circuit diagram



A two-wire current interface is used for signal transmission. A current signal is supplied by the sensor. The low current (I_{low} = induced current of the active element) is interpreted as low-signal. The high current ($I_{\text{high}} = I_{\text{low}} + \Delta I$; ΔI = additional current through a path parallel to the active element) is interpreted as high signal. In the controller, the current coming from the sensor is converted to a voltage signal by a measuring resistor R_{M} . The evaluation circuit detects whether the signal is high or low by the size of the voltage.

Technical data

Type	DSM1-10
Nominal voltage	12 V
Sensor operating voltage (U_{Sensor})	4.5 V to 20.0 V
Current consumption	Maximum 16.8 mA
Sensor current	
I_{Low}	7 mA \pm 20 %
I_{High}	14 mA \pm 20 %
Signal ratio $I_{\text{High}} / I_{\text{Low}}$	≥ 1.9
Tooth frequency	up to 5 kHz ¹⁾
Signal frequency (= Tooth frequency x 2)	up to 10 kHz ¹⁾
Measurement distance	typically 1.5 to no more than 3 mm ²⁾
Direction of rotation signal	PWM-Signal (see page 4)
Electromagnetic compatibility EMC	
Stripline (DIN 1145 2-5) 1 MHz to 400 MHz	200 V/m
Free field (DIN 1145 2-2) 200 MHz to 1 GHz	150 V/m
Overvoltage resistance	24 V, 10 • 5 min
Reverse polarity protection	
Reverse polarity current	≤ 195 mA Protective circuit must be provided in controller or externally!
Vibration resistance (IEC 60068-2-34)	
Random-shaped vibration	0.05 g ² /Hz 20 to 2000 Hz
Shock resistance (IEC 60068-2-27)	1000 m/s ² , 6 ms, 12x in each direction (positive/negative)
Resistance to salt spray (DIN 50 021-SS)	168 h
Type of protection (DIN 40 050-9)	IP69K
Operating temperature range	
Sensor zone	-40 °C to +150 °C
Cable zone	-40 °C to +115 °C
Storage temperature range (IEC 68-2-1 Aa, IEC 68-2-2 Ba)	-40 °C to +50 °C
Materials	Housing: Polyamide heat stabilized Cable: Cover insulation Polyurethane elastomer 95 \pm 5 shore A Bushing: Brass
Weight	55 g
Installation position	see page 10
Pressure resistance of measuring surface	5 bar

1) Tooth frequencies greater than 2500 Hz may have an effect on jitter and magnetic thresholds.

2) Optimum air gap strongly dependent on application (magnetic field, gear material, ...)

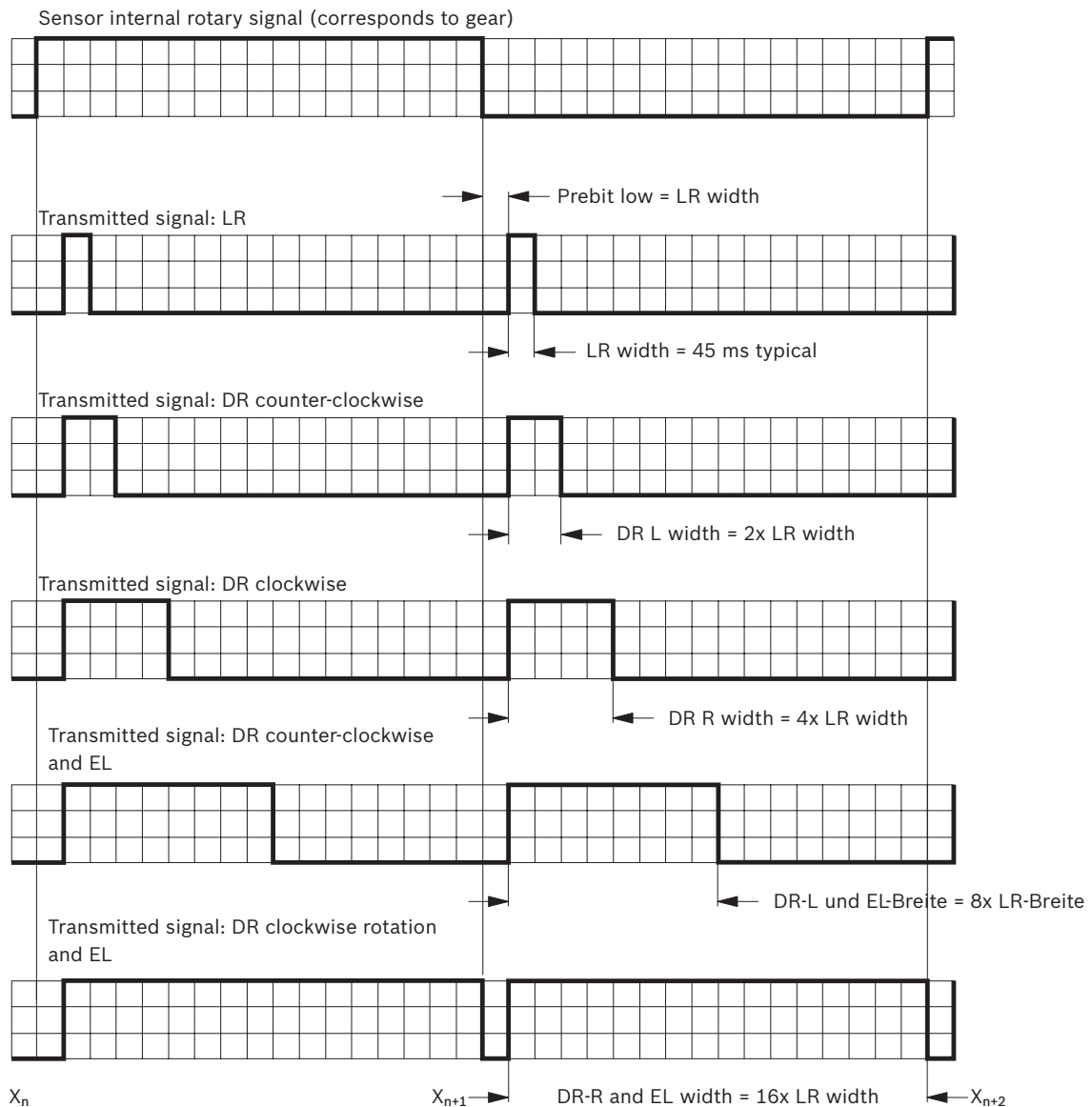
Output signals

The output signal of the DSM1-10 consists of square-wave pulses of constant amplitude, which are generated by the evaluation electronics of the DSM1-10. The length of the individual pulses provides information about the direction of rotation and any errors that there may be in the installation position.

The evaluation electronics generate a high pulse of a certain length after every flank of the internal sensor speed signal. The length of the pulse is determined by the information to be transmitted. For example, the information 'counter-clockwise rotation' is described by a pulse 90 μ s long, and the information 'clockwise rotation' by a pulse 180 μ s long.

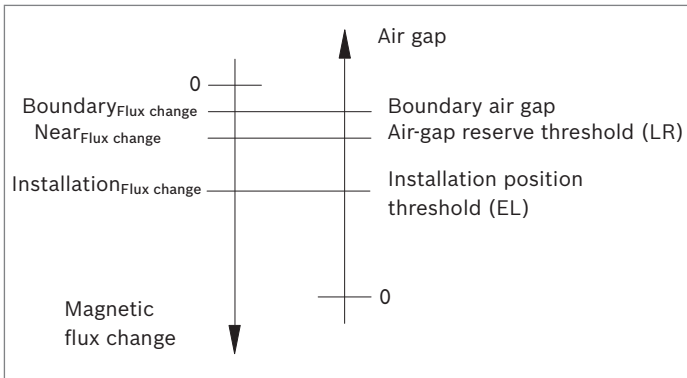
In order to ensure that the speed information can still be emitted at higher speeds even when pulses are longer, a low time (prebit low) is always placed ahead of the high pulse. So, the additional information from the signal is lost at high speeds (pulses are cut off by the low time), but the actual speed information can be output reliably up to a very high frequency (upstream low time + shortest high pulse). If the air-gap reserve signal (AR) is emitted, the other signals are overshadowed (AR is dominant), i.e. neither a direction of rotation signal (DR) nor the installation position signal (MP) is emitted above the air-gap reserve threshold.

Signal form



Air-gap reserve (LR) and installation position (EL)

The sensor reacts to magnetic flux changes. If the air gap between gear and sensor is too great, the signal output may possibly be impaired:



Performance as speed increases

As speed increases, the next edge on the wheel is detected before the signal is output in its planned length. In these cases, the signal is shortened and the zero-time (45 μs) that comes after each edge, overwrites the signal. It is thereby ensured that the frequency of the pulse and, thus, the speed is always correctly transmitted. The loss of the direction of rotation information is then uncritical, as due to high speed, no change in the direction of rotation can occur at that time. If the speed is reduced (e.g. ranging from slow-down to change in the direction of rotation), the signal is completely output again and the change in the direction of rotation occurs.

Boundary area boundary flux change

When magnetic flux changes are smaller than the boundary flux change, this may result in signal misfires.

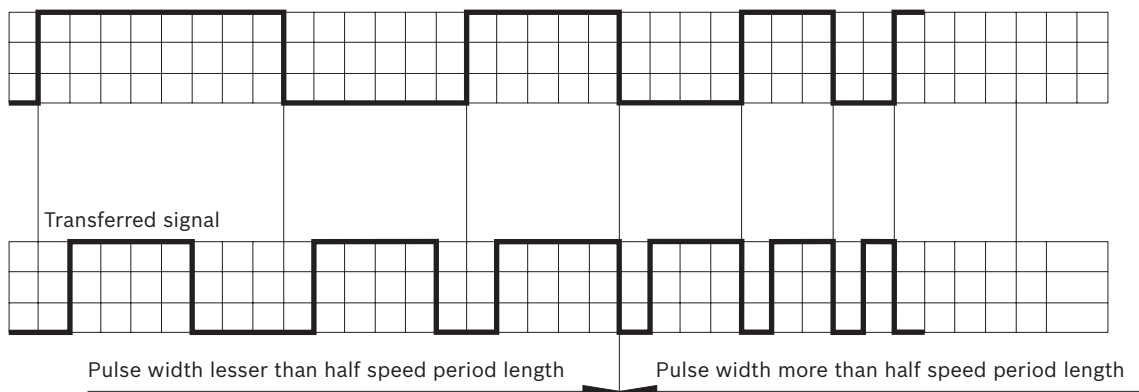
Near area near flux change

When magnetic flux changes are less than the near flux change, the LR bit is output.

Installation position installation flux change

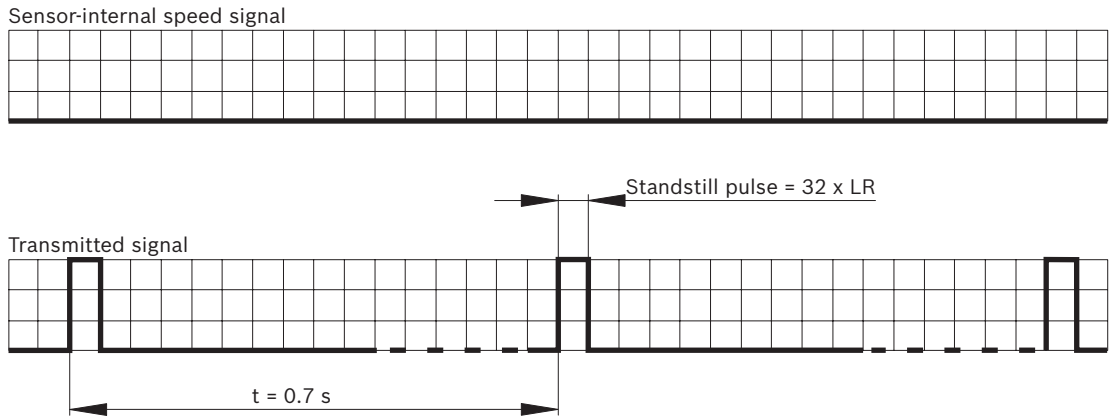
When magnetic flux changes are less than the installation flux change the EL bit is output.

Sensor-internal rotary signal at increasing speed



Response in case of standstill

Sensor signal after no speed signal was detected within one second:



Description

When the vehicle is stationary, pulses 1.44 ms in length are emitted every 0.7 seconds by the sensor. These pulses are also output after undervoltage if no speed signal is detected.

In the standstill, an initialization is also performed. This initialization lasts between 255 and 345 μ s. During this time, no signal change can be detected.

Signal when departing from a standstill or during startup

When the output values (frequency, direction of rotation, ...) are being determined, a certain number of pulses are needed so that the supplied information can be ensured after a certain number of pulses.

When starting out from a standstill or after the undervoltage state, the sensor is first set in an uncalibrated state (signal not offset-compensated).

Also during this phase, the sensor supplies a correct frequency signal at the beginning of the second signal pulse and under typical conditions also supplies a correct direction of rotation signal as of the third signal pulse. The correct output of the rotating direction demands up to seven teeth/flanks depending on the installation position. In this mode, the minima and maxima of the magnetic input signal are used as trigger points.

During the output of the signal in the uncalibrated mode, a calibration (offset calibration) of the signal is performed by the sensor. The sensor then automatically switches into the calibrated mode. From that point on, the zero crossings of the magnetic input signals are used as trigger points.

When switching over into the calibrated mode, a phase shift of the output signal can occur in infrequent cases (maximum -90° or $+90^\circ$). The number of signal pulses output in uncalibrated mode is not more than five.

Signal tolerances

From the tolerances of the internal components in the sensor, the following periods (minimum, nominal, maximum) are determined for the individual cases:

Pulse designation			Pulse width t_{pulse}		
			min	nom	max
Prebit (Low)	t_{Prebit}	μ s	37	45	53
Air-gap reserve LR	t_{LR}	μ s	37	45	53
Counter-clockwise rotation DR-L	$t_{\text{DR-L}}$	μ s	74	90	106
Clockwise rotation DR-R	$t_{\text{DR-R}}$	μ s	149	180	211
Counter-clockwise rotation and EL DR-L/EL ¹⁾	$t_{\text{DR-L/EL}}$	μ s	298	360	422
Clockwise rotation and EL DR-R/EL ¹⁾	$t_{\text{DR-R/EL}}$	μ s	597	720	843
Standstill STOP	$t_{\text{Pulse-Stop}}$	μ s	1194	1440	1685
Standstill recognition	t_{Stop}	ms	611	737	863

Vibrations

Vibrations of the not rotating sensor ring possibly can cause wrong sensor signals.

1) The pulse DR-L/EL or DR-R/EL is output only up to a signal frequency of approx. 117 Hz. Above this frequency, this pulse is then released via the shorter DR-L or DR. R

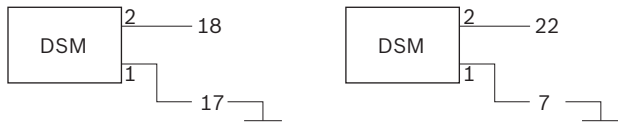
Application on controllers

Application with Rexroth BODAS controllers

The reading of the DSM1-10 is possible with the following BODAS controllers: Series 21, 22 and 30.

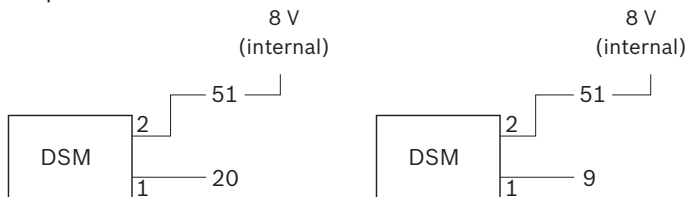
RC2-2/21

2 inputs



RCE12-4/22

2 inputs

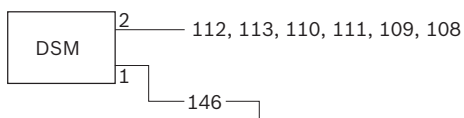


RC4-6/22 (2 inputs), **RC8-8/22** (4 inputs),
RC12-8/22 (4 inputs)

comparable with RCE12-4/22

RC36-20/30

6 inputs

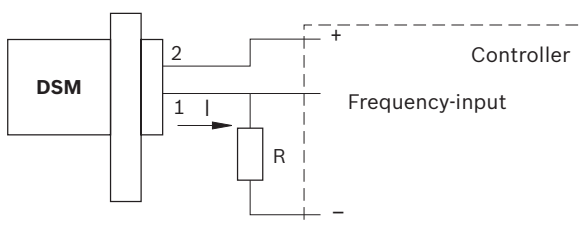


Note

The current data sheet of the controller being used is to be considered.

Application with different controllers

Basic use

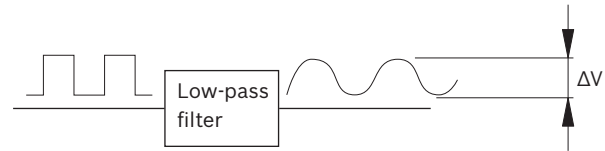


Current I supplies the sensor information in the form of pulses (details see page 4) whose low and high levels are as follows:

I	Unit	minimum	nominal	maximal
I low	mA	5.9	7	8.4
I high	mA	11.8	14	16.8

The minimum pulse width is 52 μ s. This corresponds to a frequency of 10 kHz.

In order to interpret the signal, it must be ensured that at 30 kHz input frequency the signal (after any low-pass filter that may be present) still exhibits a sufficient voltage difference (ΔV) for the evaluation.



Through resistor R , a voltage is generated that is applied to the frequency input of the RC controllers.

In an example with $R = 200 \Omega$, the following voltages are read:

U Input ($R = 200 \Omega$)	Unit	minimum	nominal	maximal
U low	V	1.18	1.4	1.68
U high h	V	2.36	2.8	3.36

The resistor R to be installed should be selected so that:

- ▶ The voltage difference for the internal signal evaluation in the controller is sufficient.
- ▶ The maximum voltage across resistor R does not become too high (adapted to the sensor supply), in order for at least 4.5 V always to be applied at the sensor pins.

If these conditions are met and the signal is present inside the controller, the sensor information can be determined.

Speed

Due to the properties of the DSM, which sees both flanks of each gear tooth, the actual speed frequency of the gear is determined as follows

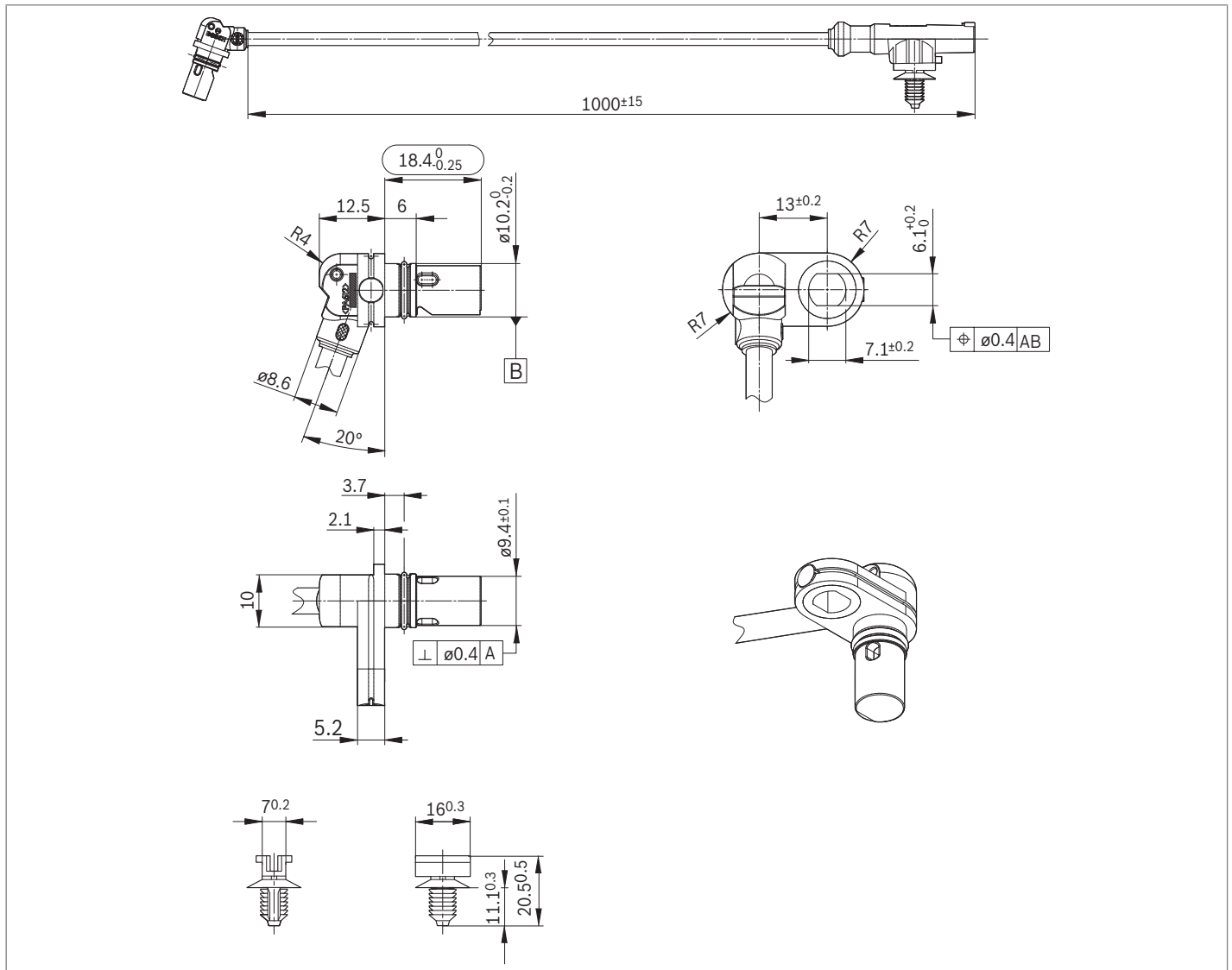
$$f_{\text{gear}} = f_{\text{read}} / 2$$

Direction of rotation, critical air gap, standstill

To determine this information, the length of the pulse should be measured. This can be accomplished by the start time and end time of the pulse being measured in the controller.

Nevertheless, the speed can always be read from this frequency without this evaluation. However, the performance during standstill should be considered (1.44 ms every 0.7 s). It can be detected in the excess length of the pulse (1.44 ms).

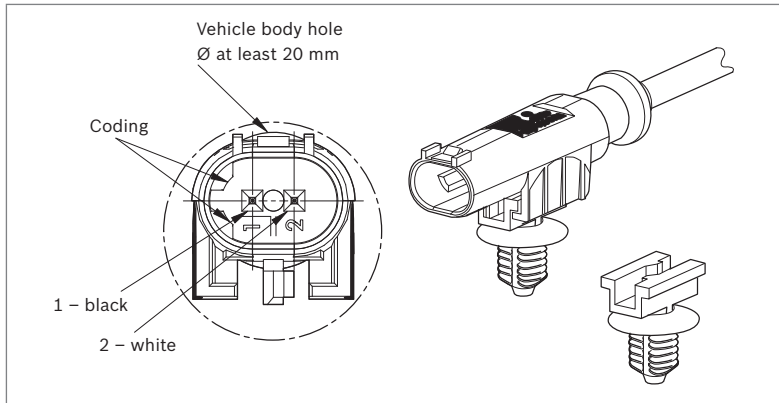
Dimensions



The connector is supplied with a clip for securing to the vehicle body. It is suitable for panel thicknesses of 0.7 to 6.0 mm and a vehicle body hole diameter of 6.5 to 7.0 mm.

Connector

▼ Pin assignment



Pin assignments of the DSM speed sensor on controller (SG)

	Series 22	RC2-2/21 RC36-20/30
Pin 1	Signal	Ground
Pin 2	Supply	Signal

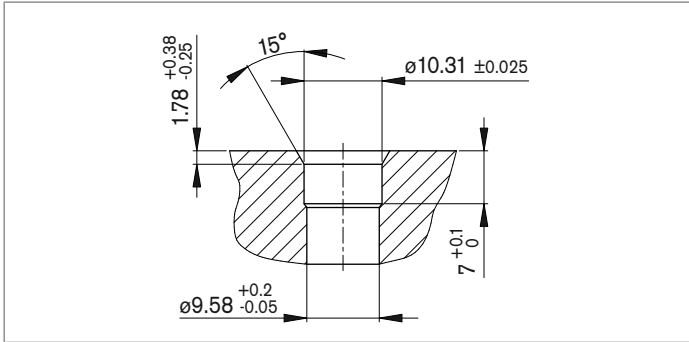
▼ Mating connector

Connector housing consisting of protective cap / housing seal ring / contact lock / socket housing AMP material number	Socket contact AMP material number	Conductor cross section (mm²)	Insulation diameter (mm)	Single seal AMP material number
1-967644-1	965906-1	0.75	1.4 to 1.9	967067-1
	962885-1	0.5	0.9 to 1.4	967067-2
		0.35		
		0.2		

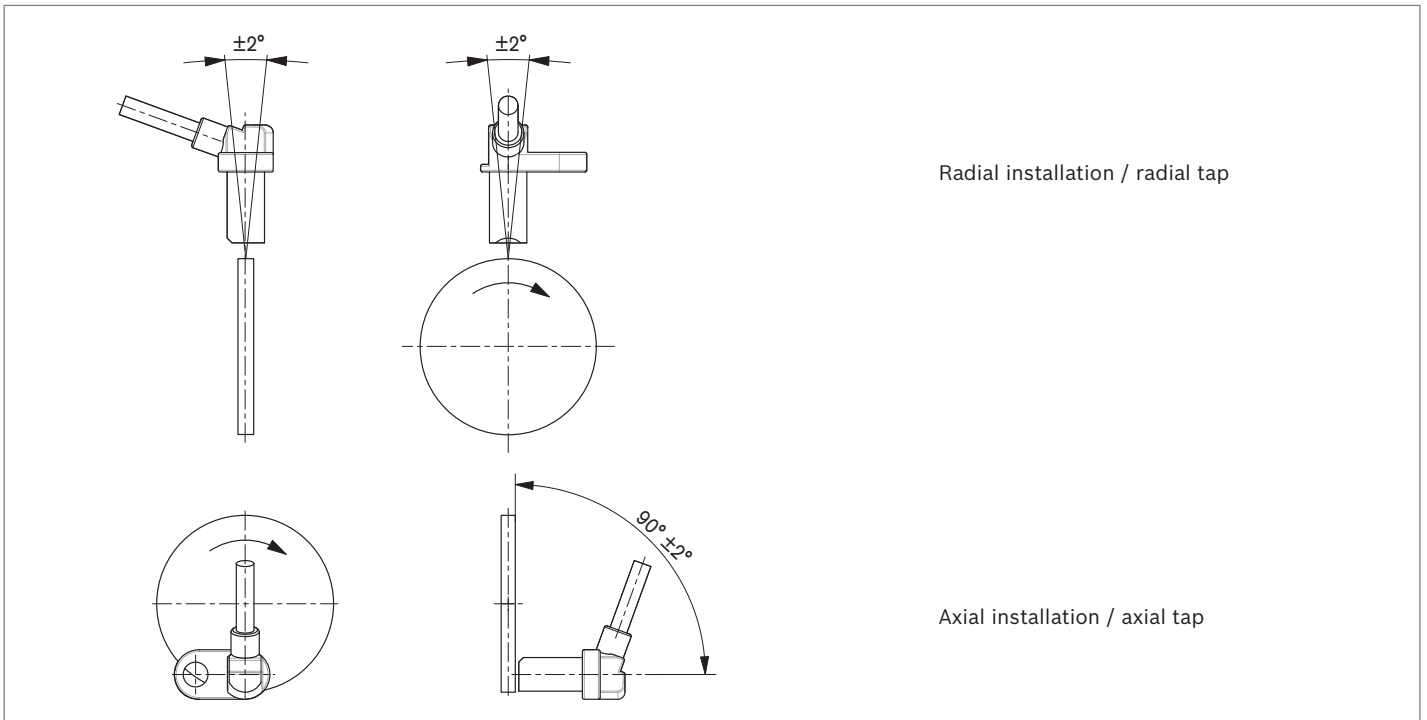
The mating connector is not included in the scope of supply. This can be supplied by Bosch Rexroth on request (material number R917002704).

Notes on installation

Installation hole



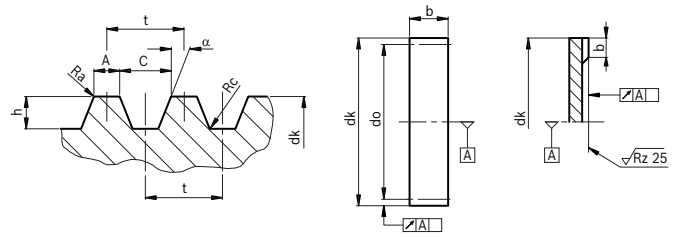
Installation position



Gear specifications

Material

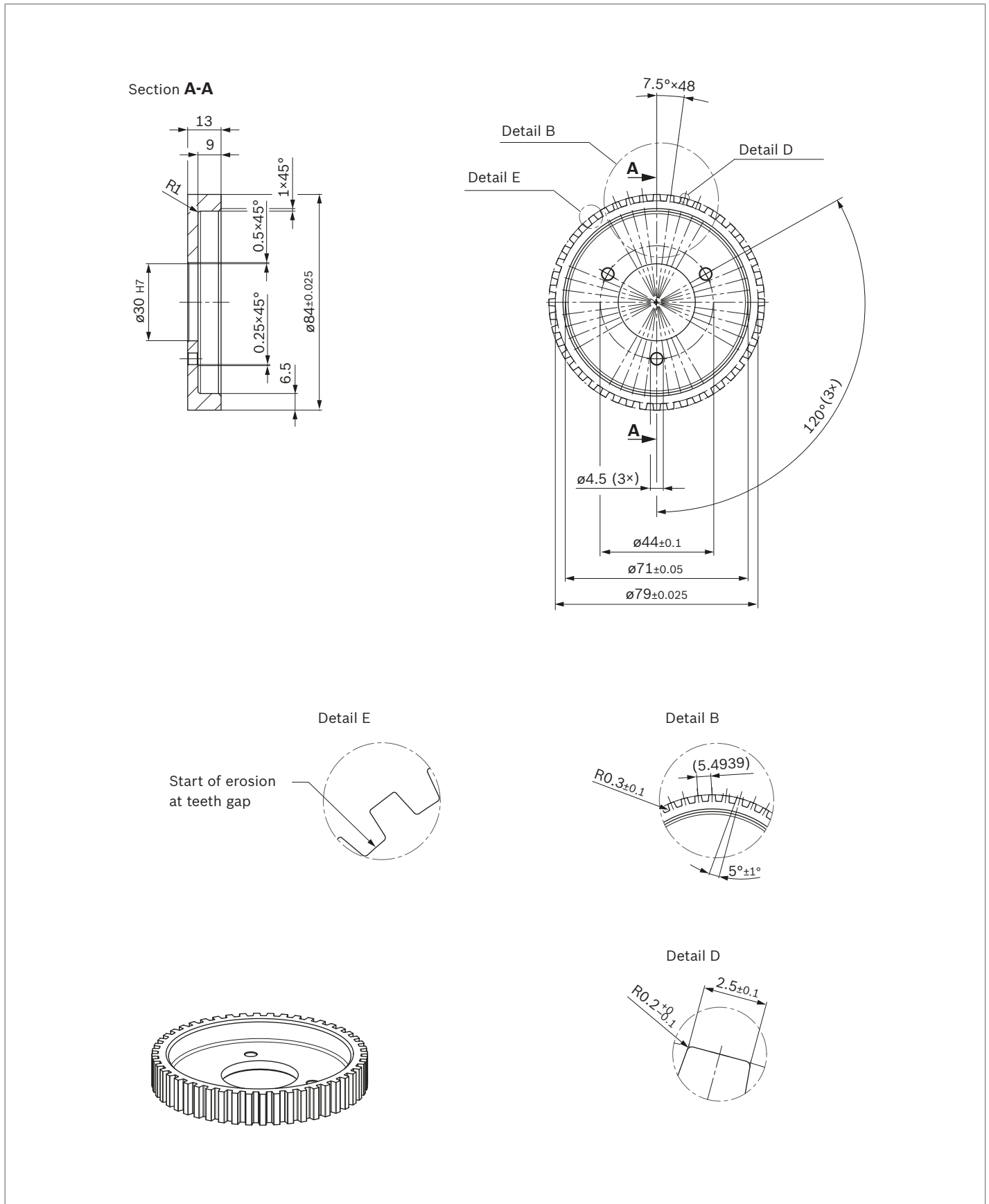
The sensor rings must be magnetically conductive. The material should be magnetically soft. So far free-cutting steels, hardened steels, sintered material (e.g. St37, 9SMn28, C45, GGG20, GGG40, X8Cr17) have been tested.



▼ Gear meshing data valid for base tooth count 48

Nominal size		Permissible deviations
z	Base tooth count 48	—
t	Pitch	> 4.1 mm
t _p	Adjacent pitch error	± 4 %
T _p	Total pitch error	4 %
A/t	Tooth tip (top land) width to pitch ratio	60 to 120 mm, A/t = 0.4 to 0.5
dk	Tooth tip diameter	> 60 mm
h	Tooth depth	> 2.5 mm
A	Tooth tip width	calculated from A/t
b	Sensor ring width	> 5 mm
α	Engagement angle	0 to 20
Ra	Radius at the tooth tip (top land)	< 0.3 mm (at A = 2 mm) to < 0.6 mm (at A = 6 mm)
Rc	Radius at the bottom land	< 0.6 mm
	Tooth form	Rectangular and trapezoidal
		other forms per agreement

Standard gear



Manufacturer confirmation of DSM MTTFd-values

The MTTFd-values were determined in accordance with ISO 13849-1:2008-12, Appendix D, Parts Count Method, and the specified temperature profiles below.

Ambient temperature Control unit [°C]	Self-heating [°C]	Temperature profile, Operating time share [%]					
		1	2	3	4	5	6
10	15	1	1	1	1	1	0
30	15	2	2	2	2	1	0
40	15	3	3	3	3	1	0
50	15	4	3	3	3	1	100
60	15	5	3	3	3	1	0
70	15	6	3	3	3	1	0
80	15	79	85	3	3	1	0
90	15	0	0	82	3	1	0
100	15	0	0	0	79	92	0
110	15	0	0	0	0	0	0
MTTFd-value [years] with	4h use per day	7240	7016	4660	3196	2876	20748
	8h use per day	4525	4385	2913	1998	1798	12968
	16h use per day	2588	2508	1666	1143	1028	7417
	24h use per day	1810	1754	1165	799	719	5187

Ambient temperature Control unit [°C]	Self-heating [°C]	Temperature profile, Operating time share [%]					
		7	8	9	10	11	12
10	15	0	0	0	0	0	0
30	15	0	0	0	0	0	0
40	15	0	0	0	0	0	0
50	15	0	0	0	0	0	0
60	15	100	0	0	0	0	0
70	15	0	100	0	0	0	0
80	15	0	0	100	0	0	0
90	15	0	0	0	100	0	0
100	15	0	0	0	0	100	0
110	15	0	0	0	0	0	100
MTTFd-value [years] with	4h use per day	14340	9408	6332	4068	2700	1864
	8h use per day	8963	5880	3958	2543	1688	1165
	16h use per day	5127	3363	2264	1454	965	666
	24h use per day	3585	2352	1583	1017	675	466

According to ISO 13849-2: 2008-09, the product meets the basic safety principles and the well-tried safety principles to the extent that they apply to the product.

The component is not a safety component in the sense of Directive on Machinery 2006/42/EC and has not been developed according to ISO 13849:2008.

Note

The MTTFd-values given are only valid for the sensor. For assessment of the functional safety for sensors according to ISO 13849, the entire signal chain has to be considered. For this reason, the corresponding kinematics (e.g. geared ring) are also to be taken into account for sensor application in hydraulic drive units.

Assessment of Safety Principles

List of the safety principles that must be to take into account in the higher-level system.

Chapter	Well-tried safety principles (SP)	Remarks	Technology	Area of use	Implemented in product
D.1.7	Suppression of voltage peaks	A set up for suppressing voltage peaks (an RC element, a diode or a varistor) must be used parallel to the applied load but not parallel to the contacts. NOTE: A diode increases the switching off time.	Electrical system	Components	For unlimited operation, the higher-level system must ensure that the supply voltage of 20 V is not exceeded. Voltage peaks of 24 V are permissible for maximum 10 × 5 minutes.
D.1.12	Protection from unexpected restarting after restoring the energy supply	Avoiding unexpected start-up, e.g. after restoring the energy supply [see EN 292-2:1991 (ISO/TR 12100-2:1992), 3.7.2, EN 1037 (ISO 14118), EN 60204-1 (IEC 60204-1)]. Special applications, e.g. maintaining the energy for clamping devices or securing a position, need to be considered separately.	Electrical system	Components	Expected start-up characteristics: A phase shift of 0 to 80° is possible after the first two pulses if, after a reset (vehicle standstill or undersupply), the sensor is supplied with a supply voltage ranging from 4.5 V to 20 V. The sensor is calibrated to pulse 6. During the calibration phase, a phase shift of -45° to 120° (>-135° to 300° phase difference between following pulses) is possible after the first two pulses. After a vehicle standstill or undersupply, the sensor therefore requires six magnetic flanks in order to be able to output the rotational speed correctly.
D.3.4	Energy limitation	A capacitor must be used to supply a limited amount of energy, e.g. when using a time cycle control.	Electrical system	Components	Not complied for the component. The maximum current level of 16.8 mA and/or maximum voltage level of 20 V defined the component must be guaranteed/limited via the higher-level system.
D.3.5	Limiting electrical parameters	Limiting of the voltage, current, energy or frequencies to avoid an unsafe status, e.g. by torque limitation, offset/time-limited running and reduced speed.	Electrical system	Components	Not complied for the component. The maximum current level of 16.8 mA and/or maximum voltage level of 20 V defined the component must be guaranteed/limited via the higher-level system.
D.3.8	Status orientation in the case of failures	If possible, all equipment/circuits should enter a safe condition or be safe to operate.	Electrical system	Components	Not complied with for the component. The higher-level system must detect faulty operating conditions of the sensor and appropriate remedies must be defined and implemented.
D.3.9	Directed failure	If it is possible to implement, components or systems should be used whose types of failure are known in advance [see EN 292-2:1991 (ISO/TR 12100-2:1992), 3.7.4].	Electrical	Systems	
D.3.11	Reduction of possible faults/separation	Separation of safety-related functions from other ones.	Electrical	Components	Not relevant to the component, since it is a complex signal that contains several items of information. The higher-level system must detect faulty operating status conditions of the sensor and appropriate remedies must be defined and implemented.

Safety instructions

General instructions

- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ It is not permissible to open the sensor or to modify or repair the sensor. Modifications or repairs to the wiring could result in dangerous malfunctions.
- ▶ Connections in the hydraulic system may only be opened in depressurized state.
- ▶ The sensor may only be assembled/disassembled in depressurized and deenergized state.
- ▶ System developments, installation and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and with the complete system.
- ▶ While commissioning the sensor, the machine may pose unforeseen dangers. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the sensor should fail or demonstrate faulty operation, it must be replaced.
- ▶ Despite every care being taken when compiling this document, it is not possible to take into account all feasible applications. If instructions for your specific application are missing, you can contact Bosch Rexroth.

Notes on the installation location and position

- ▶ Do not install the sensor close to parts that generate considerable heat (e.g. exhaust).
- ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ The connector of the sensor is to be unplugged during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.

Notes on transport and storage

- ▶ Please inspect the device for any damages which may have occurred during transport. If there are obvious signs of damage, please immediately inform the transport company and Bosch Rexroth.
- ▶ If it is dropped, the sensor must not be used any longer as invisible damage could have a negative impact on reliability.

Notes on wiring and circuitry

- ▶ Lines to the sensors must be designed as short as possible and be shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The sensor should only be plugged and unplugged when it is in a de-energized state.
- ▶ The sensor lines are sensitive to radiation interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor lines should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.
- ▶ Lines from the sensor to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The wiring harness should be fixated mechanically in the area in which the sensor is installed (spacing < 150 mm). The wiring harness should be fixated so that in-phase excitation with the sensor occurs (e.g. at the sensor mounting points).
- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.

Intended use

- ▶ The sensor is designed for use in mobile working machines provided no limitations/restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the sensor must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the sensor other than that described in chapter "Intended use" is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, interference in the component not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ The customer is responsible for performing a risk analysis of the mobile working machine and determining the possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.).
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

Further information

- ▶ Further information about the sensor can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The sensor must be disposed according the national regulations of your country.

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Hall-effect speed sensor HDD series 20

RE 95135

Edition: 07.2016

Replaces: 10.2015



- ▶ Dual sensor for contact-free speed sensing

Features

- ▶ Simple installation without setting work
- ▶ Detects even low speeds
- ▶ Large temperature range
- ▶ Short circuit resistance, reverse polarity protection
- ▶ Pressure-resistant sensor measurement surface
- ▶ O-ring seal
- ▶ High protection rating IP69k
- ▶ The attachment is encoded by way of asymmetrical screw fastenings.

Main components

- ▶ Two integrated hall semiconductors with permanent magnets and amplifiers
- ▶ Robust plastic housing
- ▶ Molded connection cable

Inhalt

Ordering code	2
Description	2
Technical data	4
Output signals	5
Measuring arrangement	5
Dimensions	6
Connector	7
Safety instructions	8

Ordering code

01	02	03	04	05	06	07
HDD					/	2 0

Type

01	Hall-effect speed sensor	HDD
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Version

02	One frequency output, one output for direction of rotation	1
	Two frequency outputs	2

Installation depth

03	16 mm	L16
	32 mm	L32

Output circuitry

04	NPN	N
	PNP	P

Electric port

05		HDD 1L16 HDD 1L32 HDD 2L32		HDD 2L16		
		N	P	N	P	
	Core end sleeve	●	●	●	●	A
	Connector DEUTSCH DT04-4P-EP04	●	-	-	-	D

Series

06		2
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Index

07		0
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● = Available - = Not available

Description

The hall-effect speed sensor (HDD) is used for contact-free measurement, even at very low rotational speeds. Two hall-effect semiconductor elements inside the sensor measure changes in the magnetic flux caused by the ferromagnetic teeth on the sensor. These are converted into square-wave signals by the integrated electronics. The frequency f of the square-wave voltage output by the sensor is calculated from the number of teeth z on the circumference of the gear wheel and the rotational speed n of the drive or output shaft using the following formula:

$$f = \frac{z \cdot n}{60} \quad \begin{array}{l} f [\text{sec}^{-1}] \\ n [\text{rpm}] \\ z = \text{number} \\ \text{of teeth} \end{array}$$

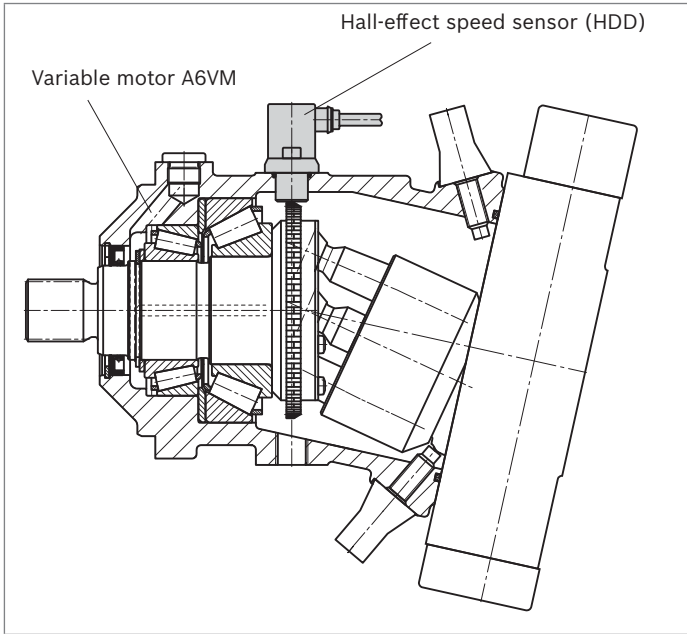
The sensor is available in four basic versions:

HDD1 returns a square-wave signal that is proportional to the speed plus a switching signal for identifying the direction of rotation.

HDD2 returns two square-wave signals that are phase shifted by approx. 90° which are suitable for the redundant detection of the speed. In addition, this can be used, for example, to calculate the direction of rotation using a controller from Rexroth.

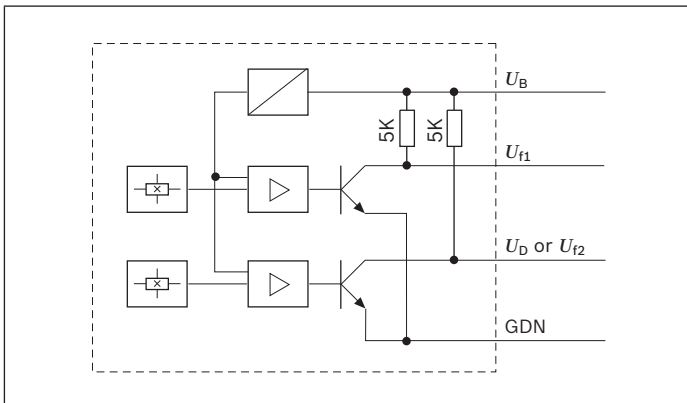
Both variants are available with NPN (standard) or PNP output circuitry.

Application example

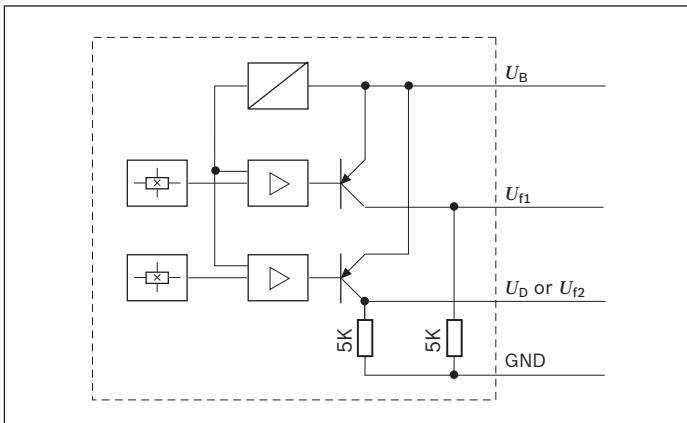


Block circuit diagram

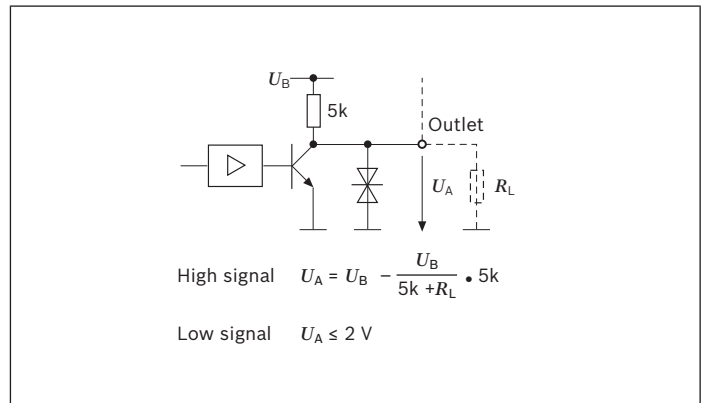
▼ NPN output



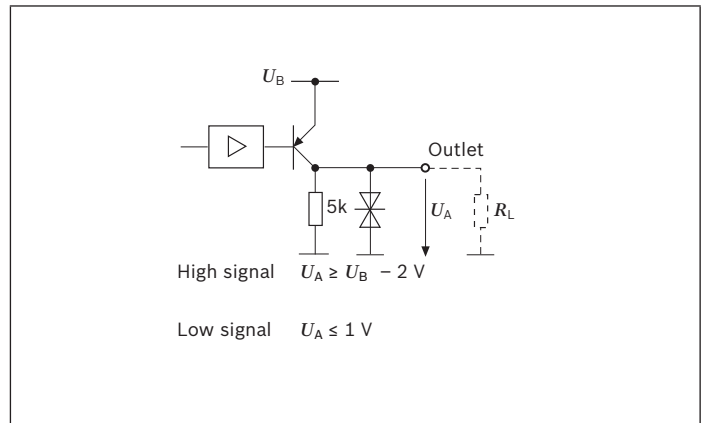
▼ PNP output



▼ NPN output signal level calculation



▼ PNP output signal level calculation



The output circuitry for the rotational speed signal and the direction of rotation signal are identical.

Technical data

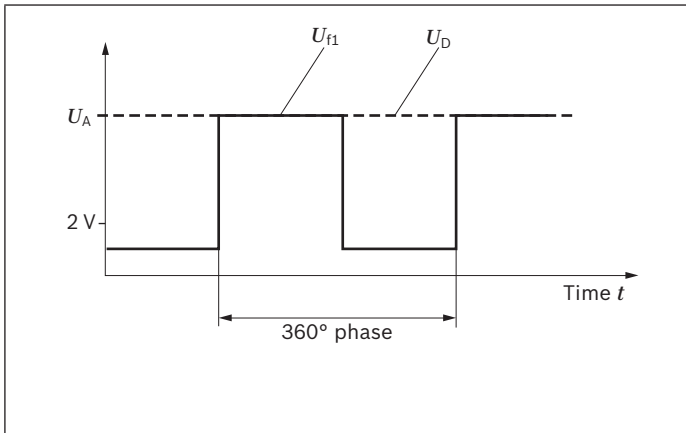
Type	HDD1, HDD2
Nominal voltage	12 V and 24 V DC
Residual ripple (DIN 40839, Part 1)	maximum ± 2 V DC
Supply voltage U_B , voltage range absolute	8 V to 32 V DC
Current consumption	maximum 33 mA AT 24 V DC
Current capacity	500 mA at 24 V and 25 °C 50 mA at 24 V and 125 °C
Frequency outputs	0.1 Hz to 20 kHz
Rotation direction signal	
Clockwise	high
Counter-clockwise	low
Standstill	undefined
Short circuit resistance to	supply voltage and ground
Reverse polarity protection	fitted
Electromagnetic compatibility (EMC)	
Spurious interference (Automotive Directive 95/54/EC)	100 V_{eff} /m
Line-bound interference (ISO 7637-1/-2/-3)	values on request
Load dump	maximum 70 V
Vibration resistance	
Sinusoidal vibrations (IEC 60086-2-6)	10 g / 57 to 2000 Hz 10 cycles per axis
Random-shaped vibrations (IEC 60086-2-36)	0.05 g^2 / Hz 20 to 2000 Hz
Shock resistance	
Transport shock (IEC 60068-2-27)	15 g/11 ms 3x in each direction (positive/negative)
Continuous shock (IEC 60068-2-29)	25 g/6 ms 1000x in each direction (positive/negative)
Moisture resistance	95% (+25 °C to +60 °C)
Salt spray resistance (DIN 50021)	48 h, 35 °C, 5% NaCl
Type of protection (IEC 60529) when installed and plugged	
with core end sleeves	IP 67 and IP 69 k
with DEUTSCH connector DT04-4P-EP04	IP 69 k with mating connector
Operating temperature range (IEC 68-2-14)	-40 °C to +125 °C
Storage temperature range (IEC 68-2-1, IEC 68-2-2)	-55 °C to +125 °C
Housing material	brass/plastic
Weight	approx. 95 g
Installation position	arbitrary
Measurement distance	0.2 to 2.5 mm for module 2
Pressure capability of measurement surface	10 bar

Output signals

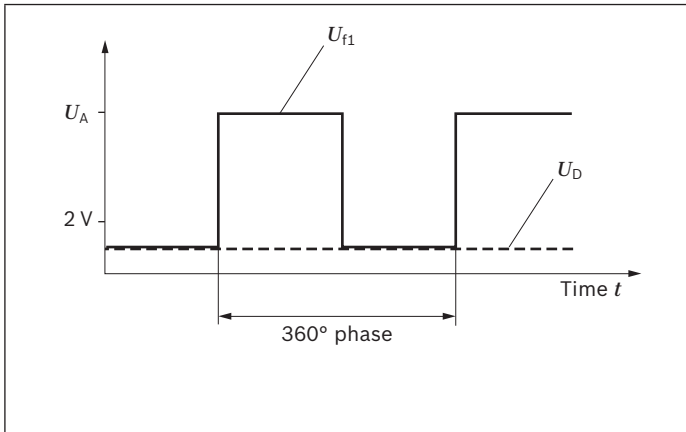
HDD1

Rotational speed signal and rotation direction signal

▼ Clockwise



▼ Counter-clockwise

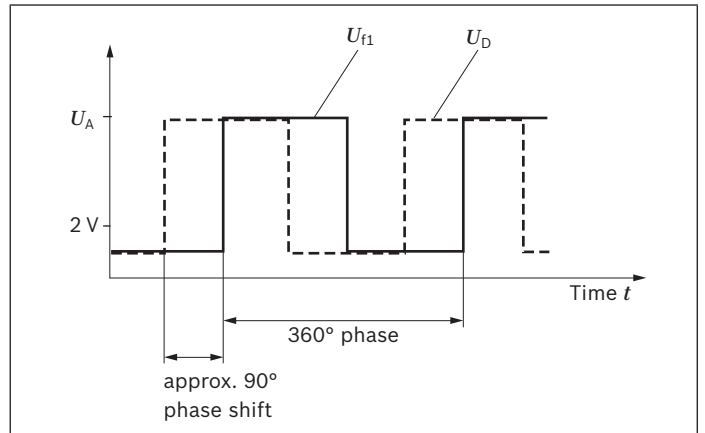


Frequency signal and direction of rotation signal can be evaluated in the measurement range from 0.1 Hz to 20 kHz.

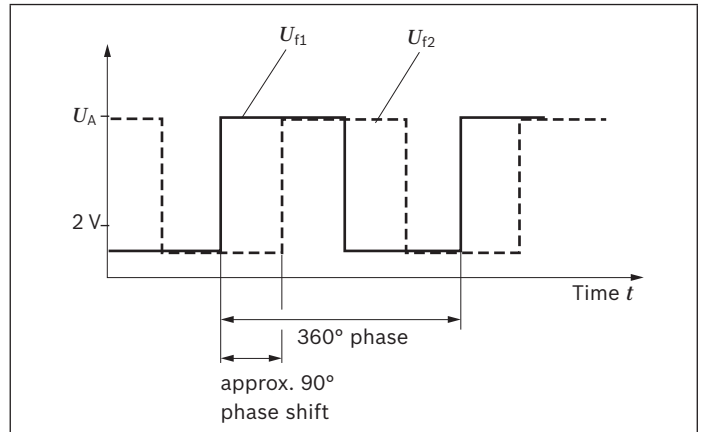
HDD2

Two partially redundant rotation direction signals

▼ Clockwise

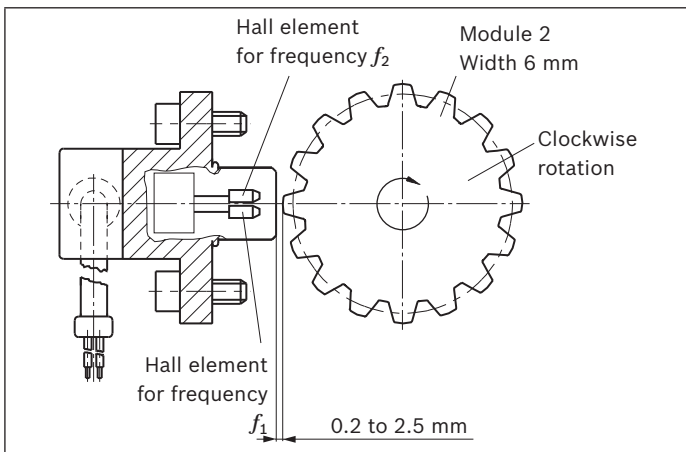


▼ Counter-clockwise

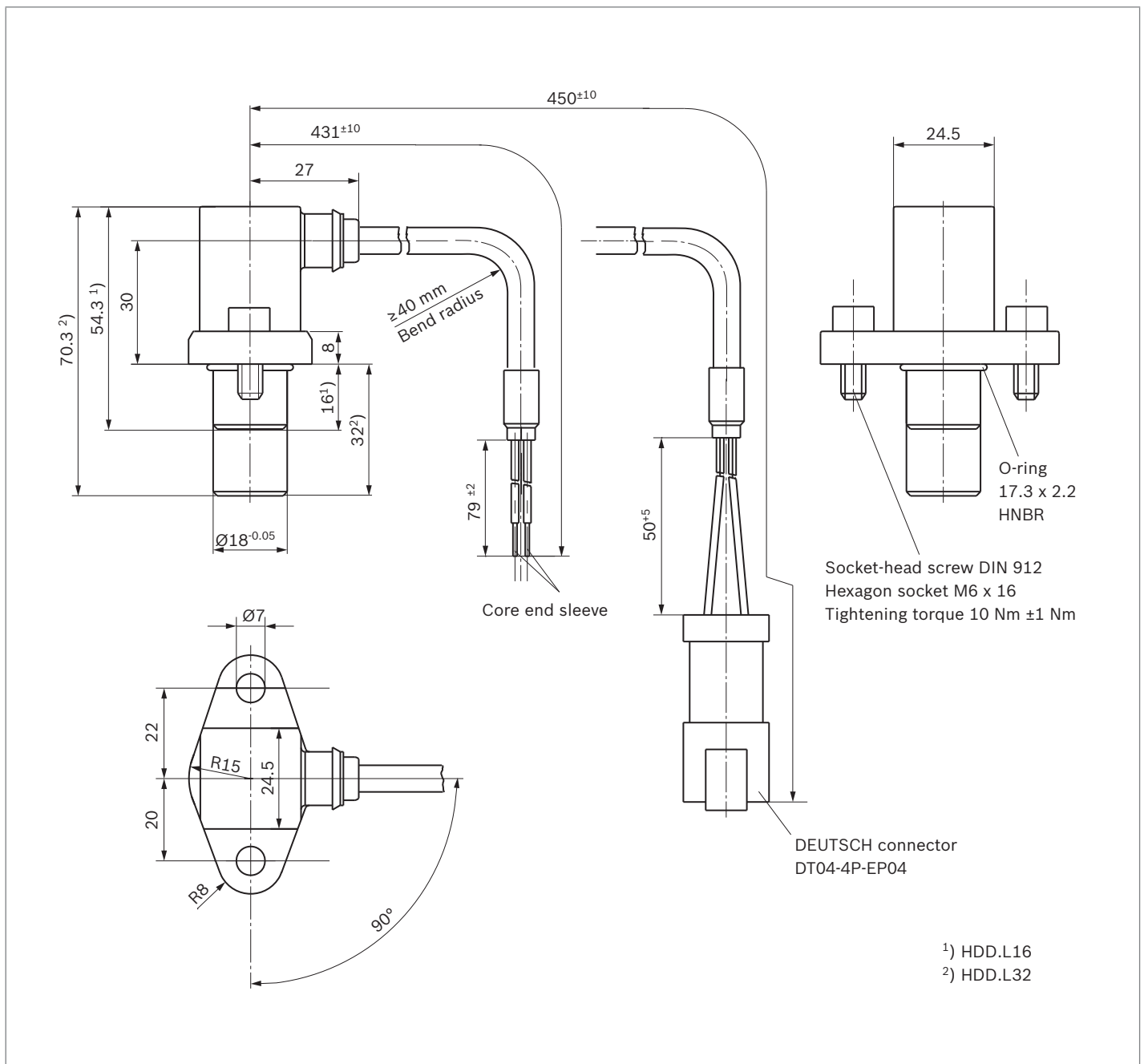


Frequency signals can only be evaluated in the measurement range from 0.1 Hz to 20 kHz.

Measuring arrangement

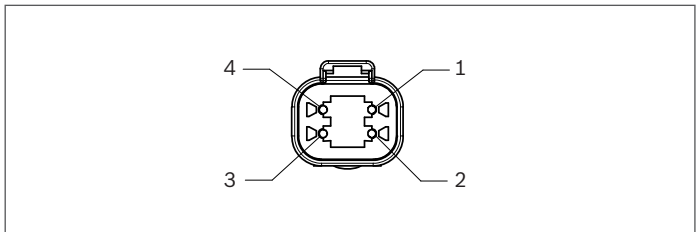


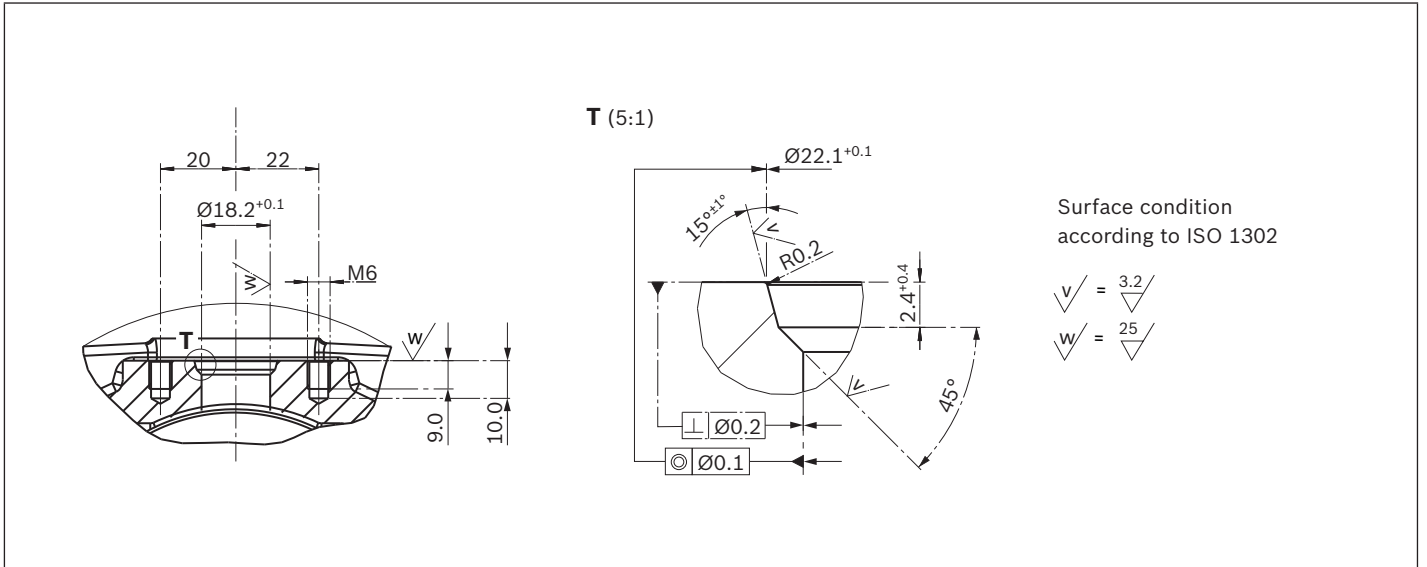
Dimensions



Pin assignment

Pin	Port
1	8 ... 32 VDC
2	ground
3	frequency signal 1
4	frequency signal 2 or direction of rotation



Locating hole**Connector****Pin assignment**

Pin	Wire color	Port
1	Brown	supply voltage U_B
2	Blue	ground GND
3	Black	frequency U_{f1}
4	White	for HDD1 direction of rotation U_D for HDD2 frequency U_{f2}

Mating connector

DEUTSCH DT06-4S-EP04

Bosch Rexroth Mat. No. R902601805

Designation	Number	DT designation
Housing	1	DT06-4S-EP04
Wedge	1	W4S
Sockets	4	0462-201-16141

The mating connector is not included in the scope of supply.
This can be supplied by Bosch Rexroth on request.

Cable dimensions

	Dimensions
Outer diameter of cable sheath	6.2 ± 0.2 mm
Wire diameter	2.2 ± 0.1 mm
Maximum strand diameter	1.2 mm (0.75 mm ²)
Core end sleeve	0.75 mm ²

Manufacturer confirmation of MTTF_d HDD values

The product meets the basic and proven requirements as per ISO 13849-2: 2008-09 as they apply to the product.

The product is not a safety component in the sense of the Machinery Directive 2006/42/EC and has not been developed according to ISO 13849:2008.

The following measured values can be used for rating:

MTTF _d value (years)	At temperature (°C)
1255	60
847	70
388	90
173	110

TM = 10 years

The specifications referred to in the table are valid under the following conditions:

- ▶ Components are used under the responsibility of the user.
- ▶ Specifications relating to installation and operating conditions must be observed in accordance with the operating instructions and the data sheet.
- ▶ The user must take into account the requirements of EN ISO 13849-1 (such as CCF, DC, software, systematic errors).
- ▶ In the interest of preventive maintenance, it is advisable to exchange the components within the maximum TM period of use.
- ▶ The fundamental safety principles of ISO 13849-2 for implementing and operating the component must also be met.
- ▶ The fundamental safety principles as per ISO 13849-2 for implementing and operating the component must also be met for categories 1, 2, 3 or 4.
- ▶ The components must be replaced only by spare parts that have the properties specified for the components being changed as a minimum.
- ▶ The MTTF_d value was calculated according to SN29500 and according to ISO 13849-1:2008-12, Appendix D Parts Count.

Assessment of safety principles

List of the safety principles that must be taken into account in the higher-level system.

Basic safety principle A1	Remarks	Manufacturer rating
Suitable selection, combination, arrangement, assembly and installation of the components/system	Consideration of the manufacturer's application instructions, e.g. catalog sheets, installation instructions, specifications, as well as application of proven technical experience with similar components/systems.	Observe the specifications for installation by the user. Associated documentation in the product data sheet.
Adequate mounting	Manufacturer's application instructions must be observed when using screw locks. An appropriate torque limitation method can be used to prevent excessive stress and to achieve adequate resistance to prevent the connection from loosening.	Observe the specifications for installation by the user. Associated documentation in the product data sheet.
Limitation of the environmental parameters range	Temperature, air humidity and contamination at the installation location are examples of these parameters. Section 10 and the manufacturer's application instructions must be observed.	The sensor meets the specifications according to the product data sheet. The user must ensure that these conditions are not exceeded. The product data sheet must be observed.
Limitation of speed and similar parameters	Observe the speed, acceleration and deceleration that are required by the application.	This must be done in the higher-level system.
Protection against unexpected start-up	Consideration of unexpected start-up caused by stored energy and after reestablishment of energy supply for different operation categories like operating mode, maintenance mode etc. A special device for releasing the stored energy may be necessary. Special applications, e.g. for saving energy for clamping device or for ensuring of a position have to be considered separately.	The sensor itself cannot produce any unexpected start-up. The higher-level system must be designed to prevent unexpected start-up.
Adequate protection to keep out fluids and dust	IP protection type observance (see IEC 60529)	This must be done in the higher-level system.
Well-tried safety principle A2		
Secured position	The mobile element of the component is held mechanically in a secure position (friction alone is not sufficient). The application of a force is required for movement out of the secured position.	The sensor is tightened and has no mechanical moving parts. The specifications for this are given in the product data sheet.
Careful selection, combination, arrangement, assembly and installation of the components/systems for the relevant application		Observe specifications for installation and intended use, as well as documentation in the product data sheet.
Careful selection of the mounting type for each application	Avoid mounting by friction only.	The sensor is tightened. The specifications for this are given in the product data sheet.
Reduced speed range and similar parameters	Set the required limitation depending according to experience and the respective application. Examples include centrifugal governor, secure monitoring of speed and travel limitation.	If necessary, this must be done in the higher-level system. Not applicable to the sensor.
Reduced environmental parameters range	Determining the necessary limitations. Examples are temperature, air humidity and contamination during installation. Observe section 10 and the manufacturer's application instructions.	Observe specifications for installation and intended use, as well as documentation in the product data sheet. The sensor meets the specifications according to the product data sheet. The user must ensure that these conditions are not exceeded.



10 **HDD Series 20** | Hall-effect speed sensor
 Manufacturer confirmation of MTTFd HDD values

Basic safety principle D1	Remarks	Manufacturer rating
Suitable selection, combination, arrangement, assembly and installation of the components/ system	Consideration of the manufacturer's application instructions, e.g. catalog sheets, installation instructions, specifications, as well as application of proven technical experience.	Instructions for installation and intended use are described in the product data sheet
Protection against unexpected start-up	Protection of unexpected start-up, e.g. after restoring the energy supply (see ISO 12100:2010, 6.2.11.4, ISO 14118, IEC 60204-1).	The sensor itself cannot produce any unexpected start-up. The higher-level system must be designed to prevent unexpected start-up.
Consideration of sequential switching for circuits with series connections of redundant signals	To prevent the common cause failure of both contacts during welding, no simultaneous switching on and off occurs, thereby ensuring that one contact always operates without power.	This must be done in the higher-level system. This is not a requirement to be met by the sensor.
Well-tried safety principle D2		
Avoidance of errors in cables	To avoid short circuits between two adjacent lines, either ► use cables with shielding that is connected to the protective conductor system on every single line, or ► use a protective conductor between all signal lines in flat cables.	The sensor cable must be fitted by the user in such a way that this requirement is met.
Distances between electrical conductors	Ensure that sufficient distance is used to prevent any unintentional connections between terminals, components and cables.	The sensor cable must be fitted by the user in such a way that this requirement is met.
Limiting electrical parameters	Limiting of the voltage, current, energy or frequencies in order to restrict movement, e.g. by torque limitation, offset/time-limited running and reduced speed to prevent any unsafe condition.	This must be taken into account by the user in the higher-level system. The product data sheet must be observed.
Prevention of undefined conditions	Undefined conditions in the control system should be avoided. The control system must have a structural design that enables all expected control system operating conditions, e.g. output/outputs, to be predetermined.	This must be taken into account by the user in the higher-level system. The sensor does not represent the control system.
Status orientation in the case of failures	If possible, all equipment/circuits should enter a safe condition or be safe to operate.	For HDD1 and HDD2, see separate table below.
Directed failure	If practicable, all components or systems should be applied for which the type of failure is known in advance, (see ISO 12100:2010, 6.2.12.3).	For HDD1 and HDD2, see separate table below.

HDD1

Component	Error direction output 1 (F1)	Error direction output 2 (direction of rotation)
Voltage regulator/supply voltage for Hall ICs faulty	Not determined, no information from the linear regulator manufacturer	Not determined, no information from the linear regulator manufacturer
Hall IC1 faulty	Not determined, no information from the Hall IC manufacturer	Not determined, no information from the Hall IC manufacturer
Hall IC2 faulty	Normal function	Normal function Not determined, no information from the Hall IC manufacturer
Output driver 1 (F1) faulty	Not determined, no information from the output driver manufacturer	Normal function
Output driver 2 (direction of rotation) faulty	Normal function	Not determined, no information from the output driver manufacturer
Pullup/pulldown resistances in output 1 (F1) faulty	NPN variants: Low level PNP variants: High level	Normal function
Pullup/pulldown resistances in output 2 (direction of rotation) faulty	Normal function	NPN variants: Low level PNP variants: High level
EMC measures on output 1 (F1) or output 2 (direction of rotation) overvoltage diode faulty	Low level	Low level
EMC measures on output 1 and 2 capacitors faulty	Not determined	Not determined

HDD2

Component	Error direction output 1 (F1)	Error direction output 2 (F2)
Voltage regulator/supply voltage for Hall ICs faulty	Not determined, no information from the linear regulator manufacturer	Not determined, no information from the linear regulator manufacturer
Hall IC1 faulty	Not determined, no information from the Hall IC manufacturer	Normal function
Hall IC2 faulty	Normal function	Not determined, no information from the Hall IC manufacturer
Output driver 1 (F1) faulty	Not determined, no information from the output driver manufacturer	Normal function
Output driver 2 (F2) faulty	Normal function	Not determined, no information from the output driver manufacturer
Pullup/pulldown resistances in output 1 (F1) faulty	NPN variants: Low level PNP variants: High level	Normal function
Pullup/pulldown resistances in output 2 (F2) faulty	Normal function	NPN variants: Low level PNP variants: High level
EMC measures on output 1 (F1) or output 2 (F2) overvoltage diode faulty	Low level	Low level
EMC measures on output 1 and 2 capacitors faulty	Not determined	Not determined

Safety instructions

General instructions

- ▶ Before finalizing your design request a binding installation drawing.
- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ It is not permissible to open the sensor or to modify or repair the sensor. Modifications or repairs to the wiring could lead to dangerous malfunctions.
- ▶ Connections in the hydraulic system may only be opened in depressurized state.
- ▶ The sensor may only be assembled/disassembled in depressurized and deenergized state.
- ▶ System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- ▶ When commissioning the sensor, the machine may pose unforeseen hazards. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the sensor should fail or demonstrate faulty operation, it must be replaced.
- ▶ Despite every care being taken when compiling this document, it is not possible to take into account all feasible applications. If instructions for your specific application are missing, you can contact Bosch Rexroth.
- ▶ Sensors do not fall under the scope of EMC-RL 2004/108/EC or 2014/30/EU. A declaration of conformity and the CE marking for individually sold sensors is not required, since the sensors are only sold to machine manufacturers (OEM) or to companies with the necessary expertise (i.e. certified Bosch Rexroth partners or companies with trained and qualified service personnel).
Furthermore, the responsibility of the above mentioned companies for machine EMC testing remains unaffected in principle.
- ▶ The use of sensors by private users is not permissible, since these users do not typically have the required level of expertise.

Notes on the installation location and position

- ▶ Do not install the sensor close to parts that generate considerable heat (e.g., exhaust).
- ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ The connector of the sensor is to be unplugged during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the sensor.

Notes on transport and storage

- ▶ Please examine the sensor for any damages which may have occurred during transport. If there are obvious signs of damage, please immediately inform the transport company and Bosch Rexroth.
- ▶ If it is dropped, the sensor must not be used any longer as invisible damage could have a negative impact on reliability.

Notes on wiring and circuitry

- ▶ Lines to the sensors must be designed as short as possible and be shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The sensor mating connector should only be plugged and unplugged when it is in a deenergized state.
- ▶ The sensor lines are sensitive to radiation interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor lines should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.
- ▶ Lines from the sensor to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The wiring harness should be fixated mechanically in the area in which the sensor is installed (spacing <150 mm). The wiring harness should be fixated so that in-phase excitation with the sensor occurs (e.g. at the sensor mounting points).

- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.

Intended use

- ▶ The sensor is designed for use in mobile working machines provided no limitations / restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the sensor must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the sensor other than that described in chapter "Intended use" is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, interference in the component not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ The customer is responsible for performing a risk analysis of the mobile working machine and determining the possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.).
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

Further information

- ▶ Further information about the sensor can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The sensor must be disposed according to the national regulations of your country

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BODAS Pressure sensor PR3 series 10

RE 95155

Edition: 06.2016

Replaces: 05.2015



- ▶ Measurement ranges to 25, 50, 160, 200, 250, 400, 600 bar
- ▶ Ratiometric output signal 0.5 to 4.5 V with 5 V supply voltage
- ▶ Fixed output signal 0.5 to 4.5 V with 8 to 36 V supply voltage
- ▶ Output signal 25% to 75% supply voltage with 8 to 12 V supply voltage
- ▶ Type of protection: IP67 and IP69K

Features

- ▶ Thin-film measurement principle
- ▶ Compact dimensions for all pressure ranges
- ▶ Shock and vibration resistant
- ▶ EMC characteristics to 100 V/m
- ▶ High resistance to pressure spikes
- ▶ Very good resistance to temperature shock

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Ordering code

	01	02	03	04	05	06
BODAS -	PR3				/	10

Type

01	Pressure sensor	PR3
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Measurement range

02	0 to 25 bar	025
	0 to 50 bar	050
	0 to 160 bar	160
	0 to 200 bar	200
	0 to 250 bar	250
	0 to 400 bar	400
	0 to 600 bar	600

Mechanical connection

		25, 50, 160, 200, 250, 400	600	
03	G1/4 A in according to DIN EN ISO 1179-2		●	G
	M14 x 1.5 according to ISO 6149-2		-	M

Electrical connection

		25, 50	160	200	250, 400	600G	600M	
04	AMP Superseal 1.5	●	●	-	●	●	-	S
	DEUTSCH DT04-3P	-	-	-	-	-	●	D
	Jet connector	-	●	●	-	-	-	J

Supply

		Output signal	25, 50	160GS	160GJ	200	250, 400	600GS	600MD	
05	5 ±0.5 V	0.5 to 4.5 V ratiometric	●	●	-	-	●	●	-	05
	8 to 36 V	0.5 to 4.5 V fixed	-	-	-	-	-	-	●	36
	8 to 12 V	25% to 75% U_{sup}	-	-	●	●	-	-	-	12

Series

06		10
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● = Available - = Not available

Available variants

Type							Material number
PR3	025	G	S	05	/	10	R917008819
PR3	050	G	S	05	/	10	R917008821
PR3	160	G	S	05	/	10	R917008822
PR3	250	G	S	05	/	10	R917008823
PR3	400	G	S	05	/	10	R917008824
PR3	600	G	S	05	/	10	R917008825
PR3	160	G	J	12	/	10	R917008828
PR3	200	G	J	12	/	10	R917008829
PR3	600	M	D	36	/	10	R917008826

Description

This sensor is used for measuring pressure in hydraulic circuits, but is also suitable for measuring all kinds of gases of fluid group 2 according to the pressure vessel directive up to 200 bar (e.g. air). Due to its outstanding characteristics, it is also ideally suited for use in mobile hydraulics: shock and vibration resistance, type of protection,

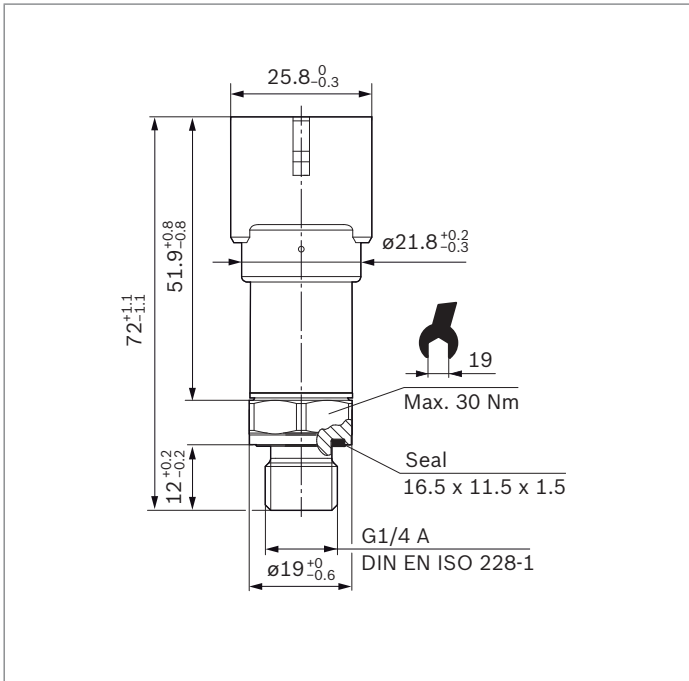
resistance to pressure spikes, resistance to temperature shock, EMC characteristics (up to 100 V/m), and much more. The measurement principle uses a hermetically welded thin-film measurement cell, which ensures long-term leak resistance. The sensor signal can be directly evaluated by a BODAS controller RC.

Technical data

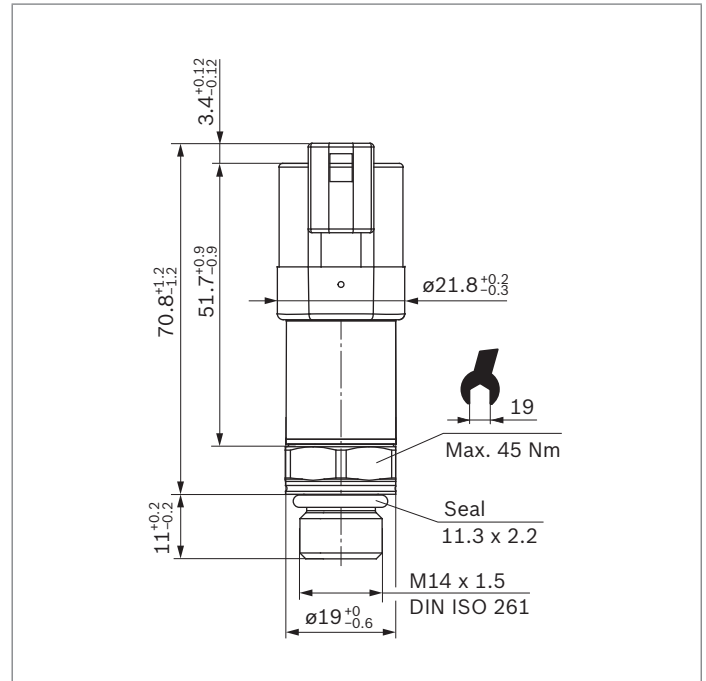
Type PR3		025	050	160	250	400	600	600	160	200
		GS05	GS05	GS05	GS05	GS05	GS05	MD36	GJ12	GJ12
Measurement range	bar	0...25	0...50	0...160	0...250	0...400	0...600	0...600	0...160	0...200
Overload limit	bar	50	100	320	500	800	1200	1200	320	400
Bursting pressure	bar	125	250	800	1200	1700	2400	2400	800	1000
Output signal		0.5 V to 4.5 V, ratiometric						0.5 to 4.5 V, fixed	25 to 75% U_{sup}	
Supply voltage U_{sup}		5 V \pm 0.5 V						8 to 36 V	8 to 12 V	
Connector		AMP Superseal 1.5						DEUTSCH DT04-3P	Jet connector	
Parts contacting measuring materials		CrNi steel, HNBR								
Housing material		PPS GF40/CrNi steel								
Load resistance		4.5 k Ω , for Jet connectors however > 1 k Ω								
Maximum current consumption										
For voltage interface		\leq 5 mA without load								
Jet connector variants		\leq 10 mA without load								
Response time (10 to 90%)		\leq 2 ms								
Overall accuracy		\leq \pm 2%								
Reproducibility		\leq 0.2% of tensioning								
Stability per year		\leq 0.3% of tensioning (with reference conditions)								
Medium temperature range		-40 °C to +125 °C								
Ambient temperature range		-40 °C to +100 °C								
Storage temperature range		-40 °C to +120 °C								
Compensated range		0 °C to +80 °C								
Middle temperature coefficient zero point		\leq 0.15 % of tensioning / 10K in compensated range								
Middle temperature coefficient of tensioning		\leq 0.15 % of tensioning / 10K in compensated range								
Temperature error in the nominal temperature range		\leq 1 % of tensioning typ. \leq 1.5% of tensioning								
CE conformity		Pressure vessel directive 97/23/EC UN ECE 10 Rev4 and ISO 11452-2, -4, -5 as well as according to IEC 61000-4-3.								
E1 type approval		existing								
Pressure cycles over service life		20 million cycles (10% to 90% of nominal pressure)								
Shock resistance		50 g (DIN EN 60068-2-27, 11 ms), 500 g (DIN EN 60068-2-27, 1 ms)								
Vibration resistance		20 g (DIN EN 60068-2-6, 5 Hz to 2000 Hz)								
Electromagnetic compatibility EMC		100 V/m Irradiation: ISO 11452-2 intensity IV; emissions: ISO 14982								
Electrical protection		Protection from voltage reversal, short circuits and undervoltage; protection from overvoltage in the defined supply voltage range								
Type of protection with installed mating connector		IP67 and IP69K								
Weight		approx. 50 g								

Dimensions

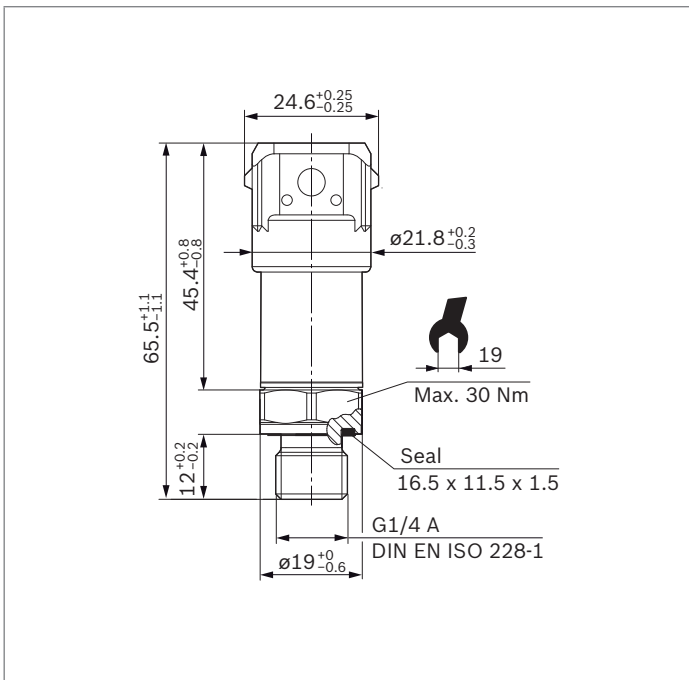
AMP Superseal



DEUTSCH DT04-3P



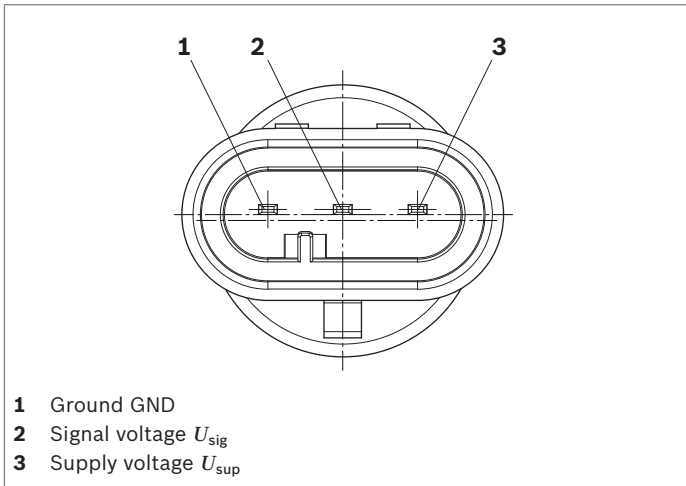
Jet connector



Connector

AMP Superseal

▼ Pin assignment

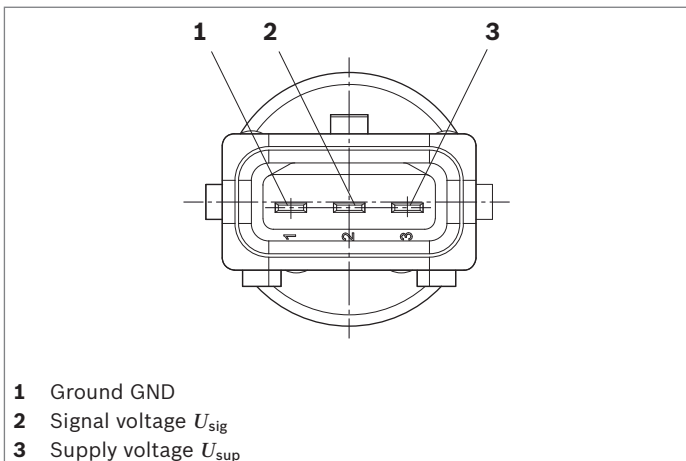


▼ Mating connector¹⁾

Designation	Number	Material number
Mating connector set		R902602132 ¹⁾
Socket housing 3-pin	1	282087-1 ²⁾
Single-wire seal, yellow	3	281934-2 ²⁾
Socket contact	3	183025-1 ²⁾

Jet connector

▼ Pin assignment

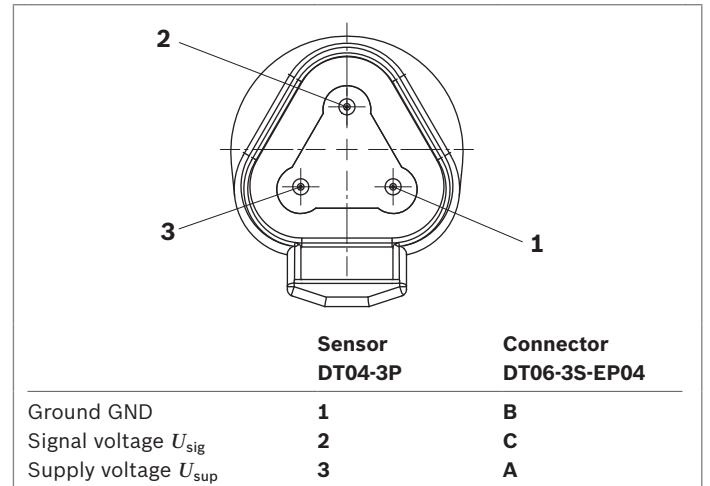


▼ Mating connector¹⁾

Designation	Number	Material number
Bosch connector, 3-pin		R917000515 ¹⁾
Connector housing with retention spring	1	1928402579 ⁴⁾
Contact for mini timer	3	929939 ²⁾
Protection cap	1	1280703022 ⁴⁾
Single seal	3	828904-1 ²⁾

DEUTSCH DT04-3P

▼ Pin assignment



▼ Mating connector¹⁾

Designation	Number	Material number
Mating connector set		R902603524 ¹⁾
Housing 3-pin	1	DT06-3S-EP04 ³⁾
Wedge	1	W3S ³⁾
Sockets	3	0462-201-16141 ³⁾

1) The mating connectors are not included in the scope of supply. These are available from Bosch Rexroth under the corresponding material numbers.

2) Available from AMP

3) Available from DEUTSCH

4) Available from Bosch

Manufacturer confirmation of PR3 MTTF_d-values

The MTTF_d-values was determined in accordance with ISO 13849-1:2008-12, Appendix D, Parts Count Method.

According to ISO 13849-2: 2008-09, the product meets the basic safety principles and the well-tried safety principles to the extent that they apply to the product.

The sensor is not a safety component in the sense of Directive on Machinery 2006/42/EC and has not been developed according to ISO 13849:2008.

Note

The MTTF_d-values given are only valid for the sensor. For assessment of the functional safety for sensors according to ISO 13849, the entire signal chain has to be considered.

PR3 DEUTSCH-Connector

Valid for PR3-600MD36

Calculated with IEC TR 62380:2004 with real stress of the components 2014-01-30 FSM-ps

Ambient temperatur Control unit [°C]	Self-heating [°C]	Temperature profile, Operating time share [%]					
		1	2	3	4	5	6
10	10	1	1	1	1	1	0
30	10	2	2	2	2	1	0
40	10	3	3	3	3	1	0
50	10	4	3	3	3	1	100
60	10	5	3	3	3	1	0
70	10	6	3	3	3	1	0
80	10	79	85	3	3	1	0
90	10	0	0	82	3	1	0
100	10	0	0	0	79	92	0
110	10	0	0	0	0	0	0
125	10	0	0	0	0	0	0
MTTF _a -value [years] with use	4h per day	845	841	756	685	872	3547
	8h per day	802	797	712	639	617	3211
	16h per day	721	715	632	562	536	2672
	24h per day	783	774	661	570	534	4673

Ambient temperatur Control unit [°C]	Self-heating [°C]	Temperature profile, Operating time share [%]					
		7	8	9	10	11	12
10	10	0	0	0	0	0	0
30	10	0	0	0	0	0	0
40	10	0	0	0	0	0	0
50	10	0	0	0	0	0	0
60	10	0	0	0	0	0	0
70	10	100	0	0	0	0	0
80	10	0	100	0	0	0	0
90	10	0	0	100	0	0	0
100	10	0	0	0	100	0	0
110	10	0	0	0	0	100	0
125	10	0	0	0	0	0	100
MTTF _a -value [years] with use	4h per day	3017	2743	2470	2205	1952	1605
	8h per day	2582	2273	1978	1705	1457	1139
	16h per day	1977	1666	1390	1150	947	704
	24h per day	2578	1938	1469	1124	868	599

3

PR3 AMP-Connector

Valid for PR3-025GS05, PR3-050GS05, PR3-160GS05, PR3-250GS05, PR3-400GS05, PR3-600GS05

Calculated with IEC TR 62380:2004 with real stress of the components 2014-01-30 FSM-ps

Ambient temperatur Control unit [°C]	Self-heating [°C]	Temperature profile, Operating time share [%]					
		1	2	3	4	5	6
10	10	1	1	1	1	1	0
30	10	2	2	2	2	1	0
40	10	3	3	3	3	1	0
50	10	4	3	3	3	1	100
60	10	5	3	3	3	1	0
70	10	6	3	3	3	1	0
80	10	79	85	3	3	1	0
90	10	0	0	82	3	1	0
100	10	0	0	0	79	92	0
110	10	0	0	0	0	0	0
125	10	0	0	0	0	0	0
MTTF _d -value [years] with use	4h per day	1077	1071	954	856	1048	4485
	8h per day	1007	999	882	784	751	3954
	16h per day	880	871	761	668	632	3159
	24h per day	1038	1038	880	752	702	4626

Ambient temperatur Control unit [°C]	Self-heating [°C]	Temperature profile, Operating time share [%]					
		7	8	9	10	11	12
10	10	0	0	0	0	0	0
30	10	0	0	0	0	0	0
40	10	0	0	0	0	0	0
50	10	0	0	0	0	0	0
60	10	0	0	0	0	0	0
70	10	100	0	0	0	0	0
80	10	0	100	0	0	0	0
90	10	0	0	100	0	0	0
100	10	0	0	0	100	0	0
110	10	0	0	0	0	100	0
125	10	0	0	0	0	0	100
MTTF _d -value [years] with use	4h per day	3662	3260	2876	2516	2186	1751
	8h per day	3031	2606	2218	1873	1572	1199
	16h per day	2219	1827	1493	1214	984	718
	24h per day	2537	1902	1439	1098	846	582

PR3 JET-Connector

Valid for PR3-160GJ12 and PR3-200GJ12

Calculated with IEC TR 62380:2004 with real stress of the components and inclusive conductor film 2014-01-30 FSM-ps

Ambient temperatur Control unit [°C]	Self-heating [°C]	Temperature profile, Operating time share [%]					
		1	2	3	4	5	6
10	10	1	1	1	1	1	0
30	10	2	2	2	2	1	0
40	10	3	3	3	3	1	0
50	10	4	3	3	3	1	100
60	10	5	3	3	3	1	0
70	10	6	3	3	3	1	0
80	10	79	85	3	3	1	0
90	10	0	0	82	3	1	0
100	10	0	0	0	79	92	0
110	10	0	0	0	0	0	0
125	10	0	0	0	0	0	0
MTTF _a -value [years] with use	4h per day	843	838	751	678	821	3543
	8h per day	788	782	695	621	596	3120
	16h per day	690	683	599	528	501	2489
	24h per day	720	711	602	515	479	3721

Ambient temperatur Control unit [°C]	Self-heating [°C]	Temperature profile, Operating time share [%]					
		7	8	9	10	11	12
10	10	0	0	0	0	0	0
30	10	0	0	0	0	0	0
40	10	0	0	0	0	0	0
50	10	0	0	0	0	0	0
60	10	0	0	0	0	0	0
70	10	100	0	0	0	0	0
80	10	0	100	0	0	0	0
90	10	0	0	100	0	0	0
100	10	0	0	0	100	0	0
110	10	0	0	0	0	100	0
125	10	0	0	0	0	0	100
MTTF _a -value [years] with use	4h per day	2937	2631	2334	2051	1788	1437
	8h per day	2422	2093	1788	1514	1274	974
	16h per day	1765	1458	1195	973	971	578
	24h per day	2032	1522	1151	879	677	467

Assessment of Safety Principles

List of the safety principles that must be to take into account in the higher-level system.

Basic safety principle A1	Remarks	Assessment
Application of the principle of energy separation	<p>The safe state is achieved by connection of energy. Please check process for stopping in ISO 12100:2010, 6.2.11.3.</p> <p>Energy is supplied for actuation of movement of a mechanism. Please check process for movement in ISO 12100:2010, 6.2.11.3.</p> <p>Respect different operating categories, e.g. operating mode, maintenance mode.</p> <p>Important: This principle may not be applied if a dangerous situation can happen because of energy loss, e.g. release of a tool by loss of loading force.</p>	Request has to be ensured by higher-level system.
Protection against unexpected movement	<p>Consideration of unexpected movement caused by stored energy and after reestablishment of energy supply for different operation categories like operating mode, maintenance mode etc. A special device to let off stored energy may be is necessary.</p> <p>Special applications, e.g. for saving energy for clamping device or for ensuring of a position have to be considered separately.</p>	Request has to be ensured by higher-level system.
Well-tried safety principle A2		
Application of components with defined breakdown	The predominant occurring breakdown behavior of a component is known in advance and always the same. Please check ISO 12100:2010, 6.2.12.3	Request has to be ensured by higher-level system.
Basic safety principle C1		
Application of principle energy separation	<p>The safe state will be achieved by activating of energy at all relevant devices. Please check process for stopping in ISO 12100:2010, 6.2.11.3.</p> <p>Energy is supplied for actuation of movement of a mechanism.. Please check process for movement in ISO 12100:2010, 6.2.11.3.</p> <p>Respect different operating categories, e.g. operating mode, maintenance mode.</p> <p>This principle may not be applied for some applications, e.g.if because of loss of hydraulic pressure an additional endangering happens.</p>	Request has to be ensured by higher-level system.
Protection against unexpected movement	<p>Consideration of unexpected movement caused by stored energy and after reestablishment of energy supply for different operation categories like operating mode, maintenance mode etc. A special device to let off stored energy may be is necessary.</p> <p>Special applications, e.g. for saving energy for clamping device or for ensuring of a position have to be considered separately.</p>	Request has to be ensured by higher-level system.

Basic safety principle D1	Remarks	Assessment
Application of energy separation principle	<p>A safe state will be achieved by disconnecting all important devices from energy source, e.g. by application of a common closed contact (NC) for inputs (tactile and position switch) and common open contact (NO) for relay (see also ISO 12100:2010, 6.2.11.3).</p> <p>In some cases exceptions are possible, e.g. if the breakdown of energy source is an additional endangering.</p> <p>Time delayed functions can be necessary to achieve a safe state of the system (see IEC 60204-1:2005, 9.2.2).</p>	Request has to be ensured by higher-level system.
Protection against unexpected movement	Protection of unexpected movement, e.g. recovering of energy supply (see ISO 12100:2010, 6.2.11.4, ISO 14118, IEC 60204-1).	Request has to be ensured by higher-level system.
Protection against steering current circuit	Steering current circuit shall be protected according to IEC 60204-1:2005, 7.2 und 9.1.1.	Request has to be ensured by higher-level system.
Well-tried safety principle D2		
Avoidance of errors in cables	<p>In order to prevent short circuits between two lines:</p> <ul style="list-style-type: none"> ▶ At every single line use a cable, which shield is connected to the protection system or ▶ In flat cables application of a protection conductor between all signal conductors. 	Request has to be ensured by higher-level system.
Limiting of energy	For supply of a limited amount of energy a capacitor has to be used, e.g. for clock pulse steering.	Request has to be ensured by higher-level system.
State alignment of breakdowns	If possible in case of breakdown all devices/circuits shall switch to a safe state or safe conditions.	Request has to be ensured by higher-level system.
Directed breakdown	If realizable all components or systems shall be applied, where the case of breakdown is known ahead, (see ISO 12100:2010, 6.2.12.3).	Request has to be ensured by higher-level system.

Installation instructions

Electrical connection

- ▶ The device may only be installed by a trained electrician.
- ▶ The national and international specifications regarding the installation of electro-technical systems must be followed.
- ▶ Voltage supply according to SELV, PELV.
- ▶ De-energize the system.

Mechanical connection

- ▶ Before installing and removing the device, make certain that the system is not pressurized.

Safety instructions

Risk of injury!

Overload pressures that exceed the specified maximum permissible pressure are to be prevented through appropriate measures. The specified bursting pressure must not be exceeded. Even exceeding the bursting pressure for brief periods can destroy the device.

General instructions

- ▶ Before finalizing your design, request a binding installation drawing.
- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ It is not permissible to open the BODAS pressure sensor PR3 or to modify or repair the BODAS pressure sensor PR3. Modifications or repairs to the wiring could result in dangerous malfunctions.
- ▶ Only allow pressure measurement devices to be installed by trained and specialist personnel who are authorized by the system owner.
- ▶ Connections must only be opened while in a depressurized state!
- ▶ System developments, installation and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and with the complete system.
- ▶ While commissioning the BODAS pressure sensor PR3, the machine may pose unforeseen dangers. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the BODAS pressure sensor PR3 should fail or demonstrate faulty operation, it must be replaced.
- ▶ Residual measurement materials in unmounted pressure measurement devices could endanger people, the environment and equipment. Take appropriate precautionary measures.
- ▶ In spite of taking great care in preparing this document, all conceivable application cases could not be taken into account. If information is lacking for your specific application, please contact Bosch Rexroth.

Pressure vessel directive

- ▶ Devices with MEV (measurement range end value) 600 bar correspond to directive 97/23/EC and are not designed for overheated fluids of fluid group 2. These devices are manufactured and inspected according to module A.
- ▶ Devices with MEV 25 to 400 bar correspond to article 3 paragraph (3) of directive 97/23/EC and are not designed and manufactured for overheated fluids of fluid group 2, in accordance with good engineering practice.

Notes on the installation location and position

- ▶ Do not install the BODAS pressure sensor PR3 close to parts that generate considerable heat (e.g. exhaust).
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ The connector of the BODAS pressure sensor PR3 is to be unplugged during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.

Notes on transport and storage

- ▶ Please inspect the device for any damages which may have occurred during transport. If there are obvious signs of damage, please immediately inform the transport company and Bosch Rexroth.
- ▶ If it is dropped, the BODAS pressure sensor PR3 must not be used any longer as invisible damage could have a negative impact on reliability.

Notes on wiring and circuitry

- ▶ Lines to the pressure sensors must be designed as short as possible and be shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The BODAS pressure sensor PR3 should only be plugged and unplugged when it is in a de-energized state.
- ▶ Lines from the BODAS pressure sensor PR3 to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The wiring harness should be fixated mechanically in the area in which the sensor is installed (spacing < 150 mm). The wiring harness should be fixated so that in-phase excitation with the sensor occurs (e.g. at the sensor mounting points).
- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.

- ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.
- ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.
- ▶ The sensor lines are sensitive to radiation interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor lines should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.

Intended use

- ▶ The BODAS pressure sensor PR3 is designed for use in mobile working machines provided no limitations/restrictions are made to certain application areas in this data sheet.
- ▶ Prior to installation, commissioning and operation, make certain that the correct pressure measurement device was selected with respect to measurement range, design and – based on the specific measurement conditions – parts which are in contact with measuring materials (corrosion). Furthermore, the respective national safety regulations are to be observed.
- ▶ Operation of the BODAS pressure sensor PR3 must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.
- ▶ Failure to observe the respective specifications may result in serious bodily injury and/or property damage.

Improper use

- ▶ Any use of the BODAS pressure sensor PR3 other than that described in chapter "Intended use" is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, interference in the component not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ The customer is responsible for performing a risk analysis of the mobile working machine and determining the possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.).
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

Further information

- ▶ Further information about the BODAS pressure sensor PR3 can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The BODAS pressure sensor PR3 must be disposed according to the national regulations of your country.

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BODAS Pressure sensor PR4 series 10

RE 95156

Edition: 12.2015



- ▶ Measurement range
 - 0 to 280 bar
 - 0 to 420 bar and
 - 0 to 600 bar
- ▶ Ratiometric output signal 0.5 to 4.5 V with 5 V supply voltage
- ▶ Type of protection IP67 and IP69K

Features

- ▶ Thin-film measurement principle
- ▶ Compact dimensions for all pressure ranges
- ▶ Shock and vibration resistant
- ▶ EMC characteristics better than 150 V/m
- ▶ High resistance to pressure spikes
- ▶ Very good resistance to temperature shock
- ▶ High accuracy over the complete measuring range
- ▶ Maximum tightening torque 45 Nm

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Ordering code

	01	02	03	04	05	06
BODAS	PR4				/	10

Type

01	Pressure sensor	PR4
----	-----------------	------------

Measurement range

02	0 to 280 bar ¹⁾	280
	0 to 420 bar	420
	0 to 600 bar	600

Mechanical connection

		280	420	600	
03	G1/4 A nach DIN EN ISO 1179-2	●	●	-	G
	M14 x 1.5 nach ISO 6149-2	-	-	●	M

Electrical connection

04	Bosch Compact	B
----	---------------	----------

	Supply	Output signal	
05	5 ±0.25 V	0.5 to 4.5 V ratiometric	05

Series

06		10
----	--	-----------

Available variants

Type	Material number					
PR4 280 G B 05 / 10	R917005562 ¹⁾					
PR4 420 G B 05 / 10	R917009842					
PR4 600 M B 05 / 10	R917010105					

● = Available - = Not available

Description

This sensor is used for measuring pressure in hydraulic circuits. Due to its outstanding characteristics, it is also ideally suited for use in mobile hydraulics: shock and vibration resistance, type of protection, resistance to pressure spikes, resistance to temperature shock, EMC characteristics better than 150 V/m. The measurement principle uses a hermetically welded thin-film measurement cell, which ensures long-term leak resistance. The sensor signal can be directly evaluated by a BODAS controller RC.

¹⁾ Start of production: Mid of 2016

Technical data

Type PR4	280 GB05	420 GB05	600 MB05
Measurement range	0 to 280 bar	0 to 420 bar	0 to 600 bar
Overload limit ¹⁾	400 bar	560 bar	800 bar
Bursting pressure ²⁾⁴⁾	2500 bar	3750 bar	5250 bar
Output signal	0.5 V to 4.5 V, ratiometric		
Supply voltage U_{sup}	5 V \pm 0.25 V		
Maximum supply voltage	18 V (maximum 1 h)		
Connector	Bosch Compact 1.1a		
Short circuit signal output to GND or supply (maximum 8 h) with supply at the same time of U_s at $U_s, kurz$	0 to 18 V		
Sensor output impedance $R_{differential}$ at $0.1 U_s < U_{out} < 0.9 U_s$	typical: 5 Ω maximum: 10 Ω		
Current consumption			
Typical at 5V supply voltage	12 mA		
Maximum without load	\leq 15 mA		
Maximum at reverse connection	260 mA		
Parts contacting measuring cell materials	X5CrNiCuNb16-4		
Housing material	PBT-GF30/CrNi steel		
Response time (10 to 90%)	\leq 1.0 ms		
Overall accuracy	\leq 1.5 %, refer to table "tolerance over temperature, pressure and life time"		
Medium temperature range ³⁾	-40 °C to +150 °C		
Ambient temperature range	-40 °C to +100 °C		
Storage temperature range	-30 °C to +60 °C at 0 to 80 % relative humidity and 5 years		
Transportation conditions			
Conditions deviating from the storage conditions are allowed for the transport:			
Duration, max. 48 h temperature	-40 °C to +80 °C		
Relative humidity	0 % to 80 %		
CE conformity	Pressure vessel directive 97/23/EC UN ECE 10 Rev4 and ISO 11452-2, -4, -5 as well as according to IEC 61000		
Service life	10000 operating hours or 10 years		
Pressure cycles over service life	10 million cycles		
Shock resistance	50 g (DIN EN 60068-2-27, 11 ms), 500 g (DIN EN 60068-2-27, 1 ms)		
Vibration resistance			
Amplitude of the deflection	$s = 0.35$ mm in the range 70 Hz to 147 Hz		
Amplitude of the acceleration	$a = 300$ m/s ² in the range 147 Hz to 1350 Hz $a = 250$ m/s ² in the range 1350 Hz to 2000 Hz		
Frequency change	0.5 octave/min		
Duration of excitation	100 h in each spatial direction with the same test specimen		
Drop test	Controlled drop from 1 m height onto concrete in accordance with ISO 16750-3. One drop event per axial direction.		
Electromagnetic compatibility EMC			
BCI up to 200 mA	open and closed loop according ISO 11452-4 up to 400 MHz.		
Antenna > 150 V/m	according ISO 11452-2 from 200 MHz - 3.2 GHz		
Electrical protection	Protection from voltage reversal, short circuits and undervoltage; protection from overvoltage in the defined supply voltage range		
Type of protection with installed mating connector	IPX6K and IPX9K according to ISO 20653 (2006-08-15)		
Weight approx.	G 1/4: 48 g, M14: 52 g		

- 1) maximum 15 minutes at P_n to P_{max}
 2) maximum 15 minutes at P_n to P_{berst}
 3) 150 °C: 250 h over live time

- 4) The specified bursting pressure is valid for the device only.
 This value does not include the mechanical interface - the thread between the sensor and the hydraulic component

Characteristics

Output voltage as function of the pressure

The signal output voltage is (up to the nominal pressure) calculated from the actual pressure as follows:

$$U_{OUT} = (c_{1p} + c_0) U_S$$

where

U_{OUT} = Signal output voltage

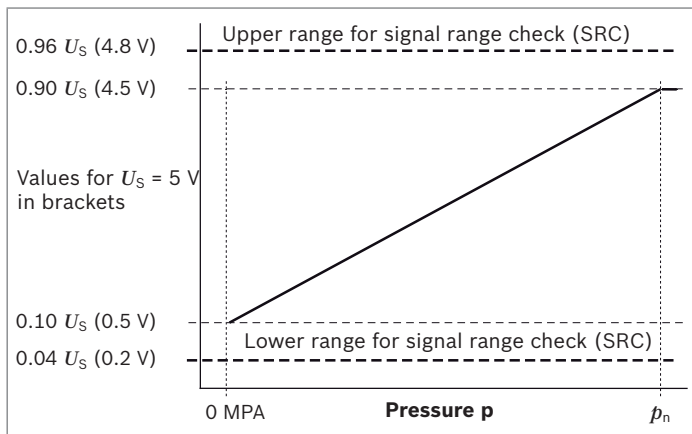
U_S = Supply voltage (typ. 5 V)

p = Pressure [MPa]

$c_0 = 0.1$

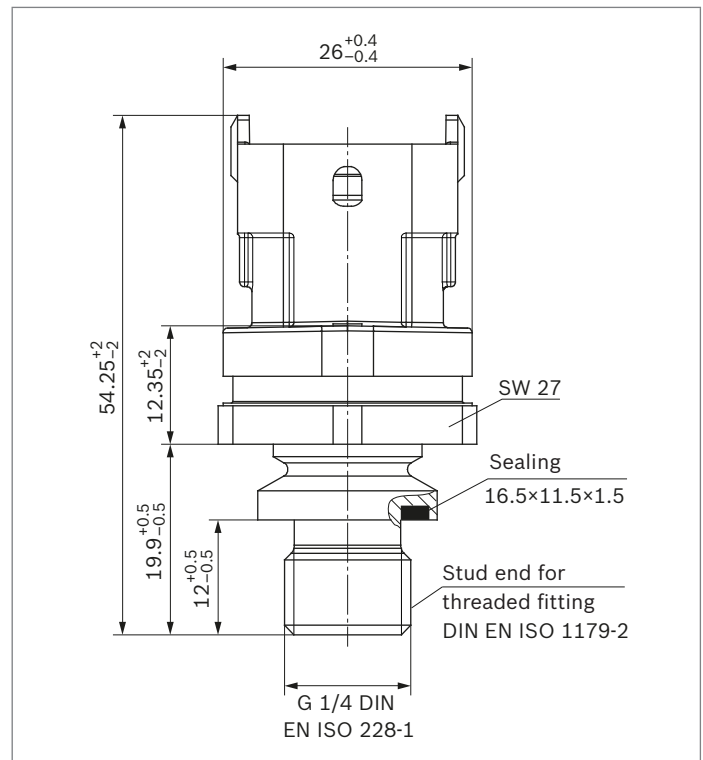
$c_1 = 0.8 / P_n \text{ MPa}^{-1}$

p_n = Nominal pressure [MPa]

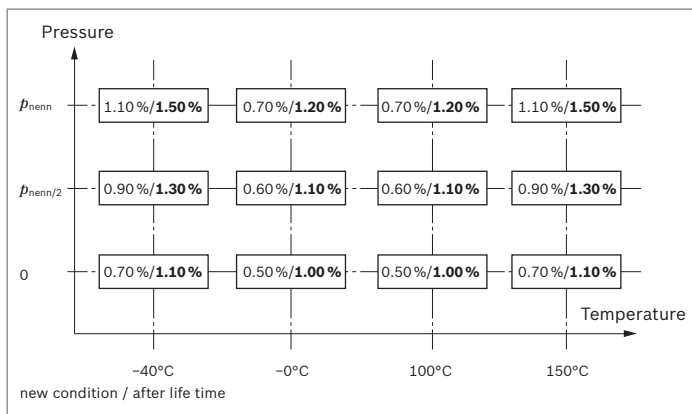


Dimensions

Sensor with mechanical connection G 1/4 according DIN EN ISO 1179-2

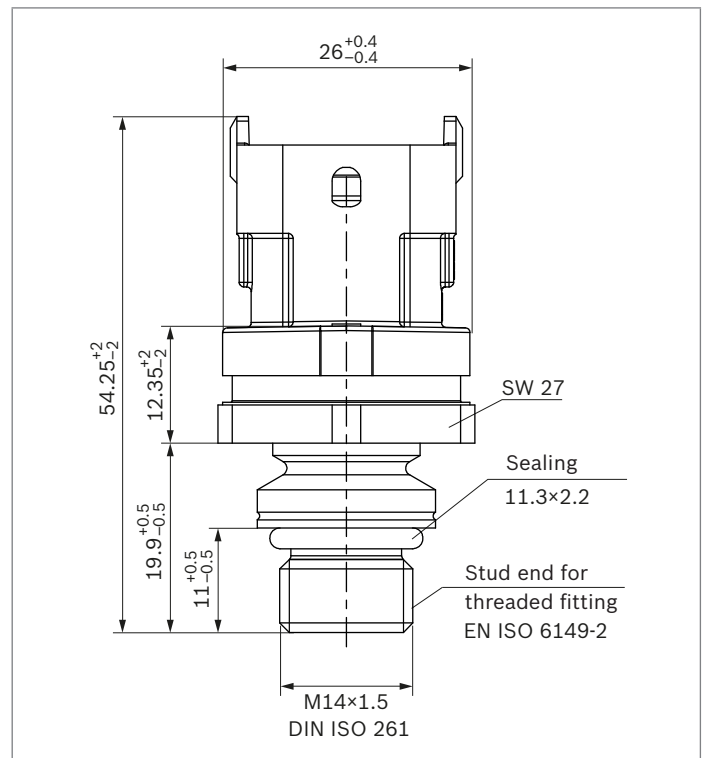


Tolerance over temperature, pressure and life time



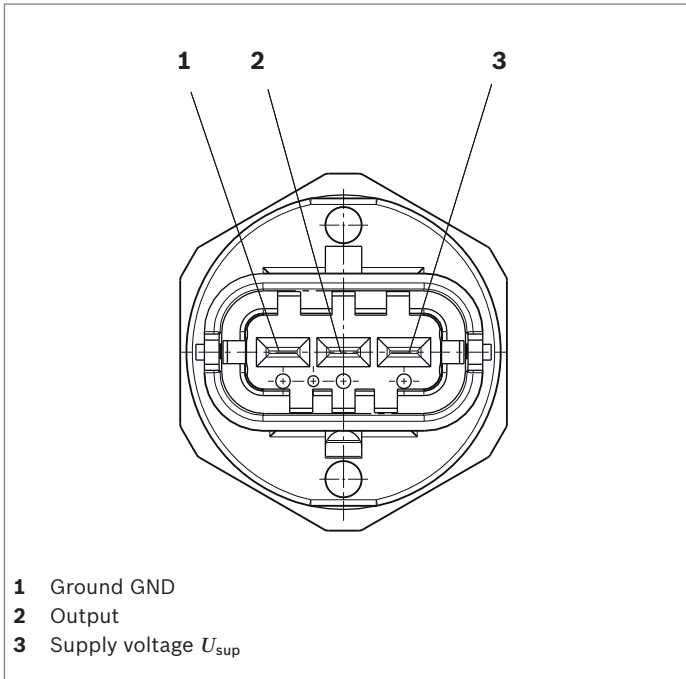
The tolerance for the pressure measurement is given in % FS = "full scale". FS denotes the sensor nominal pressure p_{nenn} or the usable range. The relative tolerance is dependent on the pressure and temperature, and increases over the service lifetime. Here, the service lifetime encompasses the entire lifetime. The tolerances for new parts are statistically observed with 3 Sigma per manufacturing batch. Delivery of 100 % sorted products is permitted. After lifetime the tolerance for new parts can broaden to the values given in the diagram. Here the given tolerances also represent the 3 Sigma limit.

Sensor with mechanical connection M14 x 1.5 according DIN EN ISO 6149-2

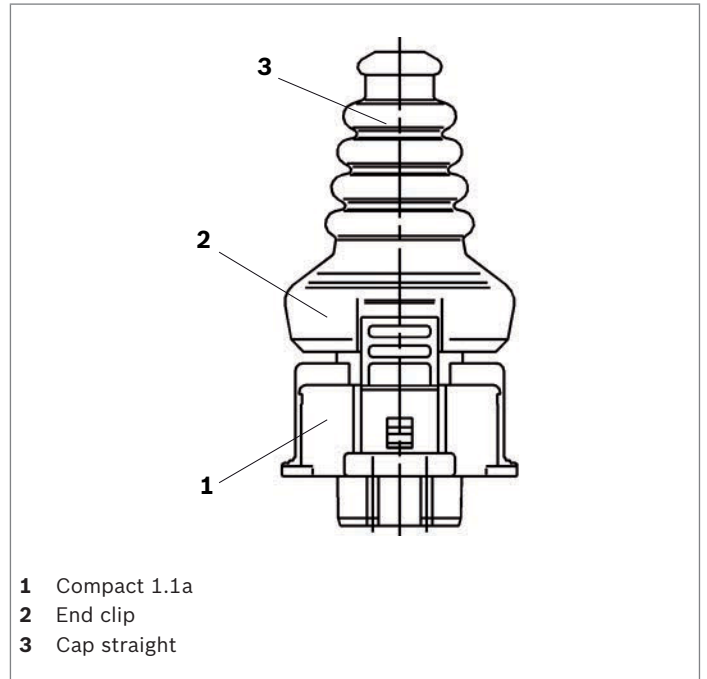


Connector Bosch Compact

Pin assignment



Assembly example



Mating connector¹⁾

Mating connector sets with the following content are available under Rexroth part number R917009890 for the manual assembly of wiring harness connectors for laboratory or small-series requirements:

Designation	Number	Material number
Bosch Compact 1.1a Connector	1	1928403966
BDK Terminal Gold for 18-20 AWG, 0.5-1.0 mm ²	3	1928498054
Bosch compact cap straight	1	1928300527
Single seal, BDK, blue, ROHS	3	1928300599
End clip	1	1928403423

Required tooling²⁾

Designation	Number	Material number
Bosch crimping tool for BDK 2.8 terminal 0.5, 0.75, 1.0 sq mm wire	1	1928498161
Bosch terminal extraction tool for BDK 2.8 terminals	1	1928498167

Notes regarding assembly

In the assembly of the connectors, respect the assembly instructions for plug connections (Y 928 P00 222) and BDK 2.8 contacts (1 928 F00 025). These assembly instructions are available on request from Rexroth.

Caution:

In the installation of the connector in the vehicle, observe the following:
 The fixation of the cable harness must be done at a distance ≤ 150 mm after the outgoing cable unit at the same vibration level of the sensor.

¹⁾ The mating connectors are not included in the scope of supply. These are available from Bosch Rexroth under the corresponding material numbers.

²⁾ The tools may be purchased from Bosch dealers or Bosch Service (www.bosch-service.com)
 Drawings and further information about Bosch connectors and tools can be found on the internet: www.bosch-connectors.com

Installation instructions

Mounting

Mounting process of sensor must be ensured by customer by adequate validation.

Rexroth recommends to wet the surface of thread and tightening plane of pressure sensor completely with Oil or Molykote WI5 prior to mounting.

To prevent accumulation of lubricant in the pressure port application of lubricant by spraying while pressure port facing downwards is recommended.

Pressure vessel directive

- ▶ Devices with MEV (measurement range end value) 600 bar correspond to directive 97/23/EC and are not designed for overheated fluids of fluid group 2. These devices are manufactured and inspected according to module A.
- ▶ Devices with measurement range end value 280 to 420 bar correspond to article 3 paragraph (3) of directive 97/23/EC and are not designed and manufactured for overheated fluids of fluid group 2, in accordance with good engineering practice.

Electrical connection

- ▶ The device may only be installed by a trained electrician.
- ▶ The national and international specifications regarding the installation of electro-technical systems must be followed.
- ▶ Voltage supply according to SELV, PELV.
- ▶ De-energize the system.

Mechanical connection

- ▶ Before installing and removing the device, make certain that the system is not pressurized.

Tightening torque

Before mounting the PR4 pressure sensor, check the specified tightening torque of the hydraulic pump, motor or valve block.

If the torque for mounting the sensor in the respective hydraulic component is not specified use a torque of 35 ± 5 Nm.

Do not exceed the maximum tightening torque of: 45 Nm.

Risk of injury!

Overload pressures that exceed the specified maximum permissible pressure are to be prevented through appropriate measures. The specified bursting pressure must not be exceeded. Even exceeding the bursting pressure for brief periods can destroy the device.

Operating conditions - temperatures

The sensor is designed for use in hydraulic components (direct motor attachment) and the corresponding ambient temperatures with a typical temperature distribution:

Temperature	
-40 °C	6 %
23 °C	20 %
85 °C	65 %
135 °C	8 %
140 °C	1 %

Storage conditions

The pressure sensor is to be stored under the following conditions:

Temperature range	-30 °C to +60 °C
Rel. humidity	0 to 80 % r. h.
Maximum storage duration after the delivery	4 years

The sensor has to be kept under dry and dust-free storage conditions. It is important to ensure that there is no contamination due to liquid or solid media in the connector area or on the threaded fitting. Sulfurous atmospheres have to be avoided for silver-plated connector pins.

These storage conditions do not lead to any change in the properties and the functioning of the high-pressure sensor. After the maximum storage duration is exceeded, the sensors must be sent back to Bosch Rexroth AG for inspection or testing.

Transportation conditions

Conditions deviating from the storage conditions are allowed for the transport:

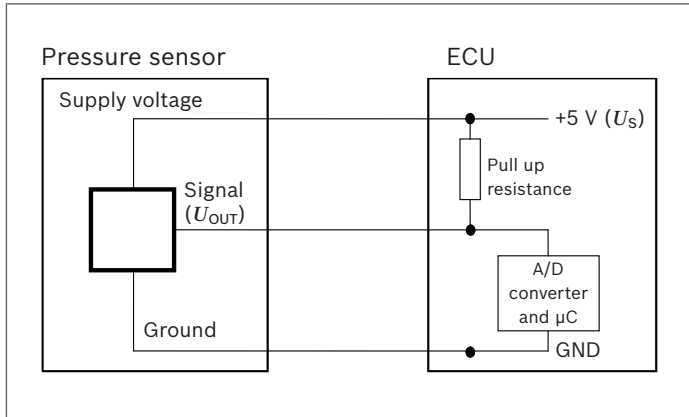
Duration	max. 48 h
Temperature	-40 °C to +80 °C
Relative humidity	0 % to 80 %

Wiring and error diagnostic of the sensor

Recommended wiring of the sensor

The sensor is to be connected to the ECU according to the following wiring diagram and provided with a supply voltage of 5 V.

▼ Sensor wiring in the ECU



The assignment of the connector pins of the high-pressure sensor is described in the offer drawing.

The pressure sensor delivers an analog output signal that has a ratiometric relationship with the supply voltage.

Specification of the pull-up resistor:

Quantity	Symbol	Value			Unit
		min	typ	max	
Pull-up resistor as per US	$R_{\text{Pull-up}}$	4.41	4.64	4.87	k Ω

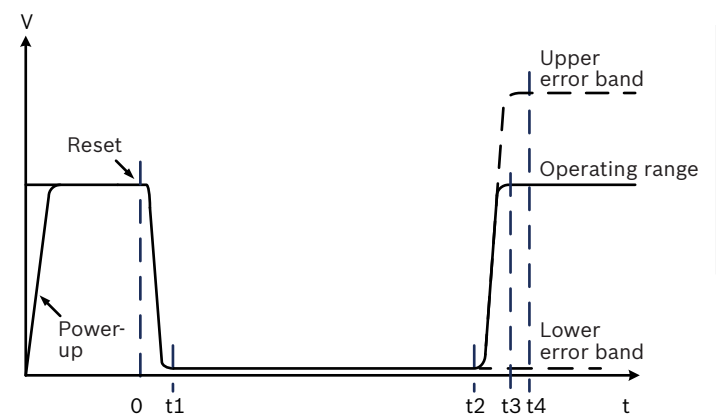
In addition to this, a low-pass filter with a time constant of maximum 0.7 ms is to be provided in the signal path.

The electrical output of the sensor is designed such that malfunctions through cable breaks or short-circuits can be detected with the wiring shown in the representation with a pull-up resistor of 4.64 k Ω \pm 5 % against supply voltage.

Behavior after reset and initialization

In case of certain errors, a reset is triggered in the sensor. These are then generated every 400 ms. After a reset, and during the subsequent initialization of the sensor, the output is pulled to ground. If the error is still present, the output signal either remains in the lower error band, or the output signal rises to the upper error band. In case, the error is no longer present, the output signal controls its value into the applicable operating range. The course of the output signal and the related typical time at room temperature, after the reset, are shown in diagram below.

▼ Representation of the time after reset and initialization



Typicals [ms]	t1	t2	t3 / t4
CRC OK	0.03	0.9	1.1 / 1.2
CRC NOK	0.03	2.1	2.3 / 2.4

Behavior after undervoltage and overvoltage

In case of undervoltage <4.75 V or overvoltage >5.25 V detection, the output is pulled to ground. The upper error band (if the error is still present), as shown in the diagram, is reached after time t4.

Safety instructions

General instructions

- ▶ Before finalizing your design, request a binding installation or offer drawing.
- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ It is not permissible to open the sensor or to modify or repair the sensor. Modifications or repairs to the wiring could result in dangerous malfunctions.
- ▶ Only allow pressure measurement devices to be installed by trained and specialist personnel who are authorized by the system owner.
- ▶ Connections must only be opened while in a depressurized state!
- ▶ System developments, installation and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and with the complete system.
- ▶ While commissioning the sensor, the machine may pose unforeseen dangers. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the sensor should fail or demonstrate faulty operation, it must be replaced.
- ▶ Residual measurement materials in unmounted pressure measurement devices could endanger people, the environment and equipment. Take appropriate precautionary measures.
- ▶ In spite of taking great care in preparing this document, all conceivable application cases could not be taken into account. If information is lacking for your specific application, please contact Bosch Rexroth.

Notes on the installation location and position

- ▶ Do not install the sensor close to parts that generate considerable heat (e.g. exhaust).
- ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ The connector of the sensor is to be unplugged during electrical welding and painting operations.
- ▶ Electrostatic painting of the sensor is not allowed (hazard: ESD damage).

- ▶ Cables/wires must be sealed individually to prevent water from entering the device.
- ▶ Make sure, by appropriate installation of the sensor, that no water is gathering the sensor measuring element. This might result to a malfunction of the measuring signal (freezing condition, in worst case: crack of measuring element).

Notes on transport and storage

- ▶ Please inspect the device for any damages which may have occurred during transport. If there are obvious signs of damage, please immediately inform the transport company and Bosch Rexroth.
- ▶ If it is dropped, the sensor must not be used any longer as invisible damage could have a negative impact on reliability.

Notes on wiring and circuitry

- ▶ Use twisted pair wires to connect the pressure sensor.
- ▶ Use short wires to avoid voltage drop along the lines and choose wires with bigger gauge in case of longer distances between the sensor and the electronic.
- ▶ We recommend to use shielded wire to increase the signal quality. Connect the shield on one side, either to the machine or the vehicle ground or to the electronic via a short low resistance connection.
- ▶ The mating connector of the sensor must not be plugged or unplugged, if the electrical system of the machine is energized.
- ▶ The sensor lines are sensitive to radiation interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor lines should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.
- ▶ Lines from the sensor to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The wiring harness should be fixated mechanically in the area in which the sensor is installed (spacing < 150 mm). The wiring harness should be fixated so that in-phase excitation with the sensor occurs (e.g. at the sensor mounting points).
- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.

- ▶ Lines must not rub against edges and must not be routed through sharp-edged ducts without protection.
- ▶ Bosch Rexroth warranty will cover the function of the connector system only in the case of combination with harness connector system parts according to this data sheet.
- ▶ Use only the appropriate tooling to crimp and mount the mating connector.

Attention:

Use harness connector for protection against water ingress.

- ▶ First cable mounting point max. 150 mm after the plug (straight cable length). It must be located on the sensor carrier.
- ▶ Angle of bending the cable (deviation from straight line) between cable exit at sensor and first mounting point, 20° to 90°.
- ▶ Admissible bending radius of the cable up to the first cable mounting point: $R \geq 50$ mm.
- ▶ Installation instructions see also corresponding offer drawing.

Intended use

- ▶ The sensor is designed for use in mobile working machines provided no limitations/restrictions are made to certain application areas in this data sheet.
- ▶ Prior to installation, commissioning and operation, make certain that the correct pressure measurement device was selected with respect to measurement range, design and – based on the specific measurement conditions – parts which are in contact with measuring materials (corrosion). Furthermore, the respective national safety regulations are to be observed.
- ▶ Operation of the sensor must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ If required, install a throttle, that limit possible pressure peaks. Attention should be also paid to side effects e.g. cavitation. Ensure that there will be no cavitation in any point of operation.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.
- ▶ Failure to observe the respective specifications may result in serious bodily injury and/or property damage.

Improper use

- ▶ Any use of the sensor other than that described in chapter “Intended use” is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, interference in the component not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ The customer is responsible for performing a risk analysis of the mobile working machine and determining the possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.).
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

Further information

- ▶ Further information about the sensor can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The sensor must be disposed according the national regulations of your country.

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Angle Sensor WS1

RE 95140/07.07 1/4
Replaces: 05.03

Technical data sheet

Series 10



Features

The angle sensor is used for measuring rotary movements of an adjusting shaft or the angle positions of levers, e.g. to determine the setting of the injection pump lever of a diesel engine.

The sensor has a robust, sealed housing and an integrated electronic system specially developed for automotive applications.

The voltage supply for the WS1 angle sensor can be delivered directly by the control units (MC or RC).

As output variable, the WS1 angle sensor delivers a voltage proportional to the angle of rotation.

The sensor contains two internal contact-free measuring systems with a common power supply.

For safety-related system solutions, the output signals are partially redundant.

Main components

- Hall-effect semiconductor elements and integrated amplifiers
- Robust plastic housing with moulded plug
- Metal inner housing and line filter for high electromagnetic compatibility (EMC)
- Guide lever with fixing hole

Special features

- Life span designed for more than 30 million cycles
- Resistant to shock and vibration
- Molded-in metal bushing for low-wear on lever arm

Type Code

WS1	T	90	/	1	0
01	02	03		04	05

Type

01	Angle sensor	WS1
----	--------------	------------

Safety

02	Partially redundant (2 output signals)	T
----	--	----------

Version/ Measuring range

03	90° angle of rotation	90
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Series

04		1
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Index

05		0
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Technical Data

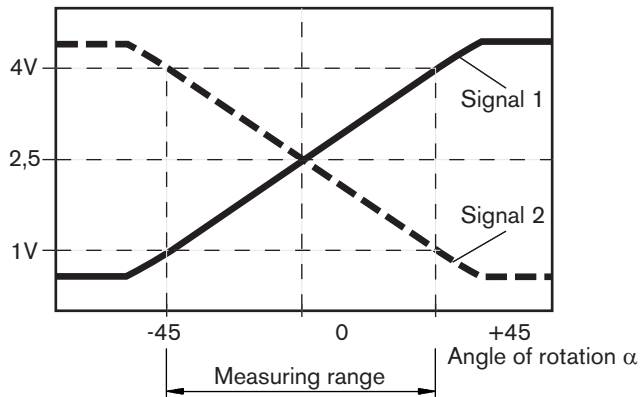
Table of values

Type	WS1T90/10
Supply voltage U_b	5V DC \pm 0,25 V
Input current	max. 11 mA
Output voltage U_a	0,5 ... 4,5 V (bei 5 V power supply)
Linearity of the output voltage U_a	$\pm 0,5$ % bei $-45^\circ \leq \alpha \leq -15^\circ$ $\pm 0,25$ % bei $-15^\circ \leq \alpha \leq +15^\circ$ $\pm 0,5$ % bei $+15^\circ \leq \alpha \leq +45^\circ$
Accuracy of output voltage U_a at 20°C	± 2 %
Load impedance to earth	min. 10 k Ω max. 22 nF
Short-circuit resistance of the signal outputs to	Supply voltage and earth
Polarity mismatch protection	Supply voltage to earth
Electromagnetic compatibility	
Broadcast noise (ISO 11452)	200 V _{eff} /m
Line-borne interference (ISO 7637-1)	Values on request
Operating temperature, housing	-40°C ... +100°C, max. +120°C for 1h
Storage temperature, housing	-40°C ... +100°C, max. +130°C for 16h
Vibration resistance (IEC 60086-2):	
Oscillation, sinusoidal	10 g / 50...500 Hz
Oscillation, noise	4,5 g rms/ 5...500 Hz
Protection class (DIN/EN 60529)	IP 6k6
with connected mating plug	IP 6k9k
Housing material	Plastic
Mass	approx. 95 g
Angle of rotation, mechanical	360° (spinnable)
Angle of rotation, measuring range	a = $\pm 45^\circ$
Actuating torque at lever arm	$\leq 0,1$ Nm
Installation position	any

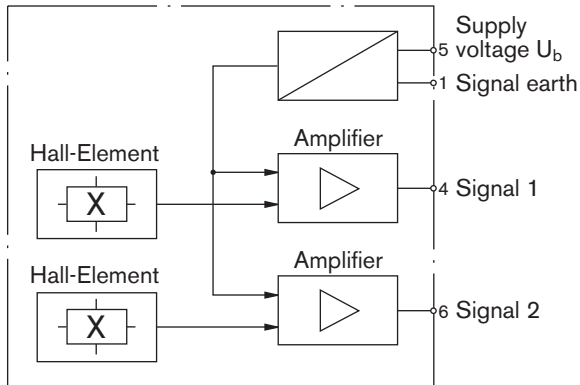
Technical Data

Characteristic

Output voltage U_a at supply voltage U_b 5V. (The output voltage is proportional to the supply voltage)

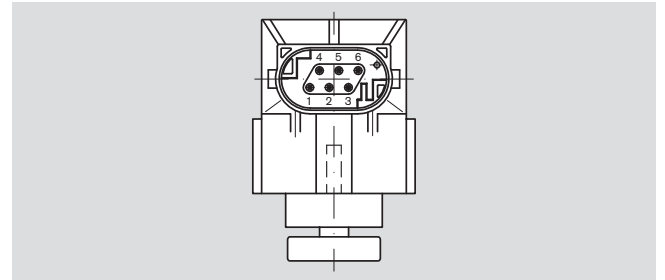


Block Circuit Diagram



Pin Assignment

Pin. Nr.	Connection
1	Ground
2	-
3	-
4	Signal 1
5	Supply voltage U_b
6	Signal 2



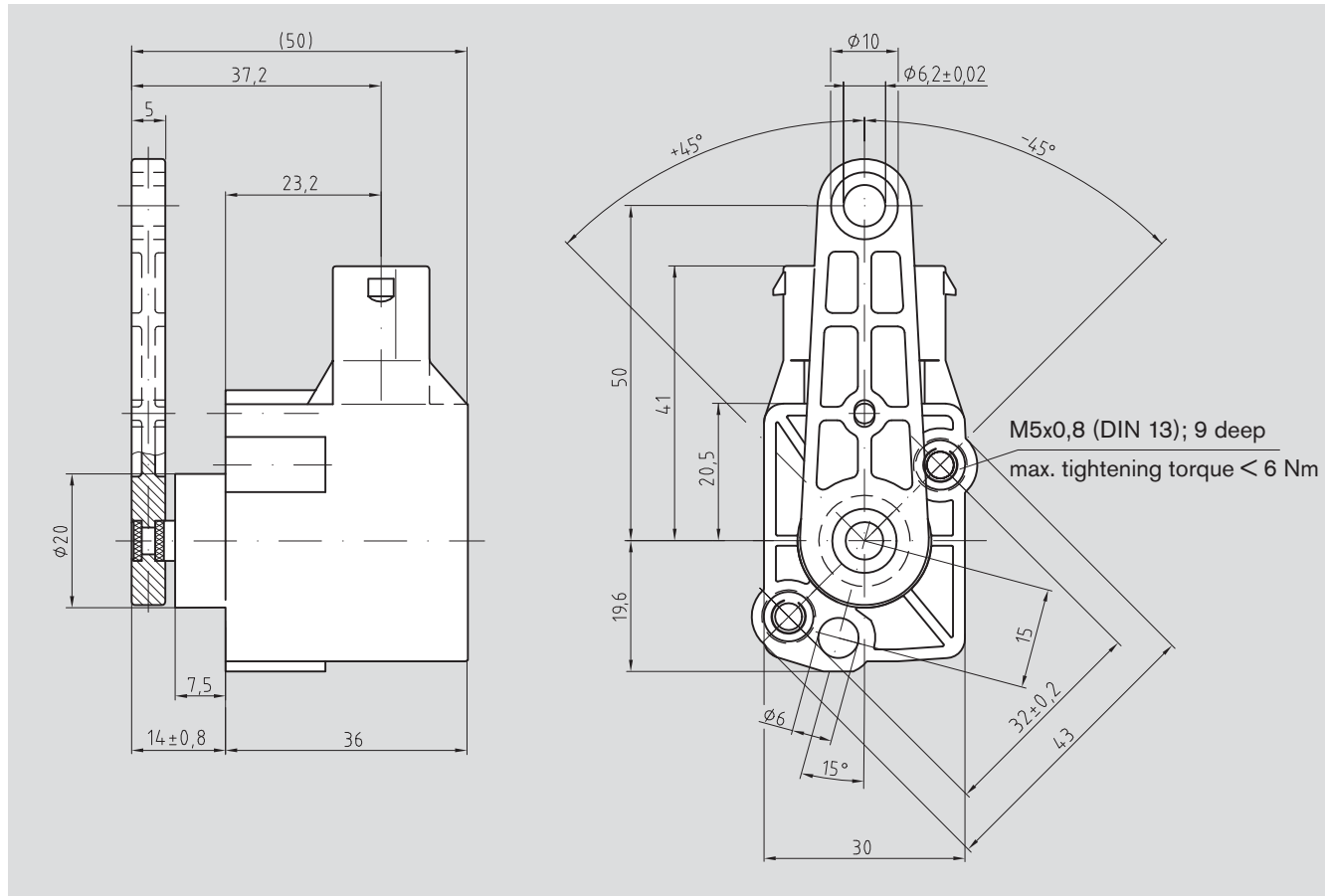
Mating Connector

AMP MQS female connector 6-pin, comprising:

- 1 MQS female connector 6-pin, code A _____ 1-967616-1
- 7 sleeve contacts _____ 0-0963727-1
- 3 blanking plugs _____ 0-0967056-1
- 6 single lead seals _____ 0-0967067-1

The connector is not included as standard. Female connector AMP MQS 6-pin can be ordered from Rexroth under the Mat. No. R902601914.

Dimensions



Safety Notes

- The suggested circuits do not imply any technical liability for the system on the part of Rexroth.
- System developments and commissioning of electronic systems for controlling hydraulic drives must only be performed by trained and experienced specialists who are suitably familiarized with working with the used components as well as the entire system.
- No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.
- During commissioning, make certain that no one is present in the immediate working or movement range of the machine or can be placed at risk by the machine.
- All connectors must be unplugged from the electronics during electrical welding and paint operations.
- Cables to the electronics must not be routed close to other power-conducting cables in the machine or vehicle.
- A sufficiently large distance to radio systems must be maintained.
- Cables/wires must be sealed individually to prevent water from entering the device.

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The data specified above only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.

Subject to change.

Angle sensor AN2 series 30

RE 95143

Edition: 06.2015

Replaces: 10.2013



- ▶ Hall-effect sensor for angular measurement

Features

- ▶ Angle sensor element based on the Hall-effect principle
- ▶ Shaft can be turned through mechanically
- ▶ Integrated electronics with temperature compensation
- ▶ Output signal ratiometrically proportional to angle
- ▶ Zero point and sensitivity are calibrated

Contents

Ordering code	2
Description	2
Technical data	3
Characteristics	4
Dimensions	5
AMP Connector	5
Installation instructions	6
Safety instructions	7

Ordering code

01	02	03	04	05	06
AN2				/	30

Type

01	Hall-effect angle sensor	AN2
----	--------------------------	------------

Version

02	Without pin	V1
	With pin to the bottom	V2
	With pin to the top	V3

Characteristics

03	Positive course	A
	Negative course	B

Angles

04	±17°	17
	±28°	28
	±35°	35
	±36°	36
	±41°	41
	±44°	44

Supply voltage Signal voltage

05	5 ±0.5 V	10% to 90% U_{sup}	05
	8 to 10.4 V	25% to 75% U_{sup}	10

Series

06		30
----	--	-----------

Description

The AN2 angle sensor is used for angular measurement from ±17° to ±44°.

The sensor returns a ratiometric voltage with rising characteristic (positive course) or inverted characteristic (negative course).

This sensor is a typical part of an electro-hydraulic hitch control (EHC) and is supplied directly from a Rexroth EHR controller or an SRC controller.

Available variants

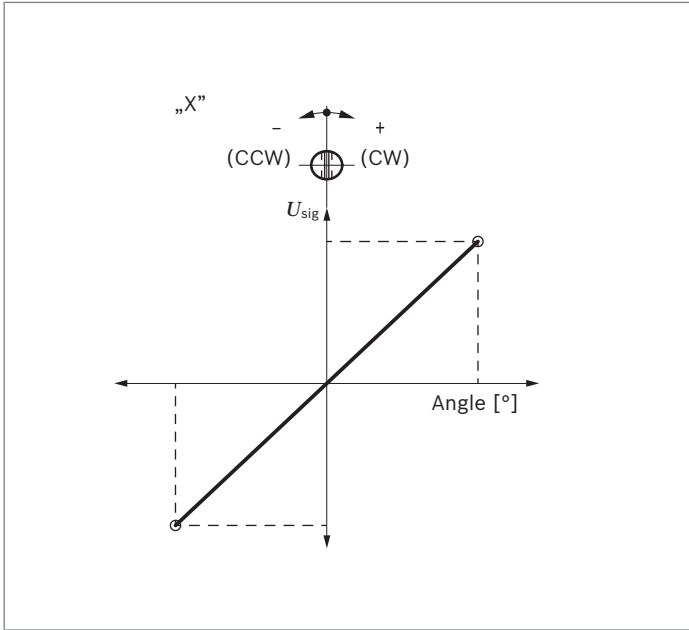
Type							Material number
AN2	V1	B	35	05	/	30	R917008154
AN2	V1	B	35	10	/	30	R917005164
AN2	V1	A	41	05	/	30	R917005568
AN2	V1	A	41	10	/	30	R917005165
AN2	V2	A	36	05	/	30	R917008155
AN2	V2	A	36	10	/	30	R917005166
AN2	V1	A	44	05	/	30	R917008160
AN2	V1	A	44	10	/	30	R917004856
AN2	V3	A	28	05	/	30	R917008156
AN2	V3	A	28	10	/	30	R917005167
AN2	V1	A	17	05	/	30	R917008157
AN2	V1	A	17	10	/	30	R917005168
AN2	V2	A	41	05	/	30	R917008158
AN2	V2	A	41	10	/	30	R917005169
AN2	V3	A	41	05	/	30	R917008159

Technical data

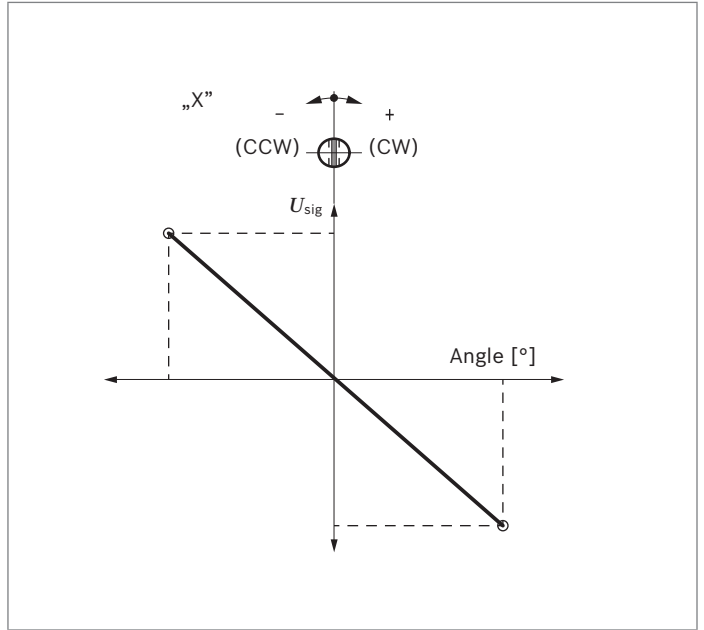
Type	AN2					
Measuring principle	Hall effect Maximum permissible external magnetic field: 0.3 mT					
Nominal angular range	±17°	±28°	±35°	±36°	±41°	±44°
	Shaft can be mechanically rotated					
Starting torque	≤ 5 Ncm					
Shaft loading	radial	≤ 10 N				
	axial	≤ 20 N				
Supply voltage U_{sup}	8 to 10.4 V DC			5 ±0.5 V DC		
Supply current I_{sup}	≤ 15 mA			≤ 15 mA		
Signal voltage U_{sig} (ratiometric)	25% to 75% U_{sup}			10% to 90% U_{sup}		
Load resistance	> 3 kΩ			≥ 10 kΩ		
Linearity	< ±1%					
Zero position	Marking on shaft (see drawing)					
Sensitivity of the end points	< ±1% of the supply voltage					
Hysteresis	Immeasurable					
Resolution	0.025% U_{sup}					
Temperature coefficient of zero point	≤ ±0.15% / 10 °C					
Temperature coefficient of sensitivity	≤ ±0.2% / 10 °C					
Operating temperature range	−30 °C to +85 °C					
Storage temperature range	−35 °C to +100 °C					
Housing material	PBT GF 30					
Shaft material	X 5 CrNi 18					
Type of protection with installed mating connector (IEC 60529)	IP67 and IP69K					
Connector	3-pin connector with dust boot and single-wire seal					
Insulation resistance to housing	> 100 MΩ					
Dielectric strength of insulation to housing	< 200 V					
Electromagnetic compatibility EMC (ISO 11452-2)	1 MHz to 1 GHz	200 V/m, permissible deviation 1% U_{sup}				
	1 GHz to 4 GHz	100 V/m, permissible deviation 1% U_{sup}				
Electrostatic discharge ESD (ISO TR 10605, intensity IV)	Contact discharge	±8 kV				
	Air discharge	±15 kV				
Overvoltage / inverse-polarity protection / short circuit resistance	Overvoltage protection up to 18 V Resistance against inverse-polarity and short circuits					
Dynamic tests	Broadband noise test (IEC 68-2-64)	$a_{eff} = 0.05 g^2/Hz$, 10 to 2000 Hz				
	Transport shock (IEC 60068-2-27)	15 g, 11 ms, 3x each direction (pos./neg.)				
	Continuous shock (IEC 60068-2-29)	25 g, 6 ms, 1000x each direction (pos./neg.)				

Characteristics

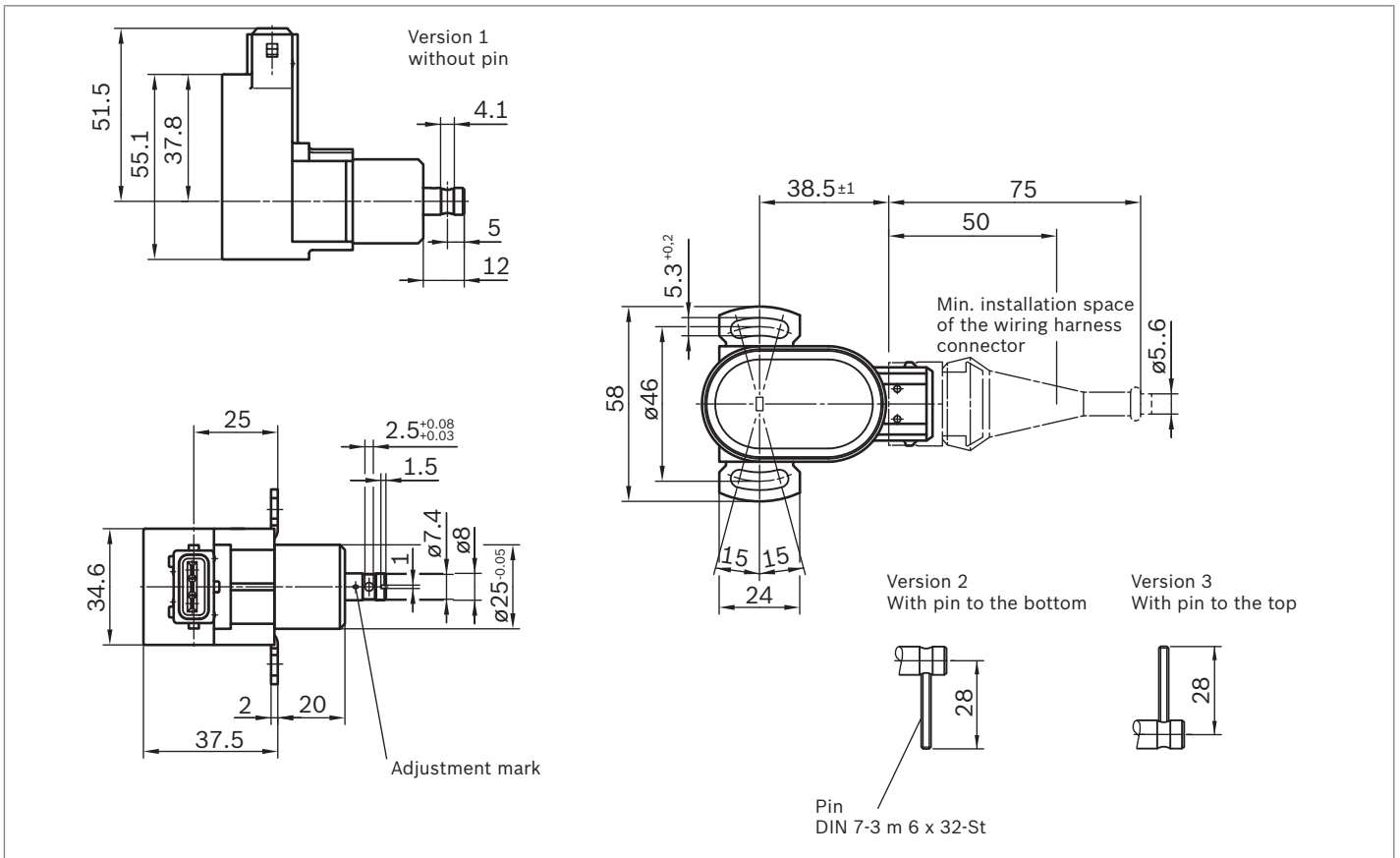
▼ Positive course



▼ Negative course

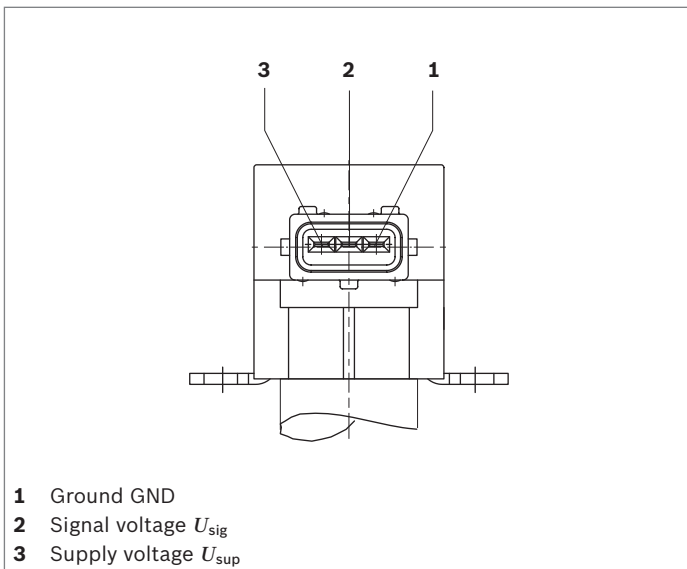


Dimensions



AMP connector

▼ Pin assignment



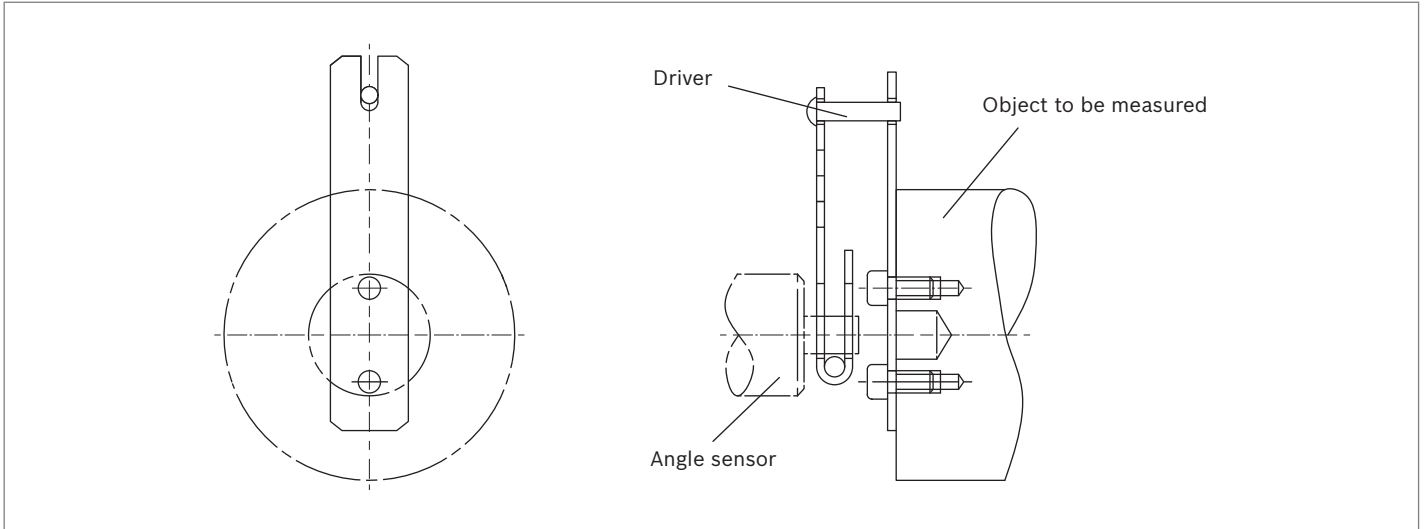
▼ Mating connector R917000515¹⁾

Designation	Number	Material number
Housing	1	1928402579 ²⁾
Protection cap	1	1280703022 ²⁾
Contacts	3	929939 ³⁾
Single-wire seal	3	828905-1 ³⁾ with FLK cable type
(wire size: 0.5 to 1.0 mm ²)	3	828904-1 ³⁾ with FLKr, FLX cable

1) The mating connector is not included in the scope of supply.
2) Available from Bosch
3) Available from AMP

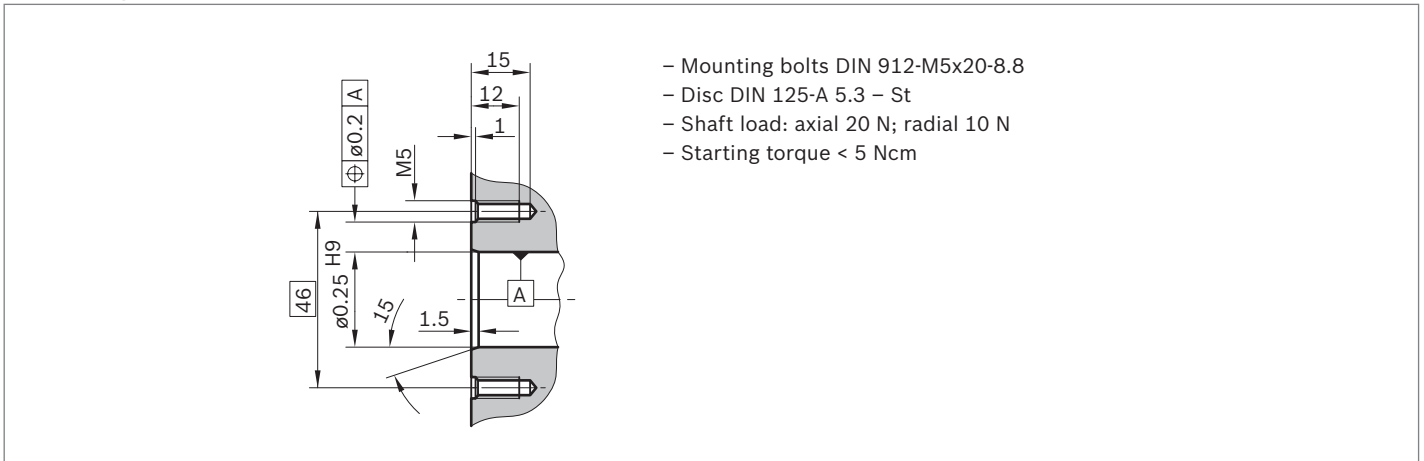
Installation instructions

▼ Coupling example



The angle sensor shaft is to be coupled to the measurement object as free of force and play as possible.

▼ Mounting hole



Safety instructions

General instructions

- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
 - ▶ It is not permissible to open the sensor or to modify or repair the sensor. Modifications or repairs to the wiring could result in dangerous malfunctions.
 - ▶ System developments, installation and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and with the complete system.
 - ▶ While commissioning the sensor, the machine may pose unforeseen dangers. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
 - ▶ Make sure that nobody is in the machine's danger zone.
 - ▶ No defective or incorrectly functioning components may be used. If the sensor should fail or demonstrate faulty operation, it must be replaced.
- ▶ Lines from the sensor to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
 - ▶ The sensor and the connection line should be supported mechanically near the installation location.
 - ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
 - ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.
 - ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.
 - ▶ The sensor lines are sensitive to radiation interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor lines should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.

Notes on the installation point and position

- ▶ Do not install the sensor close to parts that generate considerable heat (e.g. exhaust).
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ The connector of the sensor is to be unplugged during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.

Notes on transport and storage

- ▶ If it is dropped, the sensor must not be used any longer as invisible damage could have a negative impact on reliability.

Notes on wiring and circuitry

- ▶ Lines to the angle sensors are so short as possible and be shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The product should only be plugged and unplugged when it is in a de-energized state.

Intended use

- ▶ The sensor is designed for use in mobile working machines provided no limitations/restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the sensor must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the sensor other than that described in chapter "Intended use" is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, unintended interventions in the device not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ The customer is responsible for performing a risk analysis of the mobile working machine and determining the possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.).
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

Further information

- ▶ Further information about the sensor can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The sensor must be disposed according to the national regulations of your country.

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Hall-effect angle sensor AN3 series 1

RE 95144

Edition: 01.2016



- ▶ Hall-effect sensor for angular measurement

Features

- ▶ Angle sensor element based on the Hall-effect principle
- ▶ Shaft can be turned through mechanically
- ▶ Integrated electronics with temperature compensation
- ▶ Output signal ratio metrically proportional to angle
- ▶ Precise balance adjustment for zero point and sensitivity

Inhalt

Ordering code	2
Description	2
Material number	2
Technical data	3
Characteristics	4
Dimensions	5
AMP connector	5
Installation instructions	6
Safety instructions	7

Ordering code

01	02	03	04	05	06	07
AN3	V1			5	/	1 0

Type

01	Hall-effect angle sensor	AN3
----	--------------------------	------------

Version

02	Without pin	V1
----	-------------	-----------

Characteristics

03	Positive course	A
	Negative course	B

Angles

04	±28°	28
	±35°	35
	±41°	41
	±44°	44

Supply voltage

Signal voltage

05	U_{sup} 4.5 to 0.5 V	10% to 90% U_{sup}	5
----	------------------------	----------------------	----------

Series

06		1
----	--	----------

Index

07		0
----	--	----------

Description

The angle sensor AN3 is used for the angular measurement till $\pm 44^\circ$. The sensor is supplying a ratio metric voltage, available with increasing curve (positive course) or inverted curve (negative course). This sensor is a typical part of an electronic – hydraulic hitch control (EHC) and is supplied directly by a Rexroth EHC Controller or by a Rexroth SRC.

Material number

Type								Material number
AN3	V1	B	28	5	/	1	0	R913029358
AN3	V1	A	28	5	/	1	0	R913029842
AN3	V1	B	35	5	/	1	0	R983055893
AN3	V1	A	35	5	/	1	0	R983055890
AN3	V1	B	41	5	/	1	0	R983055894
AN3	V1	A	41	5	/	1	0	R983055891
AN3	V1	B	44	5	/	1	0	R983055895
AN3	V1	A	44	5	/	1	0	R983055892

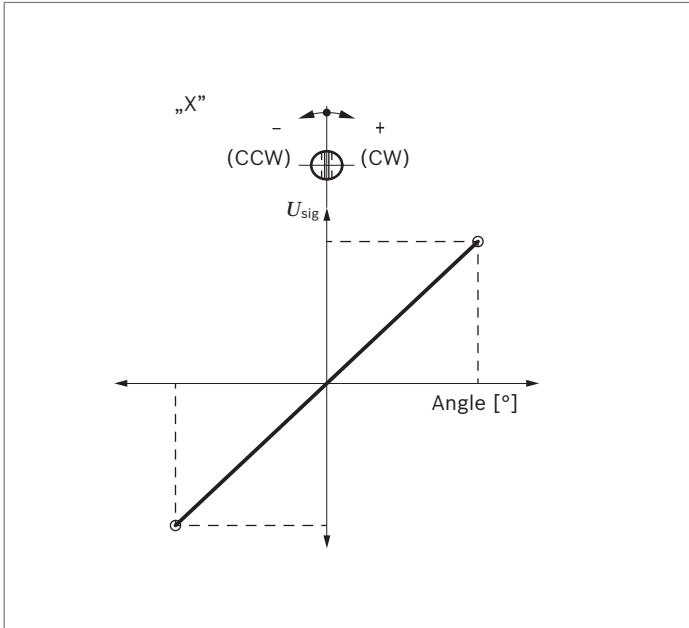
Technical data

The following values apply for $R_{load} = 30k\Omega$ (to ground) and room temperature

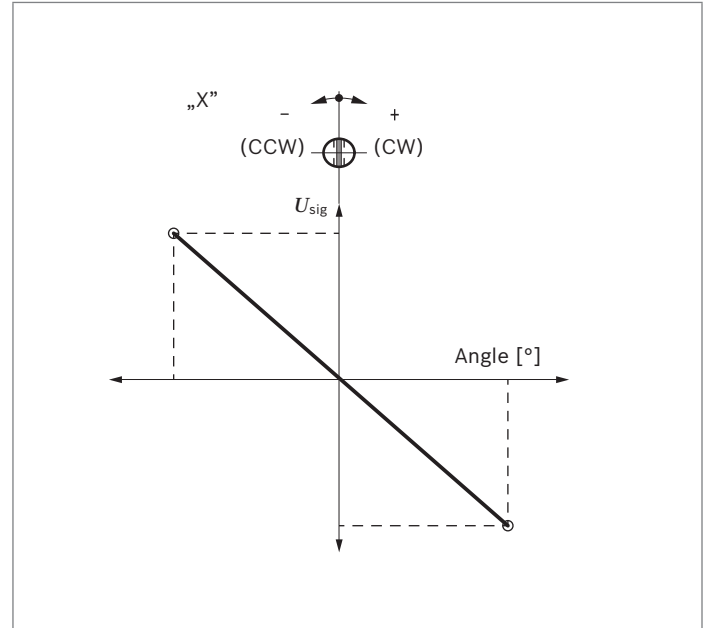
Type	AN3			
Measuring principle	Hall-effect Maximum permissible external magnetic field: 25 mT			
Nominal angular range	$\pm 28^\circ$	$\pm 35^\circ$	$\pm 41^\circ$	$\pm 44^\circ$
	Shaft can be mechanically rotated through 360°			
Starting torque	≤ 5 Ncm			
Shaft loading	radial	≤ 10 N		
	axial	≤ 20 N		
Supply voltage U_{sup}	5 \pm 0.5 V DC			
Supply current I_{sup}	≤ 15 mA			
Signal voltage U_{sig} (ratiometric)	10 % to 90 % U_{sup}			
Load resistance	≥ 8.2 k Ω			
Linearity	$< \pm 1$ %			
Sensitivity of the end points	$< \pm 1$ % of the supply voltage			
Hysteresis	0.05 °			
Resolution	0.025% U_{sup}			
Temperature coefficient of zero point	± 0.15 % / 10 K			
Temperature coefficient of sensitivity	± 0.2 % / 10 K			
Operating temperature range	-30 °C to +80 °C			
Storage temperature range	-40 °C to +85 °C			
Case material	PA66 GF 30			
Shaft material	X 5 CrNi 18-9			
Type of protection with installed mating connector	IP67 and IP69K			
Plug in connection	TYCO AMP super seal connector with 3 pins recommended			
Electromagnetic compatibility EMC	1 MHz to 1 GHz	100 V/m, no deviation > 5 % U_{sup} may occur		
Electrostatic discharge ESD	Contact discharge	± 8 kV		
	Air discharge	± 15 kV		
Overvoltage / reverse polarity / short-circuit resistance	Over voltage: +27 V, reverse voltage: -18 V short circuit monitoring			
Dynamic tests	Broadband noise test (IEC 68-2-64)	$a_{eff} = 58$ m/s ² , 20 to 2000 Hz		
	Transport shock (IEC 60068-2-27)	$\Sigma 18$ shocks; 6 directions; 6 ms; $a_{max} = 400$ m/s ²		
	Continuous shock (IEC 60068-2-29)	25 g, 6 ms, 1000x each direction (pos./neg.)		

Characteristics

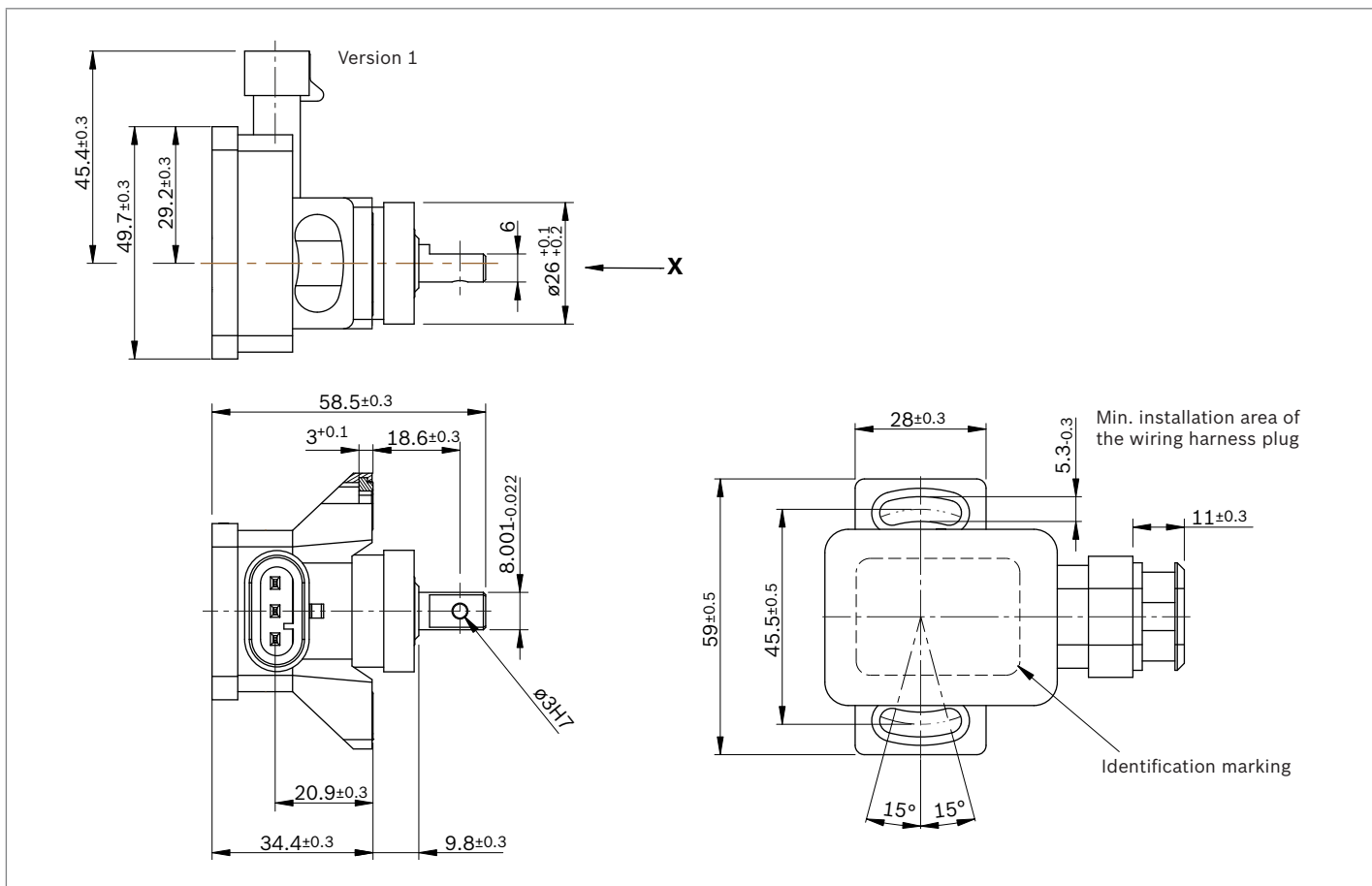
▼ Characteristic curve A Positive course



▼ Characteristic curve B Negative course

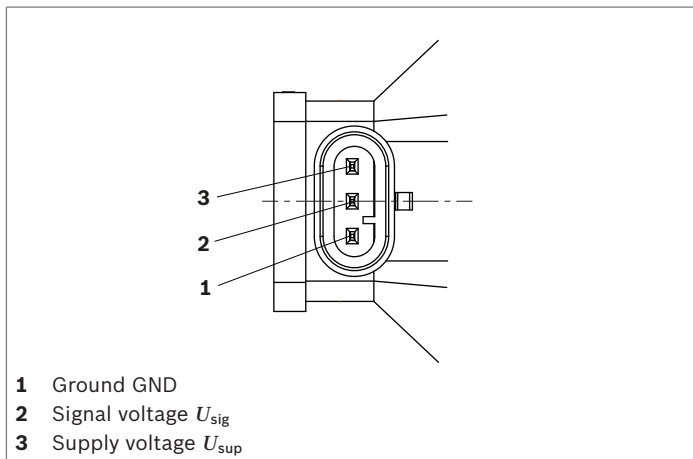


Dimensions



AMP connector

▼ Pin assignment



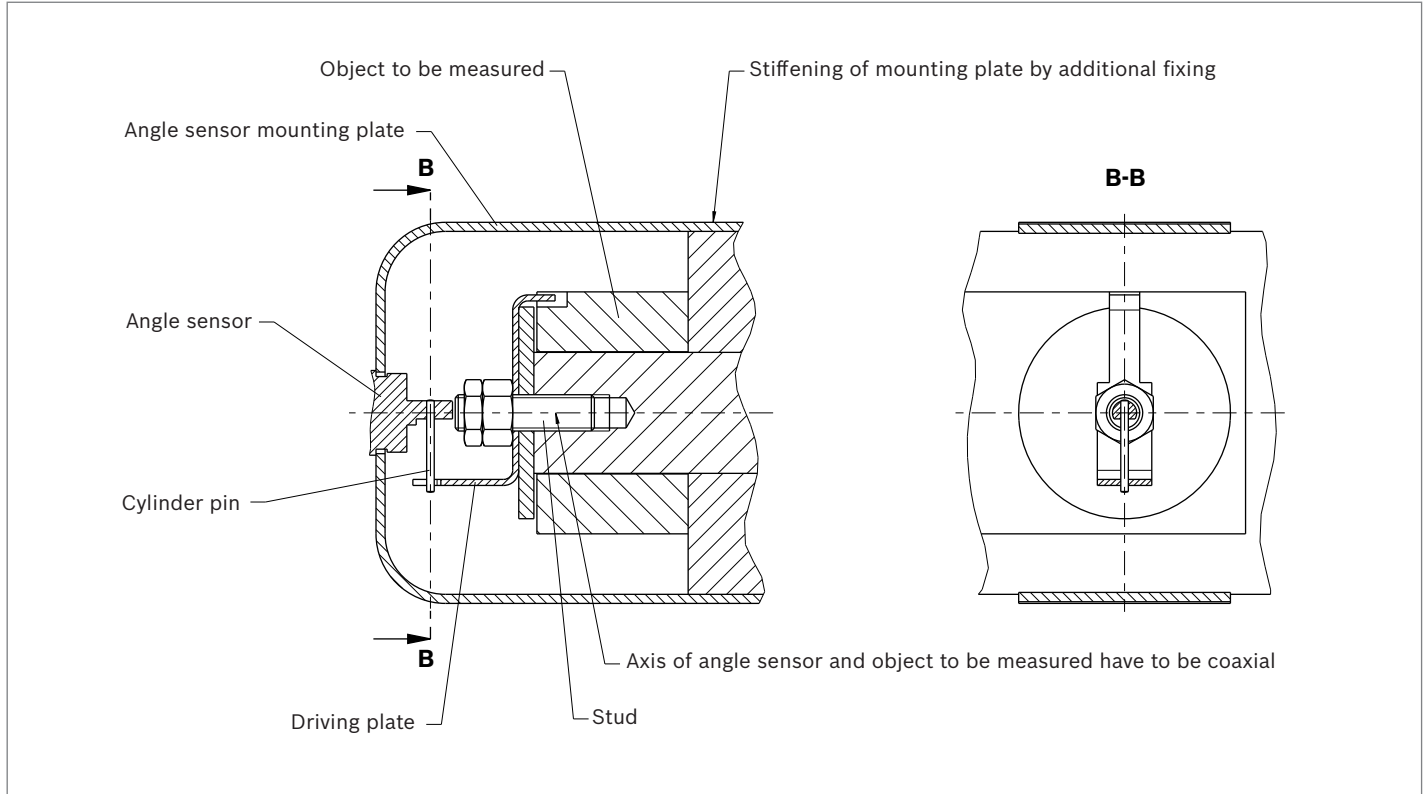
▼ Mating connector¹⁾

Designation	Number	Tyco material number
Housing	1	282087-1
Terminal	3	282466-1
Seal	3	281934-3
Rubber boot	1	880811-2

1) The mating connector is not included in the scope of supply.
2) Available from Bosch
3) Available from AMP

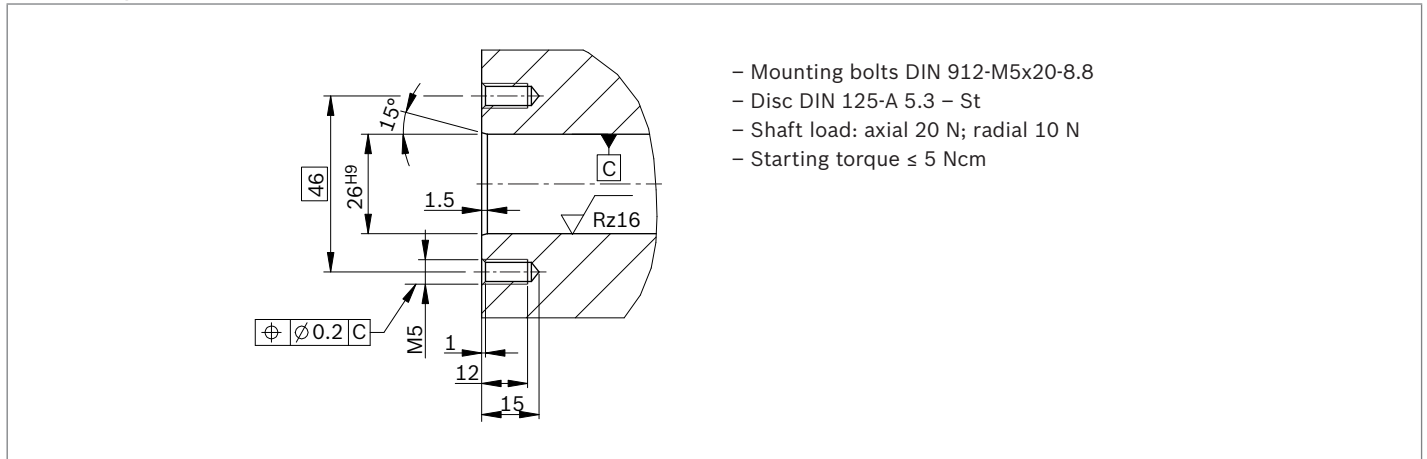
Installation instructions

▼ Coupling example



The angle sensor shaft is to be coupled to the measurement object as free of force and play as possible.

▼ Mounting dimensions



Safety instructions

General instructions

- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ It is not permissible to open the sensor or to modify or repair the sensor. Modifications or repairs to the wiring could result in dangerous malfunctions.
- ▶ System developments, installation and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and with the complete system.
- ▶ While commissioning the sensor, the machine may pose unforeseen dangers. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the sensor should fail or demonstrate faulty operation, it must be replaced.
- ▶ Lines from the sensor to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The sensor and the connection line should be supported mechanically near the installation location.
- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.
- ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.
- ▶ The sensor lines are sensitive to radiation interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor lines should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.

Notes on the installation point and position

- ▶ Do not install the sensor close to parts that generate considerable heat (e.g. exhaust).
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ The connector of the sensor is to be unplugged during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.

Notes on transport and storage

- ▶ If it is dropped, the sensor must not be used any longer as invisible damage could have a negative impact on reliability.

Notes on wiring and circuitry

- ▶ Lines to the angle sensors are so short as possible and be shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The product should only be plugged and unplugged when it is in a de-energized state.

Intended use

- ▶ The sensor is designed for use in mobile working machines provided no limitations/restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the sensor must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the sensor other than that described in chapter "Intended use" is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, unintended interventions in the device not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ The customer is responsible for performing a risk analysis of the mobile working machine and determining the possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.).
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

Further information

- ▶ Further information about the sensor can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The sensor must be disposed according the national regulations of your country.

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Inertial sensor AC1

RE 95175

Edition: 11.2014

Replaces: 10.2013


Feature

- ▶ 5-Axis (5D) inertial sensor, 3 accelerations, 2 rotation rates
- ▶ All signals via CAN interface (ISO 11898)
- ▶ 7 to 16 V supply
- ▶ Type of protection IP6K7
- ▶ Operating temperature: -40 to +85 °C
- ▶ Small size
- ▶ Bosch Automotive Quality

Contents

Description	2
Technical data	2
Vehicle axis system	5
Dimensions	6
Connector AMP-MQS Superseal	6
Assembly into the vehicle	7
Guidelines for application	8
Safety instructions	8

Description

The purpose of the inertial sensor AC1 is to measure the physical effects of yaw rate, roll rate and of lateral, longitudinal and vertical acceleration. If mounted appropriately (i.e. according to the offer drawing), the inertial sensor AC1 is measuring the yaw and roll rate and lateral, longitudinal and vertical acceleration of the vehicle.

To avoid signal disturbances or negative influences on the inertial sensor AC1 via the power supply we recommend powering the inertial sensor AC1 via the ECU or clamp 15 with a separate ground connection.

Vibration

As a result of the acceleration sensitivity of the sensors over the entire frequency range, it is necessary for the sensor unit AC1 to be tested within the framework of application release. Please also consider data shown in the offer drawing.

Mounting position

Normal position of inertial sensor AC1:

- ▶ Connector opposite to driving direction
- ▶ Definition of axes see offer drawing

Material number for AC1

R917009129

Technical data

Ambient conditions

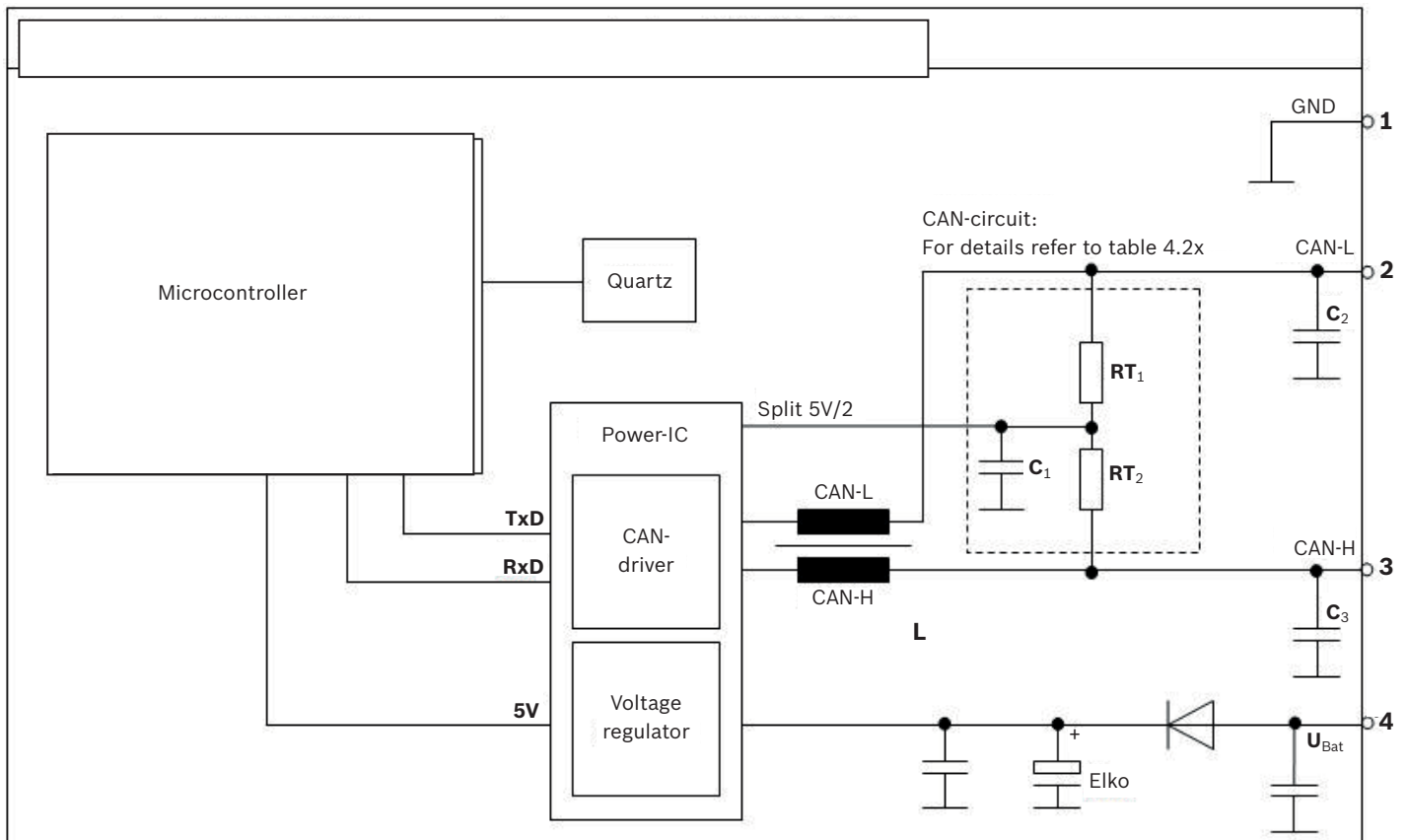
Position	Minimum	Typical	Maximum
Storage time			5 a
Storage temperature	-40 °C		+85 °C
Humidity φ_{\max}	at 40 °C		95 %r.h.
	at 55 °C		65 %r.h.
Operating temperature range	-40 °C		+85 °C
Temperature gradient			3.0 K/min
Atmospheric pressure	860 mbar		1060 mbar

Electrical data

Position	Minimum	Typical	Maximum
Nominal supply voltage		14 V	
Supply voltage range	7 V		16 V
Non-destructive supply voltage range	(within t_{life} , δ_{op})	-16 V	+16 V
	(within t_{life} , δ_{room}); $t < 5$ min	-18 V	+18 V
Supply current		65 mA	90 mA
Output short circuit protection	0 V		+18 V
Signal output (CAN)		Compatible to ISO 11898	
Type of protection according to EN 60529		IP6K7	

Electrical data (CAN-Interface)

Position	Value
EMC capacitor	100 pF
	100 pF
EMI filter	51 μH
Microcontroller	Renesas R8C/23
Power-IC	Bosch CA510
(Voltage regulator, watchdog, CAN transceiver)	Split termination resistors integrated (1k33 Ohm)
Microcontroller memory	flash
Baudrate	500 kBaud



Yaw and roll rate output

Position	Minimum	Typical	Maximum
Nominal measuring range	-163 °/s		+163 °/s
Overrange limit	-1000 °/s		+1000 °/s
Nominal sensitivity		200 LSB/°/s	
Sensitivity error at δ_{Op} within t_{life} (referred to SF)	-4 %	±2.5 %	+4 %
Non-linearity	-1 °/s	±0.5 °/s	+1 °/s
Differential non-linearity (in steps of 5 °/s)	-4 %		+4 %
Offset, absolute (within t_{life} , measured at δ_{Op})	-3 °/s	±1.5 °/s	+3 °/s
Offset drift run to run (within t_{life} , measured at δ_{Op})	-1.25 °/s	±0.6 °/s	+1.25 °/s
Rate of change of off- set	(t<3 min after U_{batt} on) (t>3 min after U_{batt} on)	±0.2 °/s/min	+0.6 °/s/min
Resolution, absolute (quantisation)			0.1 °/s
Time until availability		0.3 s	0.35 s
Cross axis sensitivity	-4 %	±2 %	+4 %
Cut-off frequency (-3dB)		15 Hz	
Output noise		0.1 °/s	0.2 °/s
g-sensitivity	-0.25 °/s/g		+0.25 °/s/g

Acceleration output (lateral (y), longitudinal (x) and vertical (z))

Position	Minimum	Typical	Maximum
Nominal measuring range	-4.2 g		+4.2 g
Overrange limit	-10 g		+10 g
Nominal sensitivity		7845 LSB/g	
Sensitivity error at δ_{Op} within t_{life} (referred to SF)	-3 %	±2.0 %	+3 %
Non-linearity	-0.072 g	±0.036 g	+0.072 g
Offset (within t_{life} , measured at δ_{Op})	-0.1 g	±0.05 g	+0.1 g
Offset drift run to run (within t_{life} , measured at δ_{Op})	-0.04 g	±0.03 g	+0.04 g
Rate of change of offset	-0.03 g/min	±0.2 g/min	+0.03 g/min
Resolution, absolute (quantisation)			0.1 g
Time until availability		0.3 s	0.35 s
Cross axis sensitivity	-4 %	±2.5 %	+4 %
Cut-off frequency (-3dB)		15 Hz	
Output noise		0.004 g_{rms}	0.005 g_{rms}

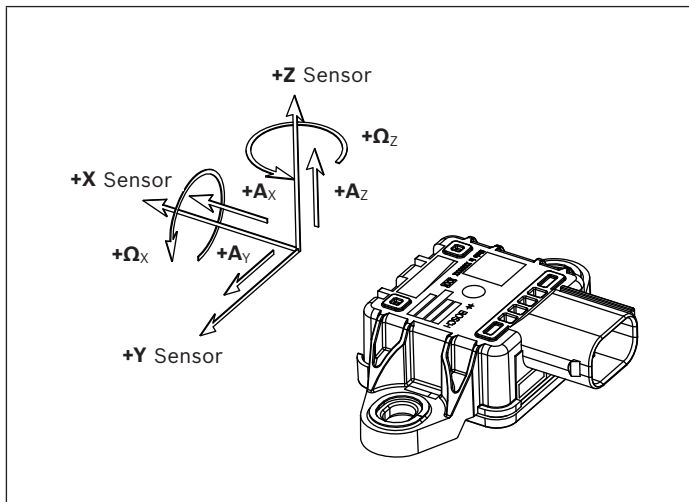
Radiated susceptibility (radiated immunity)

	Norm	Range	Value
Strip line test according to	ISO 11452-5	1 to 400 MHz	200 V/m
BCI- test according to	ISO 11452-4	1 to 400 MHz	100 mA
Absorber-lined chamber test according to	ISO 11452-2	200 to 2000 MHz	150 V/m
Mobile phone test according to	ISO 11452-9		

Radiated susceptibility (radiated emission)

Antenna measurement according to	CISPR 25-13	0.15 to 1000 MHz	
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Vehicle axis system



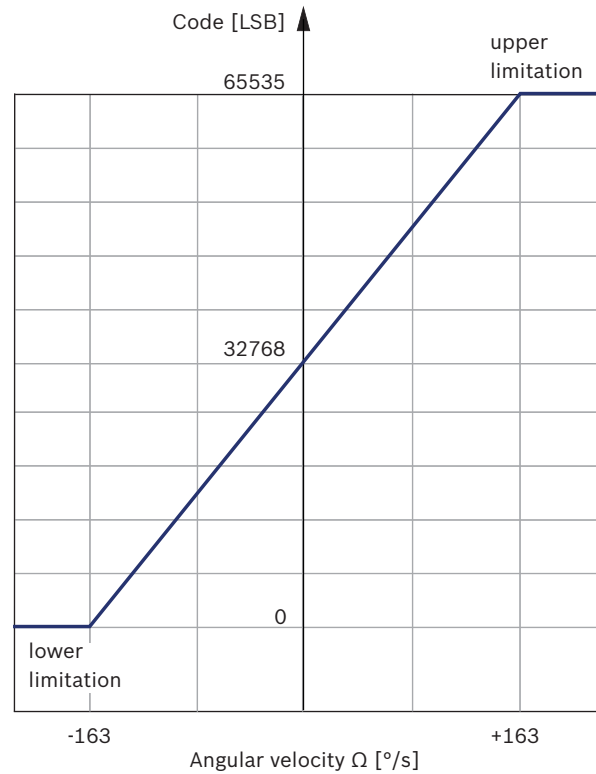
Vehicle axis system according to DIN 70000 respectively ISO 8855:

- +X_{vehicle} points to the front of the vehicle
- +Y_{vehicle} points to the left side of the vehicle
- +Z_{vehicle} points to the top of the vehicle

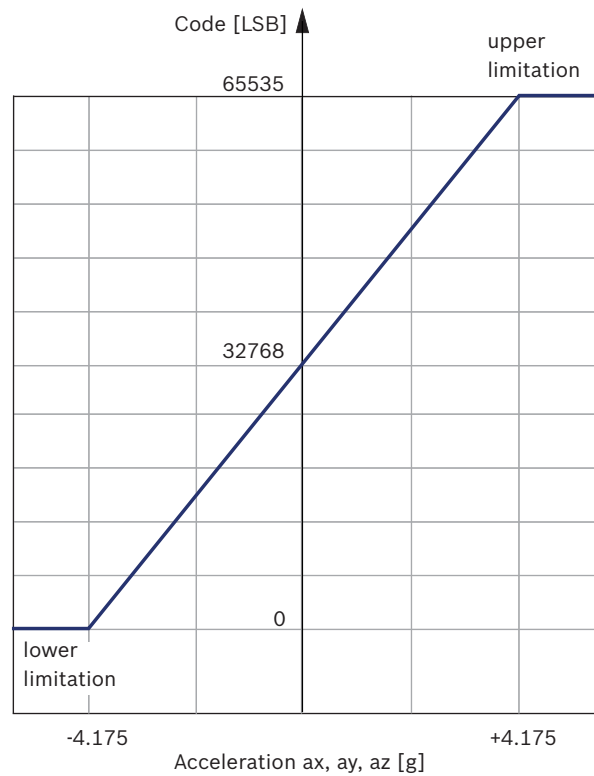
If the sensor is placed in the vehicle as shown on the offer drawing, the sensor axis and the vehicle axis are identical, i.e.:

- +X_{vehicle} = +X_{sensor}
- +Y_{vehicle} = +Y_{sensor}
- +Z_{vehicle} = +Z_{sensor}

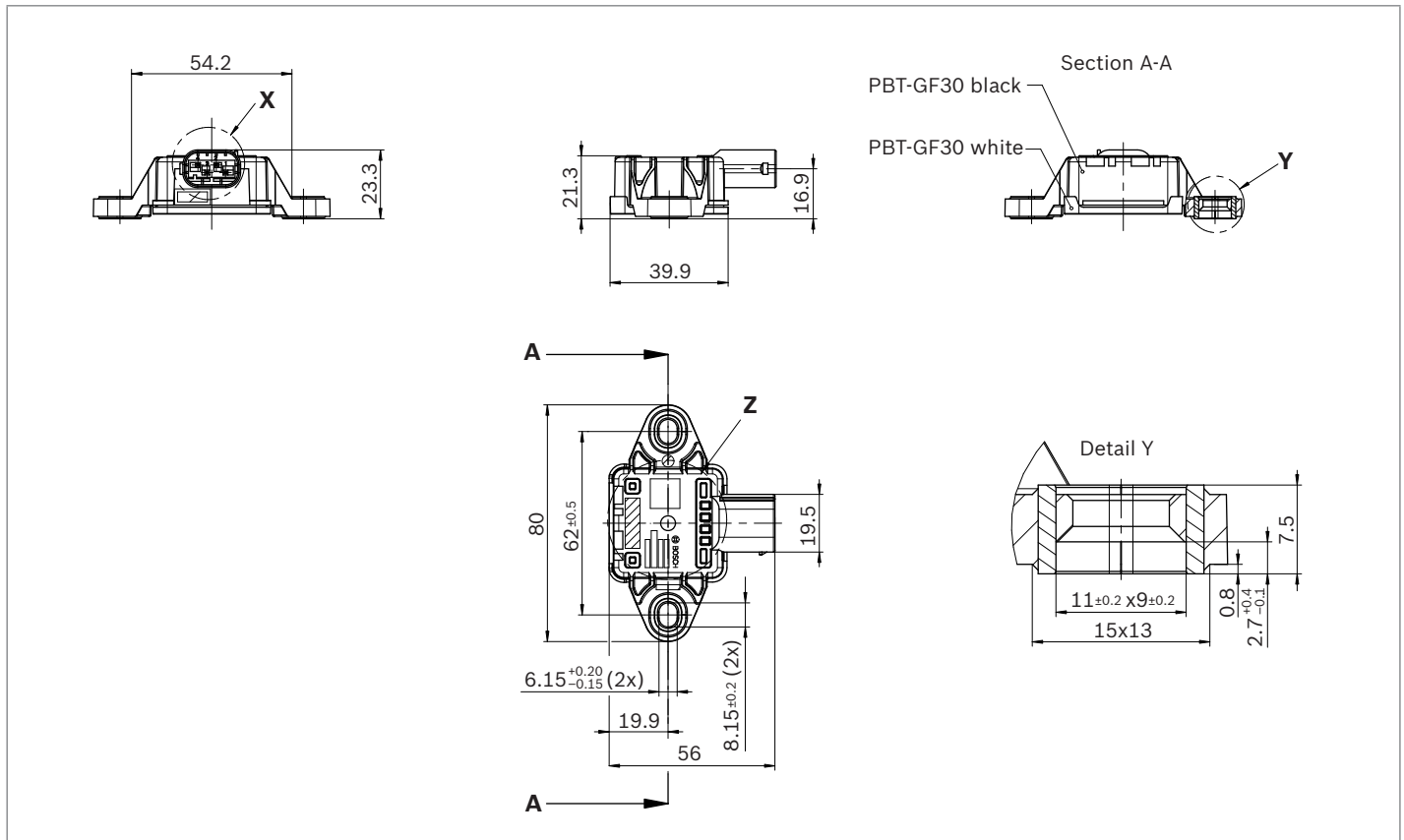
▼ Yaw and roll rate



▼ Acceleration (nominal)

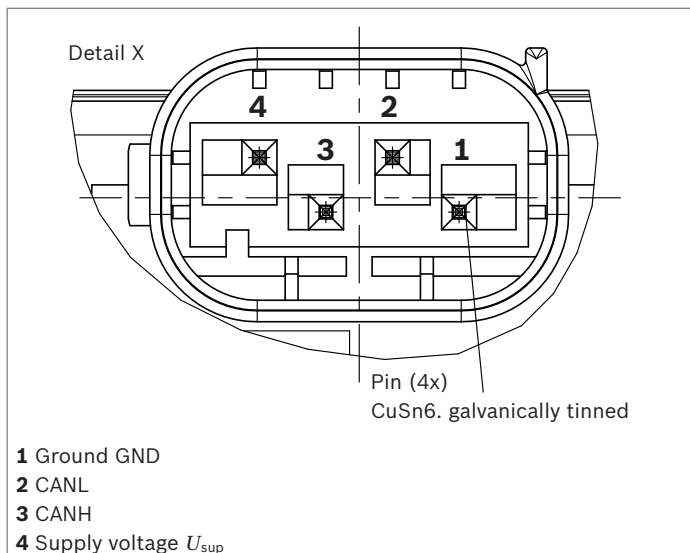


Dimensions



Connector AMP-MQS Superseal

▼ Pin assignment



▼ Mating connector

Designation	Quantity	AMP-MQS material number
Housing	1	1-967640-1
Contacts (DGB 0.75 mm ²)	4	965906-1
Single-wire seal (for $\varnothing 1.4$ bis 1.9 mm)	4	967067-1

The mating connector is not included in the scope of supply. This can be supplied by Bosch Rexroth on request (material number R917009162).

Assembly into the vehicle

The mounting location of the inertial sensor AC1 is to be chosen in such a way, that only vehicle-dynamic related motions occur at the location.
 Bosch Rexroth will give support to find suitable location.

The inertial sensor AC1 must be fixed with two bolts before operation. The corresponding size is contained in the offer drawing. Tightening torque for the M6 nut is defined in the offer drawing.

A mounting bolt with ordinal impact wrench is not allowed as the rattling vibration of the impact wrench may lead damage of the sensor. Bosch Rexroth recommends to use electronically controlled wrenches (torque and angle of rotation) for fixation process.

It is also to pay attention that no unallowable shock, e.g. hammer etc. is applied in the area of the sensor during mounting.

Large accelerations may occur from e.g. hammer blow, stopping of work piece carriers, screw-on with automatic screwdriver, etc. Exceptions are possible during repair work, for example in service.

The inertial sensor AC1 is to be assembled without application of force. Using tools like a hammer or crowbar may lead to tensions and damage of the sensor.

In the vehicle, no force must be applied to the sensor. No parts (e.g. passenger seat) must be placed on the sensor, nor must anybody step onto the sensor (e.g. assembly personnel).

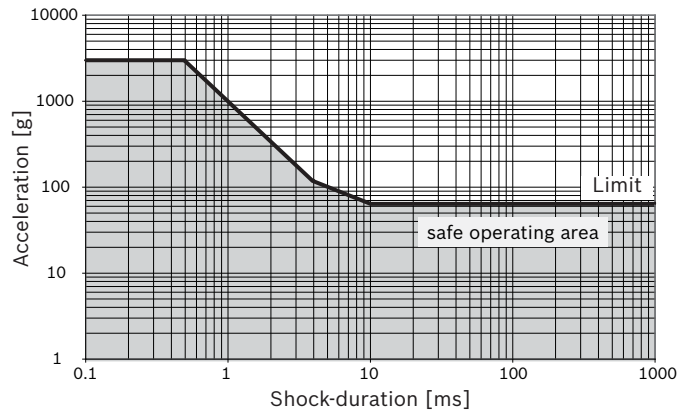
The sensor must not be connected / disconnected with supply voltage being applied.

No deformation or damage of the sensor is allowed.

Spectrum during mounting

During the sensor's attachment to the vehicle the sensor is exposed to various impacts of the housing by mounting and tooling. These values quantified by a tri-axial accelerometer mounted on the sensor's PCB must not exceed the specified area.

▼ Specification for acceleration during mounting



Guidelines for application

General information

As a result of the acceleration sensitivity of the sensors over the entire frequency range, it is necessary for the inertial sensor AC1 to be tested within the framework of application release.

Additional tests

It has to be tested whether vehicle components near the inertial sensor AC1 create signal disturbances. This can be caused by the following:

- ▶ Complete engine speed range, minimum speed to maximum speed with 3500 min^{-1}
- ▶ Actuating the shift lever

Safety instructions

General instructions

- ▶ Before finalizing your design, request a binding installation drawing.
- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ It is not permissible to open the sensor or to modify or repair the sensor. Modifications or repairs to the wiring could result in dangerous malfunctions.
- ▶ The sensor may only be assembled/disassembled in deenergized state.
- ▶ System developments, installation and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and with the complete system.
- ▶ While commissioning the sensor, the machine may pose unforeseen dangers. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the sensor should fail or demonstrate faulty operation, it must be replaced.
- ▶ Despite every care being taken when compiling this document, it is not possible to take into account all feasible applications. If instructions for your specific application are missing, you can contact Bosch Rexroth.

Notes on the installation location and position

- ▶ Do not install the sensor close to parts that generate considerable heat (e.g. exhaust).
- ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ The connector of the sensor is to be unplugged during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.

Notes on transport and storage

- ▶ Please inspect the device for any damages which may have occurred during transport. If there are obvious signs of damage, please immediately inform the transport company and Bosch Rexroth.
- ▶ If it is dropped, the sensor must not be used any longer as invisible damage could have a negative impact on reliability.

Notes on wiring and circuitry

- ▶ Lines to the sensors must be designed as short as possible and be shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The sensor should only be plugged and unplugged when it is in a de-energized state.
- ▶ The sensor lines are sensitive to radiation interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor lines should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.
- ▶ Lines from the sensor to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The wiring harness should be fixated mechanically in the area in which the sensor is installed (spacing < 150 mm). The wiring harness should be fixated so that in-phase excitation with the sensor occurs (e.g. at the sensor mounting points).
- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.

Intended use

- ▶ The sensor is designed for use in mobile working machines provided no limitations/restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the sensor must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the sensor other than that described in chapter “Intended use“ is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, interference in the component not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ The customer is responsible for performing a risk analysis of the mobile working machine and determining the possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.).
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

Further information

- ▶ Further information about the sensor can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The sensor must be disposed according the national regulations of your country.

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BODAS Inclination Sensor INC

RE 95166/05.09 1/4

Data Sheet

Series 20
Inclination sensor with MEMS technology



3

Contents

Ordering code	2
Description	2
Axis definition and output signal	2
Pin assignment	2
Technical data	3
Dimensions	3
Safety instructions	4

Features

- 2 axes inclination sensor
- High resolution and accuracy
- Current interface
- Type of protection IP67

Ordering code

INC	2	10	CT	/	2	0
01	02	03	04		05	06

Type

01	Inclination sensor	INC
----	--------------------	------------

Number of axes

02	2 axes	2
----	--------	----------

Angle range

03	$\pm 10^\circ$, each axis	10
----	----------------------------	-----------

Output signal

04	Current, 4 to 20 mA each axis	CT
----	-------------------------------	-----------

Series

05		2
----	--	----------

Index

06		0
----	--	----------

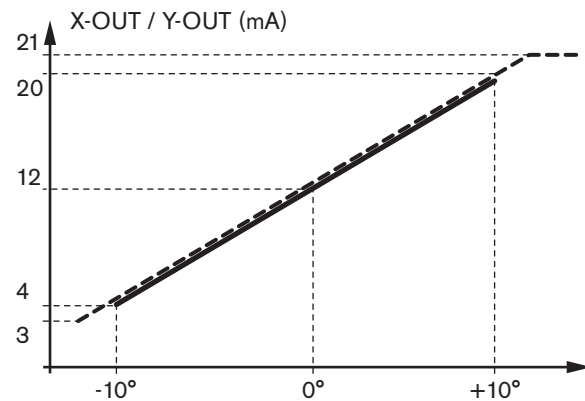
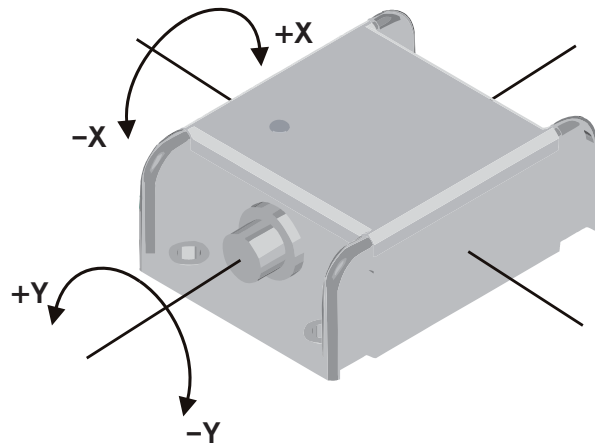
Material number

BODAS INC-2-10CT/20 _____ R913004721

Description

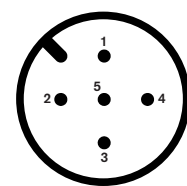
This sensor based upon micro-mechanical MEMS technology is an inclination measuring device for applications in mobile machines. Its function is the monitoring of inclination of 2 axes. The measured range is $\pm 10^\circ$ for each axis.

Axis definition and output signal



Pin assignment

Pin	Function
1	Supply (V+)
2	Sensor output Y (Y-OUT)
3	GND Supply (V-/GND)
4	Sensor output X (X-OUT)
5	GND Sensor outputs



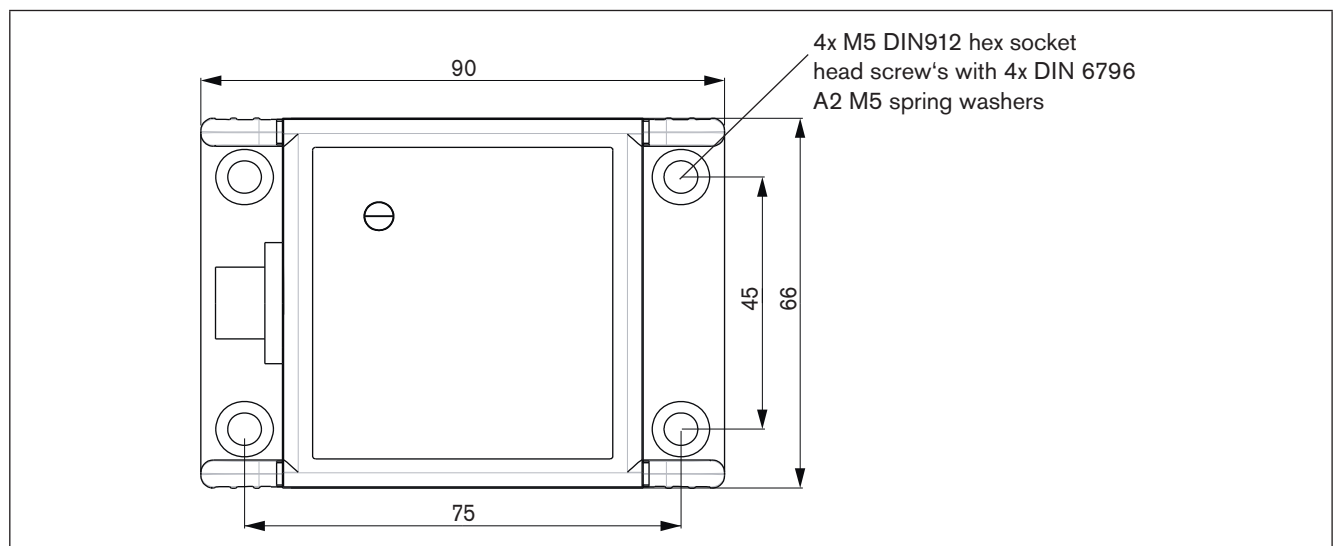
Matching connector:

Phoenix Contact Ref# 1681486 (unshielded) or Ref# 1694318 (shielded). To be ordered directly at the connector manufacturer's.

Technical data

Type	INC2
Number of axes	2
Measuring range per axis	+/- 10°
Resolution at zero point	0.01°
Calibration accuracy at 25 °C	+/- 0.1° in +/-3° window, +/- 0.3° outside
Linearity Sinus	Maximum +/- 0.2°
Temperature Drift at zero point	Maximum +/- 0.01°/K
Cross-Sensitivity	Maximum 1.5 %
Supply	11 VDC to 30 VDC
Current Consumption	Maximum 60 mA
Output signals per axis	Current interface 4..20 mA. Maximum Load at U = 11 V: 250 Ohm at U = 9 V, I _{out} maximum = 18 mA
Storage temperature	-40 °C ... +85 °C
Operating Temperature	-40 °C ... +80 °C
Case	Shock resistant plastic material
Type of protection (DIN 40 050-9)	IP65 + IP67
Dimensions	66 mm x 90 mm x 36 mm
Mass	Ca. 200 g
Assembly	4x M5 DIN912 hex socket head screw's with 4x DIN 6796 A2 M5 spring washers
Connector	Sensor-Actuator 5-pin Connector (M12), IEC 61706-2-101, IEC 60947-2
Electromagnetic compatibility EMC / Environmental Data	
EMC Stripline (ISO 11452-5:2005)	100 V/m, 0.1 MHz .. 1000 MHz
Road Vehicle Electrical Disturbances (ISO 7637-2)	Pulses 1-4: level 3 Pulse 5: level 1 (tested for 24 V power supply system) If higher disturbances are expected from battery supply, supply the sensor through a Rexroth BODAS RC controller output.
Electrostatic discharge ESD (ISO 10605:2001)	8 kV Direct Discharge 15 kV Air Discharge
Shock resistance	IEC 60068-2-27 50 g, 11 ms, 3 per axis , 6 axes IEC 60068-2-29 25 g, 6 ms, 1000 (500 pos., 500 neg.), shocks in 6 directions
Vibration resistance	IEC 60068-2-6 5 to 57 Hz: +/- 1.5 mm p-p and 57..2000Hz: 3g; 1 Oct/min, 2 hours per direction

Dimensions



Safety instructions

• General instructions

- The suggested circuits do not imply any technical liability for the system on the part of Rexroth.
- System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with the components used and with the complete system.
- No components that are defective or not working properly should be used. If components fail and/or exhibit malfunction, repair must be carried out immediately.
- Before commissioning the system, you must ensure that the vehicle and the hydraulic system are in a safe condition. Make certain that no persons are present in the danger zone of the machine.
- A sufficiently large distance to radio systems must be maintained.
- All connectors must be unplugged from the electronics during electrical welding operations.
- Cables to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.

• Intended use

- The sensor is designed for use in mobile working machines provided no limitations / restrictions are made to certain application areas in this data sheet.
- Operation of the sensor must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences. Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the complete system.
- Any use of the sensor other than described in chapter „Intended use“ is considered to be improper.
- Damages which result from improper use and/or from unauthorized, unintended interventions in the device not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

• Use in safety-related functions

- It is the customer's responsibility to perform a risk analysis of the system and de-terminer the possible safety-related functions. It is the customer's responsibility to take appropriate measures in safety-related applications (sensor redundancy, plausibility check, emergency switch,...).

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The data specified above only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.

Subject to change.

BODAS Temperature sensor for fluids TSF

RE 95180

Issue: 09.2015

Replaces: 04.2015



- Temperature measurement of cooling fluids, hydraulic oils or engine oil in vehicles

Function

The sensor element comprises a PTC nickel thin-film resistor, which is evaporated onto a ceramic carrier substrate in a meandering pattern. Installed in a metallic radiator housing, it is used to measure the temperature of fluids. Its resistance behavior is almost linear.

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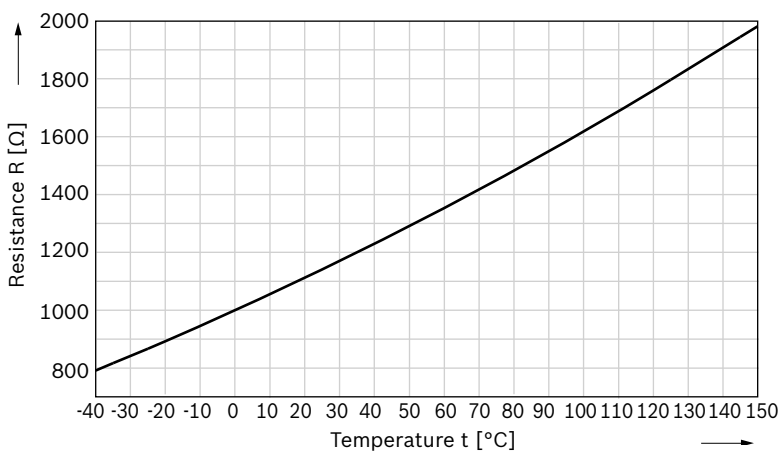
Technical data

Model	TSF
Measuring range	-40 °C to 150 °C
Pressure range	up to 150 bar
Resistance at 0 °C	1,000 Ω
Tolerance at 20 °C	±0.5 K corresponds to ±0.3 % of R20
Tolerance at 100 °C	±1.1 K corresponds to ±0.5 % of R100
Maximum permissible current	5 mA
Time constant (in standing water)	11 s
Delay	1 s
Vibration resistance	40 g
Type of protection	IP 65 with the connector plugged in
Plug connection	Jet connector, 2-pin
Insertion thread	M14 × 1.5
Material	Brass and plastic

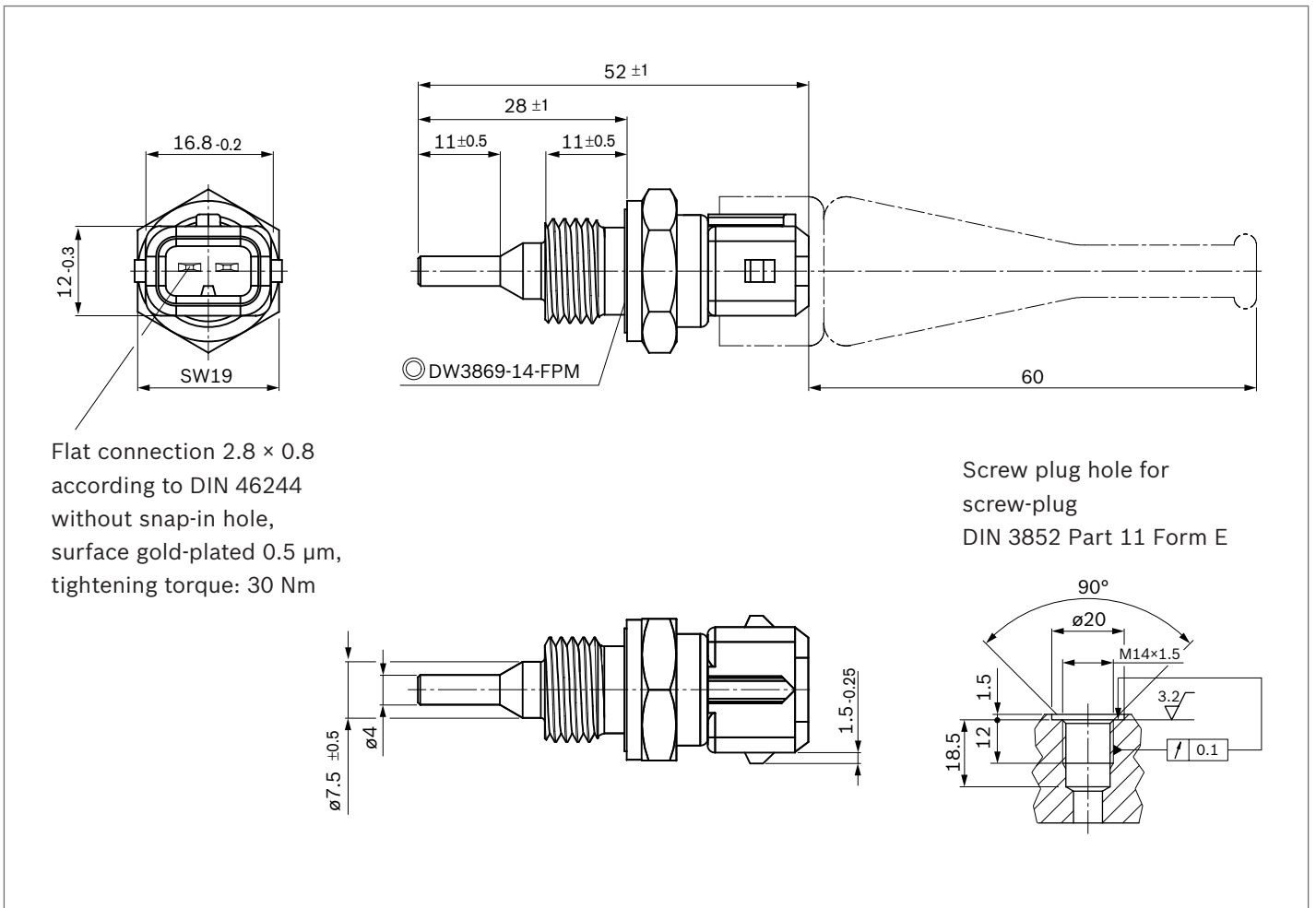
Material number:

Sensor (without accessories)	0 538 009 252
Accessories (connector set)	1 834 484 094
Connector set comprising:	1x connector housing (Bosch-Material number 1284485110) 2x contact spring (Bosch-Material number 1284477176, AMP- Material number: 925590-3) 1x protective cap (Bosch-Material number 1280703026) The connector set is not included in the delivery contents.

Curve



Dimensions



Safety instructions

General Instructions

- ▶ Before finalizing your design request a certified installation drawing.
- ▶ The suggested circuits do not imply any technical liability for the system on the part of Rexroth.
- ▶ It is not permissible to open the sensor or to modify or repair the sensor. Modifications or repairs to the wiring could lead to dangerous malfunctions.
- ▶ Connections in the hydraulic system may only be opened in depressurized state.
- ▶ The sensor may only be assembled/disassembled in depressurized and deenergized state.
- ▶ System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- ▶ When commissioning the sensor, the machine may pose unforeseen hazards. For this reason, before commissioning the system, you must ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the sensor should fail or fail to operate properly, it must be replaced.
- ▶ Despite every care being taken when compiling this document, it is not possible to take into account all feasible applications. If instructions for your specific application are missing, you can contact Bosch Rexroth.

Notes on the installation point and position

- ▶ Do not install the sensor close to parts that generate considerable heat (e.g., exhaust).
- ▶ Wires are to be routed with sufficient spacing to hot or moving vehicle parts.
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ The connector of the sensor is to be unplugged prior to electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the sensor.

Notes on transport and storage

- ▶ Please examine the sensor for any signs of transport damage. If obvious damage is present, please notify the transport contractor and Bosch Rexroth without delay.
- ▶ If the sensor is dropped, continued use is not permissible because unseen damage may affect its reliability.

Notes regarding the connection and the wiring

- ▶ Lines to the sensors are to be shielded and kept as short as possible and be shielded. The shield must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The sensor mating connector must only be plugged and unplugged when it is in a deenergized state.
- ▶ The sensor cables are sensitive to radiation interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor cables should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.
- ▶ Cables from the sensor to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The cable harness should be mechanically secured in the area in which the sensor is installed (spacing < 150 mm). The cable harness should be secured so that in-phase excitation with the sensor occurs (e.g. at the sensor bolting point).
- ▶ If possible, wires should be routed in the vehicle interior. If the wires are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Wires must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.

Intended use

- ▶ The sensor is designed for use in mobile working machines provided no limitations/restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the sensor must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the sensor other than that described in the chapter headed "Intended use" will be considered to be improper use.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, unintended interventions in the device not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ The customer is responsible for performing risk analysis on the mobile working equipment and for defining possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures to ensure safety (sensor redundancy, plausibility check, emergency switch, etc.).
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

More detailed information

- ▶ Further information about the sensor can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The sensor must be disposed of in accordance with the national regulations of your country.

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BODAS

Temperature sensor for air TSA

RE 95181

Issue: 09.2014

Replaces: 09.2011



- Temperature measurement of the ambient air and the charge air in vehicles

Function

The sensor element comprises a PTC nickel thin-film resistor, which is vapor-deposited onto a ceramic carrier substrate. This small plate is mounted in a plastic housing to protect it from damage. The lattice structure and hydrodynamic design of the inlet and outlet limit the sensor time constant and/or the delay.

Contents

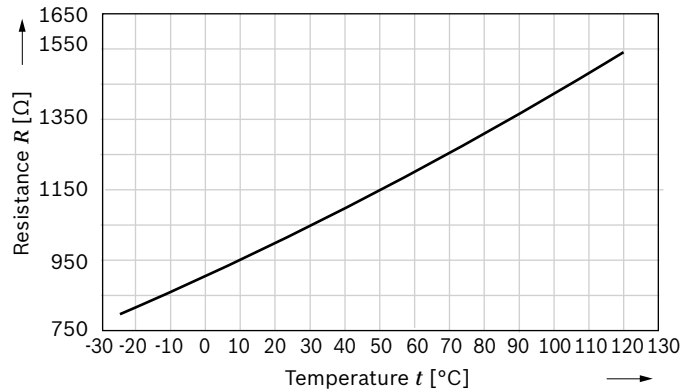
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Technical data

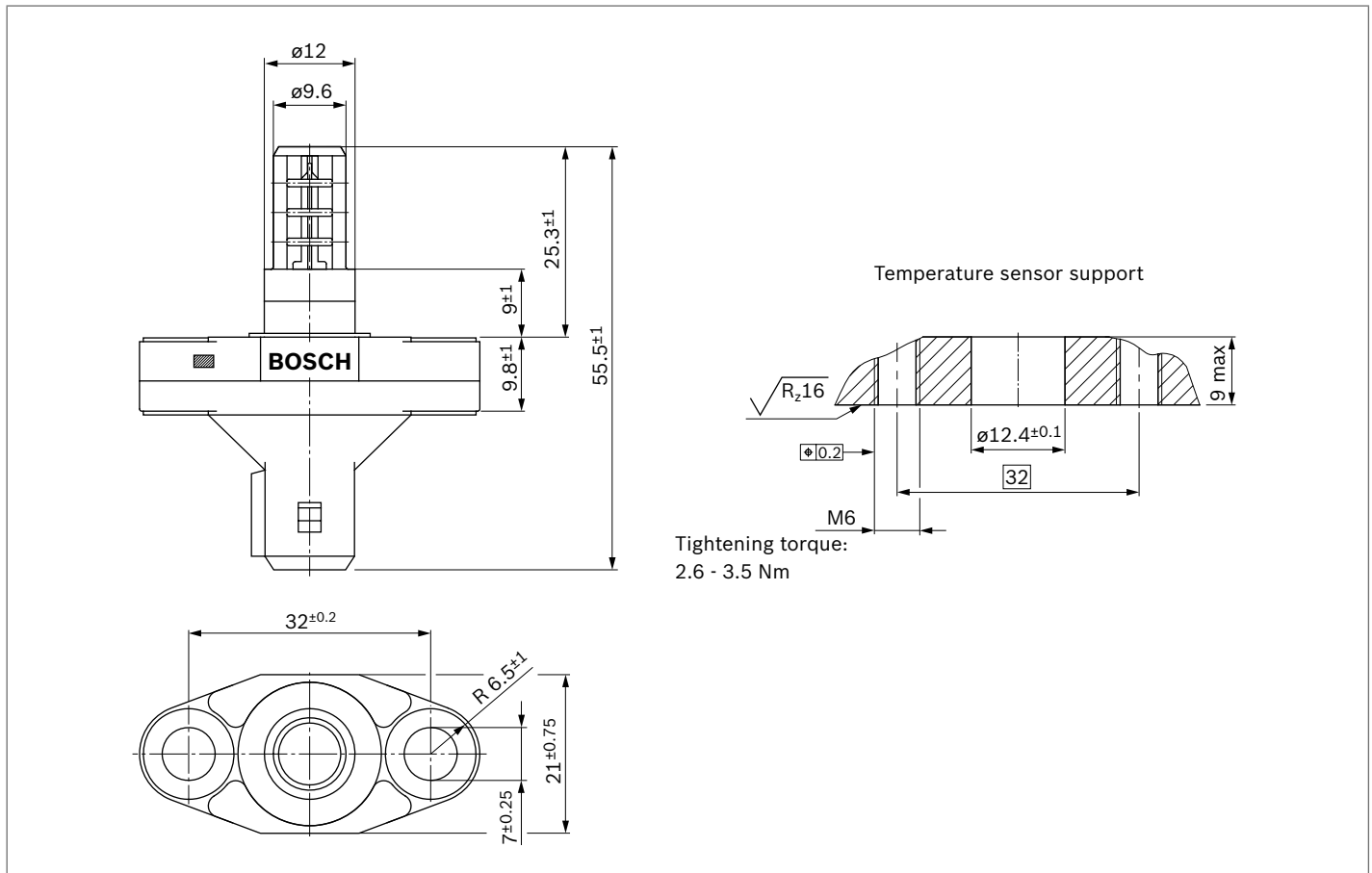
Model	TSA
Measuring range	-30 °C to 130 °C
Resistance at 20 °C	1,000 Ω
Tolerance at 20 °C	±0.5 K corresponds to ±0.3 % of R ₂₀
Tolerance at 100 °C	±1.1 K corresponds to ±0.5 % of R ₁₀₀
Maximum permissible current	5 mA
Time constant (in standing water)	→ 0
Type of protection	IP 64 with the connector plugged in
Plug connection	Jet connector, 2-pin
Fixing	2 x M6

Material number	
Sensor (without accessories)	0 538 009 203
Accessories (connector set)	1 834 484 094
Connector set comprising:	1x connector housing, 2x contact spring, 1x protective cap The connector set is not included in the delivery contents.

Curve



Dimensions



Safety instructions

General Instructions

- ▶ Before finalizing your design request a certified installation drawing.
- ▶ The suggested circuits do not imply any technical liability for the system on the part of Rexroth.
- ▶ It is not permissible to open the sensor or to modify or repair the sensor. Modifications or repairs to the wiring could lead to dangerous malfunctions.
- ▶ Connections in the hydraulic system may only be opened in depressurized state.
- ▶ The sensor may only be assembled/disassembled in depressurized and deenergized state.
- ▶ System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- ▶ When commissioning the sensor, the machine may pose unforeseen hazards. For this reason, before commissioning the system, you must ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the sensor should fail or fail to operate properly, it must be replaced.
- ▶ Despite every care being taken when compiling this document, it is not possible to take into account all feasible applications. If instructions for your specific application are missing, you can contact Bosch Rexroth.

Notes on the installation point and position

- ▶ Do not install the sensor close to parts that generate considerable heat (e.g., exhaust).
- ▶ Wires are to be routed with sufficient spacing to hot or moving vehicle parts.
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ The connector of the sensor is to be unplugged prior to electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the sensor.

Notes on transport and storage

- ▶ Please examine the sensor for any signs of transport damage. If obvious damage is present, please notify the transport contractor and Bosch Rexroth without delay.
- ▶ If the sensor is dropped, continued use is not permissible because unseen damage may affect its reliability.

Notes regarding the connection and the wiring

- ▶ Lines to the sensors are to be shielded and kept as short as possible and be shielded. The shield must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The sensor mating connector should only be plugged and unplugged when it is in a deenergized state.
- ▶ The sensor cables are sensitive to radiation interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor cables should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.
- ▶ Cables from the sensor to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The cable harness should be mechanically secured in the area in which the sensor is installed (spacing < 150 mm). The cable harness should be secured so that in-phase excitation with the sensor occurs (e.g. at the sensor bolting point).
- ▶ If possible, wires should be routed in the vehicle interior. If the wires are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Wires must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.

Intended use

- ▶ The sensor is designed for use in mobile working machines provided no limitations / restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the sensor must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the sensor other than that described in the chapter headed "Intended use" will be considered to be improper use.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, unintended interventions in the device not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ The customer is responsible for performing risk analysis on the mobile working equipment and for defining possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures to ensure safety (sensor redundancy, plausibility check, emergency switch, etc.).
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

More detailed information

- ▶ Further information about the sensor can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The sensor must be disposed of in accordance with the national regulations of your country.

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Thermal switch TS

RE 95145

Issue: 06.2015

Replaces: 05.2015



- ▶ Single-pole power switch when the temperature is rising
- ▶ Flat connector, tin-plated, 6.3 mm x 0.8 mm
- ▶ Temperature measurement of cooling fluids, hydraulic oils or engine oil in vehicles

Function

The thermal switch is used to monitor the hydraulic circuit temperature. When the temperature is rising, it switches from “Off” to “On” (current flow) when the upper switching temperature is reached. When the temperature is falling, it switches from “On” to “Off” (no current flow) when the lower switching temperature is reached.

The thermal switch can be used in both axial piston pumps and engines.

It is intended to be installed in the drain ports and the hydraulic fluid reservoir.

Contents

Type code	2
Technical data	2
Circuit diagram	2
Dimensions	2
Safety instructions	3

Type code

01	02	03	04	05
TS	12-24	T1	/	10
				-
				G22

Model

01	Thermal switch	TS
----	----------------	-----------

Supply voltage

02	12 V to 24 V	12-24
----	--------------	--------------

Design

03	lower switching temperature 87 °C upper switching temperature 92 °C	T1
----	--	-----------

Series

04		10
----	--	-----------

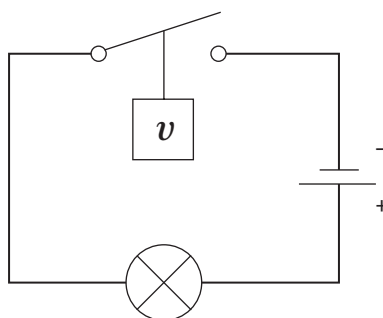
Mounting style

05	Thread M22 × 1.5	G22
----	------------------	------------

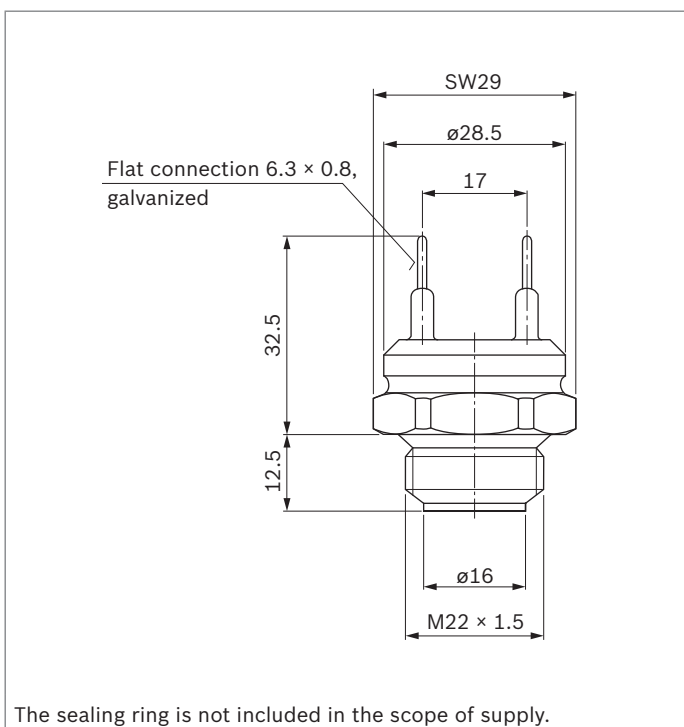
Technical data

Model	TS
Supply voltage	12 V to 24 V
Maximum switching current	
With ohmic load	15 A to 12 V 10 A to 24 V
With inductive load	15 A to 12 V 8 A to 24 V
Lower switching temperature	87 °C ¹⁾
Upper switching temperature	92 °C ¹⁾
Switching differential ΔT	5 K
Maximum permissible heat sensor temperature	
Permanent	100 °C
Short-term	120 °C

Circuit diagram



Dimensions



¹⁾ The lower and/or upper switching tolerance is ± 3 °C;
(switching differential $\Delta T = 5$ K constant).

Safety instructions

General Instructions

- ▶ Before finalizing your design request a certified installation drawing.
- ▶ The suggested circuits do not imply any technical liability for the system on the part of Rexroth.
- ▶ It is not permissible to open the sensor or to modify or repair the sensor. Modifications or repairs to the wiring could lead to dangerous malfunctions.
- ▶ Connections in the hydraulic system may only be opened in depressurized state.
- ▶ The sensor may only be assembled/disassembled in depressurized and deenergized state.
- ▶ System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- ▶ When commissioning the sensor, the machine may pose unforeseen hazards. For this reason, before commissioning the system, you must ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the sensor should fail or fail to operate properly, it must be replaced.
- ▶ Despite every care being taken when compiling this document, it is not possible to take into account all feasible applications. If instructions for your specific application are missing, you can contact Bosch Rexroth.

Notes on the installation point and position

- ▶ Do not install the sensor close to parts that generate considerable heat (e.g., exhaust).
- ▶ Wires are to be routed with sufficient spacing to hot or moving vehicle parts.
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ The connector of the sensor is to be unplugged prior to electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the sensor.

Notes on transport and storage

- ▶ Please examine the sensor for any signs of transport damage. If obvious damage is present, please notify the transport contractor and Bosch Rexroth without delay.
- ▶ If the sensor is dropped, continued use is not permissible because unseen damage may affect its reliability.

Notes regarding the connection and the wiring

- ▶ Lines to the sensors are to be shielded and kept as short as possible and be shielded. The shield must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The sensor mating connector should only be plugged and unplugged when it is in a deenergized state.
- ▶ The sensor cables are sensitive to radiation interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor cables should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.
- ▶ Cables from the sensor to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The cable harness should be mechanically secured in the area in which the sensor is installed (spacing < 150 mm). The cable harness should be secured so that in-phase excitation with the sensor occurs (e.g. at the sensor bolting point).
- ▶ If possible, wires should be routed in the vehicle interior. If the wires are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Wires must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.

Intended use

- ▶ The sensor is designed for use in mobile working machines provided no limitations/restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the sensor must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the sensor other than that described in the chapter headed "Intended use" will be considered to be improper use.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, unintended interventions in the device not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ The customer is responsible for performing risk analysis on the mobile working equipment and for defining possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures to ensure safety (sensor redundancy, plausibility check, emergency switch, etc.).
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

More detailed information

- ▶ Further information about the sensor can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The sensor must be disposed of in accordance with the national regulations of your country.

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Contamination switch VS

RE 95148

Issue: 12.2015

Replaces: 09.2015



- For detecting metallic impurities in oil

Inhalt

Ordering code	2
Description	2
Technical data	2
Connection	3
Dimensions	3
Safety instructions	4

Ordering code

01	02	03	04	05	06
VS				/	2

Type

01	Contamination switch	VS
----	----------------------	-----------

Electrical connection

02	Integrated plug connector to DIN 43650 / IEC 4400	S
	Connecting strands with protective sheath and socket DEUTSCH DT04, 2-pin	L

Screw thread

03	M18x1.5	18
	M22x1.5	22
	M26x1.5	26
	M33x2	33

Switch contact

04	Separate contact	S
----	------------------	----------

Series

05		2
----	--	----------

Index

06		2
----	--	----------

Material number

Variants	Material number
VSS18S/22	R902601956
VSS22S/22	R902601957
VSS26S/22	R902601958
VSS33S/22	R902601959
VSL22S/22	R902601963
VSL26S/22	R902601964
VSL33S/22	R902601965

Technical data

Type	VS	
Max. switching voltage	30 V	
Max. switching current	0.2 A	
Max. oil pressure	6 bar abs.	
Ambient temperature	-25 °C ... +90 °C	
Max. screw-in torque	Size 18	25 Nm
	Size 22	60 Nm
	Size 26	70 Nm
	Size 33	140 Nm
Installed position	Preferably with connector and cable outlet pointing downwards	

Description

The contamination switch VS detects metallic ferromagnetic impurities in oil. Installed in an axial piston unit, the contamination switch VS provides early warning of wear processes and makes it possible to avoid consequential damage in good time.

The contamination switch VS is screwed into the existing bores (e.g. case drain ports) of hydraulic pumps and hydraulic motors. Most abrasion is likely to occur in the case drain area. The plug connector should be fitted so that it faces downwards in order to promote the accumulation of particles due to gravity.

Ferromagnetic impurities in the oil are attracted by a permanent magnet on the measuring surface of the contamination switch VS. As the particles accumulate, they form an electric bridge between the magnet and adjacent metal contacts. This switch signal can then be used to activate an alarm via a relay, for example, or to switch off the hydraulic system.

The magnet always forms one of the two switch contacts. A separate contact which is isolated from the switch housing forms the second switch contact.

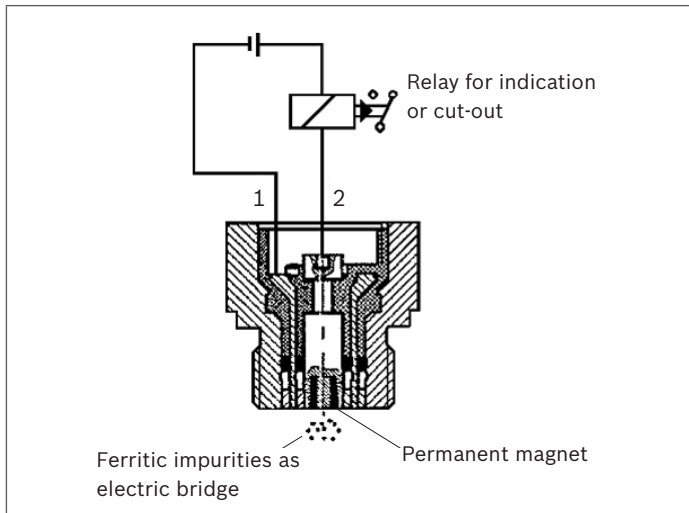
Two different versions are also available for the electrical connection: either an integrated plug connector with mating plug or a free plug connector on the end of a connecting lead with two strands and a protective sheath.

Main part

- ▶ Supplied with sealing ring
- ▶ Supplied with mating plug (connection version S)

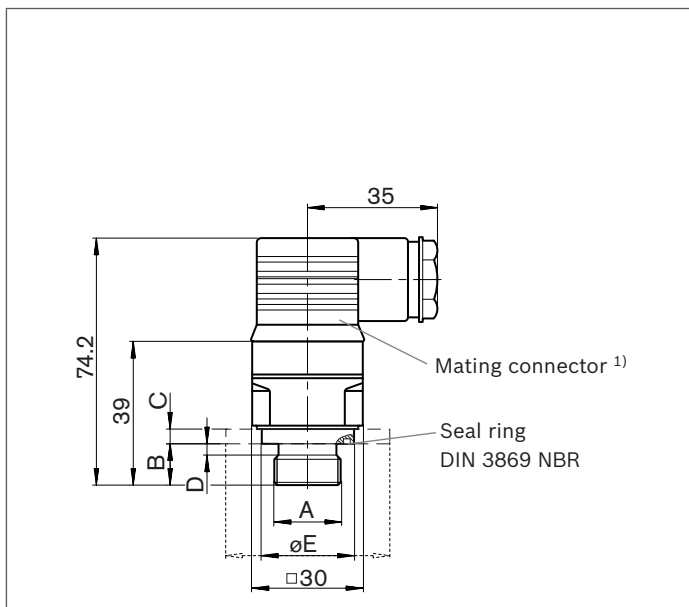
Connection

Switch contact version "S"



Dimensions

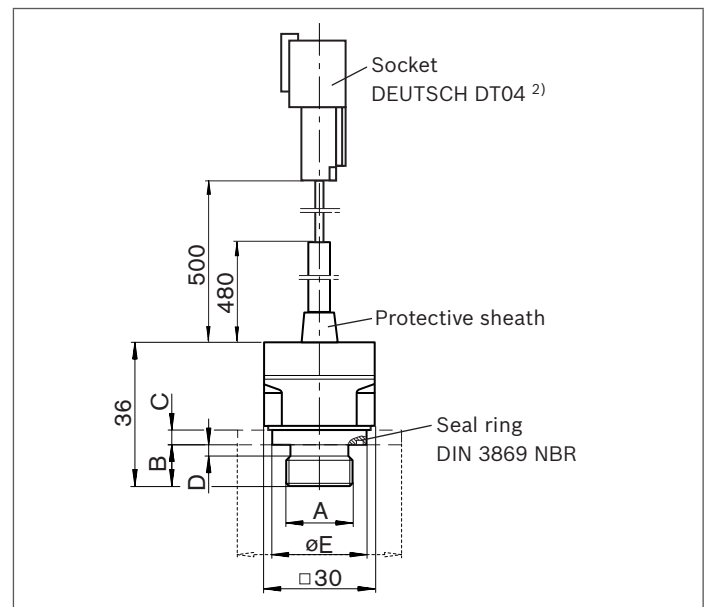
Connection version "S"



VSS	18	22	26	33
A	M18x1.5	M22x1.5	M26x1.5	M33x1.5
B	12	12	12	12
C	4	4	4	4.5
D	3	3	3	4
E	ø23.9	ø27	ø31.4	ø39.2

- 1) Connection version „S“ is supplied complete with mating connector.
- 2) The mating connector DEUTSCH DT06-2S-EP04 for connection version „L“ is not included in supply. Available from Rexroth on request.

Connection version "L"



VSL	22	26	33
A	M22x1.5	M26x1.5	M33x2
B	12	12	12
C	4	4	4.5
D	3	3	4
E	ø27	ø31.4	ø39.2

Safety instructions

General instructions

- ▶ Before finalizing your design request a binding installation drawing.
- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ It is not permissible to open the sensor or to modify or repair the sensor. Modifications or repairs to the wiring could lead to dangerous malfunctions.
- ▶ Connections in the hydraulic system may only be opened in depressurized state.
- ▶ System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- ▶ When commissioning the sensor, the machine may pose unforeseen hazards. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the sensor should fail or demonstrate faulty operation, it must be replaced.
- ▶ Despite every care being taken when compiling this document, it is not possible to take into account all feasible applications. If instructions for your specific application are missing, you can contact Bosch Rexroth.
- ▶ Sensors do not fall under the scope of EMC-RL 2004/108/EC or 2014/30/EU. A declaration of conformity and the CE marking for individually sold sensors is not required, since the sensors are only sold to machine manufacturers (OEM) or to companies with the necessary expertise (i.e. certified Bosch Rexroth partners or companies with trained and qualified service personnel). Furthermore, the responsibility of the above mentioned companies for machine EMC testing remains unaffected in principle.
- ▶ The use of sensors by private users is not permissible, since these users do not typically have the required level of expertise.

Notes on the installation location and position

- ▶ Do not install the sensor close to parts that generate considerable heat (e.g., exhaust).
- ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ The connector of the sensor is to be unplugged during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the sensor.

Notes on transport and storage

- ▶ Please examine the sensor for any damages which may have occurred during transport. If there are obvious signs of damage, please immediately inform the transport company and Bosch Rexroth.
- ▶ If it is dropped, the sensor must not be used any longer as invisible damage could have a negative impact on reliability.

Notes on wiring and circuitry

- ▶ Lines to the sensors must be designed as short as possible and be shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The sensor mating connector should only be plugged and unplugged when it is in a deenergized state.
- ▶ The sensor lines are sensitive to radiation interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor lines should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.
- ▶ Lines from the sensor to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The wiring harness should be fixated mechanically in the area in which the sensor is installed (spacing < 150 mm). The wiring harness should be fixated so that in-phase excitation with the sensor occurs (e.g. at the sensor mounting points).

- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.

Intended use

- ▶ The sensor is designed for use in mobile working machines provided no limitations / restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the sensor must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the sensor other than that described in chapter "Intended use" is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, interference in the component not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ The customer is responsible for performing a risk analysis of the mobile working machine and determining the possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.).
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

More detailed information

- ▶ Further information about the sensor can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The sensor must be disposed according to the national regulations of your country.

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Position sensor PO1 series 20

RE 95160

Edition: 06.2015

Replaces: 09.2013



- ▶ Inductive sensor for position measurement

Features

- ▶ Axially moving button with spring preload
- ▶ Inductive element according to the differential throttle measuring principle
- ▶ Integrated electronics with temperature compensation
- ▶ Ratiometric output signal proportional to position
- ▶ Zero point and sensitivity are calibrated.
- ▶ Housing with external thread M24 x 1.5 for mounting and adjustment

Contents

Ordering code	2
Description	2
Technical data	3
Characteristics	4
Dimensions	5
AMP connector	5
Installation position	6
Dimensions: Eccentric for position control	6
Safety instructions	7

Ordering code

01	02	03	04	05
PO1			/	20

Type

01	Position sensor, mobile	PO1
----	-------------------------	------------

Version

02	Without bellows	1
	With bellows	2

Characteristic

03	Standard	S
	Inverted	V

Supply voltage

04	5 ±0.5 V	05
	8 to 12 V	10

Series

05		20
----	--	-----------

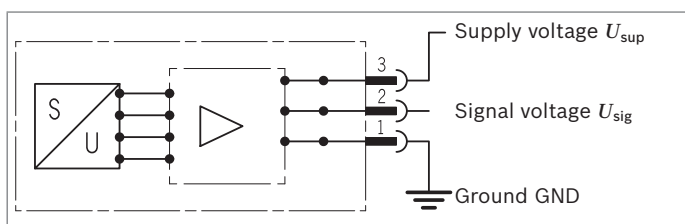
Description

The PO1 position sensor is intended for position measurement up to 10 mm. By mounting an eccentric on a rotation axis, the sensor can also be used for position control of an angle (see page 6).

The sensor returns a ratiometric voltage with increasing characteristic (U_{sig} increases when pressed in) or inverted characteristic (U_{sig} decreases when pressed in). For protection, it can also be supplied with bellows.

This sensor is a typical part of an electro-hydraulic hitch control (EHC) and is supplied directly from a Rexroth EHR control unit or an SRC controller.

▼ Block circuit diagram



Available variants

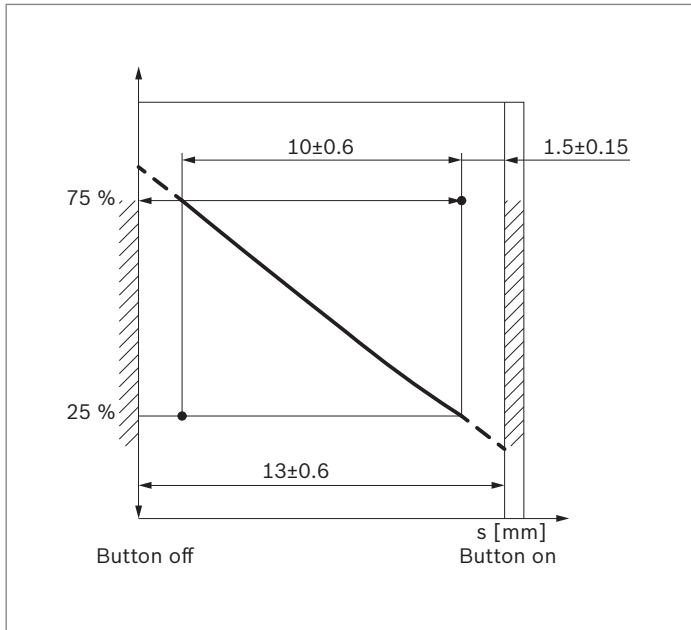
Type	Material number				
PO1 2 S 10 / 20	R917001941				
PO1 1 S 10 / 20	R917001942				
PO1 2 V 10 / 20	R917001943				
PO1 1 V 10 / 20	R917001944				
PO1 2 S 05 / 20	R917008163 ($U_{sig} = 15\% \text{ to } 85\% U_{sup}$)				
PO1 1 S 05 / 20	R917005712				
PO1 2 V 05 / 20	R917008164				
PO1 1 V 05 / 20	R917008165				
PO1 2 S 05 / 20	R917002927 ($U_{sig} = 25\% \text{ to } 75\% U_{sup}$)				

Technical data

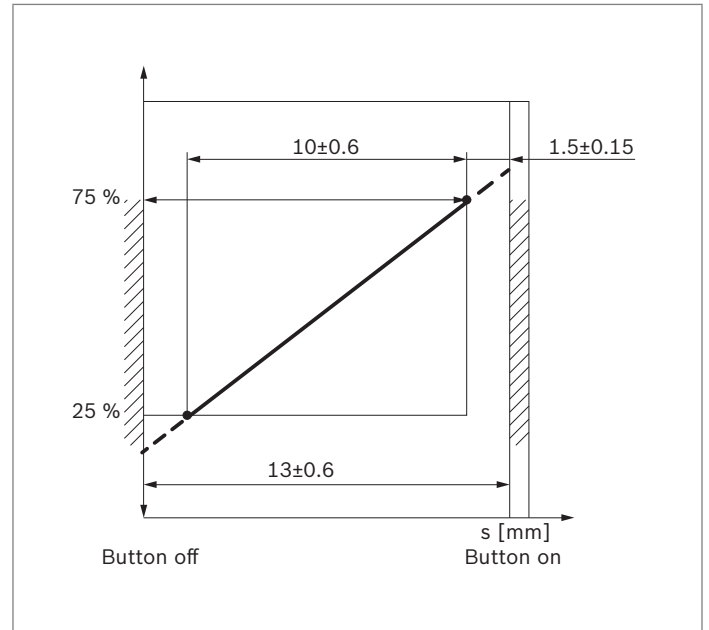
Type	PO1	
Nominal stroke	10 mm	
Mechanical stroke	13 mm	
Actuation force	≤ 16N	
Supply voltage U_{sup}	Standard 8 to 12 V	5 ±0.5 V
Supply current I_{sup}	≤ 30 mA	≤ 20 mA
Signal voltage U_{sig}	25% to 75% U_{sup}	15% to 85% U_{sup} 25% to 75% U_{sup} (R917002927)
Residual ripple	< 20 mVss	< 20 mVss
Load resistance	> 7 kΩ	≥ 10 kΩ
Linearity	≤ ±2 % (end point setting)	
Variation (upper end point)	≤ ±1 %	
Sensitivity variation	≤ ±2.5%	
Hysteresis	Immeasurable	
Resolution	Infinite	
Temperature coefficient of the end point	≤ ±0.15% / 10 °C	
Temperature coefficient of the sensitivity	≤ ±0.15% / 10 °C	
Operating temperature range	-30 °C to +85 °C	
Storage temperature range	-35 °C to 100 °C	
Housing material	GD-Al Si 12 (Cu)	
Type of protection	Coil and electronics: IP69K Connector with installed mating connector: IP69K	
Mating connector	3-pin connector with dust boot	
Insulation resistance to housing	> 100 MΩ	
Dielectric strength of insulation to housing	< 200 V	
Electromagnetic compatibility EMC (ISO 11452-5) 1 MHz to 1 GHz	100 V/m ≤ ±1% U_{sup}	

Characteristics

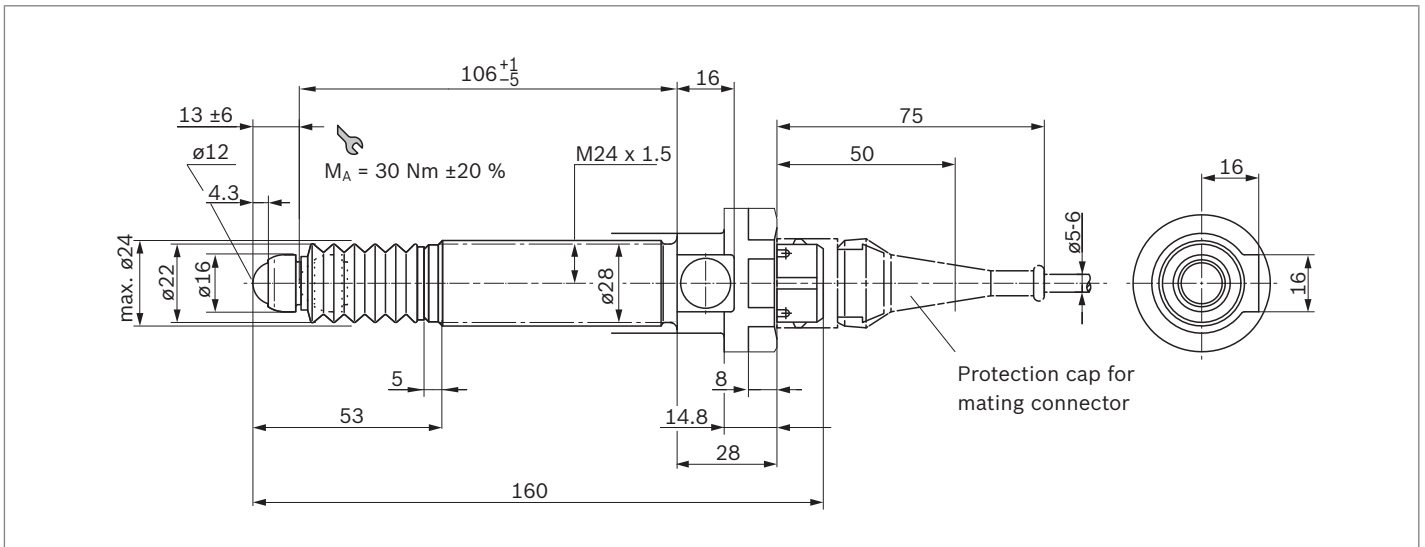
▼ Inverted



▼ Standard (increasing)

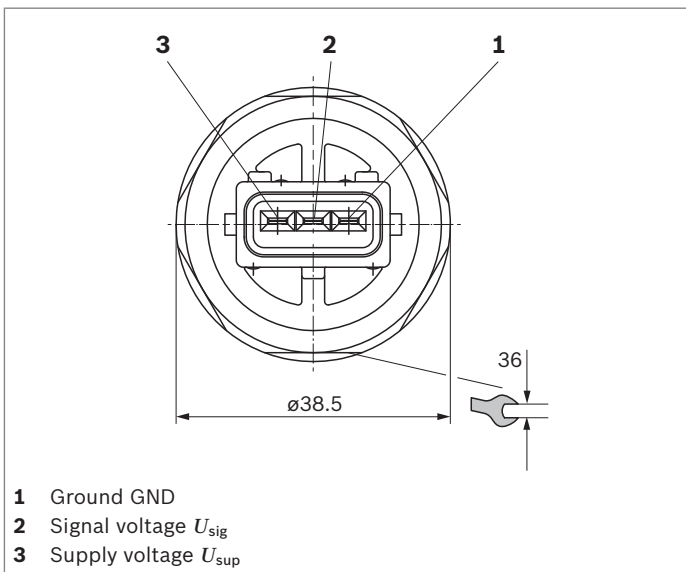


Dimensions



AMP connector

▼ Pin assignment



▼ Mating connector R917000515¹⁾

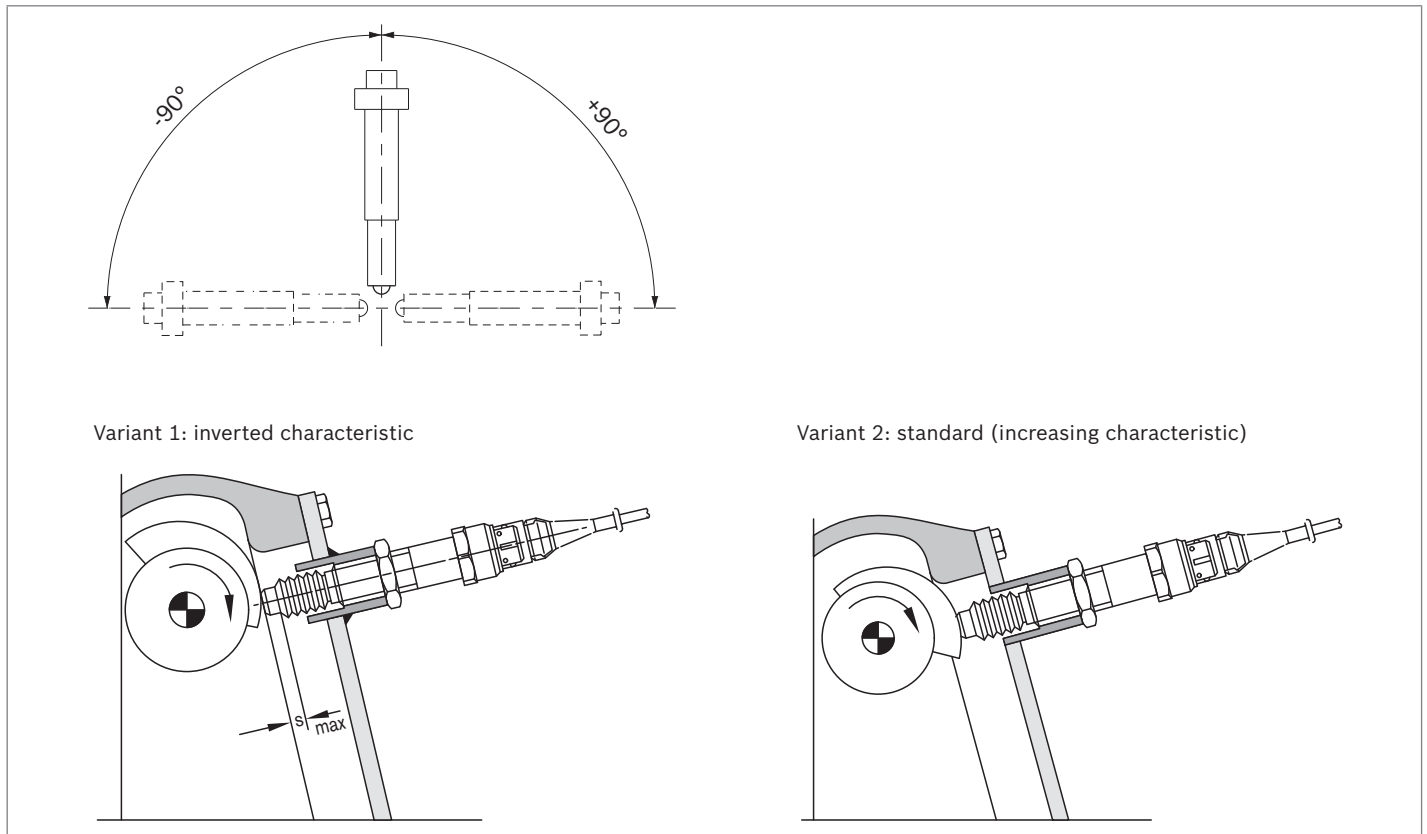
Designation	Number	Material number
Housing	1	1928402579 ²⁾
Protection cap	1	1280703022 ²⁾
Contacts	3	929939 ³⁾
Single-wire seal (wire size: 0.5 to 1.0 mm ²)	3	828905-1 ³⁾ for FLK cable type 828904-1 ³⁾ for FLKr, FLX cable

1) The mating connector is not included in the scope of supply.

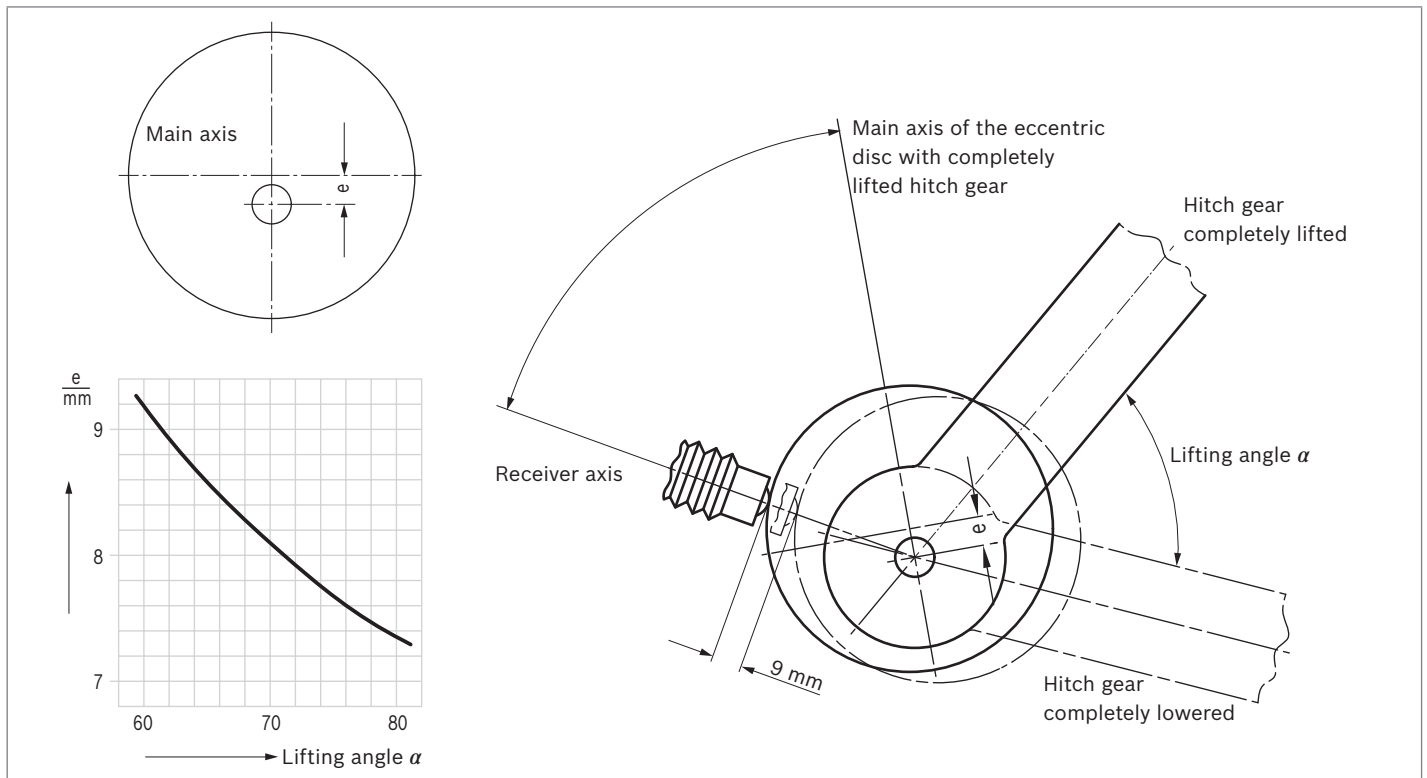
2) Available from Bosch

3) Available from AMP

Installation position



Dimensions: Eccentric for position control



Safety instructions

General instructions

- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ It is not permissible to open the PO1 position sensor or to modify or repair the PO1 position sensor. Modifications or repairs to the wiring could result in dangerous malfunctions.
- ▶ System developments, installation and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and with the complete system.
- ▶ While commissioning the PO1 position sensor, the machine may pose unforeseen dangers. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the PO1 position sensor should fail or demonstrate faulty operation, it must be replaced.

Notes on the installation point and position

- ▶ Do not install the PO1 position sensor close to parts that generate considerable heat (e.g. exhaust).
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ The connector of the PO1 position sensor is to be unplugged during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.

Notes on transport and storage

- ▶ If it is dropped, the PO1 position sensor must not be used any longer as invisible damage could have a negative impact on reliability.

Notes on wiring and circuitry

- ▶ Lines to the position sensors are so short as possible and be shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The product should only be plugged and unplugged when it is in a de-energized state.
- ▶ Lines from the PO1 position sensor to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The PO1 position sensor and the connection line should be supported mechanically near the installation location.
- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.
- ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.
- ▶ The sensor lines are sensitive to radiation interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor lines should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.

Intended use

- ▶ The PO1 position sensor is designed for use in mobile working machines provided no limitations/restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the PO1 position sensor must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the PO1 position sensor other than that described in chapter "Intended use" is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, unintended interventions in the device not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ The customer is responsible for performing a risk analysis of the mobile working machine and determining the possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures for ensuring safety (sensor redundancy, plausibility check, emergency switch, etc.).
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

Further information

- ▶ Further information about the PO1 position sensor can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The PO1 position sensor must be disposed according with the national regulations of your country.

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Draft sensor KMB series 30

RE 95170

Edition: 07.2016

Replaces: 08.2015



► Sensor for draft measurement

Features

- Draft sensor according to Category 3 rear three-point attachment (ISO 730-1)
- Sensor element with magnetoelastic measuring principle
- Integrated electronics
- Output signal ratiometric and proportional to draft
- Zero point and sensitivity are calibrated

Contents

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Description	3
Technical data	4
Characteristics	4
Dimensions	5
Connector	5
Cable versions	6
Installation instructions	7
Safety instructions	7

Ordering code

01	02	03	04	05	06	07
KMB					/ 30 -	

Type

01	Draft measurement pin	KMB
----	-----------------------	------------

Load range

02	±25 kN	025
	±40 kN	040
	±50 kN	050
	±60 kN	060
	±90 kN	090
	±110 kN	110
	±150 kN	150
	±160 kN	160

Supply voltage

03	5 ±0.5 V	05
	8 to 12 V	10

Cable version

04	Cable without protective sleeve	1
	Cable with spiral protective sleeve	2
	Cable with metal protective sleeve	3
	Cable with plastic protective sleeve	4

Connector

05	AMP connector; 3-pin	A
	DEUTSCH connector; 3-pin	B

Series

06		30
----	--	-----------

Cable length

07	800 mm	08
	965 mm	09
	1000 mm	10
	1500 mm	15
	1600 mm	16
	1800 mm	18
	2700 mm	27

Available variants

Type	Material number
KMB 025 05 1 A / 30 - 15	R917007592
KMB 025 05 4 A / 30 - 08	R917008079
KMB 025 05 4 A / 30 - 15	R917008045
KMB 025 10 1 A / 30 - 15	R917000161
KMB 025 10 4 A / 30 - 08	R917000177
KMB 025 10 4 A / 30 - 10	R917000158
KMB 025 10 4 A / 30 - 15	R917000175
KMB 040 05 1 A / 30 - 15	R917008099
KMB 040 05 3 A / 30 - 15	R917008667
KMB 040 05 4 A / 30 - 18	R917008003
KMB 040 10 1 A / 30 - 15	R917000153
KMB 040 10 2 A / 30 - 27	R917000160
KMB 040 10 3 A / 30 - 15	R917000155
KMB 040 10 3 A / 30 - 15	R917001320
KMB 040 10 4 A / 30 - 08	R917000167
KMB 040 10 4 A / 30 - 16	R917000159
KMB 040 10 4 A / 30 - 18	R917000180
KMB 050 10 2 A / 30 - 08	R917000157
KMB 060 05 1 A / 30 - 15	R917008098
KMB 060 05 3 A / 30 - 15	R917008077
KMB 060 10 1 A / 30 - 15	R917000154
KMB 060 10 1 A / 30 - 15	R917000170
KMB 060 10 2 A / 30 - 27	R917000164
KMB 060 05 3 A / 30 - 15	R917008077
KMB 060 10 3 A / 30 - 15	R917000156
KMB 060 05 4 A / 30 - 18	R917008060
KMB 060 10 4 A / 30 - 08	R917000166
KMB 060 10 4 A / 30 - 15	R917000173
KMB 060 10 4 A / 30 - 16	R917000165
KMB 060 10 4 A / 30 - 18	R917000181
KMB 090 10 1 A / 30 - 15	R917000168
KMB 090 10 1 A / 30 - 15	R917000171
KMB 090 10 2 A / 30 - 27	R917001969
KMB 090 05 3 A / 30 - 15	R917008078
KMB 090 10 3 A / 30 - 15	R917000163
KMB 090 05 4 A / 30 - 18	R917008061
KMB 090 10 4 A / 30 - 15	R917000172
KMB 090 10 4 A / 30 - 18	R917000275
KMB 110 05 1 A / 30 - 15	R917005142
KMB 110 10 1 A / 30 - 15	R917000179
KMB 110 10 2 A / 30 - 08	R917000162
KMB 150 10 2 A / 30 - 08	R917000174

Description

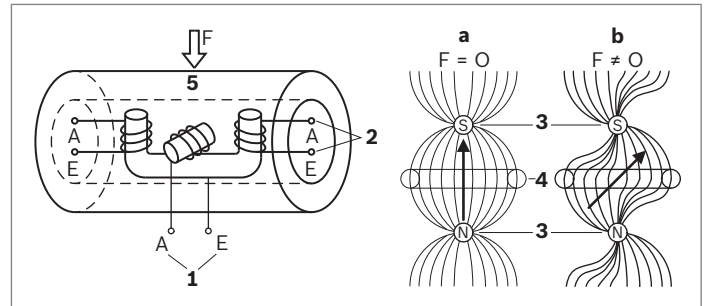
The draft sensor is designed as a bearing bolt. Shearing stress occurs at the bearing position, which is evaluated as a magnetoelastic effect.

In unloaded condition a symmetrical magnetic field is formed by the primary coil between the poles. If pulling or pressure drafts are induced, then the magnetic properties of the original isotropic material is altered. As a consequence, the magnetic field is rendered asymmetrical. This in turn induces a magnetic potential difference between the secondary poles. This causes a magnetic flux through the secondary circuit so that a voltage is induced in the secondary coils.

This voltage is proportional to the acting draft. It is amplified and rectified in an integrated evaluation circuit.

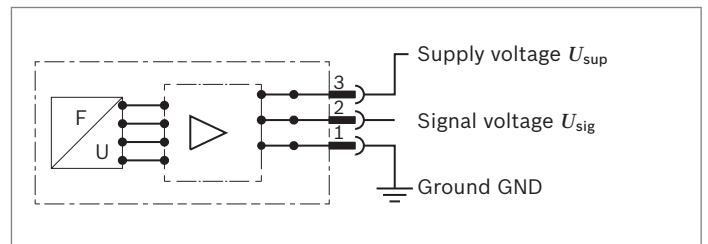
The sensor supplies a ratiometric voltage (25% to 75% of supply voltage). It is available with various measurement ranges and cable versions. This sensor is a typical part of an electro-hydraulic hitch control (EHC).

▼ Function principle



- 1 Primary coil
- 2 Secondary coil
- 3 Primary pole surface
- 4 Secondary pole surface
- 5 Steel sleeve
- a Symmetrical magnetic field
- b Asymmetrical magnetic field

▼ Block circuit diagram

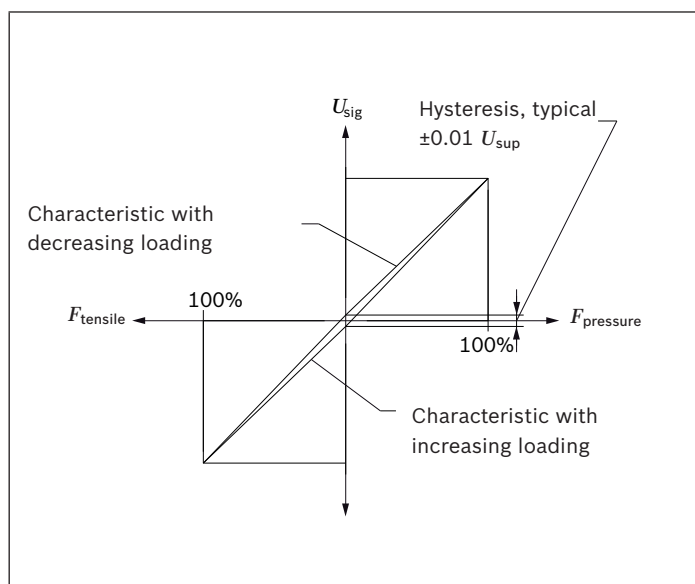


Technical data

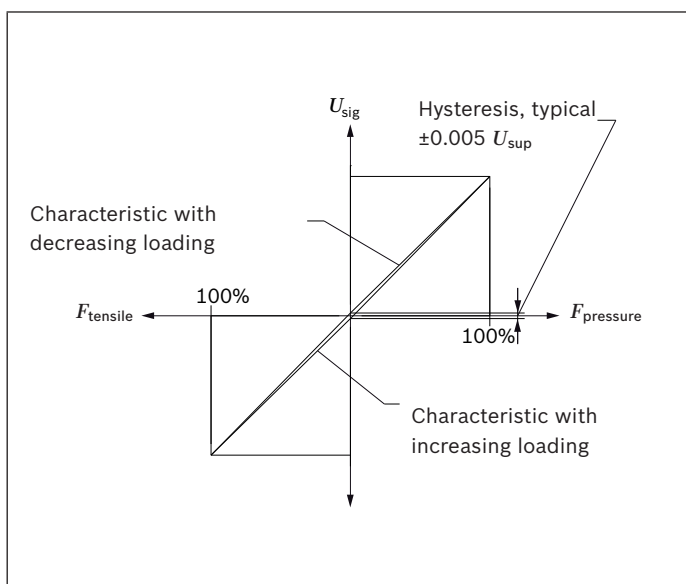
Type	025	040	050	060	090	110	150
Load range F	±25 kN	±40 kN	±50 kN	±60 kN	±90 kN	±110 kN	±150 kN
Standard overload range	±80 kN			±160 kN		±220 kN	
Electrically measurable overload	+1.2 F_{pressure} to -1.5 F_{tensile}						
Supply voltage U_{sup}	8 to 10 V regulated voltage (no direct supply out of vehicle power (battery)) or 5 ±0.5 V						
Supply current I_{sup}	< 100 mA at 8 to 10 V; < 50 mA at 5 ±0.5 V						
Signal voltage U_{sig}	25% to 75% U_{sup} at 8 to 10 V; 15% to 85% U_{sup} at 5 ±0.5 V						
Load resistance	≥ 10 kΩ						
Characteristic	1			2			
Hysteresis	See drawing						
Temperature coefficient of zero point	< ±0.25% U_{sup} / 10 °C			< ±0.5% U_{sup} / 10 °C			
Temperature coefficient of sensitivity	< 1% / 10 °C			< 1.25% / 10 °C			
Operating temperature range	-35 °C to +85 °C						
Storage temperature range	-40 °C to +125 °C (permanent); +130 °C (max. 2 h)						
Type of protection with installed mating connector	AMP DEUTSCH	IP67 and IP69K IP66K					
Vibration load	24 g						
Mating connector	3-pin connector with single-wire seal						
Electromagnetic compatibility EMC according to ISO 11452-5 2002-04 1 MHz to 2 GHz	150 V/m ≤ ±0.5% U_{sup}						

Characteristics

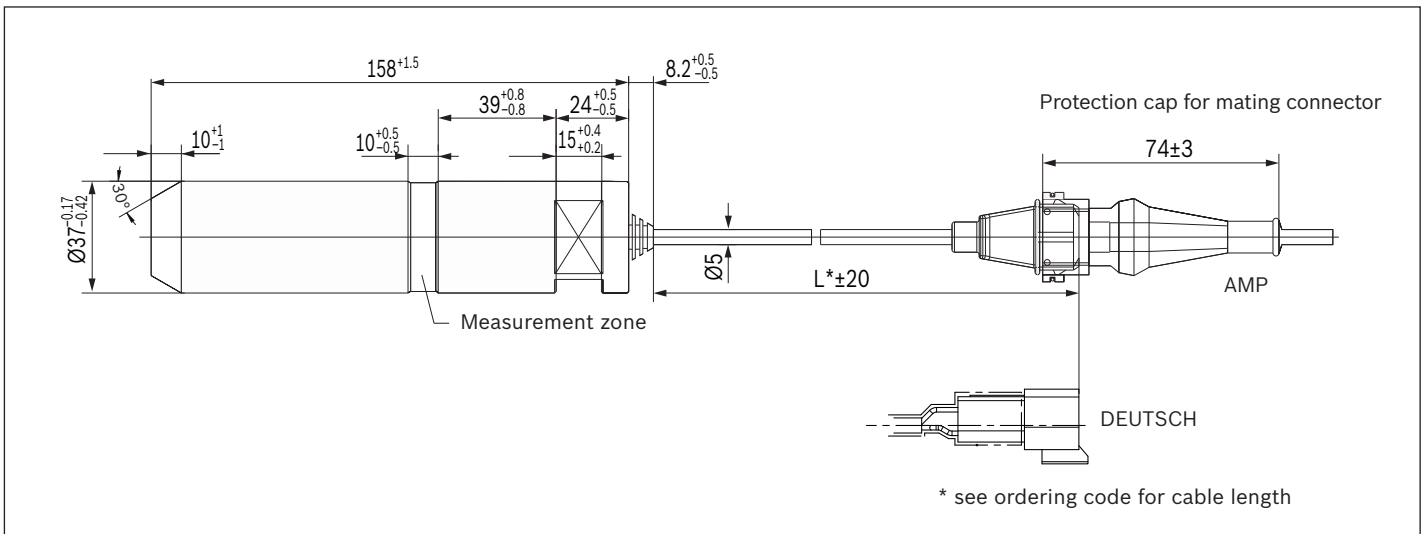
▼ Characteristic 1 (load range up to 50 kN and 5 V versions)



▼ Characteristic 2 (load range up to 60 kN)



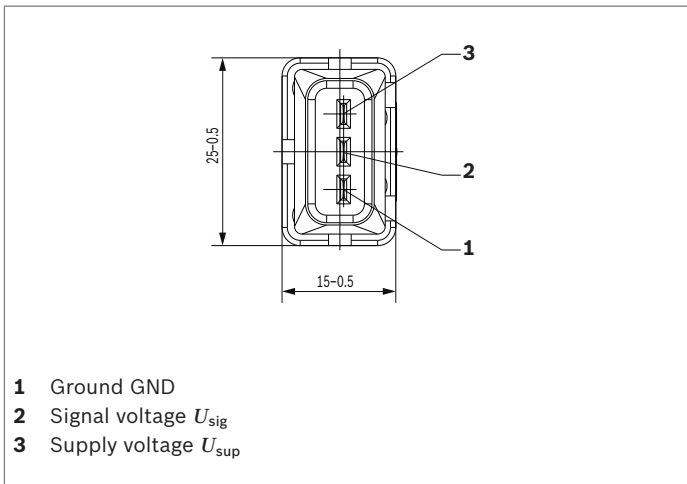
Dimensions



Connector

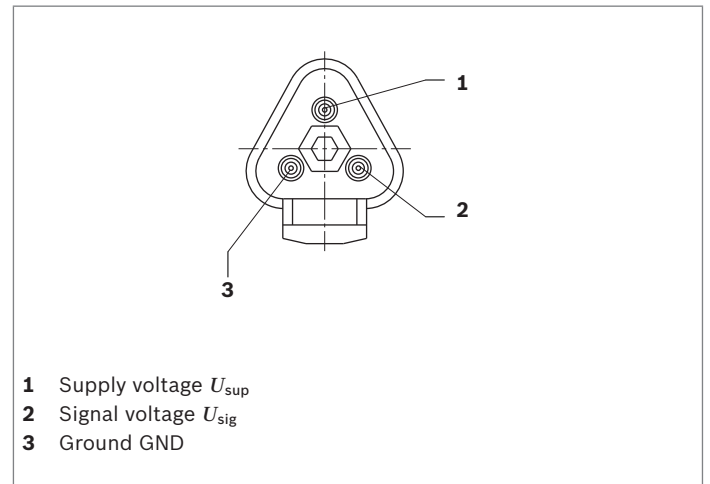
AMP

▼ Pin assignment



DEUTSCH

▼ Pin assignment



▼ Mating connector R917000515¹⁾

Designation	Number	Ordering code
Housing	1	1928402579 ²⁾
Protection cap	1	1280703022 ²⁾
Contacts	3	929939 ³⁾
Single-wire seal	3	828 905-1 ³⁾ for FLK cable type
(wire size:	3	828 904-1 ³⁾ for FLKr, FLX cable
0.5 to 1.0 mm ²)		

▼ Mating connector¹⁾

Designation	Ordering code
Plug connector	DEUTSCH DT 04-3P ⁴⁾
Wedge-lock	DEUTSCH W 3P ⁴⁾
Contacts	DEUTSCH 0460-202-16141 ⁴⁾

1) The mating connector is not included in the scope of supply.

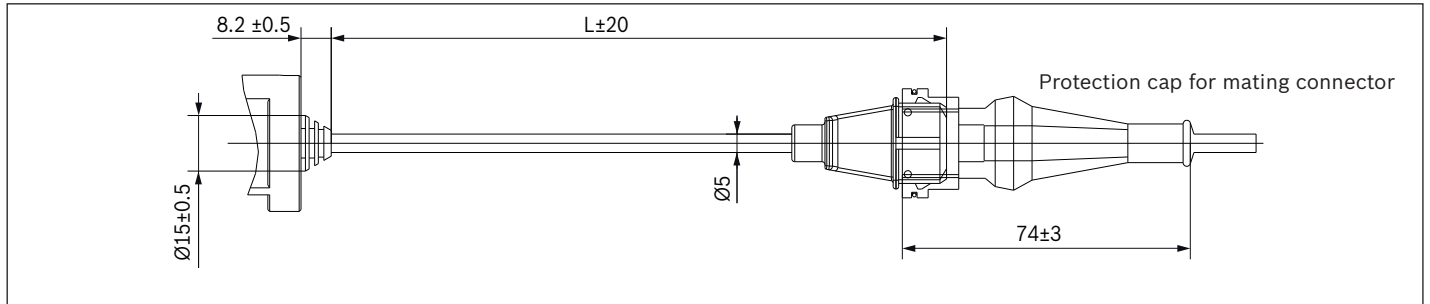
2) Available from Bosch

3) Available from AMP

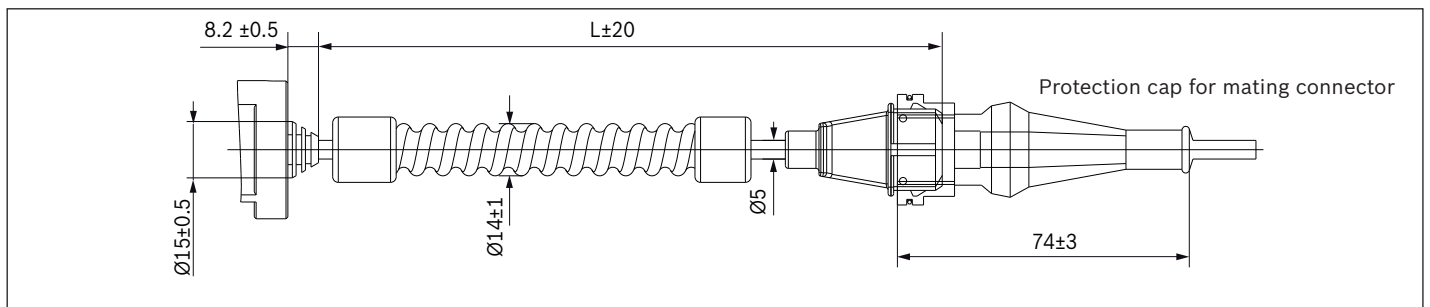
4) Available from DEUTSCH

Cable versions

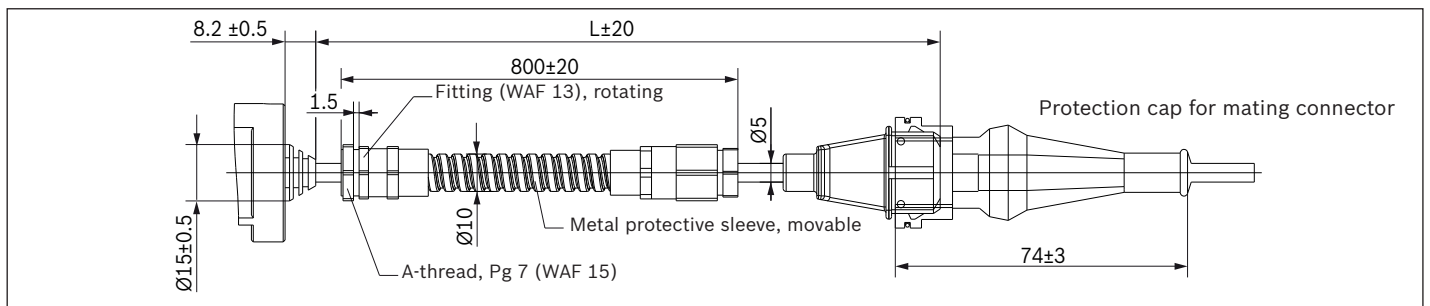
▼ Cable without protective sleeve



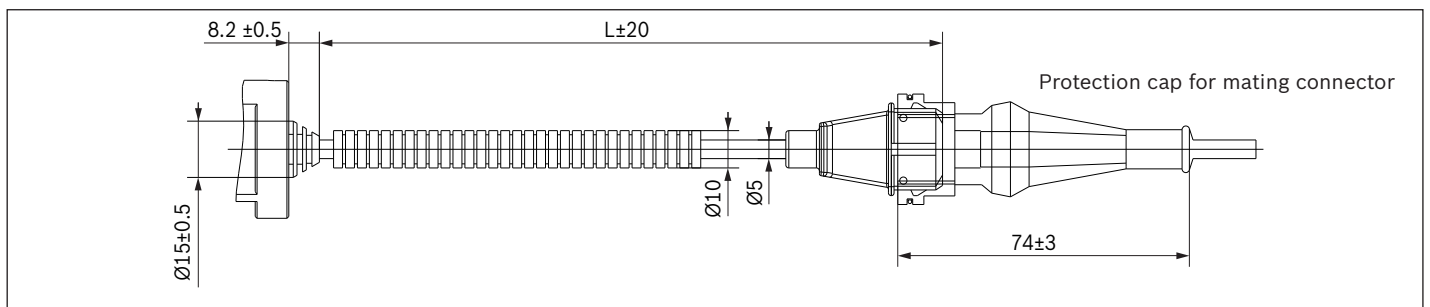
▼ Cable with spiral protective sleeve



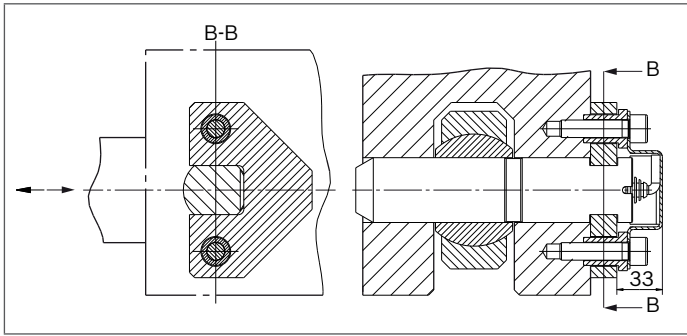
▼ Cable with metal protective sleeve



▼ Cable with plastic protective sleeve



Installation instructions



- ▶ See installation drawing Y 830 304 223 to avoid measuring uncertainties
- ▶ Defined draft application, e.g., ball bushing
- ▶ Floating mount in radial direction with key plate

Manufacturer confirmation of KMB3 MTTF_d-value

The component was developed and series produced before both the currently applicable Directive on Machinery 2006/42/EC and the harmonized EN ISO 13849 standard applied.

The KMB3 component is not a safety component in the sense of Directive on Machinery 2006/42/EC and has not been developed according to ISO 13849:2008.

The MTTF_d value was determined in accordance with ISO 13849-1:2008-12, Appendix D, Parts Count Method, and the specified temperature profiles below. The application and operating conditions are documented in data sheet RD95170. The MTTF_d value for the KMB3 is 113 years.

Operating time share [%]	Ambient temperature of control unit [°C]
0	10
0	30
0	40
0	50
0	60
0	70
0	80
100	85
0	100

According to ISO 13849-2: 2008-09, the product meets the basic safety principles and the well-tried safety principles to the extent that they apply to the product.

Assessment of Safety Principles

List of the safety principles that must be to take into account in the higher-level system.

Chapter	Basic safety principles (SP)	Remarks	Technology	Area of use	Implemented in product
D.1.6	Application of the principle of energy separation (GS-BGIA-M13: Off-load current principle , spring, return spring)	A safe condition is achieved by separating all important equipment from the energy source, e.g. by using a normally closed (NC) contact for inputs (contact and position switches) and a normally open (NO) contact for relays [see also EN 292-2:1991 (ISO/TR 12100-2:1992), 3.7.1]. There can be exceptions in some cases, e.g. if a failure of the electrical supply represents an additional hazard. Time-delaying functions may be necessary to ensure that a safe status of the system is achieved [see EN 60204-1:1997 (IEC 60204-1:1997), 9.2.2].	Electrical system	Components	If the energy supply is disconnected, the sensor does not deliver any more values. There is no substantial capacity, which means that shut-off is below 1 ms. The higher-level system must detect a cable break. A fault in the electronic system that leads to a plausible value is not detected.
D.1.7	Suppression of voltage peaks	A set up for suppressing voltage peaks (an RC element, a diode or a varistor) must be used parallel to the applied load but not parallel to the contacts. NOTE: A diode increases the switching off time.	Electrical system	Components	Measurement of radiated emissions was not carried out. The result is below the values that the standards require. The operating parameters defined inside TKU must be ensured by the higher-level system.
D.1.12	Protection from unexpected restarting after restoring the energy supply	Avoiding unexpected start-up, e.g. after restoring the energy supply [see EN 292-2:1991 (ISO/TR 12100-2:1992), 3.7.2, EN 1037 (ISO 14118), EN 60204-1 (IEC 60204-1)]. Special applications, e.g. maintaining the energy for clamping devices or securing a position, need to be considered separately.	Electrical system	Components	Assuming that the sensor is supplied with a supply voltage according to the specification, a ratiometric output signal is present. The higher-level system (control unit) must always ensure that the sensor signal is interpreted correctly.

Chapter	Well-tried safety principles (SP)	Remarks	Technology	Area of use	Implemented in product
A.2.2	Using components with a defined failure behavior	The most frequent failure behavior of a component is known in advance and is always the same, see EN 292-2:1991 (ISO/TR 12100-2:1992), 3.7.4.	Mechanical system	Components	If the pin is operated outside the specification, this can result in a zero shift or breakage. The higher-level system must detect this and evaluate it.
D.3.5	Limiting electrical parameters	Limiting of the voltage, current, energy or frequencies to avoid an unsafe status, e.g. by torque limitation, offset/time-limited running and reduced speed.	Electrical system	Components	The upper and lower limit of the supply voltage are defined. Outside of these limits, the sensor reaches a clamping voltage that the higher-level system must interpret. In general, the higher-level system must be able to interpret the ratiometric signal. From 4.2 V to 18 V, the sensor works on a ratiometric basis. Above and below the voltage limit, the output voltage becomes zero and is detected by the control unit as a cable break.
D.3.8	Status orientation in the case of failures	If possible, all equipment/circuits should enter a safe condition or be safe to operate.	Electrical system	Components	From 4.2 V to 18 V, the sensor works on a ratiometric basis. Above and below the voltage limit, the output voltage becomes zero and is detected by the control unit as a cable break. If the pin is operated outside the mechanical specification, this can result in a zero shift or breakage. The higher-level system must detect faulty operating status conditions of the sensor and appropriate remedies must be defined and implemented.
D.2.9	Multiplication of parts	Reduction in the impact of defects by using several parts of the same type; in this connection, for example, a fault that occurs on one spring (of many) does not lead to a dangerous condition.	Mechanical system	Components	Irrelevant for components, since the only mechanical part of the pin itself is known (application-specifically) and the status orientation is known in the case of failures, see D.3.8.
D.3.9	Directed failure	If it is possible to implement, components or systems should be used whose types of failure are known in advance [see EN 292-2:1991 (ISO/TR 12100-2:1992), 3.7.4].	Electrical system	Components	From 4.2 V to 18 V, the sensor works on a ratiometric basis. Above and below the voltage limit, the output voltage becomes zero and is detected by the control unit as a cable break. The higher-level system must detect faulty operating status conditions of the sensor and appropriate remedies must be defined and implemented.

Safety instructions

General Instructions

- ▶ Before finalizing your design request a certified installation drawing.
- ▶ The suggested circuits do not imply any technical liability for the system on the part of Rexroth.
- ▶ It is not permissible to open the sensor or to modify or repair the sensor. Modifications or repairs to the wiring could lead to dangerous malfunctions.
- ▶ The sensor may only be assembled/disassembled in deenergized state.
- ▶ System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- ▶ When commissioning the sensor, the machine may pose unforeseen hazards. For this reason, before commissioning the system, you must ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the sensor should fail or fail to operate properly, it must be replaced.
- ▶ Despite every care being taken when compiling this document, it is not possible to take into account all feasible applications. If instructions for your specific application are missing, you can contact Bosch Rexroth.

Notes on the installation point and position

- ▶ Do not install the sensor close to parts that generate considerable heat (e.g., exhaust).
- ▶ Wires are to be routed with sufficient spacing to hot or moving vehicle parts.
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ The connector of the sensor is to be unplugged prior to electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the sensor.

Notes on transport and storage

- ▶ Please examine the sensor for any signs of transport damage. If obvious damage is present, please notify the transport contractor and Bosch Rexroth without delay.
- ▶ If the sensor is dropped, continued use is not permissible because unseen damage may affect its reliability.

Notes regarding the connection and the wiring

- ▶ Lines to the sensors are to be shielded and kept as short as possible and be shielded. The shield must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ The sensor mating connector should only be plugged and unplugged when it is in a deenergized state.
- ▶ The sensor cables are sensitive to radiation interference. For this reason, the following measures should be taken when operating the sensor:
 - Sensor cables should be attached as far away as possible from large electric machines.
 - If the signal requirements are satisfied, it is possible to extend the sensor cable.
- ▶ Cables from the sensor to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The cable harness should be mechanically secured in the area in which the sensor is installed (spacing < 150 mm). The cable harness should be secured so that in-phase excitation with the sensor occurs (e.g. at the sensor bolting point).
- ▶ If possible, wires should be routed in the vehicle interior. If the wires are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Wires must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.

Intended use

- ▶ The sensor is designed for use in mobile working machines provided no limitations/restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the sensor must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the sensor other than that described in the chapter headed “Intended use” will be considered to be improper use.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, unintended interventions in the device not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Use in safety-related functions

- ▶ The customer is responsible for performing risk analysis on the mobile working equipment and for defining possible safety-related functions.
- ▶ In safety-related applications, the customer is responsible for taking suitable measures to ensure safety (sensor redundancy, plausibility check, emergency switch, etc.).
- ▶ Product data that is necessary to assess the safety of the machine can be provided on request or are listed in this data sheet.

More detailed information

- ▶ Further information about the sensor can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The sensor must be disposed of in accordance with the national regulations of your country.

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Mobile Electronics

Displays, video cameras and control panels

Designation	Type	Data sheet	Page
Displays and video cameras			
BODAS Display	DI4-mid	95272	315
BODAS Color video camera	CAM	95280	335
EHC Control panels			
Control panel	CP1	95255	343
Control panel	CP2	95256	349

BODAS DI4-mid display Series 10

RE 95272

Edition: 06.2016

Replaces: 04.2016



- ▶ 7" color display with 800 × 480 pixels
- ▶ iMX6 Solo processor, 800 MHz
- ▶ 2 GB flash memory and 256 MB RAM
- ▶ Interfaces:
 - 2× CAN 2.0B
 - 1× USB 2.0
 - 3× digital/analog inputs
 - 2× digital outputs
 - 2× analog video inputs (PAL, NTSC)
- ▶ Integrated ambient light sensor
- ▶ 4× status-LEDs (1× multi-color, 3× single color)
- ▶ Real-time clock with power reserve (500 h)

Features

- ▶ Freely programmable visual HMI
 - Display composition-contents, operating element function and behavior with CODESYS V3.5 development environment
 - Variable lighting of operating elements and icons (color, intensity)
- ▶ Intuitive operation of the DI4-mid
 - Ergonomic buttons and push-turn control with haptic feedback
 - Acoustic feedback via integrated loudspeaker / Audio out
- ▶ Flexible installation in the cab
 - Alignment in 90° steps is possible
 - Standalone (RAM Mount® or customer-specific solution)
 - Integrated into the dashboard (assembly frame)
- ▶ Integration of BODAS-service functions
 - Search function for connected BODAS RC controllers in the CAN bus network
 - Representation and configuration of parameters and process variables
 - Representation of active and stored faults
 - Flashing of BODAS RC controllers via the DI4-mid
- ▶ DI4-mid professional version
 - Touchscreen
 - Bluetooth (hardware prepared, software drivers in development)
 - Ethernet

Content

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DI4-mid dimensions	7
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Overview functions	9
Connector pinning on the display	10
Accessories	11
Additional offer and sales conditions	15
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Type code

01	02	03	04	05
DI	4	-	M	/ 10

Type

01	Display	DI
----	---------	-----------

Version

02	Generation	4
----	------------	----------

Frame size

03	Mid (7")	M
----	----------	----------

Version

		STD	PRO	
04	Standard	●	-	STD
	Professional	-	●	PRO
Operation				
	6+6 softkeys	●	●	
	2× hardkeys	●	●	
	Push-turn control	●	●	
	Touch	-	●	
Interfaces				
	1× USB	●	●	
	2× CAN	●	●	
	3× Analog/Dig IN	●	●	
	2× Dig OUT	●	●	
	2× Video IN	●	●	
	1× Ethernet	-	●	
	1× Bluetooth (Hardware available, software drivers in development)	-	●	
Indicators				
	3× LED status (red/yellow/ green)	●	●	
	1× Multi color LED (RGB)	●	●	
	1× Loudspeaker or audio out	●	●	
	Integrated real-time clock 500 h power reserve	●	●	
	Light sensor	●	●	
	Multi-colored background lighting	●	●	

Series

05	Series 1, index 0	10
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Note:

The BODAS DI4 is not functional without prior programming. A project must be created with CODESYS V3.5 development environment (PC tool from 3S-Smart Software Solutions GmbH) and transferred onto the DI4.

Description

With the BODAS display DI4-mid, Bosch Rexroth is offering a freely programmable high-resolution color display with a powerful 32 bit processor and a 7" display.

Depending on the programming, the display enables, for example, process variables, static and dynamic graphic elements and the operation of machine functions to be displayed on one central unit.

The robust DI4-mid has been developed specifically for use in mobile working machines and satisfies corresponding protection requirements regarding ambient temperatures, impermeability, shock and vibration and electromagnetic compatibility (EMC). It is intended for installation or assembly in the driver's cab and offers excellent readability, even in sunlight and harsh climatic conditions. The display page brightness is adjustable. An ambient light sensor automatically adjusts the backlighting. The color and brightness of the keys, the push-turn control and the icons can be changed and can be adapted to the machine manufacturer's corporate design.

12 freely programmable function keys are available for user input and menu navigation (softkeys). The display features an ergonomically arranged central push-turn control for fast navigation on and between the different screens or menus. The display also has two other function keys (hardkeys), which can have fixed functionality occupancy (such as cancel, main menu) assigned to them comprehensively across projects. In the PRO version, a capacitive touch screen is also available. The front-glass of the display is prepared with an antifog-foil to avoid mist in case of rapidly changing temperatures.

The application-specific representation of screen pages, context menus, graphic elements and video signals is provided by the CODESYS programming environment. The integrated LEDs and the loudspeakers can be used as enhanced status displays.

The display can read and process analog or digital input signals directly and can also control 2 digital live outputs.

The BODAS display can be connected to a 12 V or 24 V on-board voltage. The internal real time clock is buffered against supply voltage interruption (approx. 500 h). Communication with the BODAS controllers of the current series and other electronic assemblies in the machine takes place via CAN bus. The DI4-mid PRO displays are equipped with an Ethernet interface, which is routed via a separate external connector. A Bluetooth module for wireless communication is also available in the PRO version (still in development).

The DI4 Display can be flashed via BODAS-service, faster via USB, or optional via Ethernet (Pro- Version). Moreover, the DI4 displays can also be used for gateway access to the BODAS RC controllers to be used as a diagnosis and service interface for the configuration of BODAS RC controllers. The parameters that are stored in the BODAS controllers can be read, changed and written back to the BODAS via the DI4 CAN interface. It is possible to display the active and stored faults of a BODAS controller, as well as fault resetting using the integrated BODAS-service function.

The video interface allows direct connection of two PAL or NTSC video sources (e.g. BODAS color video cameras by Bosch Rexroth). The video signals transmitted from the cameras can be shown on the display as superimposed images (picture in-picture) or as full-screen, depending on the user interface configuration.

Programming

The DI4 is freely programmable using CODESYS V3.5 development environment from 3S.

This standard tool is extended by a product-specific Bosch Rexroth package. A design template, libraries, the license documentation and a demo project in which core functions have been applied to help you get started are included, as well as a specific online help.

Each display page can be freely composed by the user on a PC in terms of the design, arrangement and number of elements. CODESYS TargetVisu allows the easy integration of predefined or freely designed items and bitmaps (such as customer logos, display instruments, charts, etc.) in display faces designed by the user.

The development environment from 3S and the additional DI4-specific software-packages are available on demand from Bosch Rexroth.

The dynamic input parameters, which are analog, digital or based on the (J1939 and proprietary) CAN protocol, such as speed values, temperature, settings, etc. can be assigned to the relevant elements by CODESYS TargetVisu.

The designed surfaces are shown on the PC during the definition process, so that there is no need to download the configuration file to the display. The custom programming, configuration and menu navigation can be easily simulated and tested on the PC.

Applications and installation variants

The BODAS display can be used as a dashboard display/ user interface. Installation can be either integrated into the control panel or can be done as a standalone device within the drivers cabin. A mounting frame is available for dashboard integration. A mounting flange for standalone installation is available on the back of the device. Mounting is done using defined screwing points and is compatible with the RAM Mount® system.

Typical applications include driving and operating state indicator, system parametrization and diagnosis.



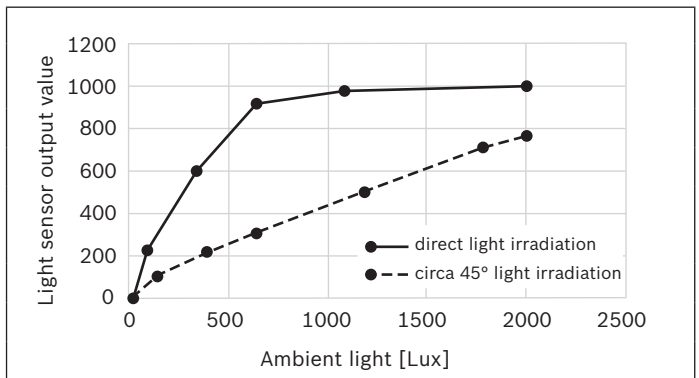
Technical data

Type		DI4-M-STD	DI4-M-PRO
Nominal voltage		12 V and 24 V (nach ISO 16750)	
Operating range		9 V bis 32 V	
Power consumption		16 W	
Fuses		5 A	
Interfaces	CAN 2.0 B (ISO11898)	2	
	USB 2.0	via wiring harness	
	Bluetooth 2.1	–	Hardware prepared, software drivers in development
	Ethernet 10/100 Mbit/s, IEEE 802.3	–	Fitted
Signal inputs	Input 1 (frequency input)	0 to 14 V, 4 to 20 mA, max. 10 kHz	
	Input 2	0 to 14 V, 4 to 20 mA	
	Input 4	0 to 14 V, 4 to 20 mA	
Digital signal outputs		2 × 12 V, 300 mA	
Indicator signals	Monochrome LED	3 (red, green and yellow)	
	Multi-color LED	Fitted	
	Spaeker	Fitted Possible volume in 1 mtr. distance from integrated speaker: test tone 3 kHz: 95,2 dB, test tone 1 kHz: 86,2 dB	
	Audio out	1	Either audio out or the integrated speaker can be operated
Control elements	Push-turn control	16 increments at 360 degree, endless, illuminated	
	Hardkeys	2, operating modes programmable, illuminated	
	Softkeys	12, operating modes programmable, illuminated	
	Touch display, capacitive	–	Fitted
Video	Video interface PAL, NTSC	2	
	Camera voltage supply	12 V maximum 500 mA	
Real-time clock		Power reserve approx. 500 h (Goldcap) - deviation <0.5 s/day	
Light sensor		available	
Short circuit resistance when display is powered		against supply voltage and ground for all inputs and outputs with the exception of the USB data-pins (maximal 6 Volt)	
Reverse polarity protection		Power supply / battery	
Microcontroller		iMX6 Solo, 800 MHz	
Memory	RAM	256 MByte	
	Flash	2 GByte	
	EEPROM	64 Mbyte	
Operating system		Linux + CodeSys RTS	
Programming		Codesys V3.5	
Display		800 × 480 Pixel, RGB 256k	
Backlighting	Brightness	typical 400 cd/m ² , maximum 500 cd/m ²	
Key illumination,	Color	variabel	
Push-turn control	Brightness	variabel	
Display diagonal		7"	
Electromagnetic compatibility		UN ECE 10 Rev. 4, DIN EN 12895, DIN 12999, DIN 13309, ISO 13766, EN ISO 14982	
Electrostatic discharge	ISO 10605	8 kV direct contact discharge, 15 kV air discharge	
Vibration resistance	Broadband noise oscillations (ISO 16750-3)	32 h per axis, as per ISO 16750-3 profile	
Shock resistance	Transport shock (DIN EN 60068-2-27)	$a = 400 \text{ m/s}^2$; $t = 6 \text{ ms}$, 4000 cycles × 3 axes	

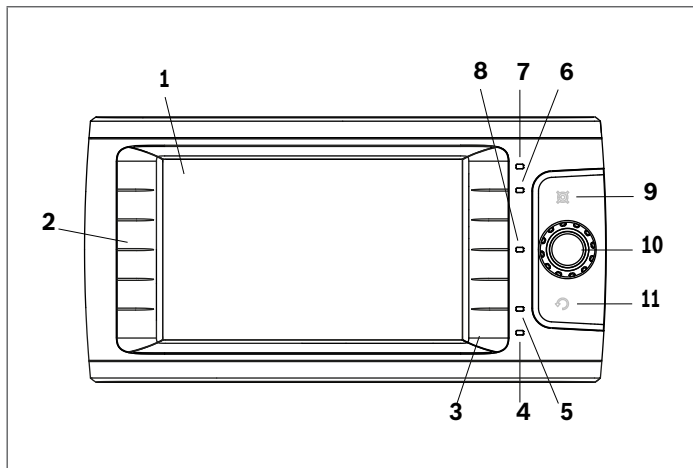
Type	DI4-M-STD	DI4-M-PRO
Medium compatibility	ISO 16750-5	Cleaner, NPK fertilizer, RME(rape methylester), gasoline, diesel, further fluids on request
Moisture resistance		
Industrial climate (DIN 50018 SFW 2.0)		3 cycles per 24 h
Salt spray test (DIN ISO EN 9227)		168 h
Condensation water (EN ISO 6270-2)		4 cycles per 24 h
Type of protection	ISO 20635	IP6KX / IPX5
UV resistance	EN ISO 4892-2	300 h
Operating temperature		-30 °C +70 °C
Storage temperature		-40 °C +85 °C
Housing material		PC+ABS (Bayblend T45), PLEXIGLAS Satinice df23 8N, Silicone (Shin Etsu KE951U), aluminum EN AC-ALSi11Cu2(Fe), Float glass, polyester (label), steel C45 (screws)
Weight approx.		1.1 kg
Dimensions		267.2 mm × 135.9 mm × 65 mm

Characteristic ambient light sensor (guidance factors)

Results at direct light irradiation		Results at circa 45° light irradiation	
Ambient light [Lux]	Sensor output value	Ambient light [Lux]	Sensor output value
20	0	20	0
100	220	150	100
350	590	400	210
650	900	650	300
1100	960	1200	490
2000	990	1800	700
		2000	750



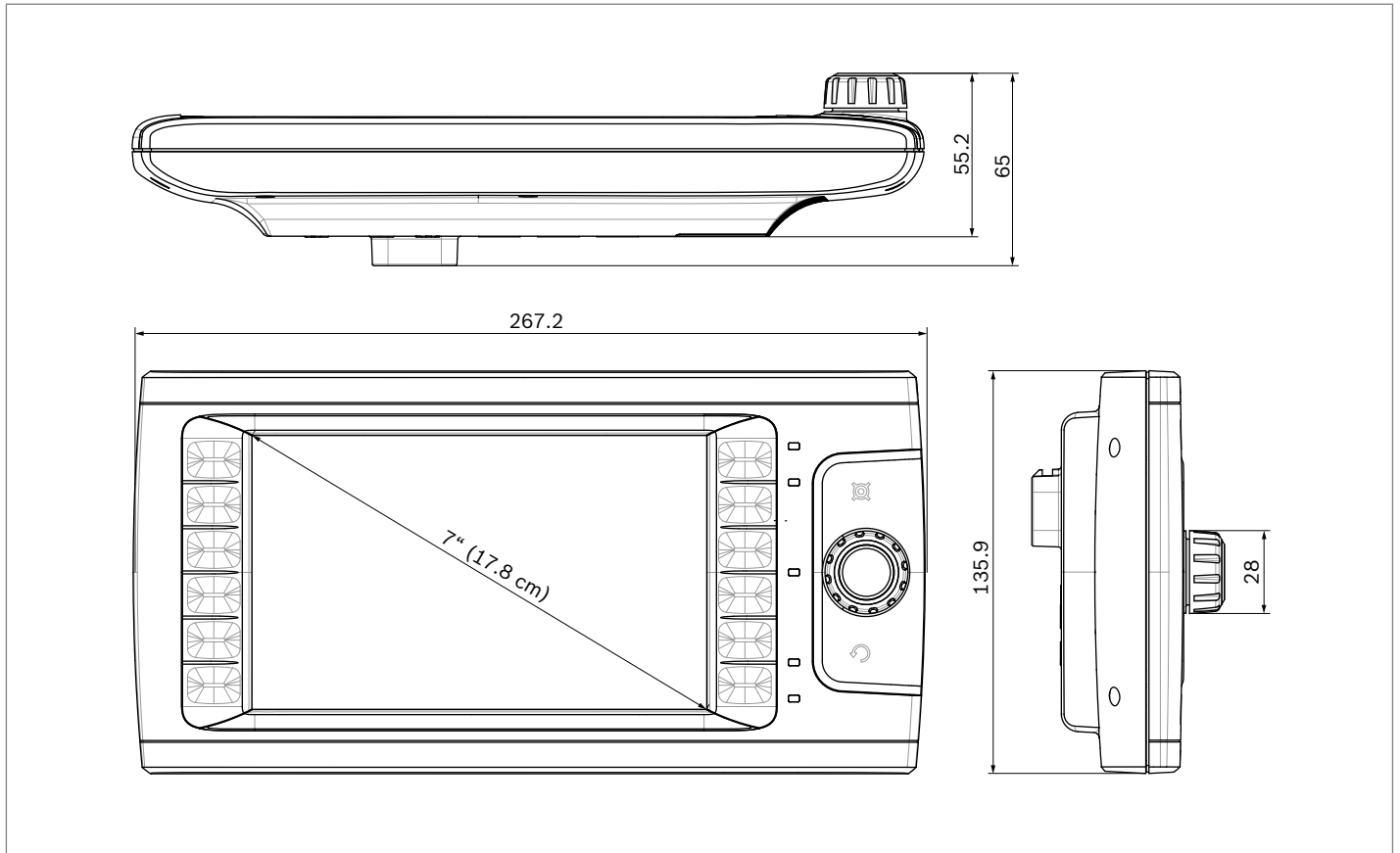
Control elements



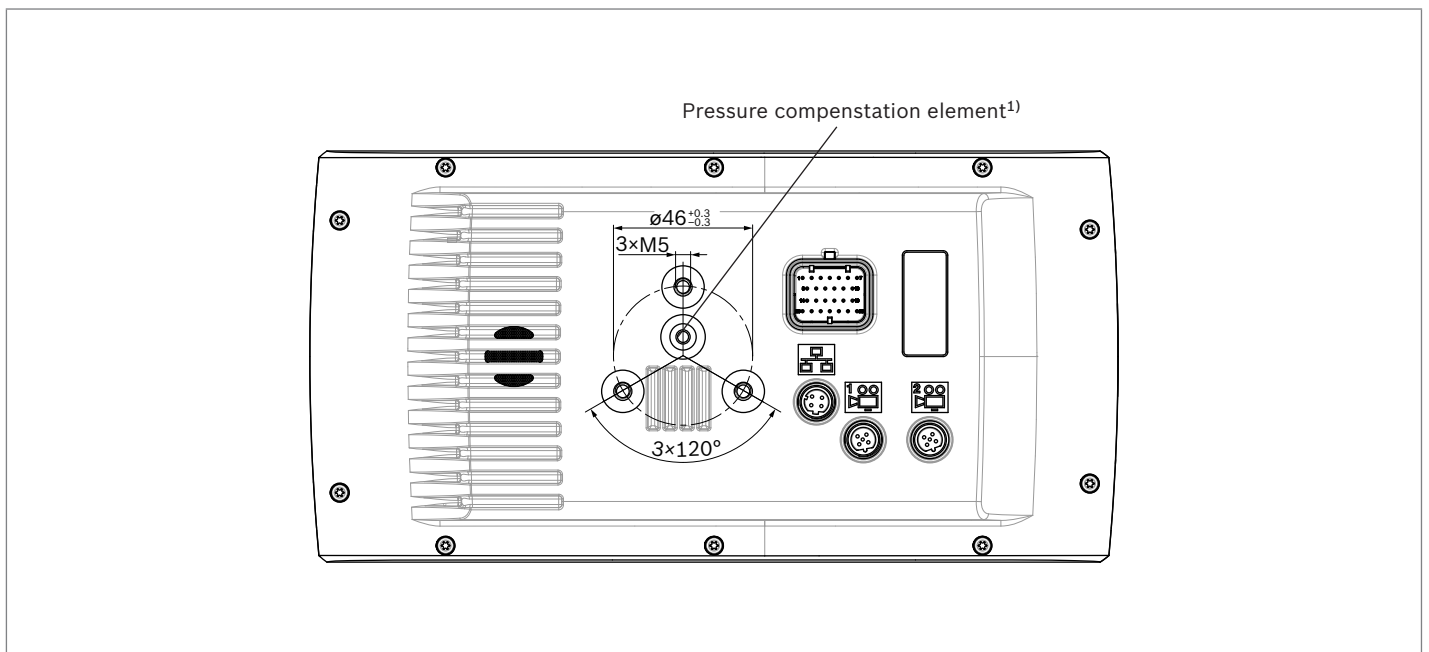
- 1 Display 7", 800 × 480 px
- 2 Button bar left side, 6 freely configurable softkeys
- 3 Button bar right side, 6 freely configurable softkeys
- 4 LED status green
- 5 LED status yellow
- 6 LED status red
- 7 Multi-colored status LED
- 8 Light sensor
- 9 "Home" button hardkey
- 10 Push-turn control
- 11 "Back" button hardkey

DI4-mid dimensions

Front and side view



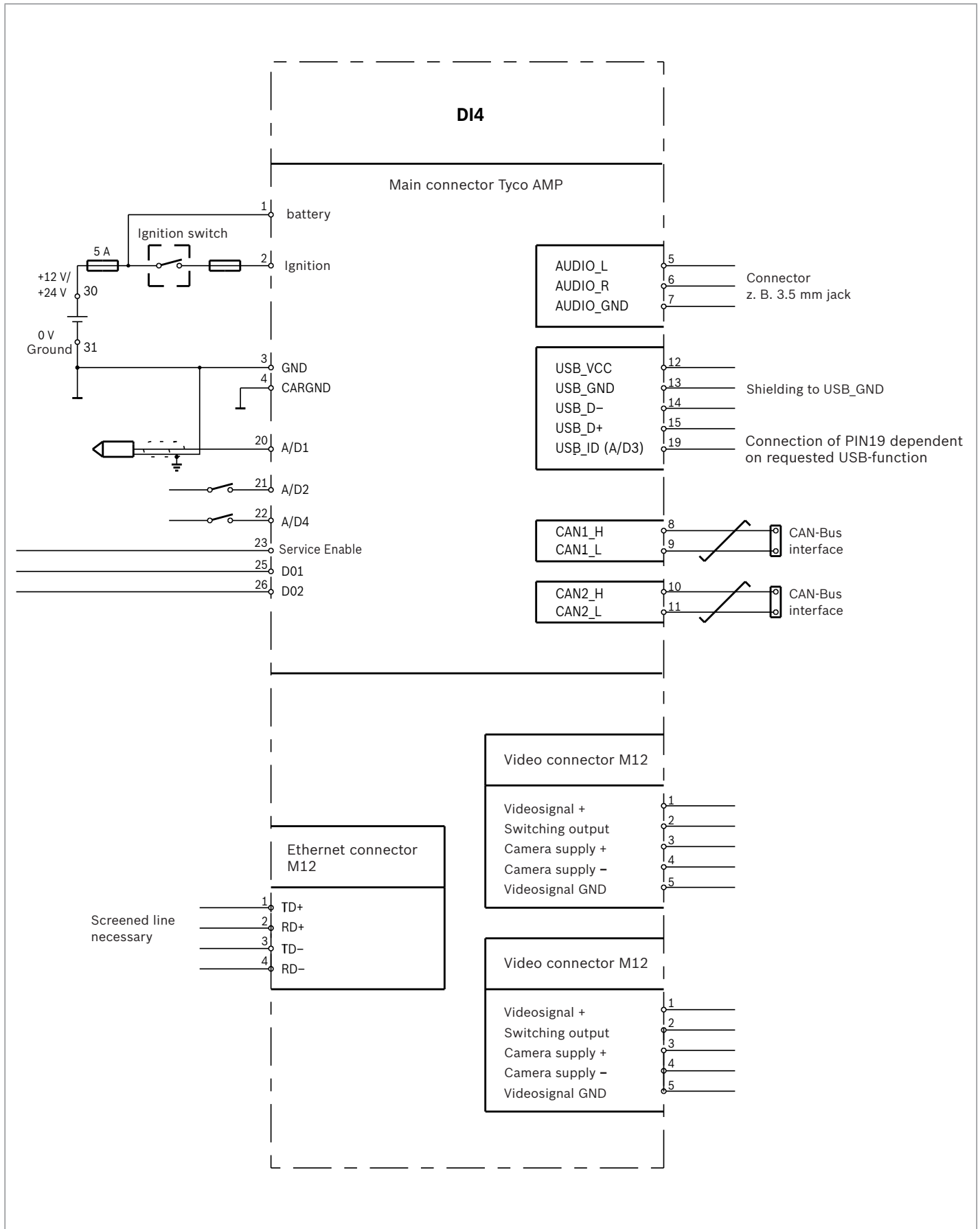
Back, housing cover with connection surface for mounting bracket



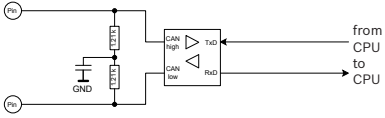
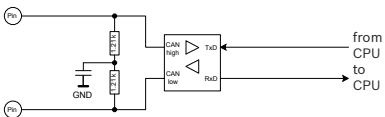
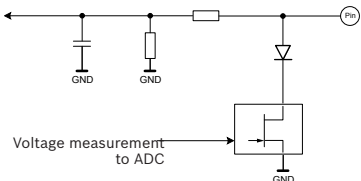
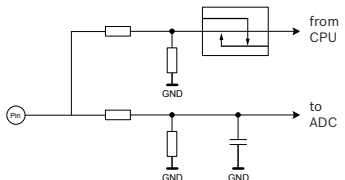
Tightening torque for RAM mount (M5): 4.5 Nm, tightening torque of M12 x 1 screw for connector: 0.6 Nm

¹⁾ The pressure compensation element needs mechanical protection

Connection diagram



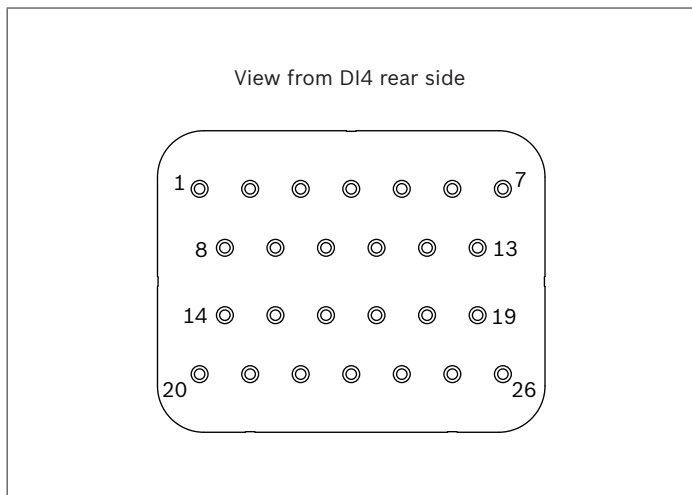
Overview functions

Pin	Description	Main function	Alternative function
1	Battery, KL 30	Battery positive nominal 12 V DC or 24 V DC, operating range 9 V DC to 32 V DC	
	IGN / Ignition	Ignition, KL15	
3	GND, KL31	Battery negative	
4	CarGND	Vehicle ground	
5, 6, 7	Output AUDIO_L, AUDIO_R, AUDIO_GND	Audio output	
8, 9	CAN-interface CAN1_H, CAN1_L	CAN-interface CAN 2.0 B, up to 1 Mbaud, terminating resistor external 120 Ω necessary, standard diagnosis interface with factory setting 250 kBaud	
			
10, 11	CAN-interface CAN2_H, CAN2_L	CAN-interface CAN 2.0 B, up to 1 Mbaud, terminating resistor external 120 Ω necessary	
			
	Ethernet interface	10BASE-T und 100BASE-TX	
12, 13, 14, 15, 19	USB-interface Pin 19 to be projected switch- able to be able to use the USB main and alternative function if necessary. USB data pins (14, 15) not pro- tected against fast voltage peaks > 6 Volt.	DI4 = MASTER (USB-device is possible to be con- nected) Application update of Codesys-proj- ects via USB-stick (DI4 acts as Host) Pin 19 (USB_ID) on GND	DI4 = SLAVE (DI4 is identified as device, no identification of USB-sticks in this use-case possible) Control of DI4 via external host device Pin 19 open
20, 21, 22	Multifunctional input A/D1, A/D2, A/D3, A/D4	Analog Voltage Input measurement range 0..14 V cut off frequency 72 Hz Apparent ohmic resistance 500 Ω current input 24 mA measurement range 4 .. 20 mA	Digital Input threshold calibratable via SW, maximum 14 V only Pin20: Frequency input Frequency input for active sensors to 10 kHz low ≤ 2.7 V high ≥ 3.8 V, Hysteresis ~ 0.5 V
			
23	Service Enable SERV_EN		Dependent on specific use- cases requested for updates of software via USB. Connection to be considered switchable against power supply.
25, 26	Digital output DO1, DO2	Digital switch against ground, maximum 300 mA	
			

Connector pinning on the display

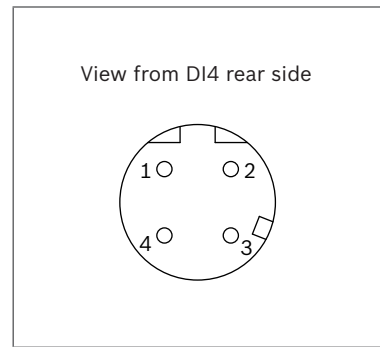
Main connector (Tyco AMP 1437288-6)

Pin	Assignment	Description
1	VCC	Battery plus, terminal 30
2	Ignition	Ignition, terminal 15
3	GND	Battery minus, terminal 31
4	CarGND	Vehicle ground
5	AUDIO_L	Audio Out L
6	AUDIO_R	Audio Out R
7	AUDIO_GND	Audio Out GND
8	CAN1H	CAN 1 high
9	CAN1L	CAN 1 low
10	CAN2H	CAN 2 high
11	CAN2L	CAN 2 low
12	USB_VCC	USB supply +5V
13	USB_GND	USB supply GND
14	USB_D-	USB data low
15	USB_D+	USB data high
16	N.a.	Bosch Rexroth use
17	N.a.	Bosch Rexroth use
18	N.a.	Bosch Rexroth use
19	A/D3	Multifunctional input or USB_ID
20	A/D1	Multifunctional input
21	A/D2	Multifunctional input
22	A/D4	Multifunctional input
23	Serv_EN	Service enable - necessary for updating BSP / firmware
24	N.a.	Bosch Rexroth use
25	DO1	Digital output
26	DO2	Digital output



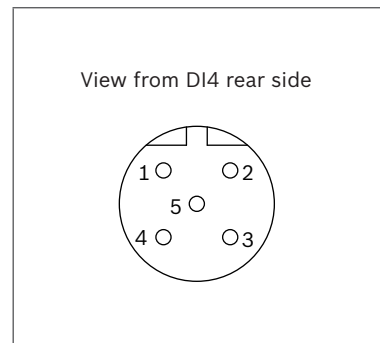
Ethernet connector (M12, D-coded)

Pin	Assignment
1	TD+
2	RD+
3	TD-
4	RD-



Video connector (M12, B-coded)

Pin	Assignment
1	Video signal +
2	Switching output
3	Camera supply +
4	Camera supply -
5	Video signal GND



Tightening torque of the M12 × 1 for connector ports: 0.6 Nm

Accessories

The following accessories are available at Bosch Rexroth for commissioning, operation and service:

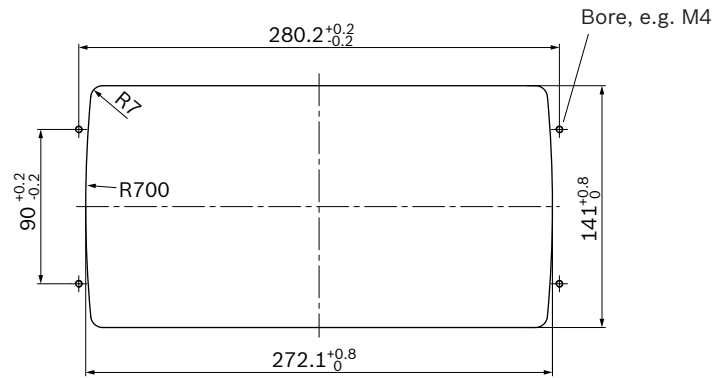
Designation	Order number
Assembly frame for DI4-mid and DI4-mid PRO	R917010011
DI4 developer wiring harness set including Ethernet USB adapter ¹⁾	R917010012
DI4 video cable	R917010013
DI4 Ethernet cable ¹⁾	R917010014
DI4 RAM Mount® set	R917010015
DI4 USB port set	R917010016
DI4 main connector set	R917010017
DI4-Mid demo setup ¹⁾	R917010019
PC connection to DI4 via CAN USB interface ¹⁾	R902602780
BODAS camera STD	R902109630
BODAS cameraPRO	R902603837
BODAS camera connection cable	R902603838

¹⁾ Suitable for development only – not for series installation

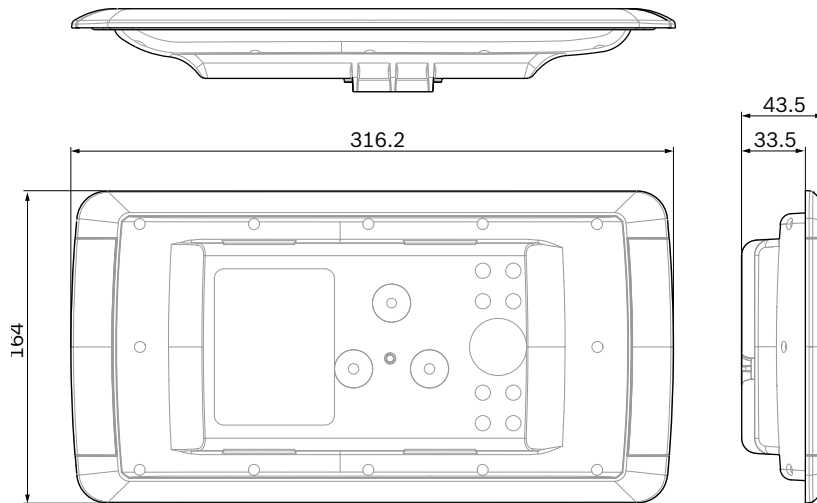
Assembly frame (R917010011)

Material for fixation of the mounting frame inside the dashboard is not scope of delivery.

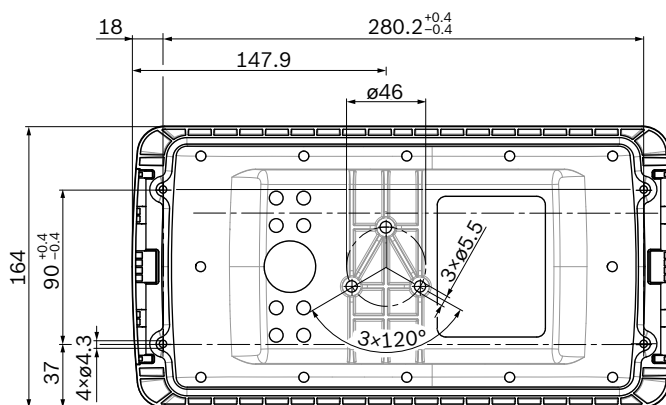
Recess



Front and side view



Back



For the mounting of the assembly frame the screws should have a screw head of maximum \varnothing 10.5 mm and a maximum height of 3.4 mm.

BODAS camera (R902109630 or R902603837)



Transmission of video signals, for example for workspace monitoring. BODAS cameras are available in the Standard or PRO versions. For additional details, see data sheet 95280.

DI4 Ethernet cable (R917010014)



The Ethernet cable consists of a M12 connector, male, 4-pin angular connector, D-coded according to EN61076-2-101. Length approx. 1 m.

DI4 video cable (R917010013)



Video camera mating connector for connection to the wiring harness. The video cable consists of a M12 connector, male, 5-pin, B-coded according to EN61076-2-101. The cable is shielded. Length: approx. 1.5 m

DI4 RAM Mount® set (R 917010015)



The set used for display installation the vehicle installation consists of 2x RAM®202U (RAM 2.5 inch round base mit AMPS hole pattern and 1.5 inch ball), one RAM-201U (double socket arm for 1.5" ball bases) and the corresponding screws.

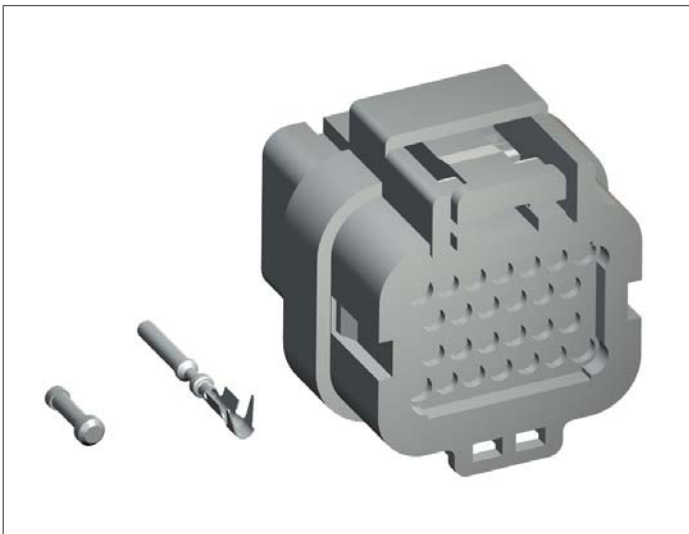
DI4 USB port set (R917010016)



Port for access to the BODAS display and controller via USB, port via wiring harness.

- ▶ USB 2.0 plug connector, IP67, approximately 1 m of cable
- ▶ Dust protection cap with chain
- ▶ Counter nut including seal (IP67)

Main connector set (R917010017)



Main connector including 26-pin connector housing, contacts and sealing for the manual connector/cable assembly.

Demo setup (R917010019)



Demo setup consisting of one DI4-mid PRO, developer cable harness, ethernet-cable, ethernet-usb-adapter, power supply unit, RAM Mount®, BODAS camera including a suitable camera cable and documentation.

Additional offer and sales conditions for used and contained software in the DI4

Open source software

- ▶ The DI4-mid software contains open source software and third party software under royalty-free licenses (“OSS”). The OSS scope that is used or is available at the time of market launch is listed in an OSS appendix. If changes occur to the OSS scope over the service life of the product, the OSS system will be updated accordingly. A complete list of all the OSS used, depending on the development and production of the offered DI4-mid, is available on request and will be delivered with the product as part of the Rexroth software package.
- ▶ The OSS included in the DI4 is subject to OSS license agreements (“OSS licenses”). Under these OSS licenses, Bosch Rexroth is obliged to pass on the conditions of these to you. You must comply with these terms and conditions and with the relevant obligations, unless you use the OSS in any manner other than simply installing it and allowing it to run internally on your machines, for example continuing to dispose of the product, for example by distributing it, selling it or otherwise transferring it to third parties. Should you distribute a copy of the product to third parties, the conditions granted under the OSS licenses applying to distribution shall apply (in some cases, the OSS license grants a direct license from the author/licensor of the OSS to the third party). Where there are numerous OSS licenses, Bosch Rexroth can neither grant you rights for these nor obtain such rights on your behalf. The applicable OSS licenses are available at the web address of the respective OSS provider or from Bosch Rexroth on request.
- ▶ You must, either expressly or in an implied manner, accept the applicable OSS licenses and take responsibility for complying with the applicable OSS licenses. You must also agree that updates or new versions of the software of product may contain different or additional OSS or changes to the OSS licenses. Bosch Rexroth will inform you of this fact at the time of delivery of updates, as well as of any additional or modified OSS licenses.
- ▶ The OSS itself has no effect on the retail price of the DI4-mid and is therefore made available free of charge.
- ▶ The sale of the DI4-mid, unless otherwise agreed, does not include service or support by Bosch Rexroth with regard to the fulfilment of your obligations arising from the OSS licenses. Any such service or support provided by Bosch Rexroth shall require a separate agreement in which these services or support are specified and reasonable remuneration is paid for this purpose.

Written Offer

- ▶ This product contains software components that are licensed by the holder of the rights under GNU General Public License (GPL), GNU Lesser General Public License (LGPL) or any other Open Source Software license, which requires that source code be made available.
- ▶ The source code of these software components is not already delivered together with this product. You can obtain the source code for these software components on a physical medium (CD or DVD) by submitting a written request to our open source office address listed below or by sending an email to open.source@boschrexroth.de. When sending such a request, please name the relevant product and the date of purchase of the same.
Bosch Rexroth AG Open Source Office
Zum Eisengießer 1, 97816 Lohr am Main Germany
- ▶ We may charge you a fee to cover the cost of physical media and processing. You may send your request (i) within three (3) years from the date you received the product that included the binary that is the subject of your request or (ii) in the case of code licensed under the GPL v3 for as long as Bosch Rexroth offers spare parts or customer support for that product.

Bosch Rexroth BODAS-service

- ▶ Bosch Rexroth grants the customer the non-exclusive right to use the preinstalled BODAS-service diagnosis- and flash-software as single license exclusively with the DI4-unit (target hardware) acquired.
- ▶ This right of use is limited to the agreed period, if there is no such agreement the right of use is for an indefinite period.
- ▶ The “Supplementary Terms and Conditions for the Supply of Software of Bosch Rexroth AG (Edition: 2.1.2006)” are to be observed.

Codesys Runtime-System

- ▶ By acquiring the product the user for indefinite period receives a single and non-transferable right to use the delivered Codesys Software.
- ▶ The conditions are defined with the “License Agreement for the Usage of the PLC Development System COD-ESYS” released by 3S-Smart Software Solutions GmbH, 87439 Kempten, Germany.

Cryptographic Software

- ▶ This product includes software developed by the OpenSSL Project for use in the OpenSSL Toolkit (<http://www.openssl.org/>).
- ▶ The special OpenSSL license agreement, which is provided as part of the Rexroth Software-package with the product or sent separately on special request, strictly needs to be observed.
- ▶ This product includes cryptographic software written by Eric Young (eay@cryptsoft.com).
- ▶ This product includes cryptographic software written by Tim Hudson (tjh@cryptsoft.com).

Export Restrictions

- ▶ You acknowledge that Software is subject to export restrictions of various countries.
- ▶ In addition, you agree that you will comply with all applicable international and national laws that apply to the software, including all applicable laws and regulations with respect to export restrictions.

Safety instructions

General instructions

- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ Work on the PC with CODESYS development environment measuring adapter in connection with a control unit or display in a machine or a vehicle may only be performed during commissioning of the machine were during service work. Appropriate safety measures must be provided against hazards caused by unexpected operational states.
- ▶ Changing parameters or loading (flash-programming) software onto the BODAS display DI4 may only be performed by trained and experienced specialists who are suitably familiarized with both the components used and the complete system.
- ▶ When performing flash-programming, the user is responsible for ensuring that the software to be flash-programmed is compatible with the BODAS display hardware for the vehicle in question.
- ▶ The unexpected reset of the device could be caused by a watchdog failure. This safety mechanism can be caused by overload, malfunction of the device or undervoltage of the supply.
The root cause needs to be determined and remedied before the device/ system is used again.
- ▶ Permanent high CAN bus load has to be avoided for consistent and reliable operation. A validation of the bus load should be determined in the overall system structure by the OEM.
- ▶ Faulty programming of the BODAS display DI4 may lead to dangers in the running operation of the machine. It is the responsibility of the machine manufacturer to identify hazards of this type in a hazard analysis and to bring them to the attention of the end user. Bosch Rexroth shall assume no liability for dangers of this kind.
- ▶ The display firmware must be installed and removed by Bosch Rexroth or by the authorized partner concerned in order to uphold the warranty.
- ▶ Unused connection ports are fitted with protection caps. If a mating plug or connection will not be used, the protection caps must be installed. (Ensure the O-ring is installed on the cap assembly and that the cap is tightened manually)

- ▶ Opening, modifying or repairing the BODAS display DI4 are prohibited. Modifications or repairs to the wiring could lead to dangerous malfunctions. Repair work on the BODAS display DI4 may be carried out by Bosch Rexroth or by suitable contracting partners.
- ▶ Make sure that the BODAS display DI4 configuration does not lead to safety-critical malfunctions of the complete system in the event of failure or malfunction. This type of system behavior may lead to danger to life and/or cause much damage to property.
- ▶ Ensure that the product has been tested by sufficient validation within the overall system, taking into account all possible combined ambient conditions and considering both normal use and misuse.
- ▶ When using cameras in conjunction with the BODAS display DI4, please note that the picture display can cause distortion, depending on the curvature of the camera lens (fish-eye effect). There may be decelerations in image response times when the processor workload is high. Take adequate account of these boundary conditions when operating your system.
- ▶ Interference to the video picture may occur when operating the DI4 with NTSC cameras in rooms with 50 Hz lighting. This is not a device fault.
- ▶ System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- ▶ While commissioning the BODAS display DI4 respectively during use of the DI4 supported BODAS-service functionality, the machine may pose unforeseen hazards. Before commissioning the system or during use of the BODAS-service functionality, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
Use of the BODAS-service function for flashing DI4 or RC-controllers is only allowed during machine stand-still and maintenance activities.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.
- ▶ No compressed air must be blown into the openings of the device (explosion risk).
- ▶ The back and the front glass of the display in particular may become hot during operation. There is a risk of burns.
- ▶ Noise hazards may occur through the integrated loudspeakers or with using the audio out signal, particularly at a short distance from the speaker. The overall system must be designed and verified to ensure that no health hazard is possible, even at the maximum level.
- ▶ The brightness of the status LEDs, buttons and encoder lighting, as well as the display brightness, must be so selected that no hazardous glare occurs. This can be done via manual level setting or by using the light level sensor. A time-delayed adjustment of the lighting level must be ensured when the light level sensor is used.
- ▶ The device must be taken out of service immediately if a smoke/vapor emission fault status is observed.

Notes on the installation point and position

- ▶ Do not install the BODAS display DI4 in the vicinity of parts that generate considerable heat (e.g. the exhaust). Increased temperatures have a negative effect on the service life of the product.
- ▶ The wiring harness should be attached mechanically in the area in which the BODAS display DI4 is installed (spacing < 150 mm).
Cables out of specification or too long of cables can lead to improper stress on connections which lead to failure. Ensure that connectors are securely latched in place and that the wiring and connectors are protected against moisture and water. For outdoor applications the main mating connector needs to have sealing plugs in unused pin locations and rear boot to prevent water ingress.
- ▶ Radio equipment and mobile telephones must not be used in the driver's cab without a suitable antenna or near the control electronics.
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ All connectors must be unplugged from the electronics during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.
- ▶ Standing and permanently running water are not permitted anywhere near the front glass, the button bar or the pressure balance element (DAE). Remind that the device cannot be controlled and read while it is in frozen condition and that it is de-iced by self-heating before being used.

- ▶ The hole to the pressure compensation element at the backside of the DI4 needs to be covered in such a way that a mechanical damage of the membrane can be avoided while ensuring there is room for sufficient ventilation.
- ▶ The assembly frame of the display should be well secured against loosening or untightening.
- ▶ The assembly frame does not secure completely against water ingress. The dashboard construction must be stiff to avoid bending but should not lead to additional vibrations.
- ▶ Attention should be paid to ergonomics requirements when positioning the display and configuring the display contents. It must be ensured that it is possible to work in a fatigue-free way at all times. Direct sunlight may decrease the readability of the display. We recommend that you use a location without direct sunlight and display content with a contrast level that is sufficiently high.
- ▶ Ensure that the screw connections are tightened to the specified tightening torque and are protected against unexpected loosening. Ensure that the DI4 cannot drop suddenly when the RAM-Mount® clamping screws are loosened. Appropriate measures for this must be taken.

Notes on transport and storage

- ▶ If it is dropped, the BODAS display DI4 may not be used any longer as invisible damage can have a negative impact on reliability or function.
- ▶ Impacts with hard objects on the case or integrated front glass could cause the case or glass to break. In such cases, the BODAS display DI4 must be replaced without delay.
- ▶ Contamination of the BODAS display DI4, and especially of the keyboard and rotary control, should be eliminated immediately to ensure correct function.
- ▶ Do not expose the case or keyboard to extremely acidic or alkaline substances. Avoid prolonged contact with oils and grease.
- ▶ Only use clean water and a damp cloth to clean the front glass and keyboard.
- ▶ When cleaning the BODAS display DI4, do not use any coarse or abrasive cleaning utensils.
- ▶ A sudden large increase in air pressure can cause the front glass to break or lead to leaks. Sudden large decrease in air pressure may cause an explosion. Take appropriate measures in these cases, for example when the device is being transported by air.

Notes on wiring and circuitry

- ▶ The BODAS display DI4 and the cameras must be powered from the same network. Powering the camera from a port on the display is recommended.
- ▶ Wires to cameras are recommended to be shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- ▶ Cables to the electronics must not be routed close to other power-conducting wires in the machine or vehicle.
- ▶ The wiring harness should be fixated mechanically in the area in which the BODAS display DI4 is installed (spacing < 150 mm). The wiring harness must be secured so that in-phase excitation with the display occurs (e.g. at the display bolting point).
- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.
- ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.

Intended use

- ▶ The BODAS display DI4 is designed for use in mobile working machines provided no limitations / restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the BODAS display DI4 must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences. The specified limits must not have a permanent effect.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the BODAS display DI4 other than that described in the chapter “Intended use” is considered to be improper.
- ▶ The BODAS display DI4 is not suitable for use in functions relevant to safety.
- ▶ The BODAS display DI4 is not allowed for functions that are used to control a machine movement.
- ▶ Do not assign safety-related functions to the function keys or the push-turn control of the display. Separate switches are always to be used to control functions relevant to safety, e.g. emergency-off switch for immediate or controlled stop of the system.
- ▶ Make sure that the display configuration does not lead to safety-critical display failures or display malfunctions of the complete system in the event of failure or malfunction. This type of system behavior may lead to danger to life and/or cause much damage to property.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, interference in the component not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

More detailed information

- ▶ More detailed information on the BODAS display DI4 can be found under www.boschrexroth.com/mobile-electronics under the heading “Display”.
- ▶ Pay regular visits to our home page for the latest product information and information about updates.

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BODAS

Color Video Camera

RE 95280/04.11
Replaces 03.08

1/8

Data sheet

Series 10
1/4" CMOS Color Video Camera for mobile applications



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Features

- Color camera with optimized interface for BODAS Color Display DI3 Video
- Compact and robust design
- Video format NTSC
- Opening angle 100° or 120° (horizontal)
- Type of protection IP69k
- Automatic heating
- Operating temperature from -40°C to + 85°C
- Switchable mirroring function
- Max. power input 3.5 watt
- Suitable for 12- or 24-volt systems
- High light sensitivity
- Automatic control
- Certified acc. to e1, E1 and CE

Ordering code

CAM	-	/		
01			02	03 04

Type

01	CAMERA	CAM
----	--------	------------

Version

02	Professional	PRO
	Standard	STD
	6-pin mating connector with 0.5 m connection cable	XXX

Series

03	1-digit, numeric (1, 2, ..., 9)	1
----	---------------------------------	----------

Index

04	1-digit, numeric (0, 1, 2, ..., 9)	0
----	------------------------------------	----------

Material numbers

CAM-STD/10 _____ R902109630

CAM-PRO/10 _____ R902603837

CAM-XXX/10 _____ R902603838

Required components

The following components are necessary for operating the cameras:

- **6-pin mating connector with 0.5 m connection cable for BODAS Color Video Camera**
- **BODAS Color Display DI3 Video**
Display for connecting to the BODAS Color Video Cameras. A stabilized 12-volt voltage supply is provided via the display.
- **12-pin display mating connector**
Deutsch DT06-12SA plug for connecting the camera cable to the display.

These components are not included in the delivery contents of the video camera but can be ordered from Rexroth under the following material numbers:

6-pin mating connector for camera _____ R902603838

BODAS Color Display DI3 Video _____ R902109505

12-pin mating connector for display _____ R900877038

Description

The BODAS Color Video Cameras from Rexroth are characterized by their compact and robust design. With their low space requirements and the freely selectable installation angle, the cameras can also be assembled and operated in areas with limited space.

The BODAS Color Video Cameras were specially developed for use in mobile working machines and satisfy the highest safety requirements with regard to ambient temperatures, impermeability, resistance to shock and vibration, as well as electromagnetic compatibility (EMC). The camera cases and the brackets are resistant to numerous chemical influences.

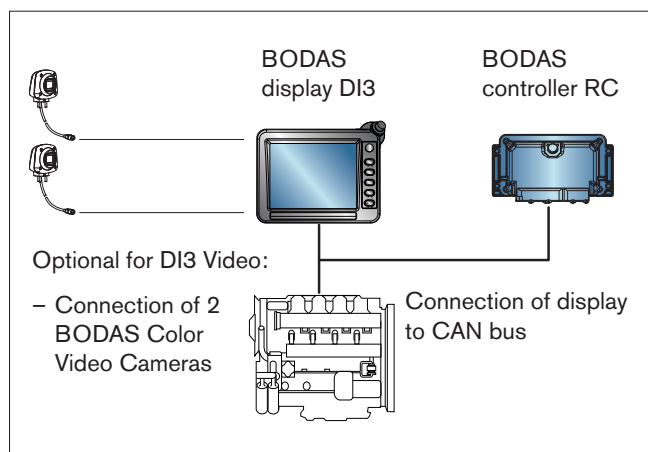
Thanks to the high light sensitivity of the 1/4" CMOS modules and the automatic adjustment to changing light conditions, the delivered image quality is always optimum. The resolution of the video signals is designed for at least 300 image lines. The 100° (Professional) or 120° (Standard) opening angle of the camera enables a broad overview range. The good image reproduction quality of the standard version was further optimized for the professional version through electronic image corrections and is nearly free of distortion.

The BODAS Color Video Camera in combination e. g. with the BODAS Color Display DI3 Video ideally complements the used electronic system with functions for rear-view and work-space monitoring.

The voltage for the BODAS Color Video Cameras can be supplied directly by the BODAS Color Display DI3 Video. This simplifies camera connection as a single cable conduit can be used for both video image transmission and voltage supply.

Depending on the configuration of the user interface, the video signals transmitted by the cameras can be shown on the display using the overlay technique or as a complete picture.

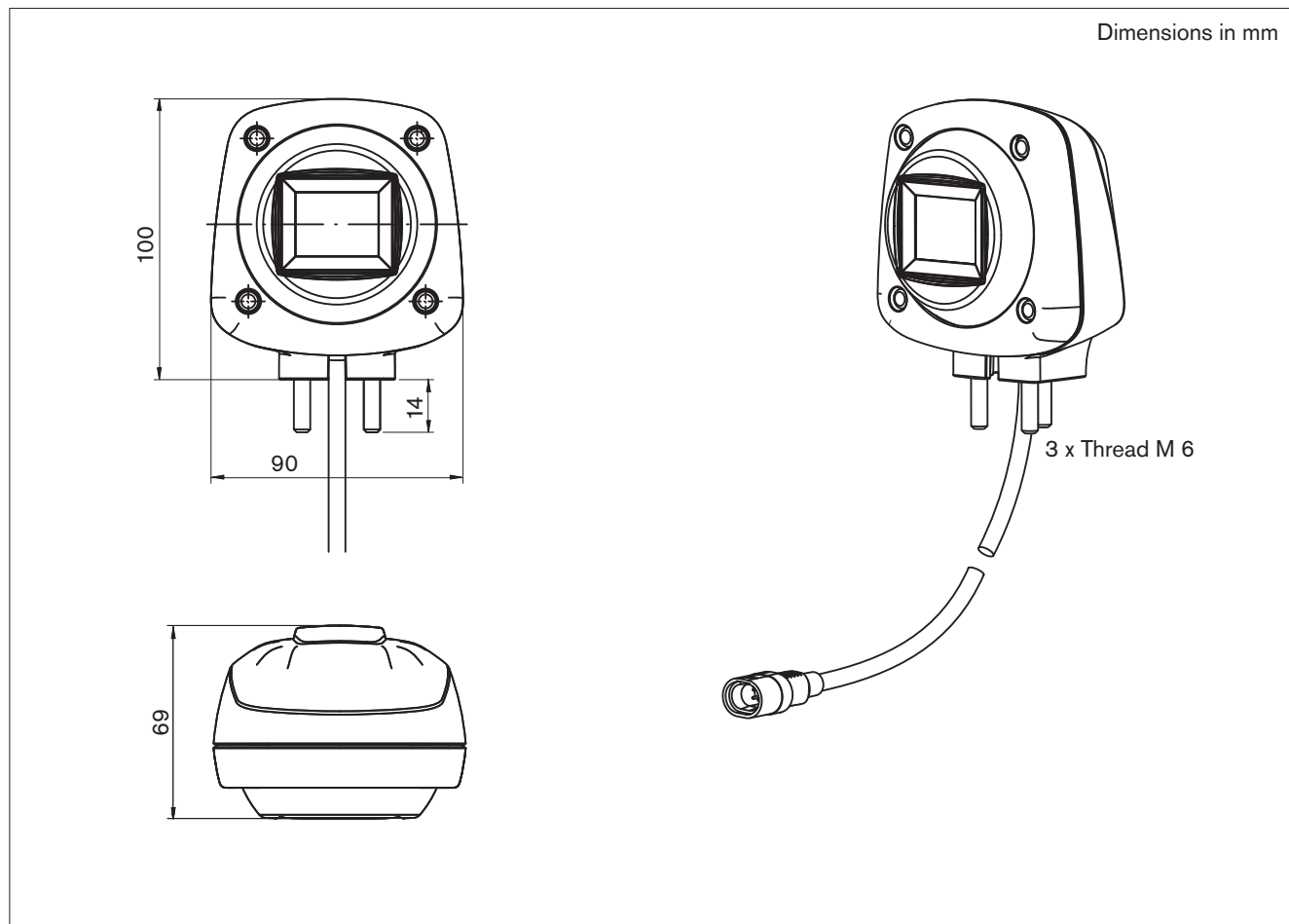
Typical system configuration



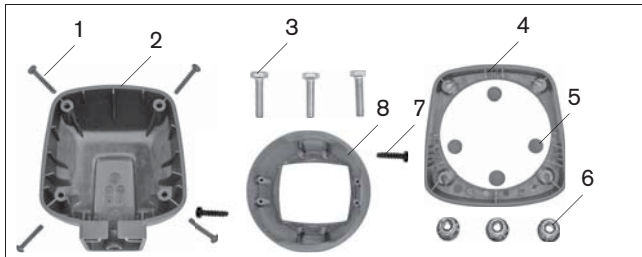
Technical data

BODAS Color Video Camera	Standard	Professional
Image sensor	1/4" CMOS	
Signal format	NTSC	
Image reproduction	525 lines, 60 images/sec.	
Minimum illumination	1 Lux	0.5 Lux
Resolution	> 300 lines	
Lens	Standard optics	Standard optics with electronic image correction (distortion free)
Horizontal opening angle	120°	100°
Vertical opening angle	90°	85°
Nominal voltage	12 V and 24 V	12 V and 24 V
Supply voltage, permissible range	10 ... 36 V	9 ... 36 V
Power input	Approx. 1 W	
Heating off	Approx. 1 W	
Heating on (self-activating at temperatures below +10° C)	Approx. 3.5 W	Approx. 4 W
Operating temperature	-40 °C ... +85 °C	
Storage temperature	-40 °C ... +90 °C	
Dimensions of camera in case without cable	Approx. 100 x 90 x 69 mm	
Weight without bracket	Approx. 180 g	
Short circuit resistance against every connection	Yes	
Reverse polarity protection	Yes	
Electromagnetic compatibility	72/245/EEC with all changes up to 2006/28/EG (e1) ECE-R10 Rev3. (E1)	ECE-R10 Rev3. (E1)
Electrostatic discharge	ESD EB 61000-4-2	
Vibration resistance	DIN EN 60068-2-6 f = 5 ... 57 Hz with 1.5 mm (p-p) f = 57 ... 2000 Hz with 30m/s ² 2 h per main axis	
	DIN EN 60068-2-64, test FH f = 12 ... 2000 Hz 8 h per main axis	
	DIN EN 60068-2-64, Acc. to ISO 16750-3 (item 4.1.3.2.4) f = 10 ... 2000 Hz 24 h per main axis	ISO 16750-3 § 4.1.2.7 f = 10 ... 2000 Hz 32 h per main axis
Shock resistance	DIN EN 60068-2-27 Half sine Duration: 11 ms Acceleration: 20 g	ISO 16750-3 § 4.2.2 ISO Half sine Duration: 6 ms Acceleration: 500 m/s ² 10 shocks per each direction
Moisture resistance	DIN EN 60068-2-38 T = + 65 °C, 5 cycles per 24 h	
Salt spray resistance	480 h / 5 % NaCl solution	
Media resistance	ISO 16750-5 among others: diesel, engine oil, hydraulic oil, biodiesel, urea, coffee, cleaner solvent, antifreeze, brake fluid, spirit, NPK artificial fertilizer solution	
Type of protection	DIN 40050 Bl.9 (May 93) IP69k	
Certification	e1, E1, CE	E1, CE

Dimensions



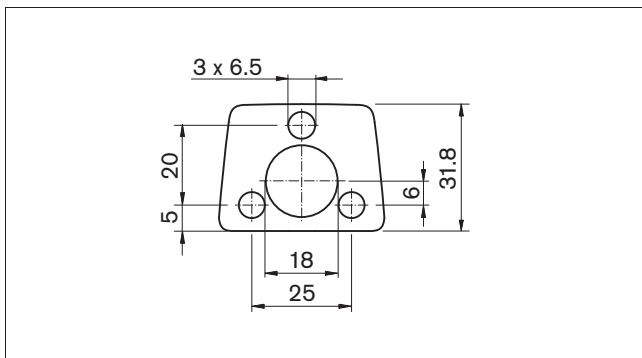
Assembly and fixing



Legend

- 1 Plastic self-tapping screw 4 x 20, Torx
- 2 Retaining shell
- 3 Hexagon screw M 6 x 25
- 4 Clamping element
- 5 Rubber buffer
- 6 Nut with M6 flange
- 7 Plastic self-tapping screws 2.5 x 16
- 8 Ball adapter

Drilling template



Tools

- The following tools are necessary for assembling the retaining shell and camera:
- Drill bits with diameters 6.5 mm and 18 mm
- Drill
- Torx 8 and Torx 15 screwdrivers
- Box wrench and open-end wrench, size 10
- Ruler
- Hammer and punch

Assembling the retaining shell on the vehicle

- 1 Drill the fixing openings according to the drilling template. The drill bit diameters are 6.5 mm and 18 mm. For the 18 mm borehole, predrill with the 6.5 mm drill bit. Make certain to adhere exactly to the dimensions in the drilling template.
- 2 Deburr the boreholes and, if necessary, apply rust protection.
- 3 To prevent injuries, cover sharp bushings, e.g. with a protective sleeve (not included in the delivery contents).
- 4 Guide the camera connection cable through the 18 mm borehole.
- 5 Assemble the retaining shell (2) with the (3) M 6 x 25 hex screws and the nuts (6). To prevent damages to the retaining shell, first tighten screws A and B and then screw C with a torque of 4.0 ± 0.5 Nm. Use a suitable tool to do this. Depending on the thickness of the assembling surface, you will need screws of different length for assembling.

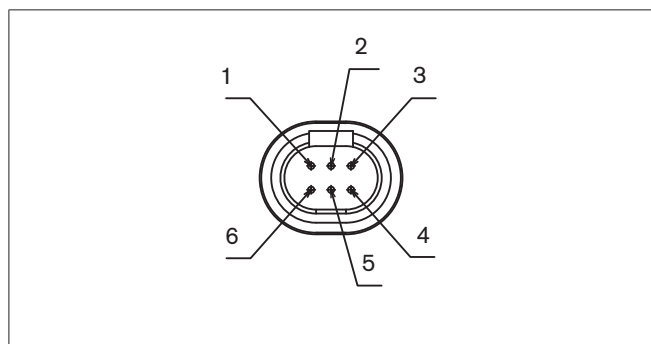
Note: If you can affix threaded bores or individual nuts, assemble the retaining shell with Allen bolts (not included in the delivery contents). Use washers of the appropriate size for the nuts.

Camera assembly

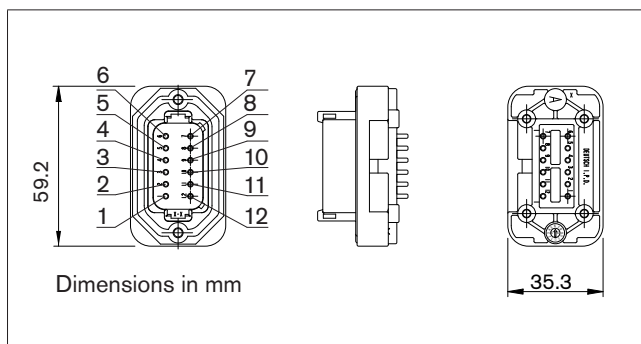
- 1 Place the camera in the ball adapter (8) so that the front side of the camera engages flush in the ball adapter.
- 2 Secure the camera and the ball adapter diagonally with the two plastic self-tapping screws (7). Tighten the screws with a torque of 0.5 Nm.
- 3 Place the 4 rubber buffers (5) in the specified openings in the clamping element (4).
- 4 Place the ball adapter (8) with the engaged camera in the clamping element. Make certain that the label "TOP" on the metal case of the camera faces upward. This ensures correct image orientation.
- 5 Use the plastic self-tapping screws (1) to secure the clamping element with the positioned ball adapter and camera in the retaining shell assembled on the vehicle (2). Align the ball adapter with camera according to the desired range of vision. Tighten the screws with a torque of 1.4 ± 0.2 Nm.
- 6 To align the ball adapter at a later time, loosen the four plastic self-tapping screws (1) two turns and retighten the screws after aligning with a torque of 1.4 ± 0.2 Nm.

Pin assignments

Camera wrap connection



Display DI3 Video wrap connection



Contact	Assignment	Wire color
1	Mirroring function	orange
2	No function	free
3	GND video	Shield
4	GND power supply	white
5	Video signal	black
6	Voltage supply	red

Contact 1 on supply voltage = mirrored image

Pin	Designation
1	GND
2	CAN2 High
3	CAN2 Low
4	CAN1 High
5	CAN1 Low
6	Terminal 15 (ignition)
7	Terminal 58 (light signal)
8	Video input 2
9	Video input 1
10	GND video input
11	Video camera supply voltage
12	V _{bat} supply voltage

Applications/installation variants

Workspace/rear-view monitoring

Up to two BODAS Color Video Cameras can be connected to the BODAS Color Display DI3 Video version and the respective video images shown on the display. These signals are displayed using the overlay technique, i.e. any content can be superimposed as a complete picture or only in a defined area of the display (size of the display area is adjustable).

Typical applications when used in combination with the camera system include

- Rear-view monitoring
- Workspace monitoring



Safety instructions

General instructions

- The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- It is not permissible to open the BODAS Color video camera, or to modify or repair the BODAS Color video camera. Modification or repairs to the wiring could result in dangerous malfunctions.
Repairs to the BODAS Color video camera may only be performed by Bosch Rexroth or by an authorized partner.
- Make sure that the BODAS Color video camera configuration does not lead to safety-critical malfunctions of the complete system in the event of failure or malfunction. This type of system behavior may lead to danger to life and/or cause much damage to property.
- When using cameras in combination with Display DI3 Video, please note that the displayed picture can show distortion, depending on the curvature of the camera-lens (fish-eye effect). Take adequate account of this deviation when operating your system.
- System developments, installations and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- While commissioning and maintenance the BODAS Color video camera the machine may pose unforeseen hazards. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- Make sure that nobody is in the machine's danger zone.
- No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.

Notes on the installation point and position

- Do not install the BODAS Color video camera close to parts that generate considerable heat (e.g. exhaust).
- Radio equipment and mobile telephones must not be used in the driver's cab without a suitable antenna or near the control electronics.
- A sufficiently large distance to radio systems must be maintained.
- All connectors must be unplugged from the electronics during electrical welding and painting operations.
- Cables/wires must be sealed individually to prevent water from entering the device.

Notes on transport and storage

- If it is dropped, the BODAS Color video camera must not be used any longer as invisible damage could have a negative impact on reliability.
- Impacts with hard objects on the case or camera lens could cause the case or glass to break. In such cases, camera must be replaced without delay.
- Avoid any utensils that scratch or which are abrasive when cleaning the BODAS Color video camera.

Safety instructions

Notes on wiring and circuitry

- The BODAS display DI3 and the cameras must be powered from the same network. Optimally, the cameras will be powered from a port on the display.
- Wires to the cameras are to be shielded. The shielding must be connected to the electronics on one side or to the machine or vehicle ground via a low-resistance connection.
- Cables to the electronics must not be routed close to other power-conducting wires in the machine or vehicle.
- The wiring harness should be fixated mechanically in the area in which the BODAS Color video camera is installed (spacing < 150 mm). The wiring harness should be fixated so that in-phase excitation with the BODAS Color video camera occurs (e. g. at the BODAS Color video camera bolting point).
- If possible, wires should be routed in the vehicle interior. If the wires are routed outside the vehicle, make sure that they are securely fixed.
- Wires must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.
- Wires are to be routed with sufficient spacing to hot or moving vehicle parts.

Intended use

- The BODAS Color video camera is designed for use in mobile working machines provided no limitations / restrictions are made to certain application areas in this data sheet.
- Operation of the BODAS Color video camera must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the complete system.

Improper use

- Any use of the BODAS Color video camera other than that described in chapter "Intended use" is considered to be improper.
- The BODAS Color video camera is not suitable for use in functions relevant to safety.
- Use in explosive areas is not permissible.
- Damage resulting from improper use and/or from unauthorized interference in the component not described in this data sheet render all warranty and liability claims void with respect to the manufacturer.

More detailed information

- More detailed information on BODAS Color video camera be found at www.boschrexroth.com/mobile-electronics.
- Pay regular visits to our home page for the latest product information and information about updates.

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Subject to change.

Control panel CP1

RE 95255

Edition: 07.2015

Replaces: 12.2013

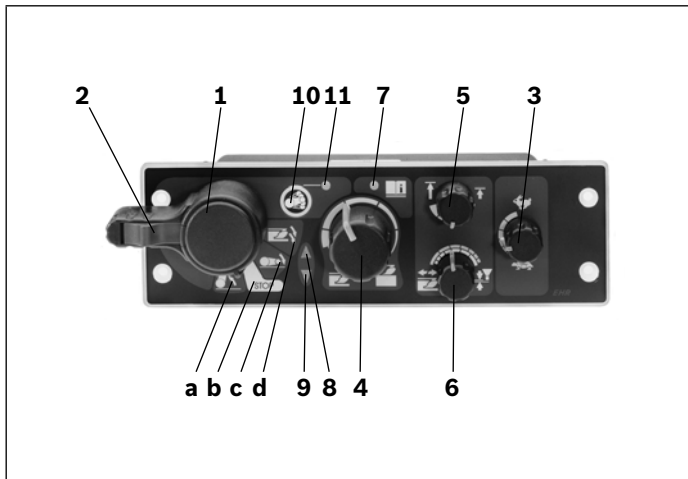


► For Electrohydraulic Hitch Control EHC

Contents

Control elements	2
Analog control panel	3
CAN control panel	4
Mating connector	5
Safety instructions	5

Control elements



- 1** Excavation lever (4 positions)
 - a Transport, lift
 - b Stop
 - c Regulate, lower
 - d Neutral, quick retract
- 2** Lock (transport)
- 3** Lowering speed setting
- 4** Setpoint setting for hitch position
- 5** Limitation to upper end position
- 6** Mixture
Infinitely variable setting between tractive force and position control
- 7** Light: diagnosis
- 8** Light: lift
- 9** Light: lower
- 10** Button for vibration damping
- 11** Light: vibration damping

Analog control panel

Pin assignment

Pin	Functions	Pin	Functions
1	10	10	3
2	6	11	9
3	11	12	8
4	Supply	13	5
5	-	14	7
6	Ground	15	Ground
7	4	16	-
8	-	17	-
9	1		

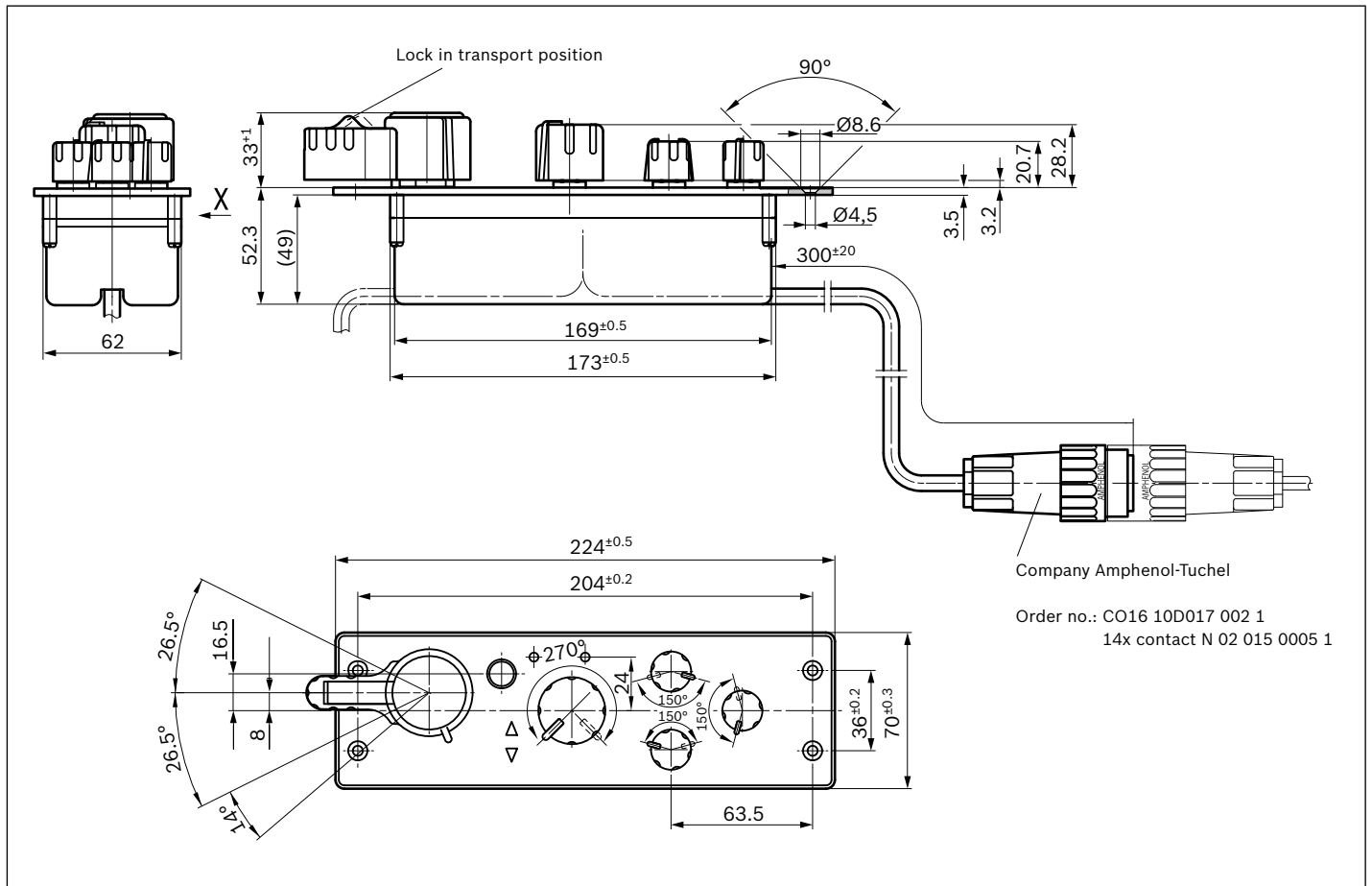
Technical data

Ambient temperature range	-20 °C to +80 °C
Supply voltage	9 V to 18 V
Installation position	see offer drawing
Type of protection	IP 66
Symbols	Illuminated
Electric connection	Connector, 17-pin
Weight	1.8 kg
Current consumption	100 mA

Material number for analog control panel

0538201611

Dimensions



4 **Control panel CP1**
CAN control panel

CAN control panel

Pin assignment

Pin	Functions
1	Supply
2	CAN Low
3	CAN High
4	Ground

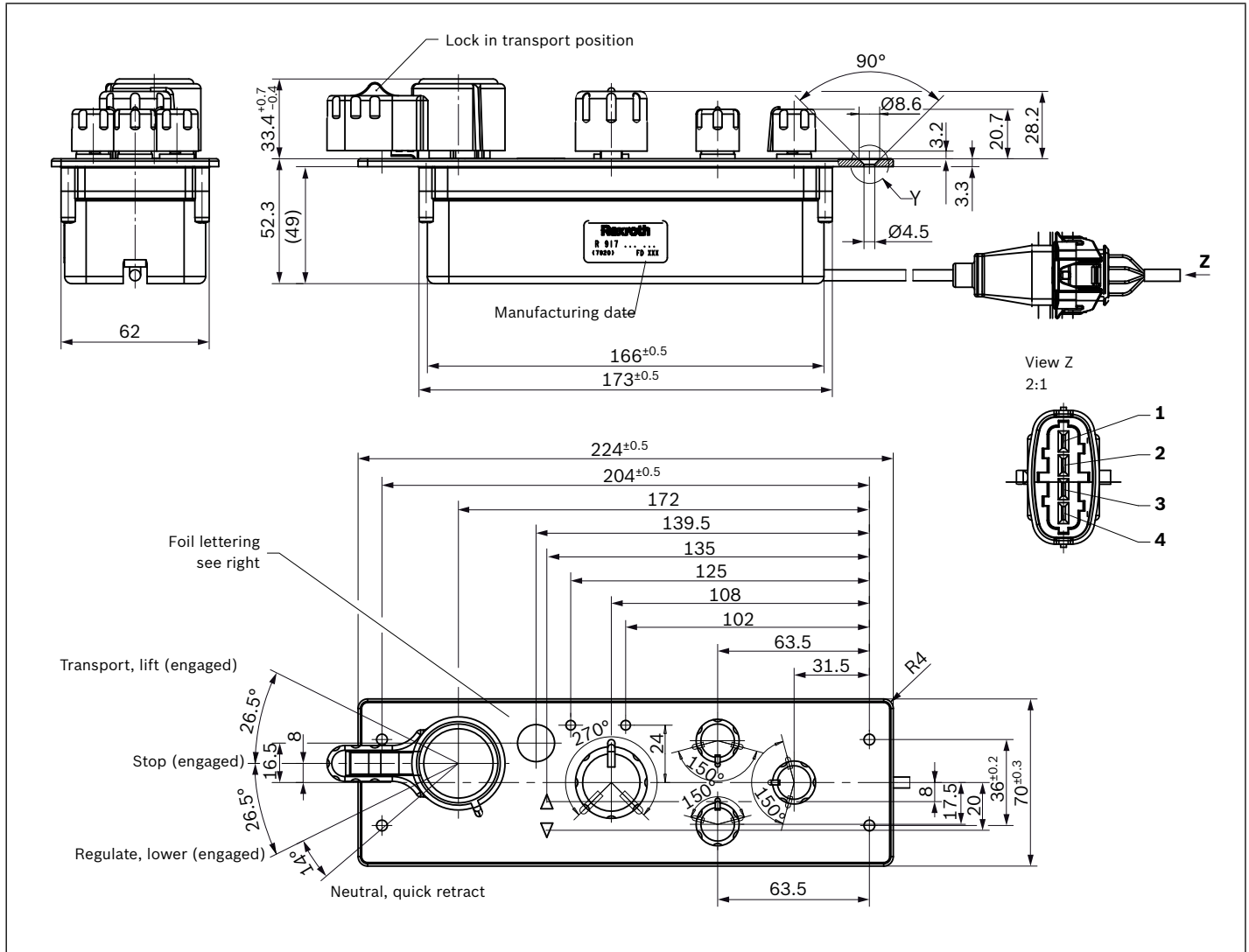
Technical data

Ambient temperature range	-20 °C to +80 °C
Supply voltage	9 V to 18 V
Installation position	see offer drawing
Type of protection	IP 66
Symbols	Illuminated
Electric connection	Connector, 4-pin
Weight	1.8 kg
Current consumption	100 mA

Material number for CAN control panel

R917000349

Dimensions



Mating connector

Wiring harness connector, comprising:

Designation	Material number	Supplier
Compact connector 1.a	1928403913	Robert Bosch GmbH
Junior Power Timer contact (pre-galvanized)	929941-3 (0.19 mm ² to 0.38 mm ²) or 929939-3 (0.50 mm ² to 1.00 mm ²)	Tyco
Single-wire seal	828904 (0.19 mm ² to 0.38 mm ²) or 828905(0.50 mm ² to 1.00 mm ²)	Tyco

Safety instructions

General instructions

- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ It is not permissible to open the control panel CP1 or to modify or repair the control panel CP1. Modifications or repairs to the wiring could result in dangerous malfunctions. Repairs on the control panel CP1 may only be performed by Bosch Rexroth or by an authorized partner.
- ▶ System developments, installation and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and with the complete system.
- ▶ While commissioning and maintenance the control panel CP1, the machine may pose unforeseen dangers. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.

Notes on the installation location and position

- ▶ Do not install the control panel CP1 close to parts that generate considerable heat (e.g. exhaust).
- ▶ Radio equipment and mobile telephones must not be used in the driver's cab without a suitable antenna or near the control electronics.
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ All connectors must be unplugged from the electronics during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.

Notes on transport and storage

- ▶ If it is dropped, the control panel CP1 must not be used any longer as invisible damage could have a negative impact on reliability.
- ▶ When cleaning the control panel CP1, do not use any coarse or abrasive cleaning utensils.

Notes on wiring and circuitry

- ▶ The control panel CP1 may only be wired when it is de-energized.
- ▶ Lines to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The wiring harness should be fixated mechanically in the area in which the control panel CP1 is installed (spacing < 100 mm). The wiring harness should be fixated so that in-phase excitation with the control panel CP1 occurs (e.g. at the control panel CP1 mounting points).
- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.
- ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.

Intended use

- ▶ The control panel CP1 is only intended for use in applications featuring hitch control with Rexroth controller and with EHC software installed.
- ▶ Operation of the control panel CP1 must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the control panel CP1 other than that described in chapter "Intended use" is considered to be improper.
- ▶ The control panel CP1 is not suitable for use in safety-related functions.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, interference in the component not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Further information

- ▶ Further information about the control panel CP1 can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The control panel CP1 must be disposed according to the national regulations of your country.

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Control panel CP2

RE 95256

Edition: 07.2016

Replaces: 05.2016



- ▶ Control panel for Electrohydraulic Hitch Control EHC
- ▶ CAN-version

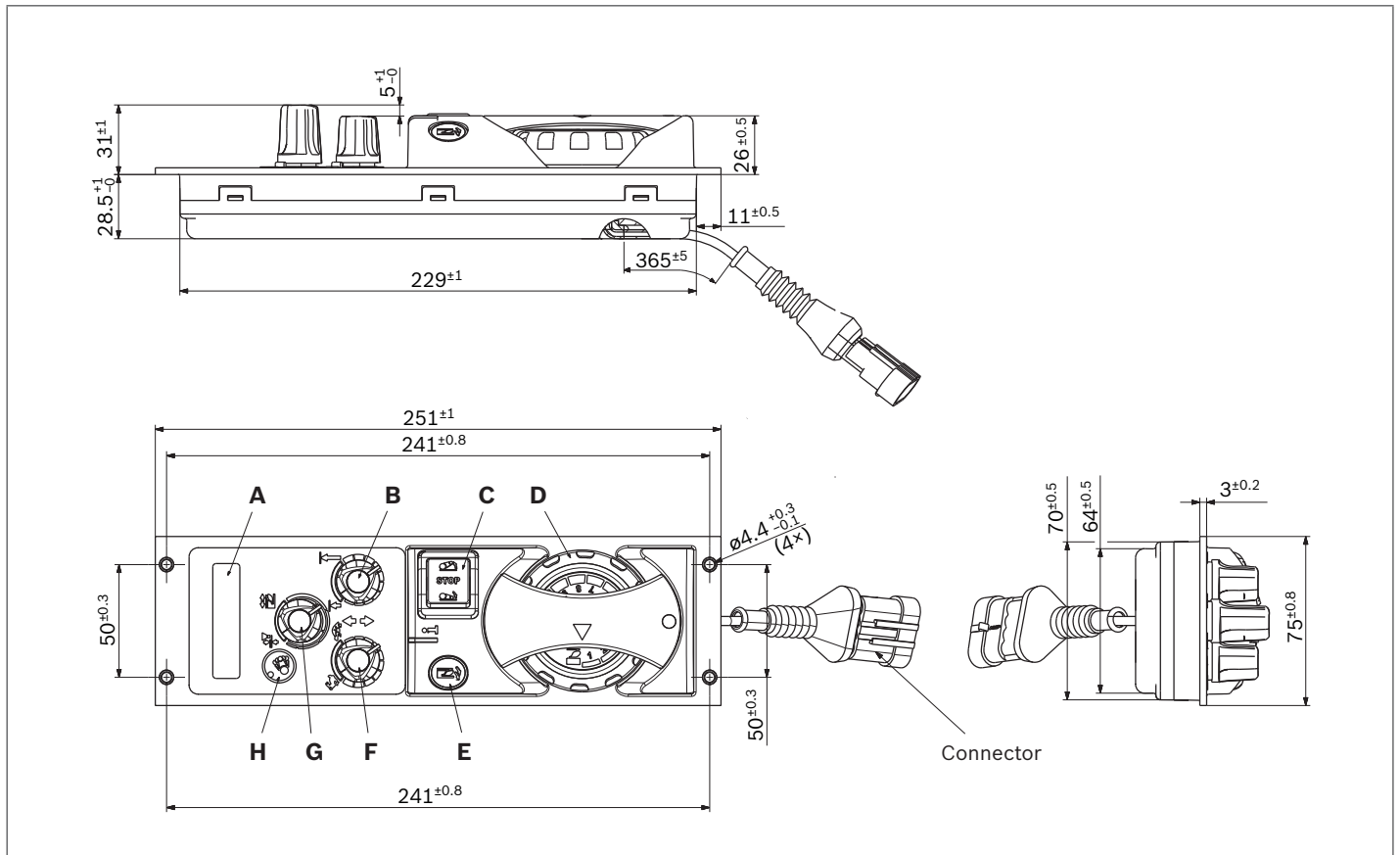
Technical data

Type	CP2
Ambient temperature range	-30 °C bis +85 °C
Supply voltage	12 V System according to ISO 16750-2 Code B
EMV	100 V/m at GHz to 4 GHz 200 V/m at 400 Hz to 1 GHz
Type of protection	IP6k7
Symbols	Illuminated
Electric connection	Tyco Superseal number 282106-1
Weight	500 g

Available variants

Type	Material number
CP2	R983077790

Dimensions

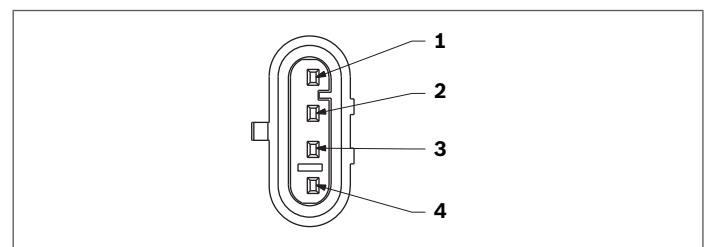


Control elements

	Description
A	LCD Display, 16×2 character
B	Height control knob
C	Transport/stop/control switch, on-off-on
D	Draft control knob
E	Fast sink switch, momentary
F	Speed control knob
G	Mix control knob
H	Damp control switch (transport mode)

Pin assignment

Pin	Functions
1	Supply
2	CAN Low
3	CAN High
4	Ground



Mating connector

Wiring harness connector, comprising:

Designation	Material number
Connector housing	282088-1
Contacts	282403-1 (strip form) or 183035-1 (loose piece)
Seal	281934-4
Protective cap	493581-1

Safety instructions

General instructions

- ▶ The proposed circuits do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ It is not permissible to open the control panel or to modify or repair the control panel. Modifications or repairs to the wiring could result in dangerous malfunctions. Repairs on the control panel may only be performed by Bosch Rexroth or by an authorized partner.
- ▶ System developments, installation and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and with the complete system.
- ▶ While commissioning and maintenance the control panel, the machine may pose unforeseen dangers. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.
- ▶ No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.

Notes on the installation location and position

- ▶ Do not install the control panel close to parts that generate considerable heat (e.g. exhaust).
- ▶ Radio equipment and mobile telephones must not be used in the driver's cab without a suitable antenna or near the control electronics.
- ▶ A sufficiently large distance to radio systems must be maintained.
- ▶ All connectors must be unplugged from the electronics during electrical welding and painting operations.
- ▶ Cables/wires must be sealed individually to prevent water from entering the device.

Notes on transport and storage

- ▶ If it is dropped, the control panel must not be used any longer as invisible damage could have a negative impact on reliability.
- ▶ When cleaning the control panel, do not use any coarse or abrasive cleaning utensils.

Notes on wiring and circuitry

- ▶ The control panel may only be wired when it is de-energized.
- ▶ Lines to the electronics must not be routed close to other power-conducting lines in the machine or vehicle.
- ▶ The wiring harness should be fixated mechanically in the area in which the control panel is installed (spacing < 100 mm). The wiring harness should be fixated so that in-phase excitation with the control panel occurs (e.g. at the control panel mounting points).
- ▶ If possible, lines should be routed in the vehicle interior. If the lines are routed outside the vehicle, make sure that they are securely fixed.
- ▶ Lines must not be kinked or twisted, must not rub against edges and must not be routed through sharp-edged ducts without protection.
- ▶ Lines are to be routed with sufficient distance from hot or moving vehicle parts.

Intended use

- ▶ The control panel is only intended for use in applications featuring hitch control with Rexroth controller and with EHC software installed.
- ▶ Operation of the control panel must generally occur within the operating ranges specified and released in this data sheet, particularly with regard to voltage, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and released boundary conditions may result in danger to life and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the control panel other than that described in chapter "Intended use" is considered to be improper.
- ▶ The control panel is not suitable for use in safety-related functions.
- ▶ Use in explosive areas is not permissible.
- ▶ Damages which result from improper use and/or from unauthorized, interference in the component not described in this data sheet render all warranty and liability claims with respect to the manufacturer void.

Further information

- ▶ Further information about the control panel can be found at www.boschrexroth.com/mobile-electronics.
- ▶ The control panel must be disposed according to the national regulations of your country.

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Accumulators

Designation	Type	Data sheet	Page
Bladder-type accumulator	HAB	50171	355
Diaphragm-type accumulator	HAD	50150	375
Safety valves, type-approved	0532 VA ...	50153	399

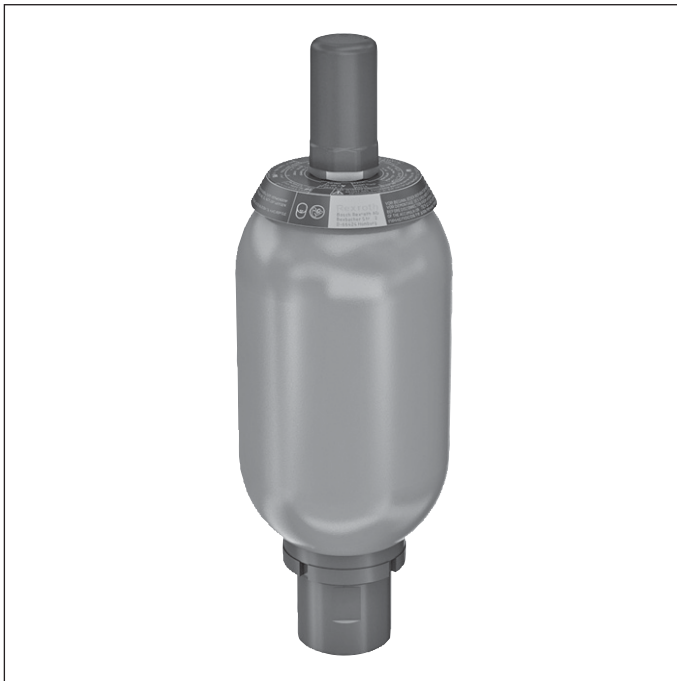
Bladder-type accumulator

Type HAB

RE 50171

Edition: 2016-03

Replaces: 50170



- ▶ Component series 6X
- ▶ Nominal volume 1 ... 50 liters
- ▶ Maximum operating pressure 350 bar

CE

Features

- ▶ Hydraulic accumulator according to Pressure Equipment Directive 2014/68/EU
- ▶ Bladder material for different applications
- ▶ Use:
 - Energy storage in intermittent operation systems
 - Energy reserve for emergencies
 - Compensation of leakage loss
 - Impact and vibration absorption
 - Volume compensation in case of pressure and temperature change

Contents

Features	1
Ordering code	2
Function, section	3
Technical data	4
Application, mode of operation	5
Calculation	5 ... 8
Dimensions	9
Spare parts and accessories	10 ... 17
Important notices	18
Safety equipment	18
Further information	19

Ordering code

01	02	03	04	05	06	07	08	09	10	11	12	13	14				
HAB		-		6X	/	0		G	-	2		1	1	1	-		

01	Bladder-type accumulator	HAB
----	--------------------------	-----

Nominal volume

02	1 liter	1
	2.5 liters	2.5
	4 liters	4
	6 liters	6
	10 liters	10
	20 liters	20
	24 liters	24
	32 liters	32
50 liters	50	

Maximum operating pressure

03	350 bar (1 ... 6 liters)	350
	330 bar (1 ... 50 liters)	330

04	Component series 60 ... 69 (60 ... 69: unchanged installation and connection dimensions)	6X
----	--	----

Gas filling pressure

05	0 bar	0
----	-------	---

Port size for hydraulic fluid ¹⁾

06		"1"	"2.5"	"4"	"6"	"10"	"20"	"24"	"32"	"50"	
	G3/4	✓	-	-	-	-	-	-	-	-	G05
	G1 1/4	-	✓	✓	✓	-	-	-	-	-	G07
	G2	-	-	-	-	✓	✓	✓	✓	✓	G09

Type of mounting (oil port form)

07	Thread with sealing surface, radial on the inside	G
----	---	---

Gas port form

08	Gas valve for filling and test device (see page 12)	2
----	---	---

Bladder material ¹⁾

09	NBR	N
	ECO	E
	FKM	F
	HNBR	H

Tank material ¹⁾

10	Steel	1
----	-------	---

Surface of the tank inside ¹⁾

11	Steel	1
----	-------	---

Surface of the connection side ¹⁾

12	Steel	1
----	-------	---

Certification (acceptance)

13	CE (PED 2014/68/EU)	CE
	Instructions for use	BA

16	Further details in the plain text, e.g. special versions	*
----	--	---

Order example:
HAB10-330-6X/0G09G-2N111-CE

¹⁾ Other versions upon request.

Function, section

General

Hydraulic accumulators are hydrostatic devices capable of storing a certain amount of energy in order to release it to the hydraulic system when needed.

Fluids only possess low compressibility; however, gases are highly compressible. The working principle of all gas-loaded hydraulic accumulators is based on this difference. The difference between bladder and diaphragm type accumulators lies in the type of separator element. Hydraulic accumulators essentially consist of a fluid section and a gas section with a gastight separator element. The fluid section has a connection to the hydraulic circuit.

If a higher liquid pressure is applied to a specific quantity of pressurized gas, the gas volume decreases as the liquid pressure increases, with the gas pressure increasing with the liquid pressure.

If the pressure of the fluid decreases, the fluid is pushed back into the hydraulic system by the expanding gas until the pressure is balanced again.

Bladder-type accumulator

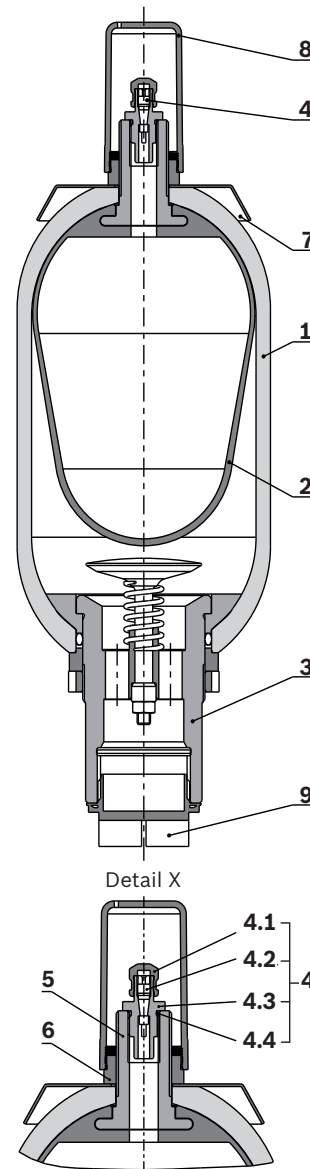
Bladder-type accumulators consist of a seamless cylindrical pressure container (1) made of high-strength steel.

An elastic bladder (2) mounted inside the container separates the accumulator into a gas side and a fluid side. Via the gas valve (4), the bladder is filled with nitrogen up to the intended gas filling pressure p_0 .

The oil valve (3) located inside the oil port of the bladder-type accumulator closes if the pressure on the gas side is higher compared to the fluid side. This prevents the bladder from entering the oil channel and being destroyed. When the minimum operating pressure is reached, a small fluid volume (approx. 10% of the hydraulic accumulator's nominal volume) should remain between the bladder and the oil valve in order to prevent the bladder from hitting the valve during each expansion process.

The gas valve (4) consists of sealing cap (4.1), gas valve insert (4.2), gas prefill valve body (4.3), and O-ring (4.4). These parts can be replaced individually.

The type cap (7) includes the technical data and features of the hydraulic accumulator.



Symbol



- 1 Tank
- 2 Bladder
- 3 Oil valve
- 4 Gas valve
- 5 Gas valve support
- 6 Nut
- 7 Type cap
- 8 Cover cap
- 9 Protective cap of oil valve

Technical data

(For applications outside these parameters, please consult us!)

General	
Weight	See table on page 10
Design	Bladder-type accumulator
Installation position	Bottom fluid connection socket, others upon request
Type of mounting	With clamping collars and console
Line connection	Screw-in thread

Hydraulic											
Nominal volume	V_{nom}	l	1	2.5	4	6	10	20	24	32	50
Effective gas volume	V_{eff}	l	1.0	2.4	3.7	5.9	9.2	18.1	24.5	33.4	48.7
Maximum flow	q_{max}	l/min	240	450	450	450	900	900	900	900	900
Maximum operating pressure	p_{max}	bar	330	330	330	330	330	330	330	330	330
			350	350	350	350	–	–	–	–	–
Maximum pressure fluctuation range	Δp_{dyn}	bar	200	200	200	200	125	125	125	125	125
Operating pressures and useful volume	See calculation on page 5 ... 8										
Hydraulic fluid	Hydraulic oil according to DIN 51524; other fluids on request!										
Hydraulic fluid temperature range (others upon request)		°C	–15 ... +80 (NBR) –32 ... +80 (ECO) –20 ... +80 (FKM) –30 ... +80 (HNBR)								

Pneumatic	
Charging gas	Nitrogen, cleanliness class 4.0, N ₂ = 99.99 vol. %
Gas filling pressure	p_0 bar 0

Hydraulic fluids	Material
Mineral oils	NBR ¹⁾ ECO ²⁾ HNBR ³⁾
HFC	NBR ¹⁾
HFD	FKM ⁴⁾

1) Acrylonitrile butadiene rubber

2) Epichlorohydrin rubber

3) Hydrated acrylonitrile butadiene rubber

4) Fluorine rubber

Application, mode of operation

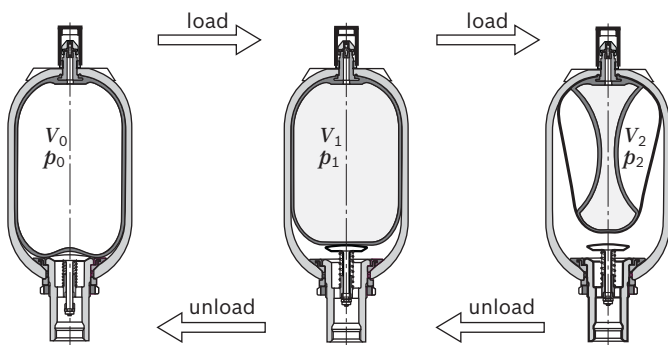
Applications

Various applications exist for hydro-pneumatic accumulators:

- ▶ Energy storage in order to save pump drive power in intermittent operation systems.
- ▶ Energy reserve for emergencies, e.g. upon failure of the hydraulic pump.
- ▶ Compensation of leakage losses.
- ▶ Impact and vibration absorption in case of periodic vibrations.
- ▶ Volume compensation in case of pressure and temperature changes.

Mode of operation

Fluids are almost incompressible and therefore cannot store pressure energy. Hydro-pneumatic Rexroth accumulators use the compressibility of a gas for fluid storage. Exclusively use nitrogen of cleanliness class 4.0! $N_2 = 99.99 \text{ vol. } \%$



Calculation

Pressures

The following pressures are of decisive importance for the calculation of an accumulator:

p_0	Gas filling pressure at room temperature and empty fluid chamber
$p_0(t)$	Gas filling pressure at operating temperature
$p_0(t_{\max})$	Gas filling pressure at maximum operating temperature
p_1	Minimum operating pressure
p_2	Maximum operating pressure

In order to achieve the best utilization of the accumulator volume possible as well as a long life cycle, compliance with the following values is recommended:

$$p_0(t_{\max}) \sim 0.9 \times p_1 \quad (1)$$

The highest hydraulic pressure should not exceed four times the filling pressure, as otherwise too much stress will be put on the elasticity of the bladder, resulting in too great a compression change with strong gas heating:

$$p_2 \leq 4 \times p_0 \quad (2)$$

The life cycle of the accumulator bladder is the higher the smaller the difference between p_1 and p_2 is. However, the operating ratio of the maximum accumulator capacity will also be reduced accordingly.

Calculation

Oil volume

According to the pressures $p_0 \dots p_2$, the gas volumes $V_0 \dots V_2$ will result. In this process, V_0 simultaneously is the nominal volume of the accumulator. The available oil volume ΔV corresponds to the difference of the gas volumes V_1 and V_2 :
 $\Delta V \cong V_1 - V_2$ (3)

The gas volume variable within a pressure differential is determined by the following equations:
 ▶ For an isothermal state change of gases, i.e. when the change of the gas cushion happens so slowly as to leave sufficient time for a complete thermal exchange between the nitrogen and its environment, therefore keeping the temperature constant, the following applies:

$$p_0 \times V_0 = p_1 \times V_1 = p_2 \times V_2 \quad (4.1)$$

▶ For an adiabatic state change, i.e. a quick change of the gas cushion accompanied by a temperature change of the nitrogen, the following applies:

$$p_0 \times V_0^\chi = p_1 \times V_1^\chi = p_2 \times V_2^\chi \quad (4.2)$$

χ = ratio of the specific gas heats (adiabatic exponent), for nitrogen = 1.4

In practice, state changes rather follow adiabatic laws. Often charging is isothermal and discharge is adiabatic. Considering the equations (1) and (2), ΔV is between 50% and 70% of the nominal accumulator volume. The following applies as a guiding principle:

$$V_0 = 1.5 \dots 3 \times \Delta V \quad (5)$$

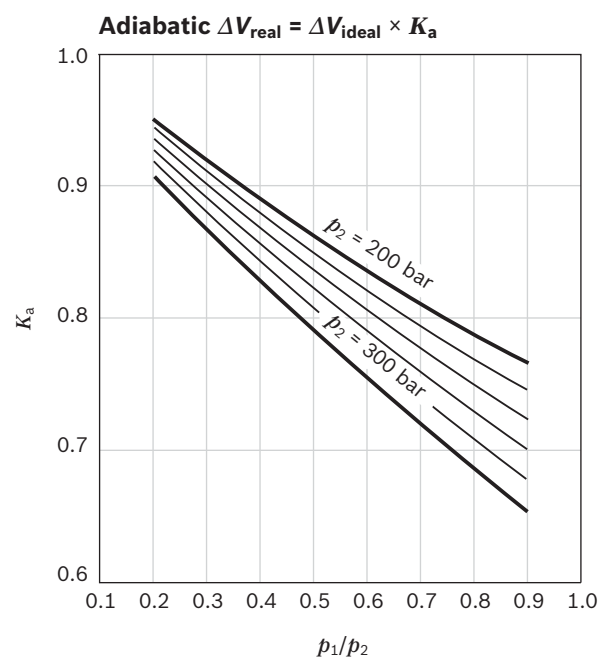
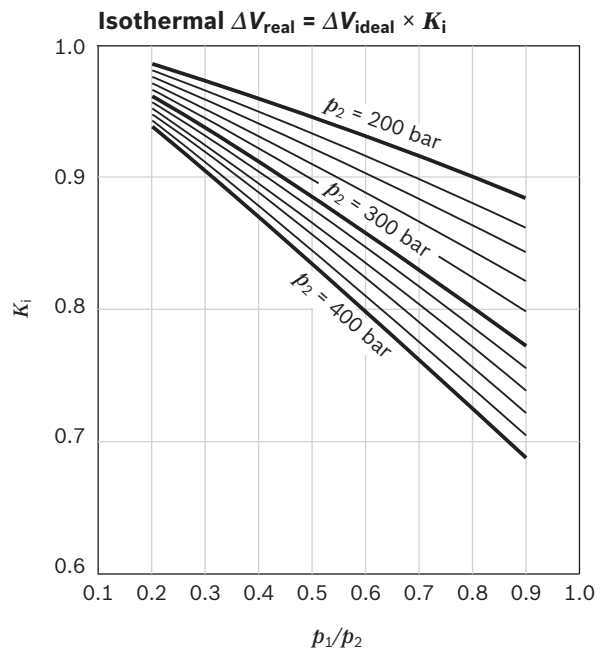
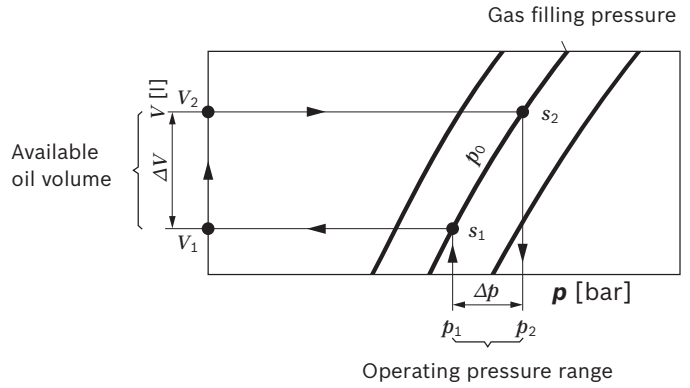
Calculation diagram

For graphic determination, the formulas (4.1) and (4.2) are converted into diagrams on pages 7 and 8. Depending on the task, the available oil volume, the accumulator size or the pressures can be determined.

Correction factor K_i and K_a

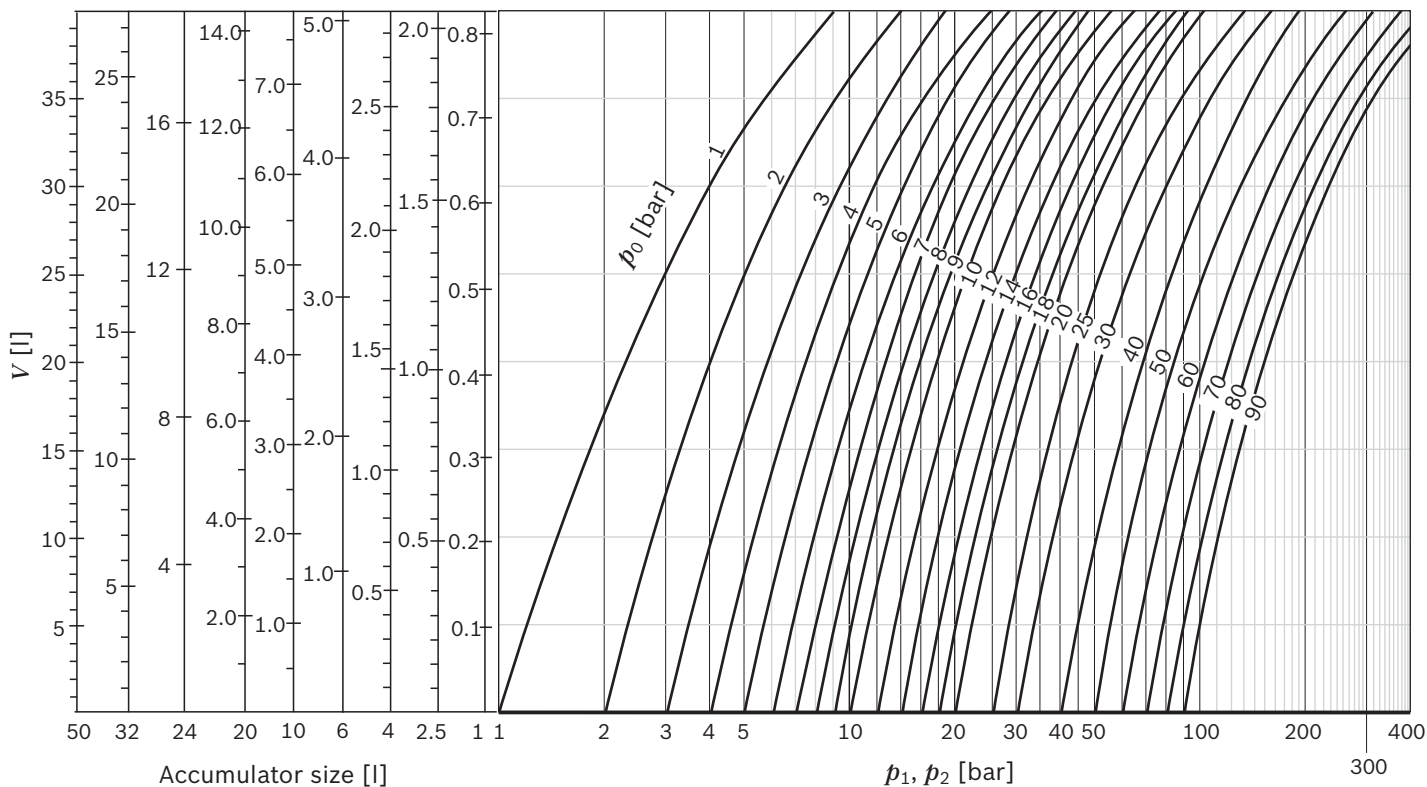
The equations (4.1) and (4.2) apply to ideal gases only. The behavior of real gases, however, will show considerable variation at operating pressures above 200 bar which will have to be accounted for by correction factors. These can be taken from the following diagrams. The correction factors the ideal sampling volume ΔV is to be multiplied with lie within a range of 0.6 ... 1.

Application of calculation diagrams
(see page 7 ... 8)

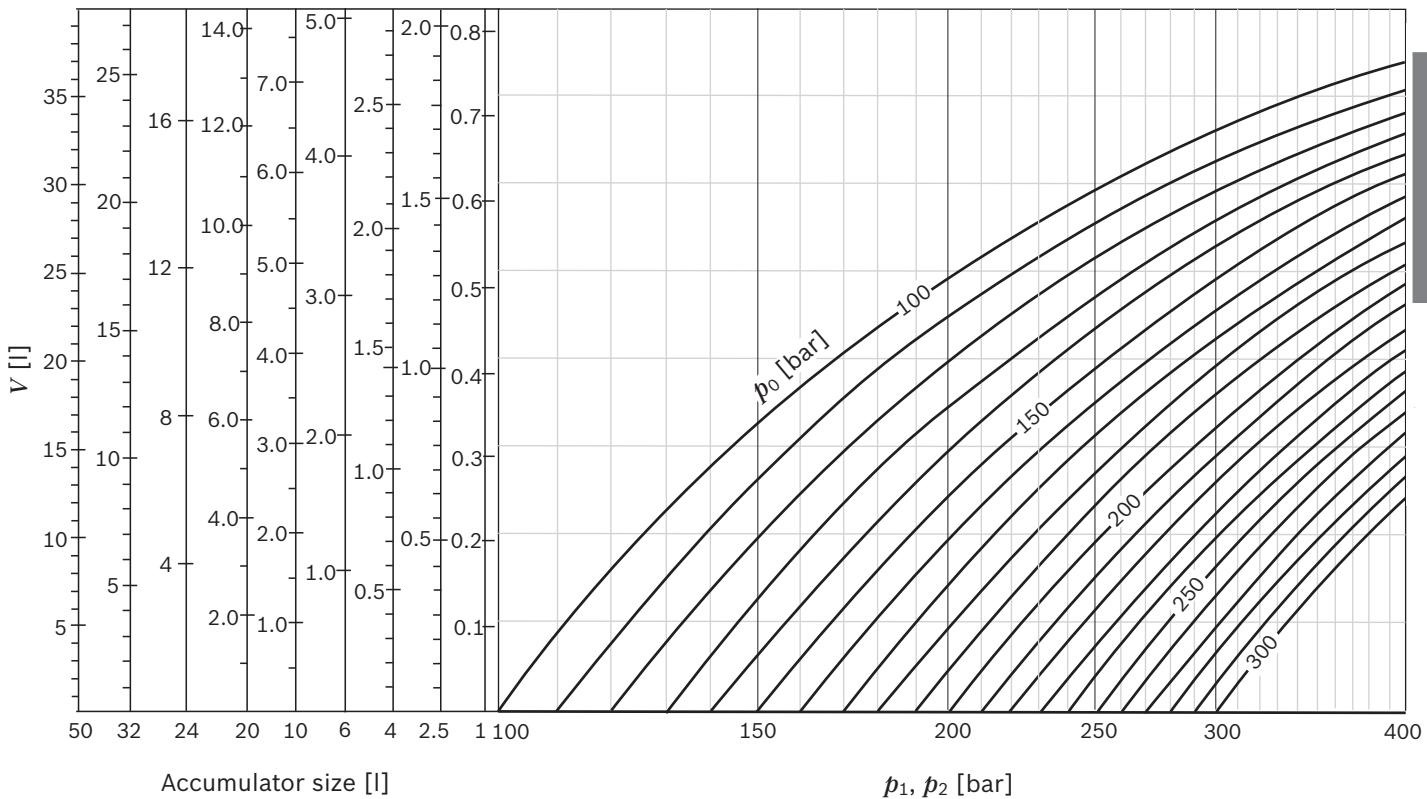


Calculation: isothermal state changes

$p_0 = 1 \dots 90 \text{ bar}$



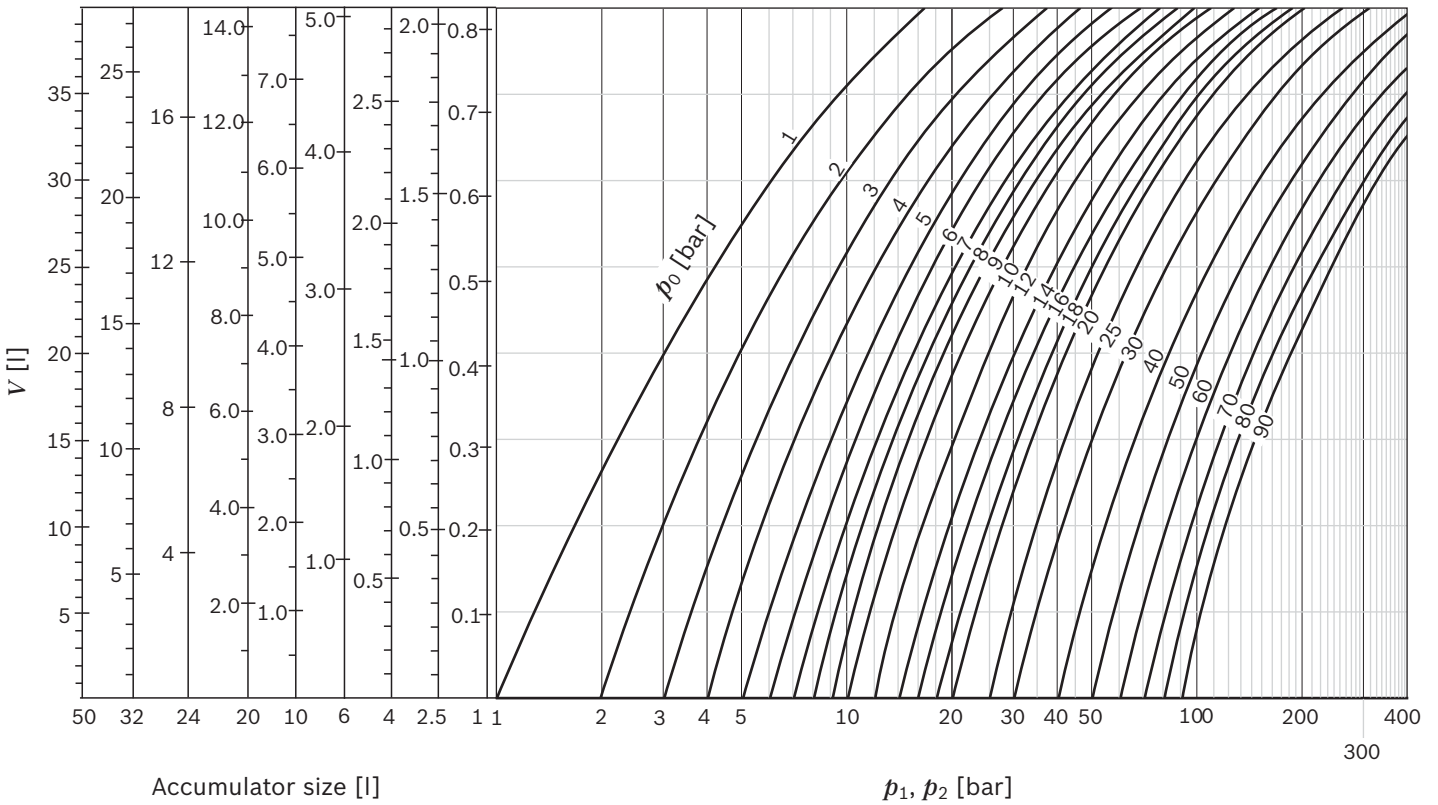
$p_0 = 100 \dots 300 \text{ bar}$



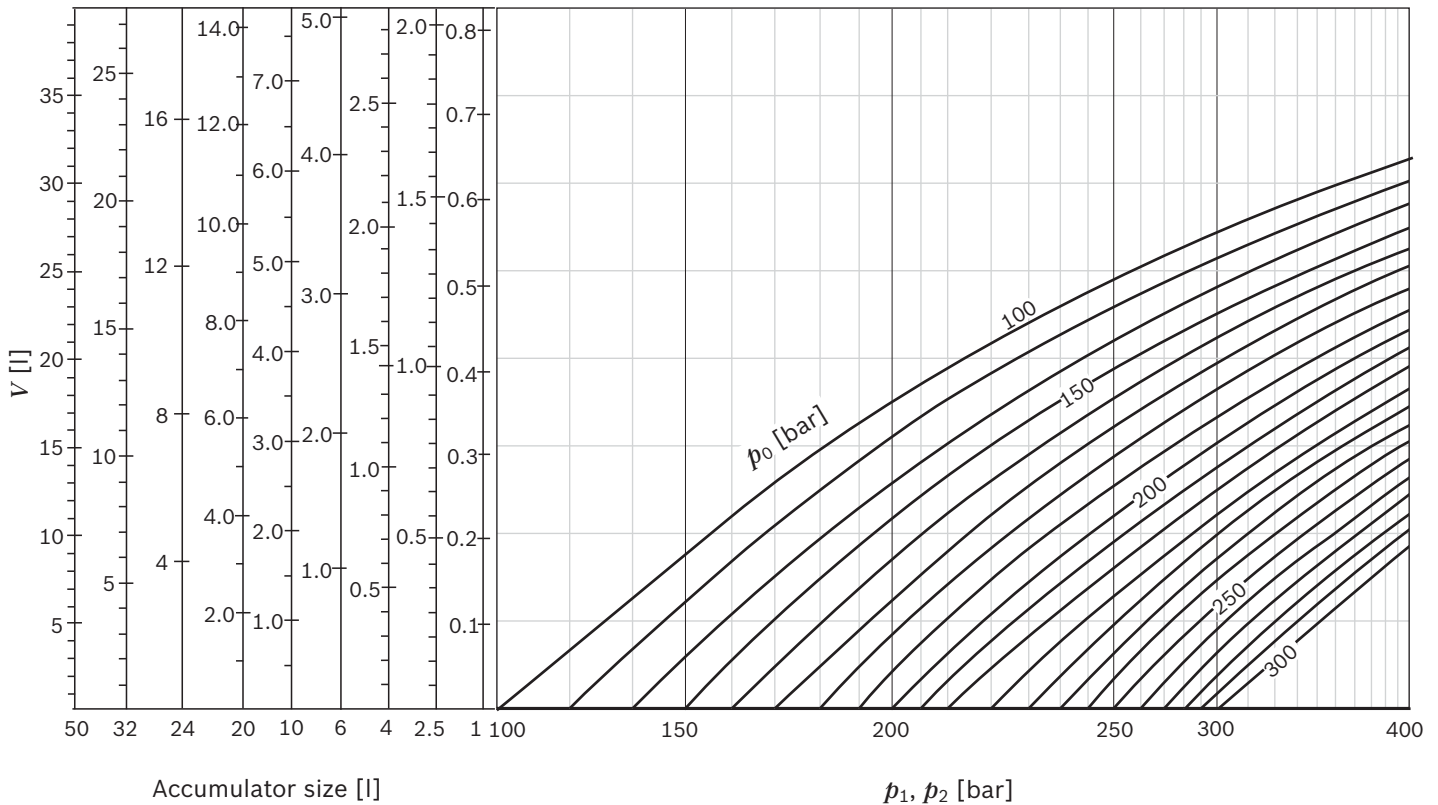
5

Calculation: Isothermal state changes

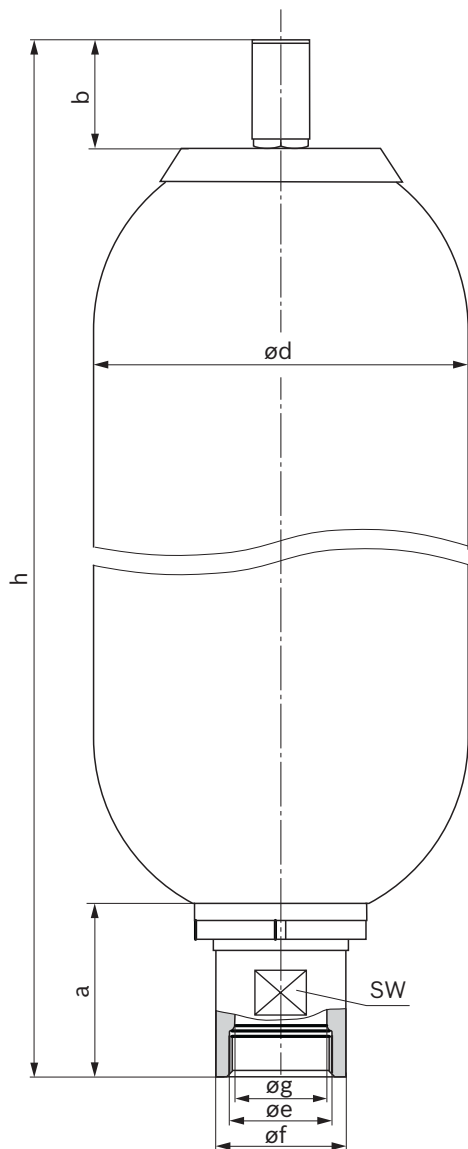
$p_0 = 1 \dots 90 \text{ bar}$



$p_0 = 100 \dots 300 \text{ bar}$



Dimensions (dimensions in mm)



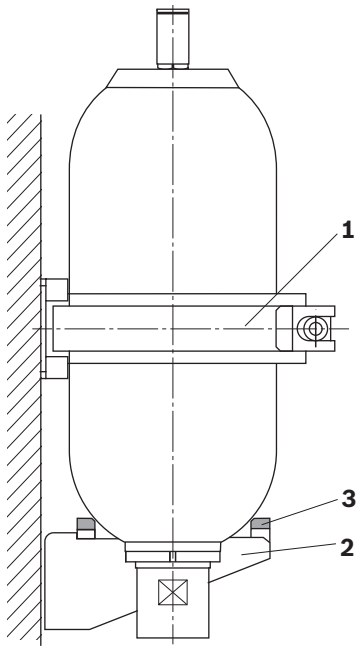
Preferred types HAB-6X

Type	Material no.
HAB1-350-6X/0G05G-2N111-BA	R901435300
HAB2,5-350-6X/0G07G-2N111-CE	R901435301
HAB4-350-6X/0G07G-2N111-CE	R901435302
HAB6-350-6X/0G07G-2N111-CE	R901435303
HAB10-330-6X/0G09G-2N111-CE	R901435304
HAB20-330-6X/0G09G-2N111-CE	R901435305
HAB24-330-6X/0G09G-2N111-CE	R901435306
HAB32-330-6X/0G09G-2N111-CE	R901435307
HAB50-330-6X/0G09G-2N111-CE	R901435308

Nominal volume [l]	Ordering code / type	h	Ød	a	b	Øe	Øf	Øg	SW	Weight [kg]
1	HAB1-330-6X/...G05G... HAB1-350-6X/...G05G...	320.5-354.5	112.5-115.5	65±3	71.5±3	G ³ / ₄ "	52.4	23H7	50	7
2.5	HAB2.5-330-6X/...G07G... HAB2.5-350-6X/...G07G...	520.5-562.5	112.5-115.5	65±3	71.5±3	G ¹ / ₄ "	52.4	36H8	50	10
4	HAB4-330-6X/...G07G... HAB4-350-6X/...G07G...	400.5-442.5	166.3-169.7	65±3	71.5±3	G ¹ / ₄ "	52.4	36H8	50	16.5
6	HAB6-330-6X/...G07G... HAB6-350-6X/...G07G...	535.5-569.5	166.3-169.7	65±3	71.5±3	G ¹ / ₄ "	52.4	36H8	50	20
10	HAB10-330-6X/...G09G...	559-591	216.8-221.2	101.5±3	71.5±3	G ² "	76	54H7	70	32
20	HAB20-330-6X/...G09G...	869-901	216.8-221.2	101.5±3	71.5±3	G ² "	76	54H7	70	53
24	HAB24-330-6X/...G09G...	1004-1036	216.8-221.2	101.5±3	71.5±3	G ² "	76	54H7	70	61
32	HAB32-330-6X/...G09G...	1389-1421	216.8-221.2	101.5±3	71.5±3	G ² "	76	54H7	70	85
50	HAB50-330-6X/...G09G...	1904-1936	216.8-221.2	101.5±3	71.5±3	G ² "	76	54H7	70	123

Spare parts and accessories
(dimensions in mm)

HAB mounting elements

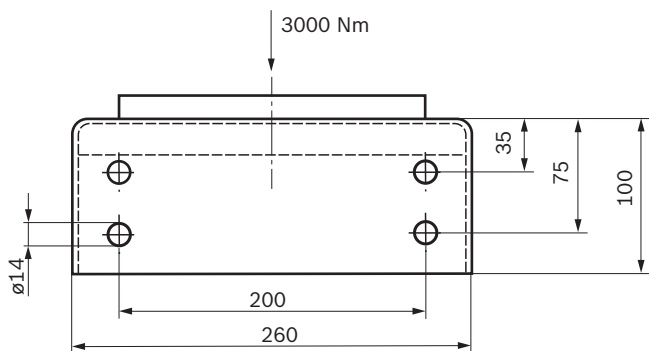


Clamp types	Material number	Accumulator size					
		1	4	20			
		2.5	6	10	24	35	50
Clamp 110-120	1531316021	1					
Clamp 160-170	1531316022		2				
Clamp 218-228	1531316026			1	2		
Clamp 224-230	1531316005						2
Console	1531334008			1	1	1	
Rubber support ring	1530221042			1	1	1	

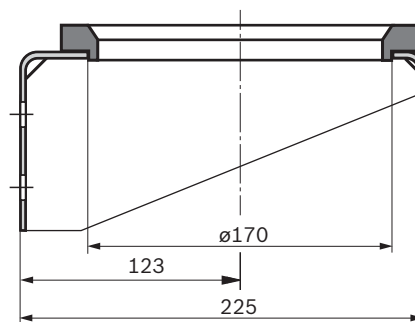
- 1 Clamp
- 2 Console
- 3 Rubber support ring

Console and rubber support ring

Console (material number: 1531334008)

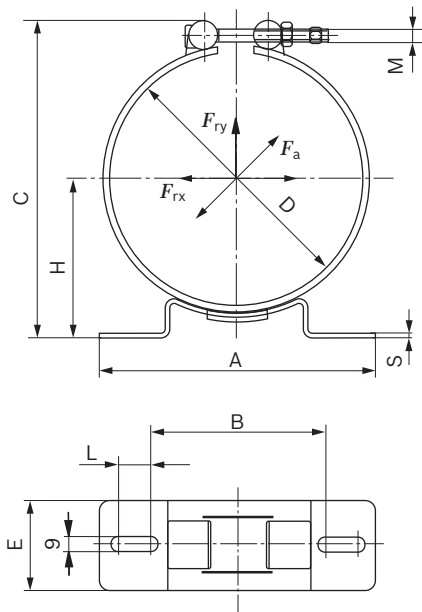


Rubber support ring (material number: 1530221042)

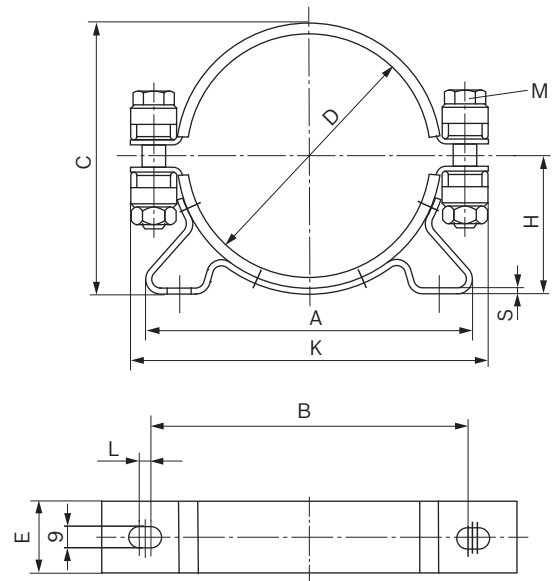


Spare parts and accessories: Mounting clamps (dimensions in mm)

Type F1



Type F2



Clamp types		Dimensions										Material number
		A	B	C	D	E	H	K	L	M	S	
Clamp 110-120	F1	135	96	150	110-120	50	64-69	-	6	M8	3	1531316021
Clamp 160-170	F1	237	147	200	160-170	50	90-95	-	35	M8	4	1531316022
Clamp 218-228	F1	237	147	258	218-228	50	120-125	-	35	M8	4	1531316026
Clamp 224-230	F2	254	212	244	224-230	30	120-123	295	4	M12	3	1531316005

Spare parts and accessories: filling and test device
(dimensions in mm)

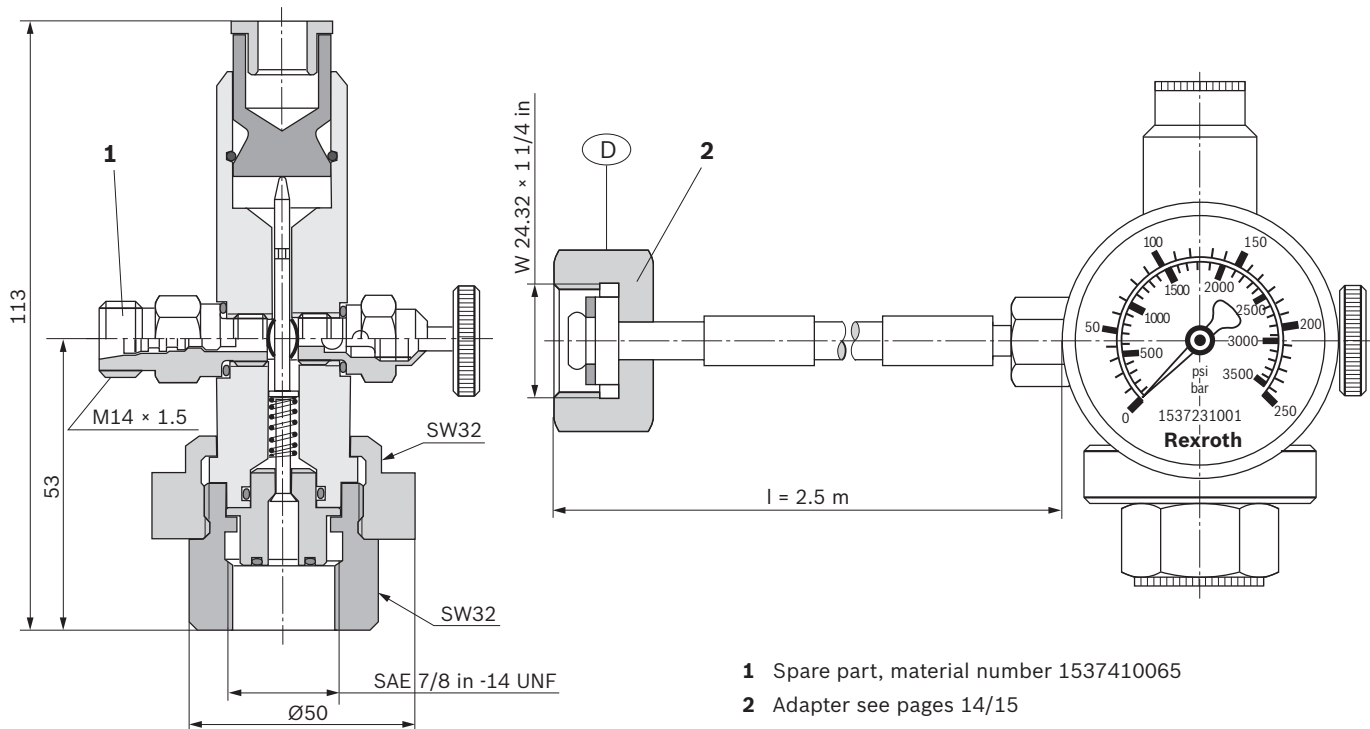


Supplemental parts (separate order)		Material number
Pressure gauge 0 ... 25 bar		R900033955
Pressure gauge 0 ... 60 bar		1537231002
Pressure gauge 0 ... 400 bar		1537231005
Transition socket	(F)	1533391010
	(GB)	1533391011
	(USA)	1533391012
	(KR)	1533391013
	(J)	1533391014
Hose l = 5 m with transition socket	(RUS)	1533391015
	(D)	1530712006

Measurement case	Material number
► for bladder-type accumulator (HAB)	0538103011
- Case (without contents)	R901079781
- Filling and test valve HAB	0538103005
- Pressure gauge 0 to 250 bar	1537231001
- Hose l = 2.5 m with transition socket (D)	1530712005
► for bladder and diaphragm accumulator (HAB/HAD)	0538103014
Components as above plus filling and test valve HAD	0538103006

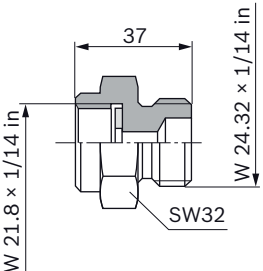
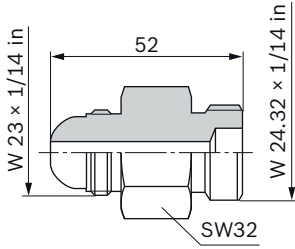
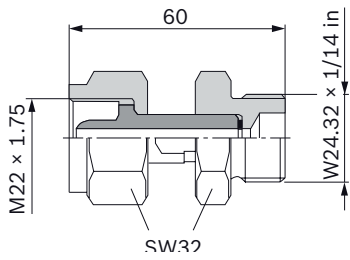
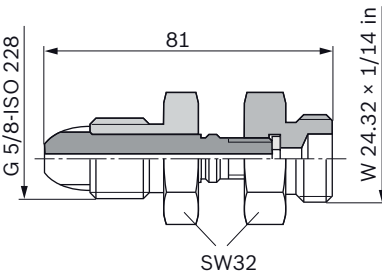
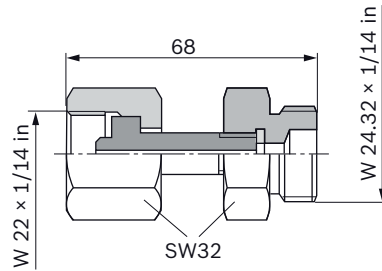
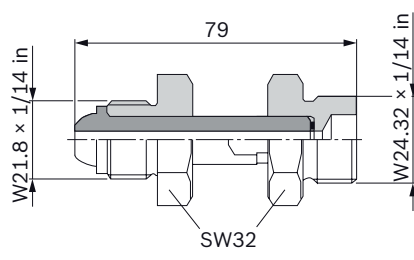
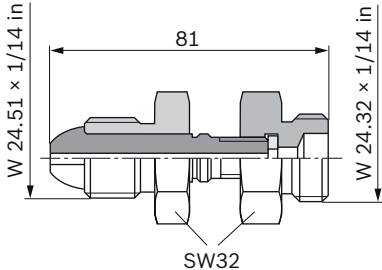
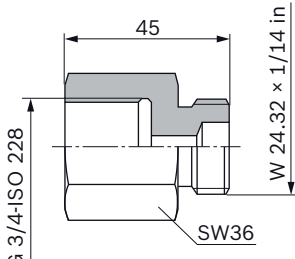
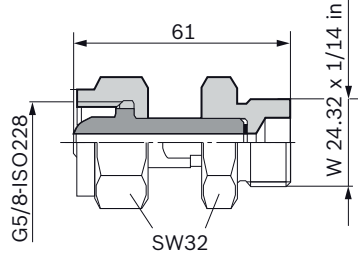
Dimensions of filling and test valve

1 valve body with check valve, drain valve, pressure gauge connection and gas hose connection.



- 1 Spare part, material number 1537410065
- 2 Adapter see pages 14/15

Spare parts and accessories: adapter for nitrogen bottle to cap nut
(dimensions in mm)

<p>Material number: 1533391010</p> 	<p>Material number: 1533391013</p> 	<p>Material number: R900034782</p> 
<p>Material number: 1533391011</p> 	<p>Material number: R900216133</p> 	<p>Material number: R900708208</p> 
<p>Material number: 1533391012</p> 	<p>Material number: 1533391015</p> 	<p>Material number: R901070776</p> 

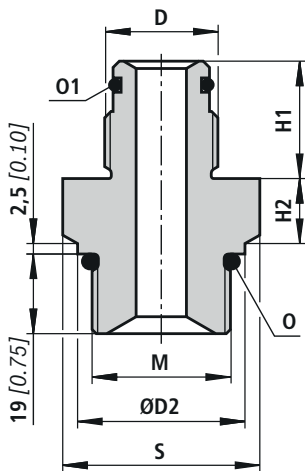
Spare parts and accessories: adapter for nitrogen bottle to cap nut
(dimensions in mm)

Country	Material number								
	1533391010	1533391011	1533391012	1533391013	R900216133	1533391015	R900034782	R900708208	R901070776
Brazil		x							
Bulgaria		x							
China									x
France	x								
Greece		x							
United Kingdom		x							
India		x							
Italy								x	
Japan					x				
Canada			x						
North Korea				x					
South Korea				x					
Malaysia		x							
Mexico	x								
Romania	x								
Russia						x			
Spain		x							
Saudi Arabia	x								
Singapore		x							
Taiwan							x		
Turkey		x							
USA			x						

Other countries upon request

Spare parts and accessories: accumulator adapter for accumulator shut-off blocks type ABZSS
(dimensions in mm [inches])

Please select the matching type according to data sheet 50131.

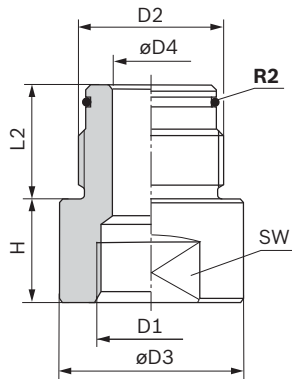


Accumulator shut-off block	Accumulator type	Accumulator DN	Accumulator adapter	D	ØD2
ABZSS 08 ABZSS 10 ABZSS 20	Bladder-type accumulator Data sheet 50171	1.0	S10 ¹⁾ S105 ²⁾	G3/4A	39.9 [1.57] ¹⁾ 35.0 [1.37] ²⁾
		2.5	S12 ¹⁾ S107 ²⁾	G1 1/4A	
		4.0			
		6.0			
		10.0	S13 ¹⁾ S109 ²⁾	G2A	
		20.0 35.0 50.0			
H1	H2	M	O	O1	S
28 [1.10]	15.5 [0.61]	33 x 2.1); 20 x 1.5 2) 29.7 x 2.8 1); 24 x 2.0 2)	29.7 x 2.8 1); 24 x 2.0 2)	18 x 2.5 [0.71 x 0.10]	SW41 [1.61A/F] ¹⁾ SW36 [1.41A/F] ²⁾
37 [1.46]	16.5 [0.65] ¹⁾ 17.5 [0.68] ²⁾			30x3 [1.18 x 0.12]	SW46 [1.81A/F]
43 [1.69]	20.5 [0.81] ¹⁾ 18.5 [0.73] ²⁾			48 x 3 [1.89 x 0.12]	SW65 [2.55A/F]

Spare parts and accessories: accumulator adapter for accumulator shut-off blocks type ABZSS (dimensions in mm)

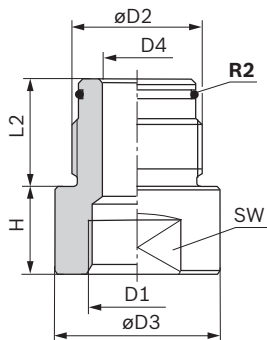
Adapter to metric thread

(HAB..-1X to HAB..-4X and -6X)



Nominal volume [l]	According to ISO 228		According to ISO 228		Dimensions [mm]					Material number adapter	Order number complete with seal ring R2
	D2	M_A [Nm]	D1	M_A [Nm]	H	L2	ØD3	ØD4	SW		
1	G3/4	180 ⁺¹⁸	M30 × 1.5	180 ⁺¹⁸	32	28	46	12	41	1533345047	R901252863
2.5 ... 6	G1/14	450 ⁺⁴⁵	M40 × 1.5	400 ⁺⁴⁰	43	37	60	20	55	1533345048	R901252864
10 ... 50	G2	500 ⁺⁵⁰	M50 × 1.5	450 ⁺⁴⁵	41	44	78	32	70	1533345049	R901252865

Adapter for reduction of pipe connection



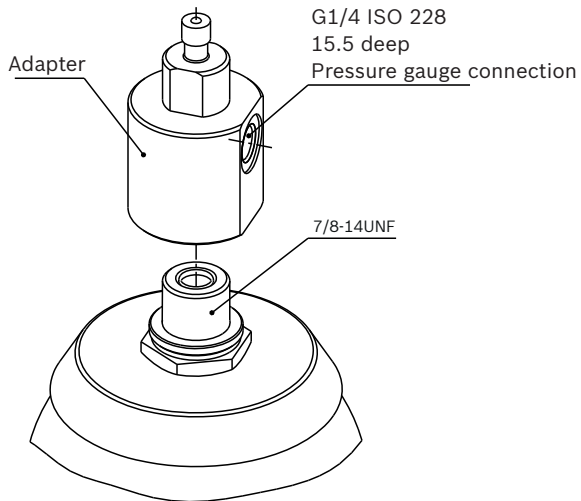
Nominal volume [l]	According to ISO 228		According to ISO 228		Dimensions [mm]					Material number adapter	Order number complete with seal ring R2
	D2	M_A [Nm]	D1	M_A [Nm]	H	L2	ØD3	ØD4	SW		
1	G3/4	180 ⁺¹⁸	G3/8	70 ⁺⁷	8	28	38	12	32	1533345039	R901252880
2.5 ... 6	G1/14	450 ⁺⁴⁵	G1/2	115 ⁺¹²	8	37	60	24	55	1533345043	R901252884
	G1/14	450 ⁺⁴⁵	G3/4	180 ⁺¹⁸	8	37	60	24	55	1533345040	R901252881
10 ... 50	G2	500 ⁺⁵⁰	G1/2	115 ⁺¹²	20	44	75	30	65	1533345044	R901252885
	G2	500 ⁺⁵⁰	G3/4	180 ⁺¹⁸	20	44	75	30	65	1533345041	R901252882
	G2	500 ⁺⁵⁰	G1	310 ⁺³¹	20	44	75	30	65	1533345045	1533345045
	G2	500 ⁺⁵⁰	G1 1/2	450 ⁺⁴⁵	40	44	75	32	65	1533345042	R901252883

Spare parts and accessories

(dimensions in mm)

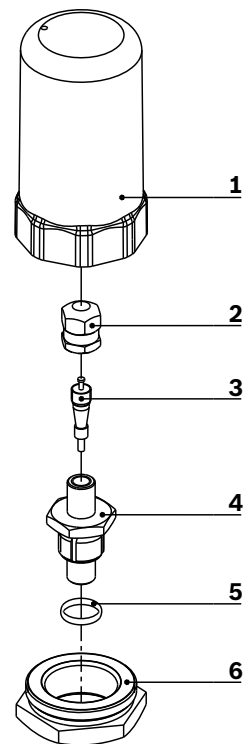
Pressure monitoring

Adapter for pressure gauge, material number 1535400171

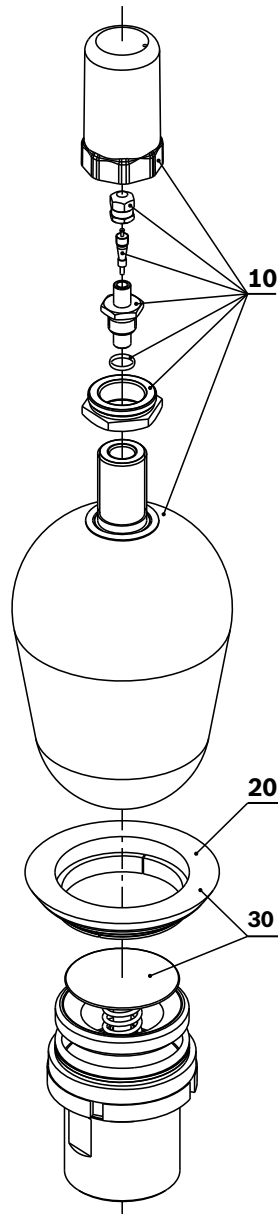


Gas valve

Spare part kit for gas valve	Material number R901438300
Components	Quantity
1 Protective cap	1
2 Sealing cap series 60	1
3 Valve insert series 60	1
4 Gas valve series 60	1
5 O-ring	1
6 Nut	1



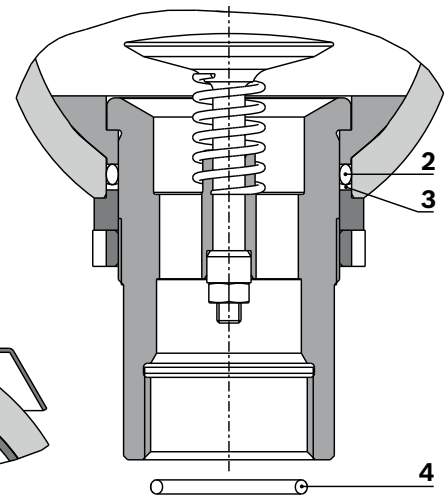
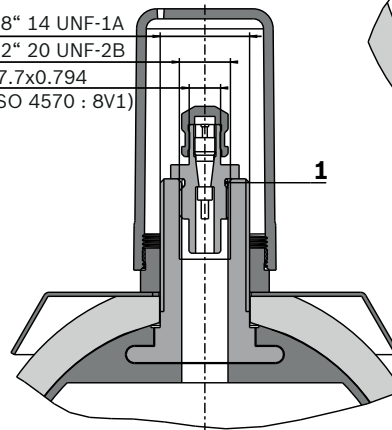
Spare parts (dimensions in mm)



Seal kit (position 1 ... 4)

Accumulator size	Material number NBR, HNBR, ECO	Material number FKM
1L	R901441920	-
2.5 ... 6L	R901441921	-
10 ... 50L	R901441922	R901441923

7/8" 14 UNF-1A
1/2" 20 UNF-2B
Ø7.7x0.794
(ISO 4570 : 8V1)



Accumulator size	10 Spare bladder with gas valve and seal kit Material number				20 Holding ring Material number		30 Oil valve kit consisting of holding ring and oil valve
	NBR	ECO	FKM	HNBR	NBR, HNBR, ECO	FKM	
1 l	R901437540	-	-	R901438250	R901438280	R901438290	-
2.5 l	R901437541	-	-	R901438251	R901438280	R901438290	-
4 l	R901437542	R901438234	-	R901438252	R901438280	R901438290	R901438270
6 l	R901437543	-	-	R901438253	R901438280	R901438290	R901438270
10 l	R901437544	R901438235	R901438240	R901438254	R901438281	R901438291	R901438271
20 l	R901437545	-	R901438241	R901438255	R901438281	R901438291	R901438271
24 l	R901437546	-	-	R901438256	R901438281	R901438291	R901438271
32 l	R901437547	R901438236	R901438242	R901438257	R901438281	R901438291	R901438271
50 l	R901437548	-	R901438243	R901438258	R901438281	R901438291	R901438271

Important notices

Intended use

Rexroth bladder-type accumulators type HAB..-6X are intended for the set-up of hydraulic drive systems in stationary mechanical engineering and plant construction. In mobile applications or applications in which acceleration forces are applied to the bladder-type accumulator during intended use, its use is permitted only following release by the competent Rexroth product manager. Please contact technical sales for this. Rexroth bladder-type accumulators type HAB..-6X are not intended for private use.

Project planning information

Bladder-type accumulators have to be safely and permanently fastened to the machine or system using mounting elements. The fastening is intended to keep the oil port tension-free. Particularly, no tension forces or static or dynamic inertia forces should be applied to the oil port.

Thermal expansion of the supporting structure and vibrations originating from the environment should be considered in the selection of suitable mounting points.

Safety instructions for hydraulic accumulators

For the hydraulic accumulator type HAB..-6X, observe the operating instructions 50171-B. The machine end-user will have sole responsibility for compliance.

General notices for hydraulic accumulators in hydraulic system can be found in ISO 4413.

Keep all documents included in the delivery in a safe place; they will be required by the expert in recurring tests.

Legal provisions

Hydraulic accumulators are pressure vessels and subject to the application national provisions and/or regulations valid at the place of installation.

In Germany, the Ordinance on Industrial Safety and Health (BetrSichV) applies.

Special regulations are to be observed in shipbuilding, aircraft construction, mining, etc.

Authorized persons

According to Ordinance on Industrial Safety and Health (BetrSichV), only authorized persons may carry out tests. Authorized persons are such persons having obtained the required expert knowledge through professional training, experience and recent professional activity.

Safety equipment

Notice:

Hydraulic accumulators have to be secured against operation outside of the admissible limits according to Pressure Equipment Directive 2014/68/EU.

In order not to exceed the maximum operating pressure, we recommend the use of an accumulator shut-off block type ABZSS according to data sheet 50131.

Further information

Operating instructions valid for HAB1 ... HAB50

Language	Operating instructions	Document number
German	RD50171-B	RA56504062
English	RE50171-B	RA56504064
French	RF50171-B	RA56504063
Spanish	RS50171-B	RA56504059
Italian	RI50171-B	RA56504061
Chinese	RC50171-B	RA56504056
Russian	R-RS50171-B	RA56504054
Norwegian	R-NO50171-B	RA56504058
Polish	R-PL50171-B	RA56504066
Czech	R-CZ50171-B	RA56504065
Romanian	R-RU50171-B	RA56504067
Hungarian	RU50171-B	RA56504057
Portuguese	RP50171-B	RA56504060
Swedish	R-SK50171-B	RA56592909

- ▶ Accumulator shut-off block
- ▶ Selection of filters
- ▶ Information on available spare parts

CE Declarations of Conformity

In German, English, French

Type	Document number
HAB1-330...	–
HAB2,5-330...	RA56313071
HAB4-330...	
HAB6-330...	
HAB1-350...	–
HAB2,5-350...	RA56313069
HAB4-350...	
HAB6-350...	
HAB10-330...	RA56313070
HAB20-330...	
HAB24-330...	
HAB32-330...	
HAB50-330...	

Data sheet 50131

www.boschrexroth.com/filter

www.boschrexroth.com/spc

Notes

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documentation@boschrexroth.de
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The data specified above only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.

Diaphragm-type accumulator



RE 50150/01.2013 1/24
Replaces: 11/07

Type HAD

Component series 1X and 2X
Nominal capacity 0.075 to 3.5 liters
Maximum operating pressure 350 bar



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Unit dimensions of standard types 70 to 250 bar	12 to 14
Unit dimensions of US standard types	15, 16
Unit dimensions of standard types 350 bar	17, 18
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Safety equipment	23
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Features

- Hydraulic accumulator according to Pressure Equipment Directive 97/23/EC
- Diaphragm material for different applications

Note

Pressure Equipment Directive 97/23/EC of the European Parliament and the Council of 29th May 1997 on the harmonization of the laws of the member states has been in force since 29th November, 1999. Since 29th May, 2002 hydraulic accumulators may exclusively be placed on the market in accordance with this Directive.

Notice for orders with delivery via air freight

Due to legal regulations, Bosch Rexroth is required to relieve the pre-charge pressure in hydraulic accumulators that are shipped via air freight prior to shipping. In this case, the customer is responsible for refilling.

If the customer is not able to perform the refilling, please contact the local Bosch Rexroth Service partner.

Diaphragm-type accumulators up to and including 1 liter

The CE Directive has been implemented since November 2001. The accumulators must, however, not be CE-marked. User instructions no. 1 539 929 064 accompany every shipping batch.

Diaphragm-type accumulators greater than 1 liter

The CE Directive has been implemented since November 2001. The accumulators must be CE-marked. They are shipped with operating instructions and a conformity declaration for each series. The conformity declaration includes technical data of the accumulators. The documents accompany each shipping batch.

Ordering code

Capacity	Permissible max. operating pressure	Component series	Certification Acceptance
0.075	250	1X	BA
0.16	250	1X	BA
0.35	210	1X	BA
0.5	160	1X	BA
	250	2X	
0.7	100	1X	BA
	180	1X	
	250	1X	
	350	2X	
1.0	200	1X	BA
1.4	140	1X	CE
	250	1X	
	350	2X	
2.0	100	1X	CE
	250	1X	
	350	2X	
2.8	70	1X	CE
	250	1X	
	350	1X	
3.5	250	1X	CE
	350	1X	



Component series

Component series 10 to 19 = 1X
 Component series 20 to 29 = 2X
 (unchanged installation and connection dimensions)

Precharge pressure

0 to 250 bar = 10
 E.g. 10 bar

Connection size for hydraulic fluid ¹⁾

M14x1.5 = Z04
 M18x1.5 = Z06
 M22x1.5 = Z08
 G 1/4 = G02
 G 3/8 = G03
 G 1/2 = G04
 G 3/4 = G05
 G 1 = G06
 3/4 – 16 UNF = U04
 1 1/16 – 12 UNF = U06
 3/8 NPTF = F02
 1/2 – 14 NPTF = F08

Type of mounting (form of oil connection)

Mounting cavity = A
 Mounting cavity with hexagon = C
 Stud ends with female thread = E
 Stud ends = F
 Stud ends M45x1.5 with female thread = E5
 Special variants on request

Further details in clear text e.g. special variants

Certification (acceptance)

CE = Acceptance according to 97/23/EC
 BA = Operating instructions

Surface of the connection side

1 = Steel
 2 = Galvanized steel

Surface of the tank interior

1 = Steel
 2 = Galvanized steel

Tank material

1 = Steel

Diaphragm material

N = NBR
 E = ECO
 I = IIR
 F = FKM

Form of gas connection

1 = Standard variant for 0 538 103 012
 2 = Gas valve for 0 538 103 011
 4 = Not re-chargeable, gas side welded

¹⁾ Further connection sizes on request

For standard types, see pages 12 to 18

Operating instructions and conformity declarations

Series	Material no.	
	Operating instructions	Conformity declaration
Up to 1.0	1 539 929 064	–
1.4/140	1 539 929 065	1 539 929 071
1.4/250	1 539 929 066	1 539 929 072
1.4/350	R901067048	R901067054
2.0/100	1 539 929 067	1 539 929 073
2.0/250	1 539 929 068	1 539 929 074
2.0/350	R901067049	R901067055
2.8/70	1 539 929 069	1 539 929 075
2.8/250	1 539 929 070	1 539 929 076
2.8/350	R901067050	R901067057
3.5/250	R901165521	R901165528
3.5/350	R901067051	R901067058

Function, section, symbol

General

One of the main tasks of hydraulic accumulators is, for example, to absorb a certain volume of a pressurized fluid from a hydraulic system and return it to the system when required.

Because the fluid is pressurized, hydraulic accumulators are regarded as pressure vessels and must be rated for the maximum operating pressure taking account of acceptance standards valid in the country of installation.

In most of the hydraulic systems, hydropneumatic (gas-charged) accumulators with separating element are used.

Depending on the design of the separating element, we distinguish between bladder-type, piston and diaphragm-type accumulators.

Hydraulic accumulators basically consist of a fluid and a gas section with a gas-tight separating element. The fluid section is connected with the hydraulic circuit. As the pressure rises, the

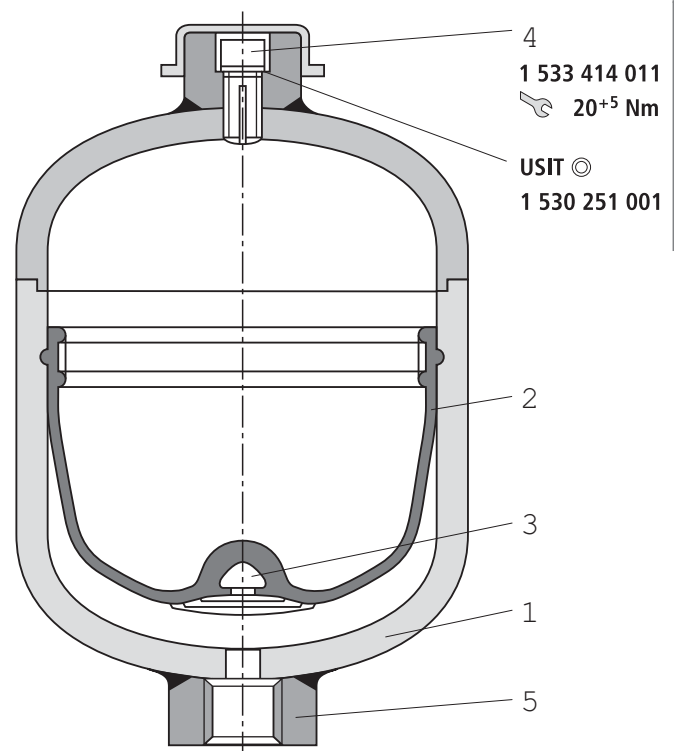
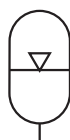
gas is compressed and fluid gets into the hydraulic accumulator. As the pressure falls, the compressed gas expands and displaces the accumulated fluid into the circuit.

Diaphragm-type accumulators

Diaphragm-type accumulators consist of a pressure-tight steel vessel (1), which is, in most of the cases, of spherical to cylindrical shape. A diaphragm (2) made of an elastic, flexing material (elastomer) with closing poppet (3) and plug screw (4) is provided as separating element in the interior of the accumulator. These elements comply with Directive 97/23/EC.

- 1 Vessel
- 2 Diaphragm
- 3 Closing poppet
- 4 Plug screw
(gas filling screw)
- 5 Fluid connection

Symbol



Technical data (for applications outside these parameters, please consult us!)**General**

Weight	kg	See tables on pages 11, 17, 18
Design		Diaphragm-type accumulator, welded
Installation position		Optional, preferably fluid connection piece pointing downwards
Type of mounting		With clamps or threaded connection
Ambient temperature range	°C	-15 to +65 ¹⁾
Pipe connection		Female thread

Hydraulic

Capacity	l	0.075	0.16	0.35	0.5	0.7	1.0	1.4	2.0	2.8	3.5
Effective gas volume	l	0.075	0.16	0.32	0.48	0.75	1.0	1.4	1.95	2.7	3.5
Permissible max. flow	l/min	10			40				60		60
Permissible max. operating pressure p	bar					100				70	
				210	160	180		140	100		
		250	250	207	207	250	200	250	250	250	250
						250	350		350	350	350
Permissible max. pressure fluctuation width Δp dyn.	bar					93				50	
				90	90	93		80	65		
		150	120	120	120	140	115	140	140	130	130
						100	130		130	130	130
Operating pressures and useful capacity		See Calculation on pages 5 to 10									
Hydraulic fluid		Hydraulic oil to DIN 51524; other fluids on request!									
Hydraulic fluid temperature range °C		-10 to +80 (NBR diaphragm) ¹⁾ -35 to +80 (ECO diaphragm) ¹⁾									
Others on request											

Pneumatic

Charge gas		Use only nitrogen!
Charge pressure p_0		See Standard types on pages 12 to 18

Usable hydraulic fluids

When selecting the accumulator variant, observe the following non-binding notes with regard to hydraulic fluid, bladder or dia-

phragm material, and the permissible temperature range.

No warranty claims may be derived from these recommendations.

In the case of other hydraulic fluids and temperatures, please consult us.

Hydraulic fluids	Temperature range	Material
Mineral oils	-10 to +80 °C -35 to +80 °C	NBR ECO
HFA, HFB ²⁾	+5 to +50 °C	NBR
HFC	-10 to +60 °C	NBR, IIR
HFD ³⁾	-10 to +60 °C -10 to +80 °C	IIR FKM
Water ²⁾	+5 to +50 °C	NBR
Diesel, fuel oil	-10 to +50 °C	NBR
Heavy fuel oil	-10 to +100 °C	FKM
Regular-grade gasoline	-10 to +40 °C	NBR
Premium gasoline	-10 to +40 °C	FKM
Kerosene	-10 to +40 °C	NBR

NBR Acrylnitrile butadiene rubber (Perbunan)

FKM Fluorine rubber

IIR Butyl rubber

ECO Epichlorhydrin rubber

¹⁾ The permissible temperature specified in the tank test is also relevant

²⁾ Special variants of tank and connection parts may be required

³⁾ Please consult us stating the detailed specification of the hydraulic fluid

Application, operating principle

Applications

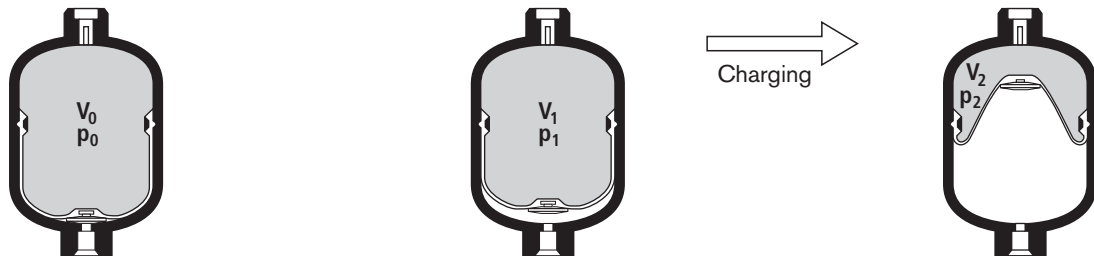
Hydropneumatic accumulators can be used in a wide variety of applications:

- Energy storage for saving pump drive power in systems with intermittent operation.
- Energy reserve for emergency cases, e.g. in the event of a hydraulic pump failure.
- Compensation for losses due to leakage.
- Impact and vibration damping in the case of periodic oscillations.
- Volume compensation in case of changes in pressure and temperature.
- Suspension element on vehicles.
- Shock absorption in the case of mechanical impact.

Operating principle

Fluids are almost incompressible and can therefore not store pressure energy. In hydropneumatic Rexroth accumulators the compressibility of gases is utilized for storing fluids. Only neutral gases may be used, usually class 4.0 "nitrogen".

N ₂	99.99 % by volume
O ₂	50 vpm
H ₂ O	ca. 30 vpm.



Calculation

Pressures

For the calculation of an accumulator, the following pressures are of significance:

p_0 = gas precharge pressure
at room temperature and drained fluid chamber

p_{0T} = gas precharge pressure
at operating temperature

p_1 = minimum operating pressure

p_2 = maximum operating pressure

(p_m = average operating pressure)

To achieve the best possible utilization of the accumulator capacity and a long service life, it is recommended that the following values be adhered to:

$$p_0, t_{\max} \approx 0.9 p_1 \quad (1)$$

The highest hydraulic pressure should not exceed the quadruple of the precharge pressure; otherwise, the elasticity of the diaphragm is overstressed and excessive variations in the compression result in strong heating up of the gas.

The smaller the difference between p_1 and p_2 the longer is the service life of the diaphragm. However, this also reduces the degree of utilization of the corresponding maximum accumulator capacity.

Diaphragm-type accumulators

$$p_2 \leq 4 \cdot p_0 \quad (2)$$

On request

$$p_2 \leq 8 \cdot p_0$$

Note!

Filling piece in diaphragm-type accumulators

To achieve an increased pressure ratio ($p_0 : p_2 > 1 : 4$) in the accumulator, a filling piece can be installed on the gas side of the accumulator.

This reduces the usable gas volume V_1 , but the diaphragm is protected against impermissible deformation.

Calculation

Oil volume

Pressures $p_0 \dots p_2$ determine gas volumes $V_0 \dots V_2$.

Here, V_0 is also the nominal capacity of the accumulator.

The available oil volume ΔV corresponds to the difference between gas volumes V_1 and V_2 :

$$\Delta V \leq V_1 - V_2 \quad (3)$$

The gas volume, which is variable within a pressure differential, is determined by the following equations:

a) In the case of **isothermal changes of state** of gases, that is, when the gas buffer changes so slowly that enough time is available for a complete heat exchange between the nitrogen and its surroundings and the temperature therefore remains constant, the following is valid:

$$p_0 \cdot V_0 = p_1 \cdot V_1 = p_2 \cdot V_2 \quad (4.1)$$

b) In the case of an **adiabatic change of state**, that is, with a rapid change of the gas buffer, in which the temperature of the nitrogen changes as well, the following is valid

$$p_0 \cdot V_0^\chi = p_1 \cdot V_1^\chi = p_2 \cdot V_2^\chi \quad (4.2)$$

χ = ratio of the specific heat of gases (adiabatic exponent) for nitrogen = 1.4

In practice, changes in state rather follow adiabatic laws. Charging is often isothermal, discharging adiabatic.

Taking account of equations (1) and (2), ΔV is 50 % to 70 % of the nominal accumulator capacity. The following can be applied as a rule of thumb:

$$V_0 = 1.5 \dots 3 \times \Delta V \quad (5)$$

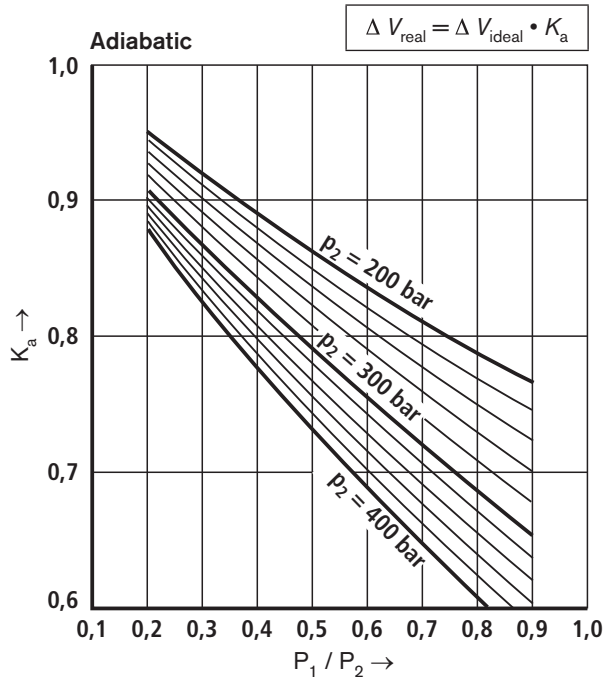
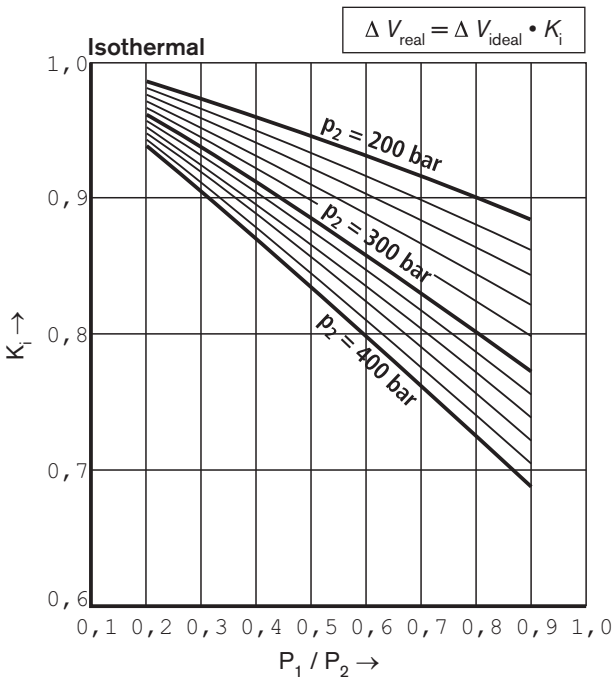
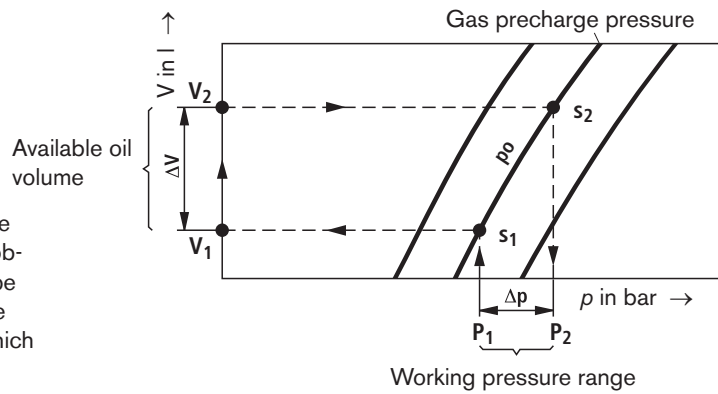
Calculation diagram

To allow a determination on the basis of a graphic representation, the formulas (4.1) and (4.2) were translated into diagrams on pages 7 to 10. Depending on the task at hand, the available oil volume, the accumulator size or the pressures can be established.

Correction factors K_i and K_a

Equations (4.1) and (4.2) are only valid for ideal gases. In the characteristics of real gases, significant deviations can be observed at operating pressures above 200 bar, which must be taken into account by applying correction factors. These are shown on the following diagrams. The correction factors which are to be multiplied by the ideal withdrawal volume ΔV are within the range of 0.6 ... 1.

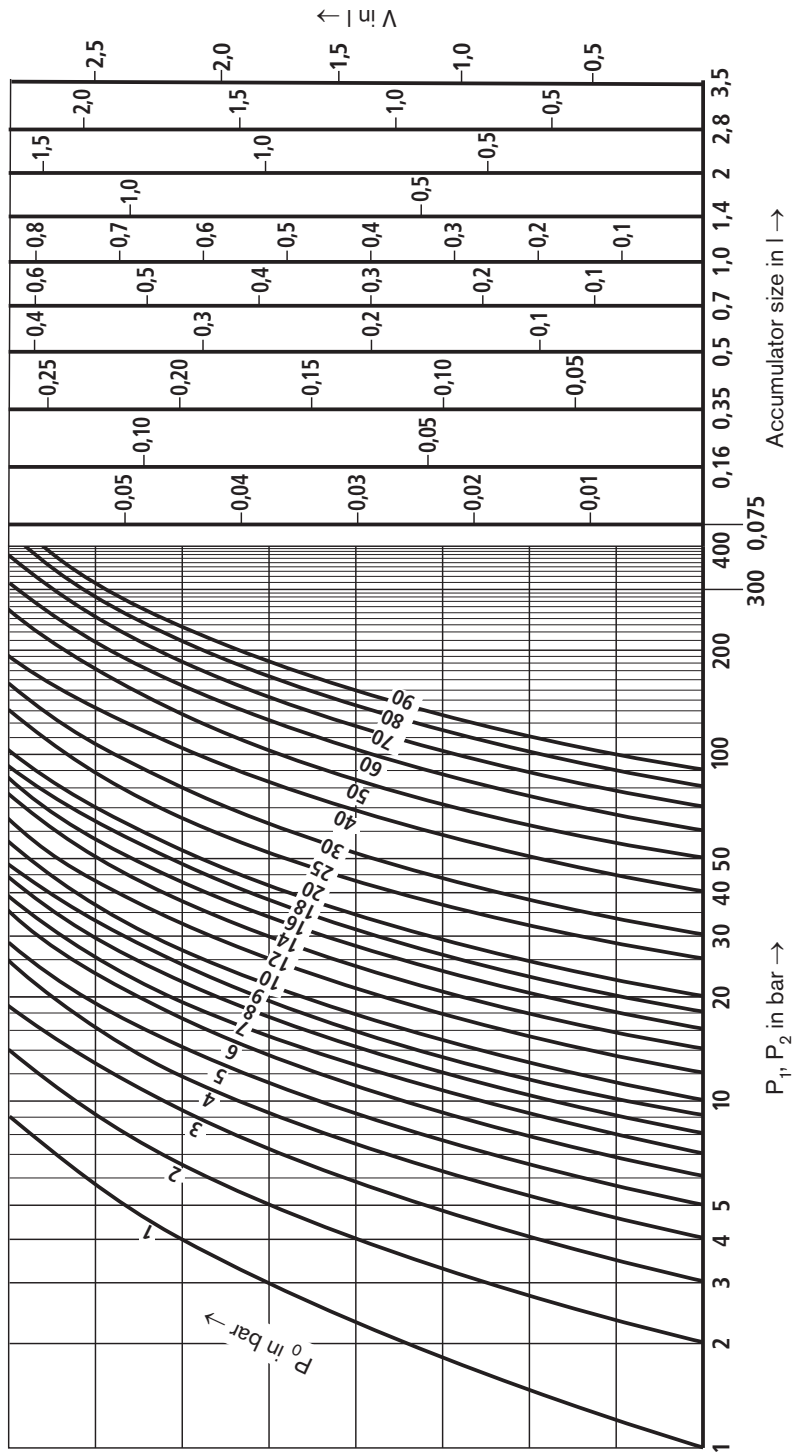
Application of the calculation diagrams



Calculation

Isothermal changes of state

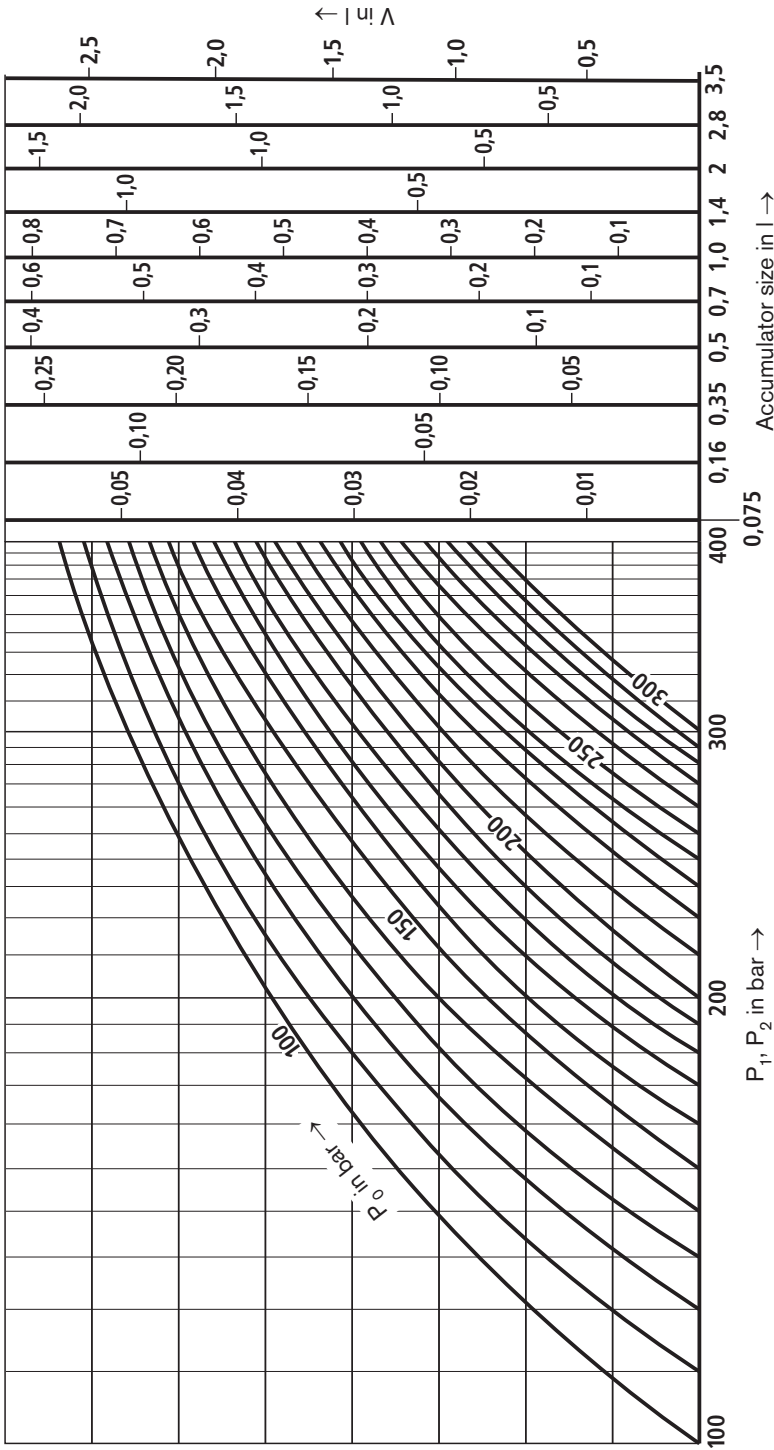
$p_0 = 1$ to 90 bar



Calculation

Isothermal changes of state

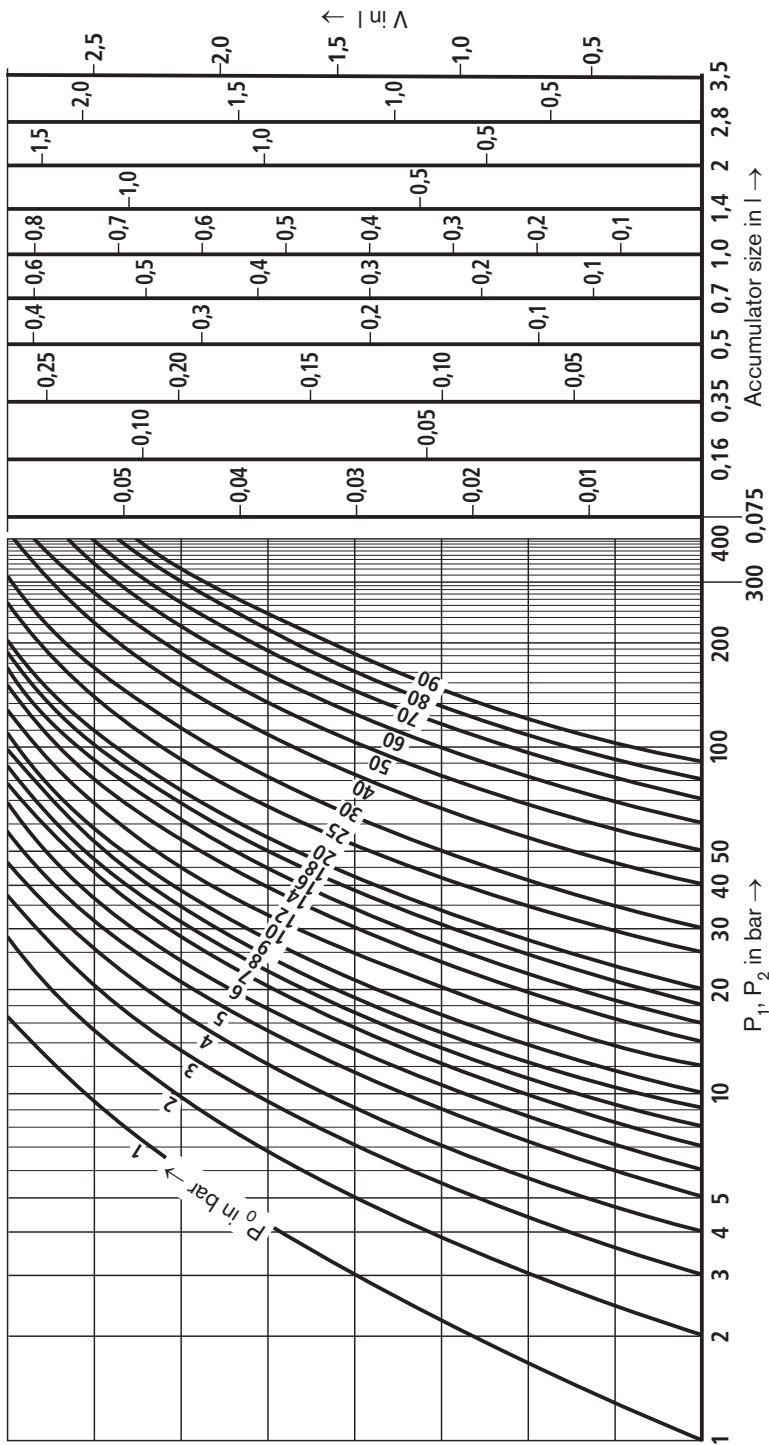
$p_0 = 100$ to 300 bar



Calculation

Adiabatic changes of state

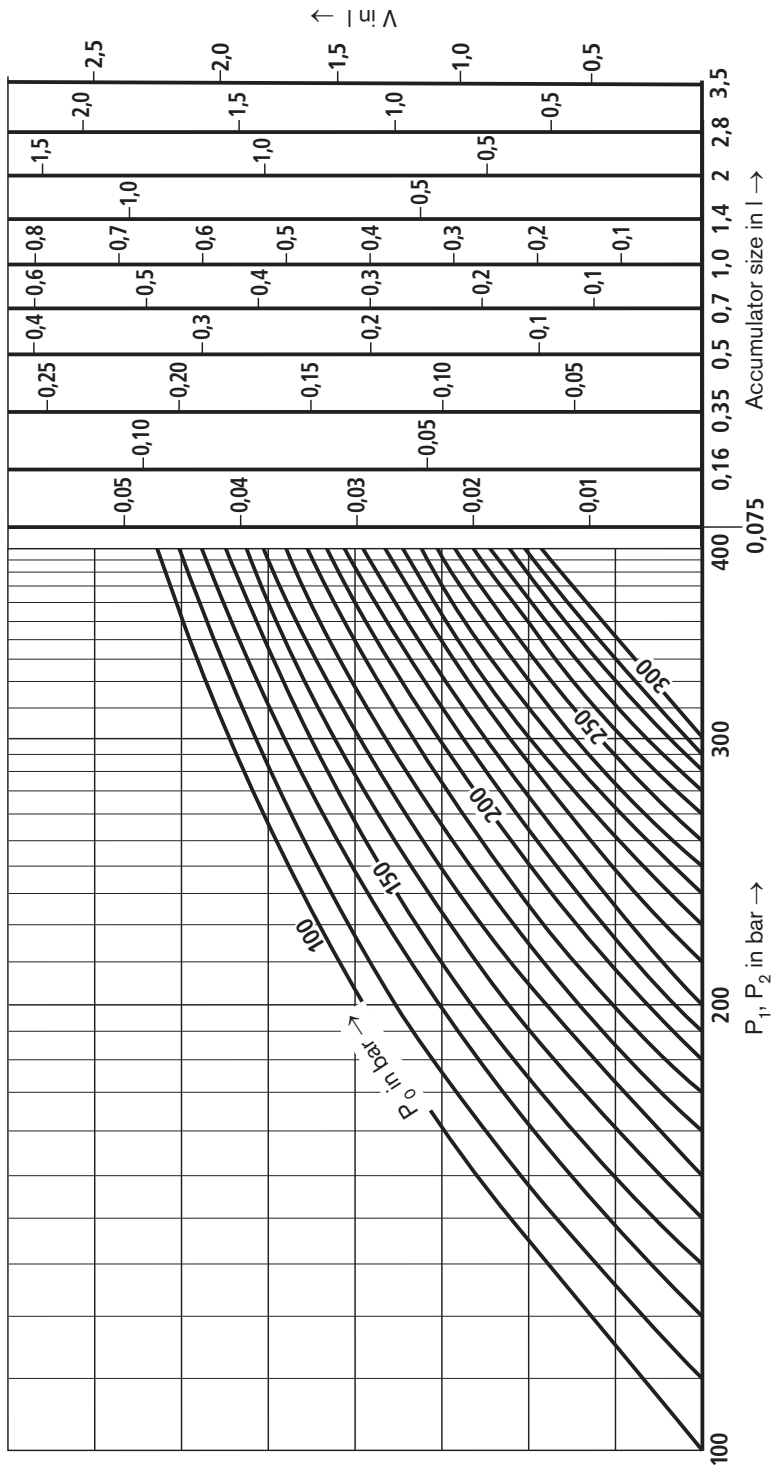
$p_0 = 1$ to 90 bar



Calculation

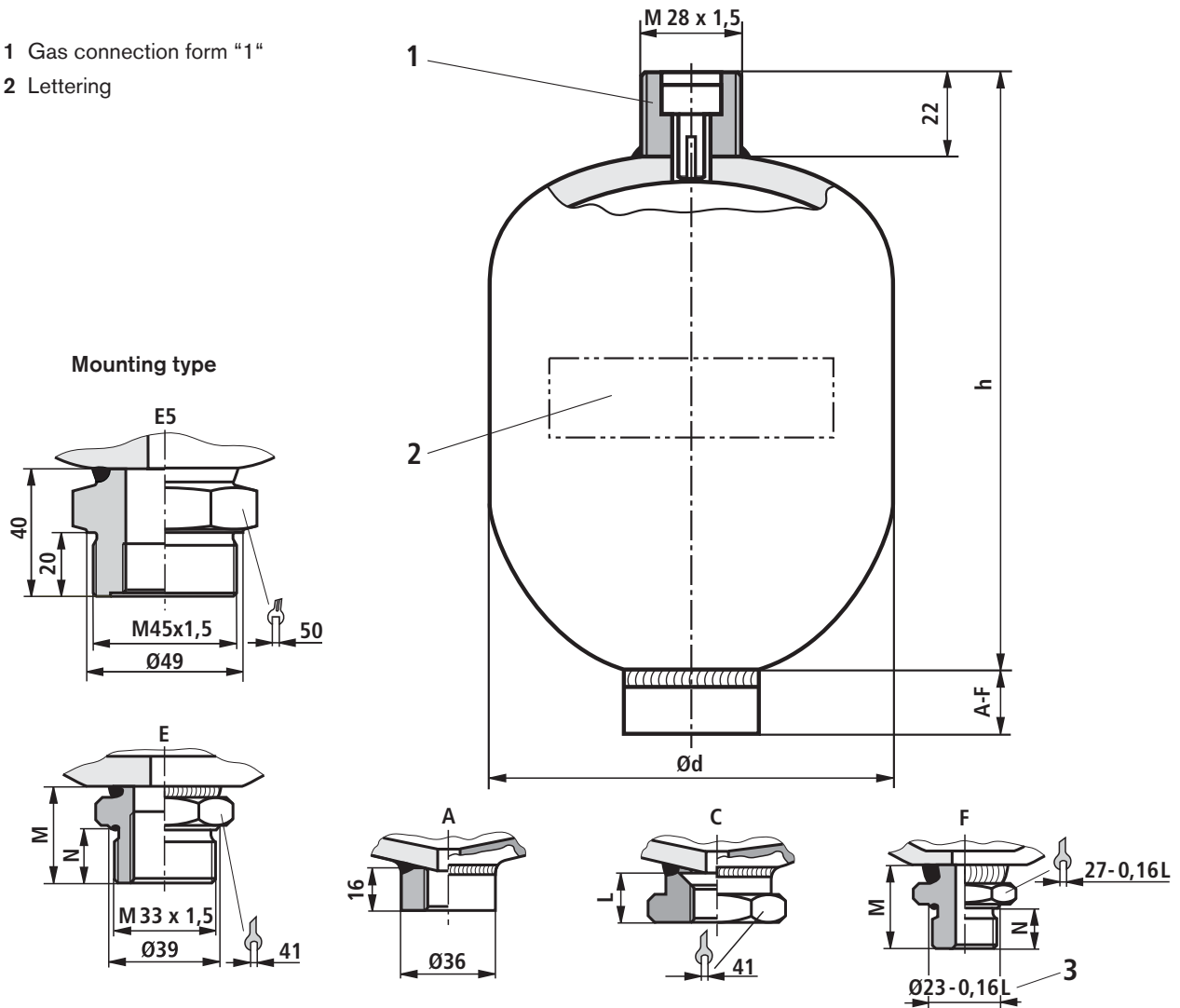
Adiabatic changes of state

$P_0 = 100$ to 300 bar



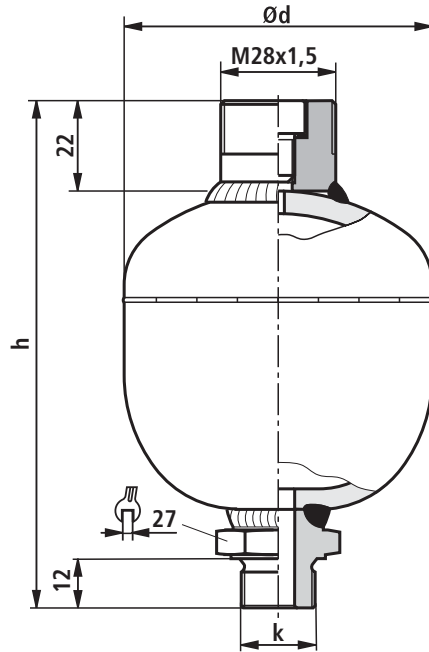
Unit dimensions: 70 to 250 bar (dimensions in mm)

- 1 Gas connection form "1"
2 Lettering

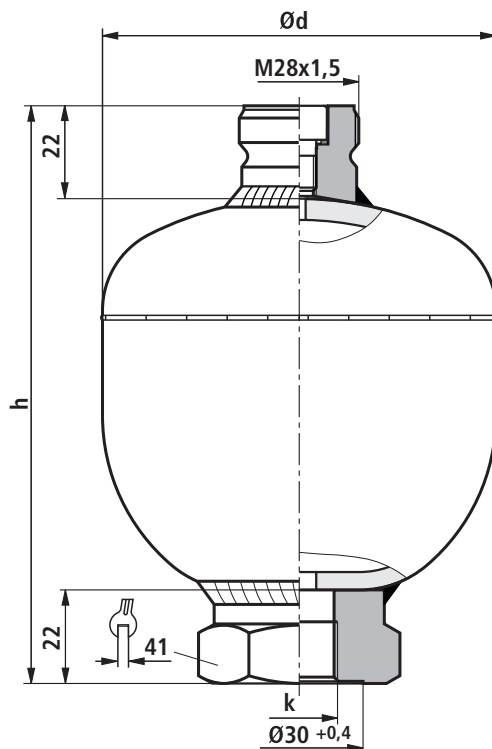


Type/V in liters	p_{max} in bar	$\varnothing d$	h	L	M	N	Weight in kg
HAD0.075	250	64	91	20	21.5	12	0.65
HAD0.16	250	75	99.5	20	24	12	1.0
HAD0.35	210	92	114	22	33	18	1.3
HAD0.5	160	103	127	22	–	–	1.6
	250	106	130	20	27	12	2.0
HAD0.7	180	121	144	22	33	18	2.6
	250	123.6	144	22	33	18	3.2
HAD1.0	200	136	158	22	33	18	3.5
HAD1.4	140	147	169	22	33	18	4.9
	250	152	173	22	33	18	6.2
HAD2.0	100	144	218	22	33	18	4.0
	250	155	229	22	33	18	9.5
HAD2.8	70	160	247	21	33	18	5.5
	250	174	247	21	33	18	10.0
HAD3.5	250	174	285	21	33	18	14.0

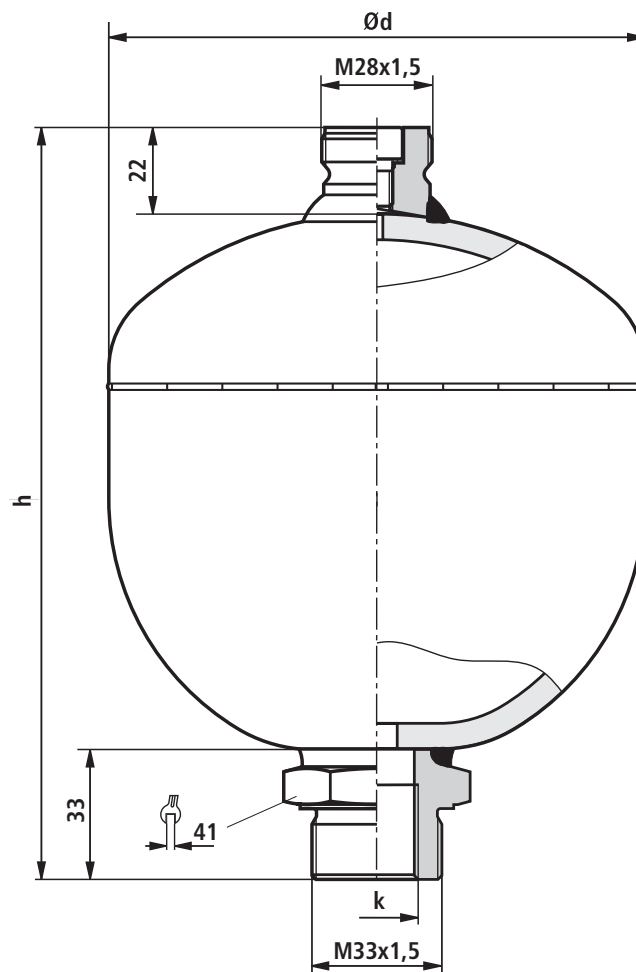
Unit dimensions of standard types: 160 to 250 bar; 0.075 to 0.5 liters (dimensions in mm)



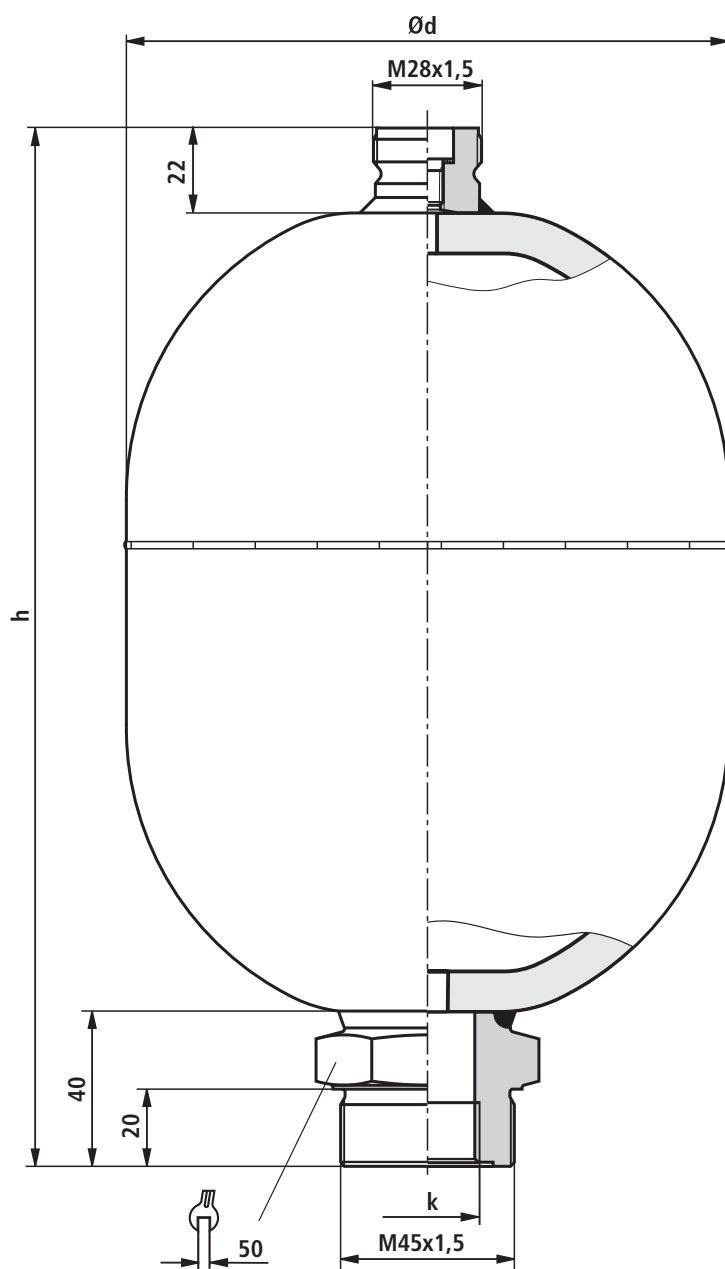
Ordering code / type	Volume in liters	Material no.	h	Ød	k
HAD0,075-250-1X/2Z04F-1N111-BA	0.075	R901183242	112.5	65.5	M14x1.5
HAD0,16-250-1X/2Z06F-1N111-BA	0.16	R901183248	123.5	76.5	M18x1.5



Ordering code / type	Volume in liters	Material no.	h	Ød	k
HAD0,35-210-1X/2Z06C-1N111-BA	0.35	R901183250	136	94.3	M18x1.5
HAD0,5-160-1X/2Z06C-1N111-BA	0.5	R901183251	149	104.8	
HAD0,5-250-2X/2Z06C-1N111-BA	0.5	R901183253	152	108.5	

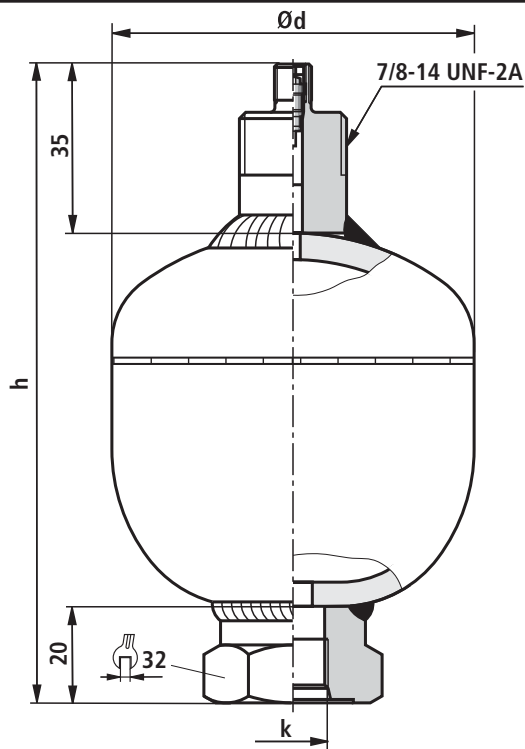
Unit dimensions of standard types: 100 to 250 bar; 0.7 to 1.4 liters (dimensions in mm)


Ordering code / type	Volume in liters	Material no.	h	$\varnothing d$	k
HAD0,7-100-1X/2G04E-1N111-BA	0.7	R901164364	172	118.8	G 1/2"
HAD0,7-210-1X/2G04E-1N111-BA	0.7	R901164365	177	123.5	
HAD1,0-200-1X/2G04E-1N111-BA	1.0	R901164367	191	138.5	
HAD1,4-140-1X/2G04E-1N111-CE	1.4	R901164368	202	149.6	
HAD1,4-250-1X/2G04E-1N111-CE	1.4	R901164369	206	152	

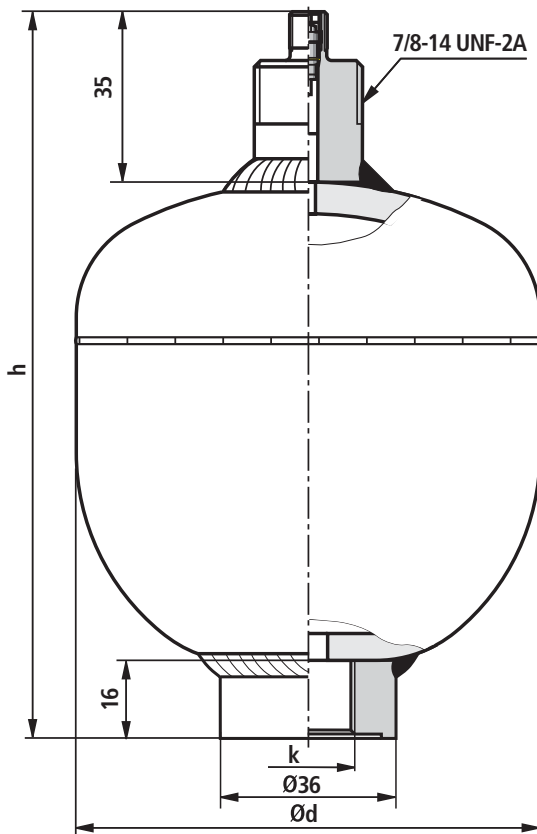
Unit dimensions of standard types: 100 to 250 bar; 2.0 to 3.5 liters (dimensions in mm)


Ordering code / type	Volume in liters	Material no.	h	$\varnothing d$	k
HAD2,0-100-1X/2G05E5-1N111-CE	2.0	R901164371	258	147.2	G 3/4"
HAD2,0-250-1X/2G05E5-1N111-CE	2.0	R901164372	269	158.6	
HAD2,8-250-1X/2G05E5-1N111-CE	2.8	R901164374	286	177.5	
HAD3,5-250-1X/2G05E5-1N111-CE	3.5	R901164376	325	177.5	

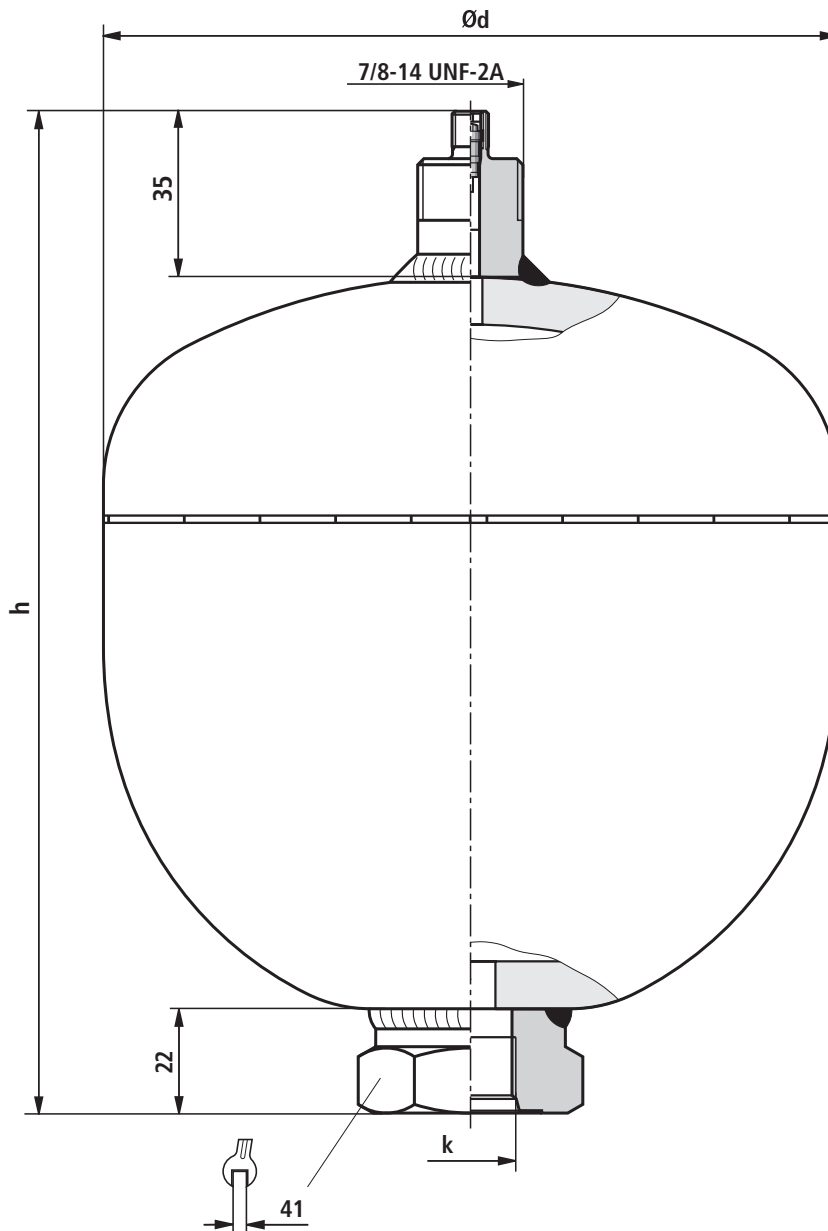
Unit dimensions of US standard types: 207 to 250 bar; 0.075 to 0.35 liters (in mm)



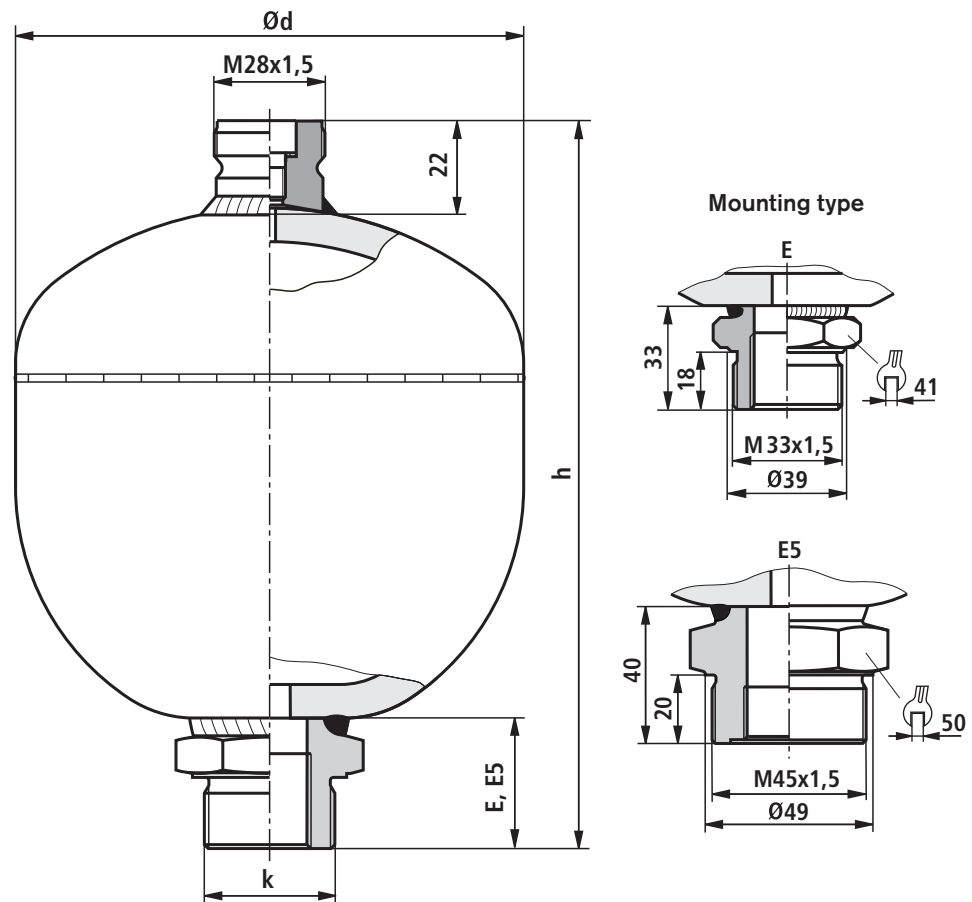
Ordering code / type	Volume in liters	Material no.	h	Ød	k
HAD0,075-250-1X/0U12C-2N111-USA	0.075	0531610632	125.8	65.5	9/16-18 UNF-2B
HAD0,16-250-1X/0U12C1-2N111-USA	0.16	0531600611	132.3	76.5	



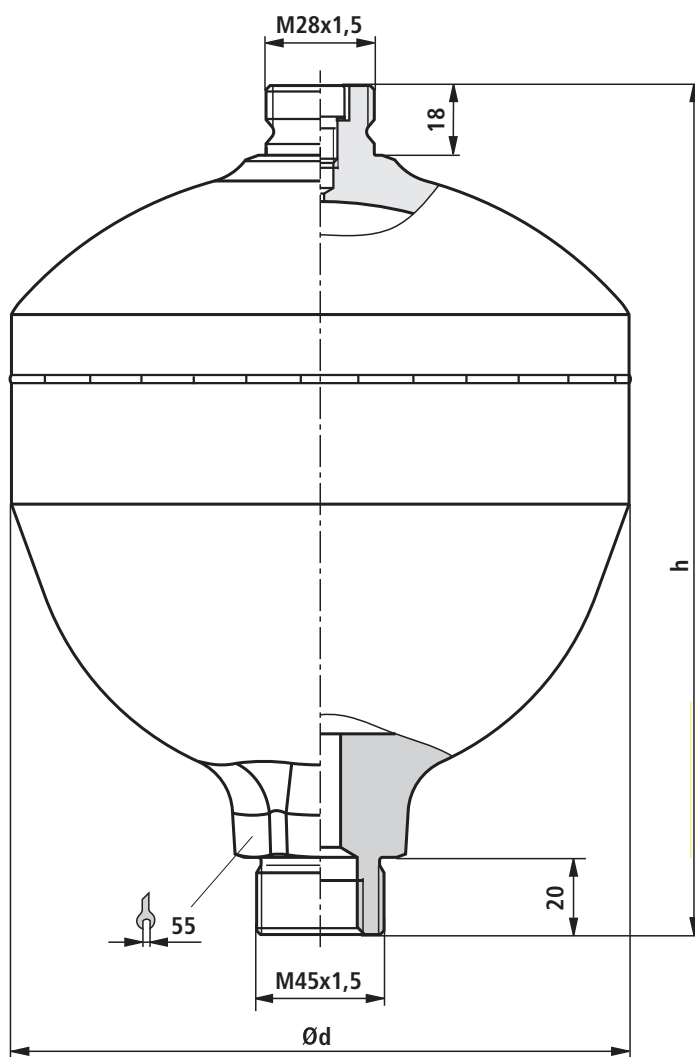
Ordering code / type	Volume in liters	Material no.	h	Ød	k
HAD0,35-207-1X/0U04A-2N111-USA	0.35	0531601572	150.5	96.5	3/4-16 UNF-2B

Unit dimensions of US standard types: 207 bar; 0.07 to 2.8 liters (dimensions in mm)


Ordering code / type	Volume in liters	Material no.	h	Ød	k
HAD0,7-207-1X/0U04C-2N111-USA	0.7	0531602588	186	128.5	3/4-16 UNF-2B
HAD1,4-207-1X/0U04C-2N111-USA	1.4	0531603501	212.8	156.5	
HAD2,0-207-1X/0U04C-2N111-USA	2.0	0531623500	265.8	156.5	
HAD2,8-207-1X/0U04C-2N111-USA	2.8	0531613503	282.5	175.5	

Unit dimensions of standard types: 350 bar; 0.7 to 2.0 liters (dimensions in mm)


Ordering code / type	Volume in liters	Material no.	$\varnothing d$	h	k	Weight kg
HAD0,7-350-2X/2G04E-1N111-BA	0.7	R901164366	128.5	184	E	4.0
HAD1,4-350-2X/2G04E-1N111-CE	1.4	R901164370	156	209	E	7.0
HAD2,0-350-2X/2G05E5-1N111-CE	2.0	R901164373	156	269	E5	9.5

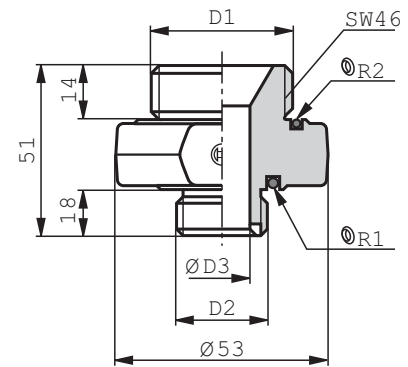
Unit dimensions of standard types: 350 bar; 2.8 and 3.5 liters (dimensions in mm)


Ordering code / type	Volume in liters	Material no.	Ød	h	Weight kg
HAD2,8-350-1X/2G05E5-1N111-CE	2.8	R901164375	180	285	13.0
HAD3,5-350-1X/2G05E5-1N111-CE	3.5	R901164377	180	325	16.0

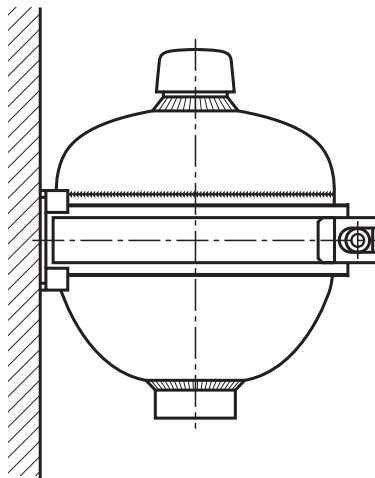
Accessories (dimensions in mm)

Adapter for size 20 blocks Connection A (accumulator)

Accumulator D1	Block D2	ØD3	Material no.
M 22 x 1.5	M 33 x 2	12	1 533 359 012
M 18 x 1.5		8	1 533 359 013
G 1/2 ISO 228		8	1 533 359 034



Holding clamps, selection table



Type	Clamp type	Material no.
HAD0,075	HY/VGBKS 62–65	1 551 316 024
HAD0,35	HY/VGBKS 92–97	1 531 316 017
HAD0,50	HY/VGBKS 101–111	1 531 316 018
HAD0,75	HY/VGBKS 119–128	1 531 316 015
HAD0,7	HY/VGBKS 128–136	R901073992
HAD1,0	HY/VGBKS 135–145	1 531 316 019
HAD1,4	HY/VGBKS 145–155	1 531 316 016
HAD2,0/100	HY/VGBKS 135–145	1 531 316 019
HAD2,0/250	HY/VGBKS 145–155	1 531 316 016
HAD2,8/70	HY/VGBKS 160–170	1 531 316 022
HAD2,8–3,5	HY/VGBKS 170–180	1 531 316 020

Charging and test device



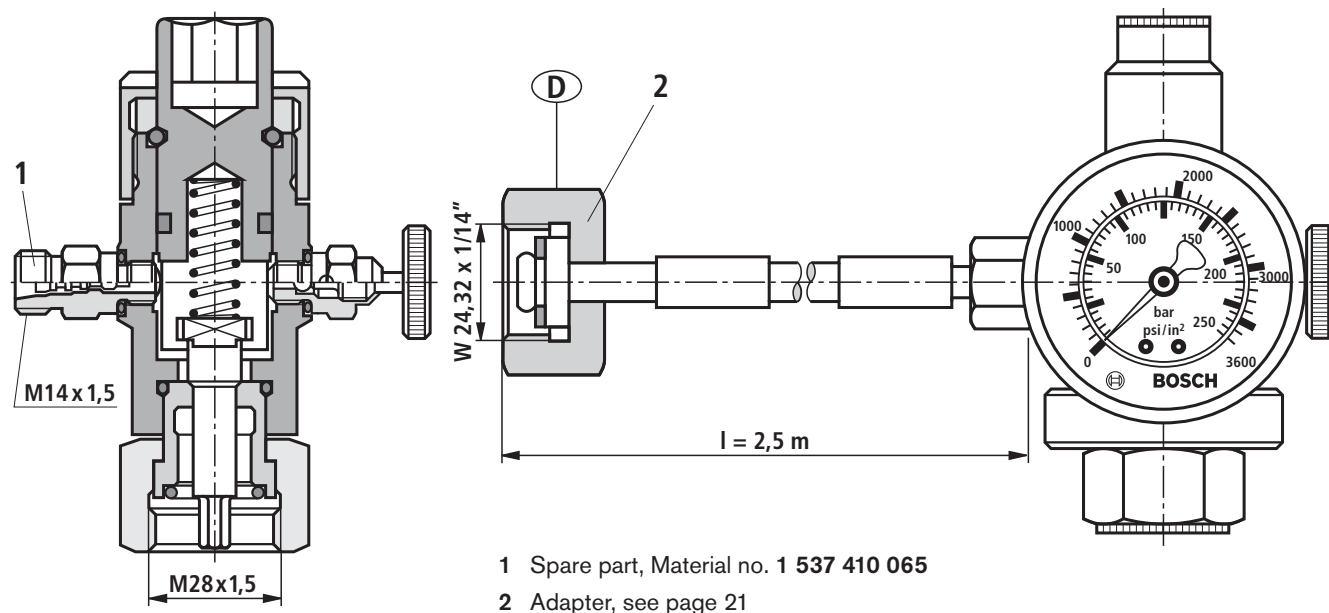
Test case, complete	Material no.	
Bladder	0 538 103 011	
Diaphragm	0 538 103 012	
Bladder and diaphragm consisting of:	0 538 103 014	
Case	R901070141	
Charging and test valve	Bladder	0 538 103 005
	Diaphragm	0 538 103 006
Pressure gauge 0 to 250 bar	1 537 231 001	
Hose l = 2,5 m with adapter piece form (D)	1 530 712 005	

Accessory parts to be ordered separately	Material no.
Pressure gauge 0 to 25 bar	R900033955
Pressure gauge 0 to 60 bar	1 537 231 002
Pressure gauge 0 to 400 bar	1 537 231 005
Adapter piece Form (F)	1 533 391 010
Form (GB)	1 533 391 011
Form (USA)	1 533 391 012
Form (COR)	1 533 391 013
Form (JAP)	1 533 391 014
Form (GUS)	1 533 391 015
Hose l = 5 m with adapter piece form (D)	1 530 712 006

Accessories (dimensions in mm)

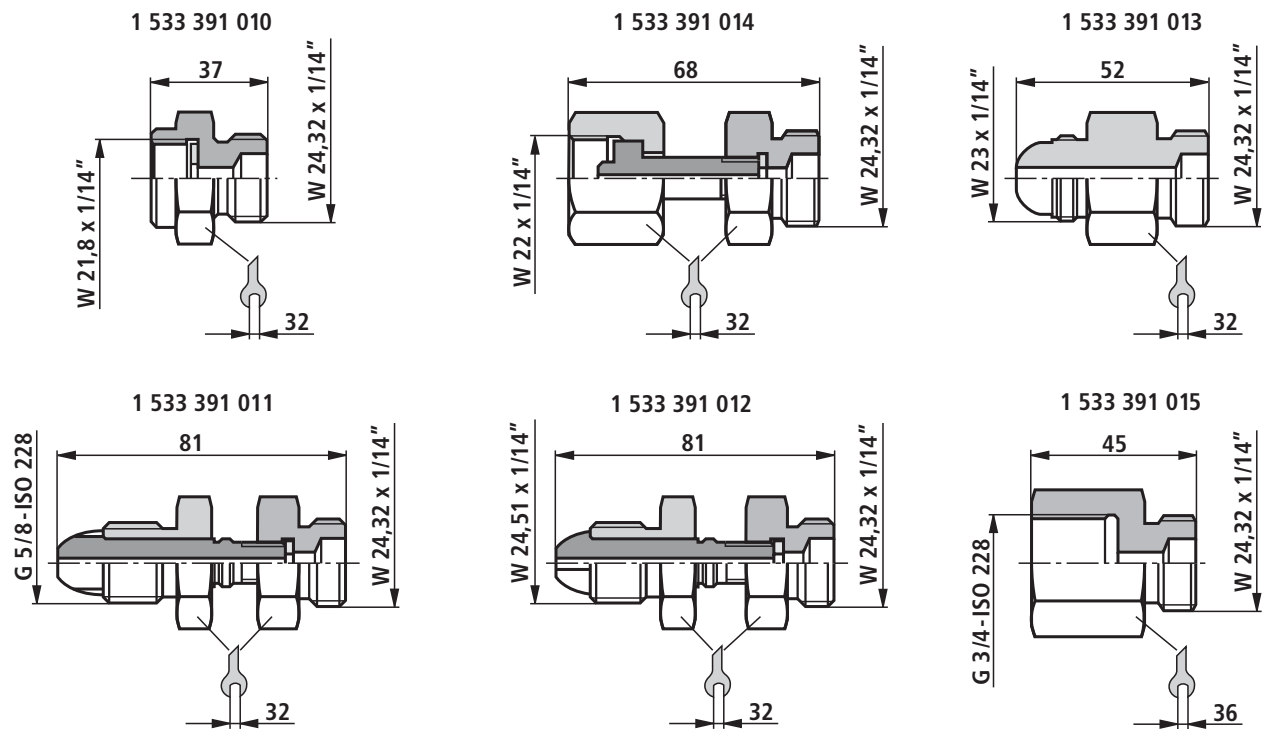
Dimensions of charging and test valve

1 valve body with check valve, discharge valve, pressure gauge connection, and gas hose connection.



Accessories (dimensions in mm)

Adapter from nitrogen bottle to cap nut



Country	1 533 391 011	1 533 391 010	1 533 391 012	1 533 391 014	1 533 391 013	1 533 391 015
Brazil	x					
Bulgaria	x					
France		x				
Greece	x					
Great Britain	x					
India	x					
Japan				x		
Canada			x			
Korea North					x	
Korea South					x	
Malaysia	x					
Romania		x				
Russia						x
Spain	x					
Saudi Arabia		x				
Singapore	x					
Turkey	x					
USA			x			
Other countries on request						

Safety notes on hydraulic accumulators

Before commissioning and during operation of hydraulic accumulators, observe the regulations valid at the place of installation.

The operator is solely responsible for observing applicable regulations.

General notes on hydraulic accumulators in hydraulic systems can be found in EN 982.

Documents included in the scope of supply must be properly kept; they are required by the surveyor for recurring inspections.

Warning

Never carry out any welding, soldering or mechanical work on the accumulator vessel!



- Risk of explosion during welding and soldering!
 - Risk of bursting and loss of the operating permission in the case of mechanical working!
- Never charge hydraulic accumulators with oxygen or air. Risk of explosion!

Before carrying out any work on hydraulic systems, depressurize the system and secure it against restarting!

Improper mounting can lead to severe accidents!

Commissioning must exclusively be carried out by qualified personnel.

Legal stipulations

Hydraulic accumulators are pressure vessels and are subject to the national regulations and ordinances valid at the place of installation.

In Germany, the Health and Safety at Work Regulations (BetrSichV) must be complied with.

Special rules must be observed in the fields of shipbuilding, aircraft construction, mining, etc.

Dimensioning, manufacture and testing must be carried out in line with the codes according to AD 2000. Rules with regard to the erection, equipment and operation are laid down in the

“Technische Regeln Druckbehälter“ (TRB) (technical rules for pressure vessels.

Vessel categories and tests/inspections in Germany

According to these German regulations, pressure vessels are categorized according to their capacity in L , the permissible operating pressure in bar, and the product of pressure and capacity $p \times L$. Depending on the category, specific inspections are compulsory.

An overview is given in the following table:

Vessel class	Initial test at the manufacturer's end	Acceptance test at the operator's end	Recurring inspections		
			Internal	Pressure	External
II $p > 25 \text{ bar}; p \cdot L \leq 200$	○	○	○	○	○
III $p > 1 \text{ bar}; p \cdot L > 200 \leq 1000$	X	X	○	○	○
IV $p > 1 \text{ bar}; p \cdot L > 1000$	X	X	X 5 ¹⁾ / 10 ²⁾	X 10 ¹⁾	X 2 ¹⁾

¹⁾ Years

²⁾ Years in the case of non-corroding fluids

X By surveyor

○ By a technical expert

Note!

All vessel categories must be protected by means of a pressure relief valve in accordance with Directive 97/23/EC.

Legal stipulations

Classification societies

Initial inspections/tests, approvals and acceptances are carried out by **surveyors**. These are representatives of the following classification societies in the individual countries:

- | | | |
|-----------|---------|---------------|
| Ⓓ TÜV | ⒼⒸ LRIS | Ⓕ D.R.I.R.E. |
| Ⓑ APRAGAZ | ⒺⒶ LRIS | ⒽⒶ Stoomwezen |
| Ⓘ ISPESEL | ⒽⒶ UDT | ⒸⒽ SVDB |

Shipbuilding and offshore

{	LRS = Lloyd's Register
	DNV = Det Norske Veritas
	GL = Germanischer Lloyd
	ABS = American Bureau of Shipping

These bodies are registered with the EU in Bruxelles and, being "notified bodies", carry out the tests/inspections according to the Pressure Equipment Directive.

Moreover, there are classification societies (Germanischer Lloyd, Lloyd's Register, Det Norske Veritas, etc.) for ships and offshore applications.

CE accumulators are shipped together with a declaration of conformity and operating instructions.

Technical experts

They are appointed by the plant of the operator and must be qualified accordingly.

In Germany, corresponding training courses are offered by classification societies.

Safety equipment

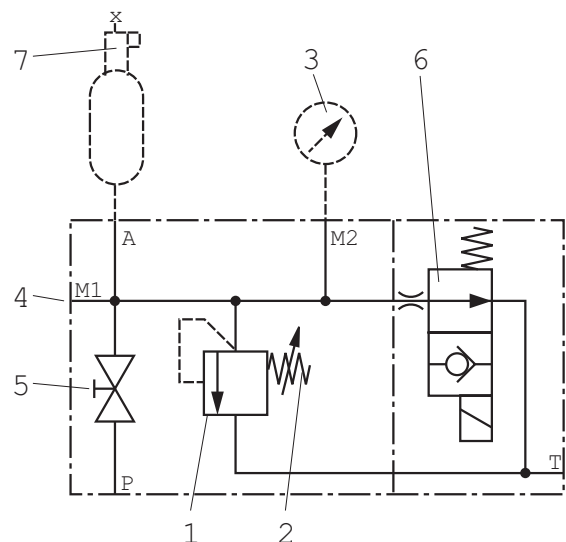
In the Federal Republic of Germany, regulations for the equipment, erection and operation of hydraulic accumulators are laid down in the "Technische Regeln Druckbehälter" (TRB) (technical rules for pressure vessels). These specify the following safety equipment:

- 1 Features against excessive pressure (type-tested)
- 2 Unloading features
- 3 Pressure measuring instruments
- 4 Test pressure gauge connection
- 5 Shut-off feature

Option:

- 6 Electromagnetically operated unloading device
- 7 Safety device against excessive temperatures

These safety devices are combined in a compact Bosch Rexroth safety and shut-off block.



Commissioning, maintenance

Notes on commissioning

Precharge pressure

Diaphragm-type accumulators are usually delivered ready for operation. The precharge pressure (p_0) is embossed on the accumulator shell.

Charging gas

Hydraulic accumulators may only be filled with purest class 4.0 nitrogen, N₂ 99.99 % by volume.

Permissible operating temperature

In the "standard variant", Bosch Rexroth hydraulic accumulators are suitable for operating temperatures from -10 to +80 °C. In the case of differing temperatures, please consult us.

Installation position

Diaphragm accumulators can be installed in optional orientation. For the test and charging device, a free installation space of 200 mm must be provided above the gas valve.

Mounting

The accumulator is to be mounted so that any forces caused, e. g., by application-related vibrations or accelerations, can be absorbed safely. If there are multiple fasteners, mechanical stresses caused by operation-related, elastic deformations or thermal expansions of the structure are to be avoided. Bosch Rexroth offers corresponding holding clamps (see page 19).

Commissioning, maintenance

Charging of the accumulator

Use the Bosch Rexroth filling and test device for charging the accumulator (see pages 19, 20).

Observe the relevant notes in operating instructions **1 539 929 010**.

Note

The precharge pressure changes as the gas temperature changes. After charging or discharging nitrogen, wait until the temperature has balanced before you check the gas pressure.

Maintenance

General

After having been charged with gas, Bosch Rexroth accumulators are largely maintenance-free.

To ensure trouble-free operation and a long service life, the following maintenance work must be carried out:

- Check the gas precharge pressure
- Check safety equipment and fittings
- Check pipe connections
- Check mounting of accumulator.

Checking the gas pre-charge pressure

Inspection intervals

After commissioning of the accumulator, the charge pressure must be checked at least once in the first week. If no loss of gas is detected, the second inspection must be made after 3 months. If the pressure is still unchanged, you can check the pressure once a year.

Measurements on the fluid side

Connect a pressure gauge to the accumulator by means of a line. Alternatively, the pressure gauge can be connected directly at the vent point.

Proceeding:

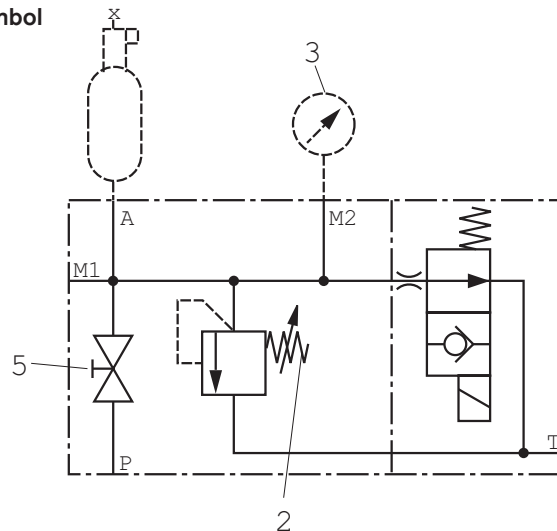
- Fill hydraulic fluid into the accumulator.
- Close shut-off valve (5).
- Let the hydraulic fluid drain slowly (temperature balancing) by opening discharge valve (2).
- Observe pressure gauge (3) during the draining process. As soon as the charging pressure is reached in the accumulator, the pointer abruptly falls to zero.

If deviations are measured, first check whether:

- pipes and fittings are leak-free,
- these deviations can be traced back to differing ambient and gas temperatures.

Only when no faults are detected here is an inspection of the accumulator required.

Symbol

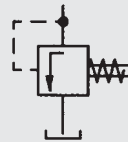


Sicherheitsventile Baumuster geprüft Safety valves, type-approved Valves de sécurité à modèle homologué

RDEF 50153/05.15 1/8

Ersetzt:
Replaces: } RDEF 50153/01.12
Remplace:

0532 VA ...



Hinweis

Die Sicherheitsventile werden zur Absicherung von Hydrospeichern eingesetzt und müssen seit 29. 05. 2002 ein CE-Zeichen tragen. Pro Gerät muss eine Betriebsanleitung und Konformitätserklärung beigelegt werden. Die Bestellnummern der Geräte bleiben unverändert.

Verwendung

Sicherheitsventile, TÜV Baumuster geprüft, werden zur Absicherung von Hydrospeichern eingesetzt.

Ausführung

Das Sicherheitsventil ist als direktgesteuertes Sicherheitsventil ausgeführt und berücksichtigt die Sicherheits- und Abnahmevorschriften, gemäß

- Betriebssicherheitsverordnung
- Technische Regeln Druckbehälter TRB 403.

Baumuster-Prüfung

Die Ventile wurden im Werk durch TÜV-Sachverständige geprüft und plombiert. Sie sind mit dem CE-Kennzeichen und einer laufenden Nummer versehen. Eine Bescheinigung über die Druckeinstellung wird mitgeliefert.

Important

Safety valves are employed to secure hydro-pneumatic accumulators and, since 29. 05. 2002, must bear a CE Mark. An instruction booklet and Declaration of Conformity must be enclosed with each valve. The Part Numbers of the valves will remain unchanged.

Application

Safety valves with TÜV type-approval are used to protect accumulators.

Design

The safety valve takes the form of a direct-controlled safety valve and complies with safety and approval regulations, namely

- Industrial Safety Decree
- Technical Regulations for Pressure Vessels TRB 403.

Type-approval

The valves have been tested and sealed by TÜV representatives. They bear the CE Mark and a serial number. Certification of the pressure setting is supplied with the valve.

Remarque

Les valves de sécurité sont utilisées pour protéger les accumulateurs hydrauliques et doivent porter un sigle CE depuis 29. 05. 2002. Chaque appareil doit être accompagné d'une notice d'utilisation et d'une déclaration de conformité. Les références de commande des appareils restent inchangées.

Utilisation

Les valves de sécurité avec homologation par le TÜV sont utilisées pour protéger les accumulateurs hydrauliques.

Exécution

La valve de sécurité est conçue comme une valve de sécurité à commande directe et est conforme aux prescriptions de sécurité et d'homologation contenues dans

- l'Ordonnance sur la sécurité de travail à l'entreprise
- les Règles techniques relatives aux réservoirs sous pression (TRB 403).

Homologation

Les valves sont contrôlées et plombées à l'usine par un expert du TÜV. Elles sont dotées du label CE et numérotées. Un certificat indiquant le réglage de la pression est fourni avec la valve.

Plombierung; Entlastung

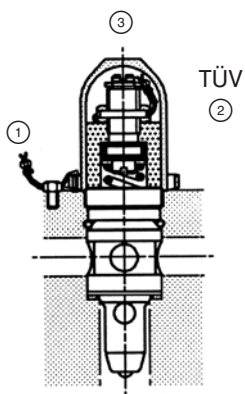
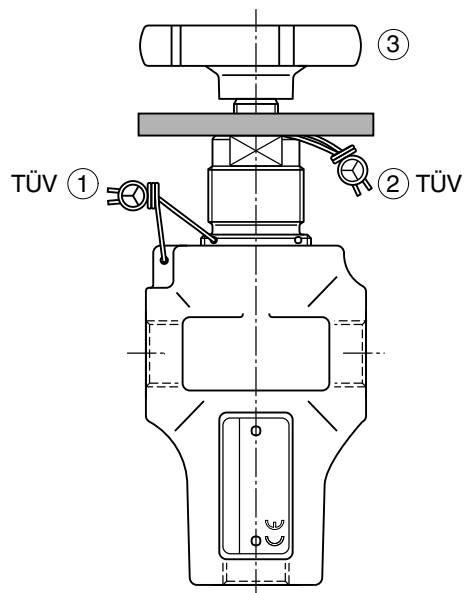
- ① Sicherung gegen Öffnen und Austausch von Federn durch Anwender.
- ② Anschlag und Konterung für p_{\max} .
- ③ Entlastungsmöglichkeit.

Sealing; discharging

- ① Protection against opening and removal of springs by the user.
- ② Stop and locking for p_{\max} .
- ③ Discharging possibility.

Plombage; décharge

- ① Sécurité contre l'ouverture et l'échange des ressorts par l'utilisateur.
- ② Butée et blocage par contre-écrou pour p_{\max} .
- ③ Possibilité de décharge.



Für Rohrleitungseinbau
For pipe connection
Pour montage sur tuyauterie

Rohrgewinde Pipe thread Filetage			p [bar]	Verstellung Adjustment Réglage	G^* [l/min]	[kg]	
03	M 18 x 1,5	N Nitril	50	D	40	1,2	0 532 004 016
04	G 1/2 ISO 228						0 532 004 018
03	M 18 x 1,5		70		50		0 532 004 017
04	G 1/2 ISO 228						0 532 004 019
03	M 18 x 1,5		100		100		0 532 004 004
04	G 1/2 ISO 228						0 532 004 007
04	G 1/2 ISO 228		140		100		0 532 004 023
03	M 18 x 1,5		150		100		0 532 004 024
04	G 1/2 ISO 228						0 532 004 025
03	M 18 x 1,5		160		100		0 532 004 005
03	G 1/2 ISO 228						0 532 004 008
04	G 1/2 ISO 228		200		100		0 532 004 028
03	M 18 x 1,5		211		100		0 532 004 006
04	G 1/2 ISO 228						0 532 004 009
03	M 18 x 1,5		250		130		0 532 004 020
04	G 1/2 ISO 228						0 532 004 014
03	M 18 x 1,5		300		130		0 532 004 021
04	G 1/2 ISO 228						0 532 004 015
03	M 18 x 1,5		330		130		0 532 004 026
04	G 1/2 ISO 228						0 532 004 027



Dichtungssatz
Set of seals
Pochette de joints

N 1 537 010 101 V 1 537 010 104

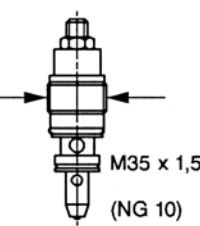


* Abblasestrom G gewährleistet
Druckanstieg $< 10\% p_{nom}$

* At excess-flow G
not pressure increase higher than
 $< 10\% p_{nom}$

* Le débit évacué G
garantit une augmentation de
pression $< 10\%$ de p_{nom}

Für Blockeinbau
For cartridge-type
Pour type cartouche

0 532 VA **03** **N** **050** **D** - **40**

		p [bar]	Verstellung Adjustment Réglage	G^* [l/min]	[kg]								
14		V FPM	D 	40	0,4	0 532 004 200							
						50	0 532 004 201						
						70	0 532 004 202						
						100	0 532 004 211						
						120	0 532 004 203						
						140	0 532 004 204						
						160	0 532 004 209						
						200	0 532 004 205						
						211	0 532 004 206						
						250	R 917 008 405						
						260	0 532 004 213						
						270	0 532 004 210						
						280	0 532 004 207						
						300	0 532 004 208						
						330							
									K 	40	0,4	0 532 004 102	
												50	0 532 004 103
												70	0 532 004 111
	80	0 532 004 104											
	100	0 532 004 114											
	120	0 532 004 107											
	140	0 532 004 105											
	160	0 532 004 113											
	180	0 532 004 110											
	200	0 532 004 100											
	211	0 532 004 106											
	250	0 532 004 115											
	260	0 532 004 112											
	280	0 532 004 101											
	300	0 532 004 108											
	330	0 532 004 109											
	360												

Dichtungssatz

N 1 537 010 236

V 1 537 010 298

Set of seals

Pochette de joints

* Abblasestrom G gewährleistet
Druckanstieg $< 10\% p_{nom}$

* At excess-flow G
not pressure increase higher than
 $< 10\% p_{nom}$

* Le débit évacué G
garantit une augmentation de
pression $< 10\%$ de p_{nom}

Kenngrößen

Bauart	Sitzventile mit Dämpfung, entlastbar
Anschlussart	für Leitungsanschluss oder für Blockeinbau
Einbaulage	beliebig
Durchflussrichtung	siehe Anschlussbezeichnungen
Umgebungstemperaturbereich	-15 °C ... +65 °C
TÜV-Bauteilkennzeichen	für Leitungsanschluss: TÜV · SV · 10-414 · 6 · F · G · p für Blockeinbau: TÜV · SV · 10-697 · 6 · F · G · p
maximaler Betriebsdruck	330 bar
Abblasestrom G [l/min] und p_{nom} bar	siehe Tabellen Seite 3 ... 4
Druckflüssigkeit F	Mineralöle nach DIN 51 524 und schwer entflammbare Druckflüssigkeiten nach VDMA 24 317/24 320
Betriebstemperaturbereich	-15 °C ... +80 °C
Viskositätsbereich	10 ... 380 mm ² /s
Δp -Q Kennlinie	siehe Seite 6

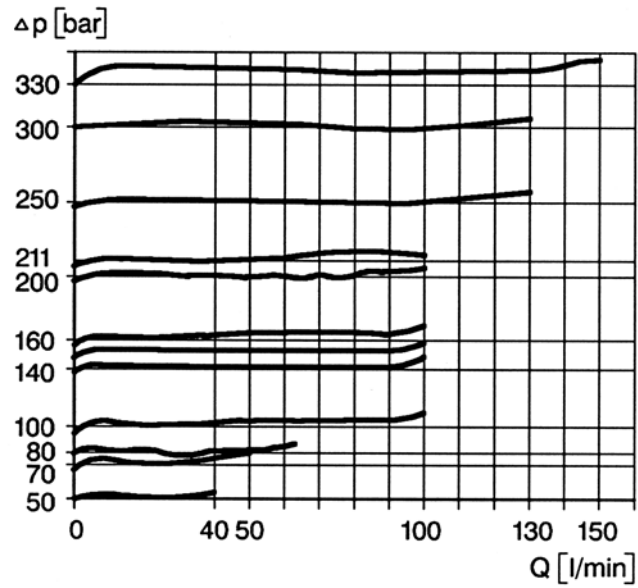
Characteristics

Design	Damped poppet valve, manual opening
Mounting	Pipe connection or cartridge installation
Installation position	As desired
Direction of flow	See symbols
Ambient temperature range	-15 °C ... +65 °C
TÜV codes	For pipe connection: TÜV · SV · 10-414 · 6 · F · G · p For cartridge installation: TÜV · SV · 10-697 · 6 · F · G · p
Max. operating pressure	330 bar
Excess flow G [l/min] and p_{nom} bar	See tables on page 3 ... 4
Hydraulic fluid F	Mineral oils to DIN 51 524 and flame-resistant fluids to VDMA 24 317/24 320
Operating temperature range	-15 °C ... +80 °C
Viscosity range	10 ... 380 mm ² /s
Δp -Q characteristics	See table on page 6

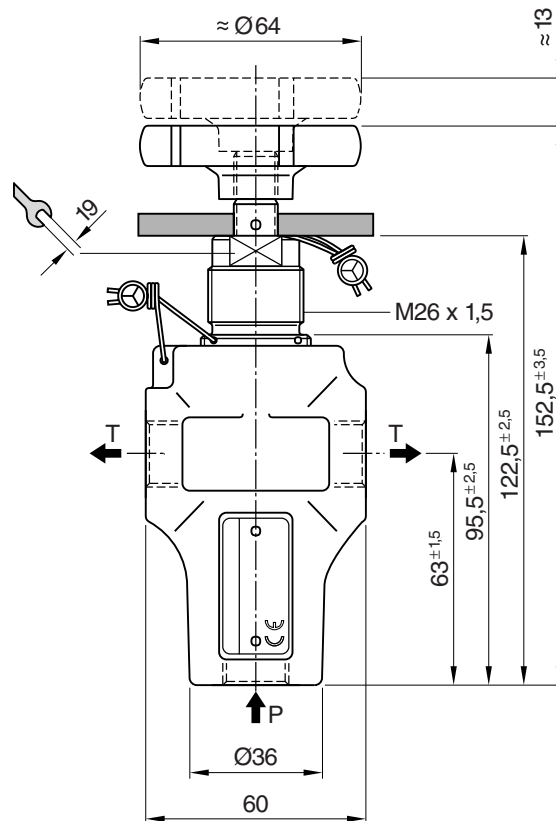
Caractéristiques

Construction	à clapet avec amortissement, déchargeable
Raccordement	Montage sur tuyauterie ou type cartouche
Position de montage	indifférente
Sens d'écoulement	voir désignations des raccords
Température ambiante	-15 °C ... +65 °C
Références de réception du TÜV	Montage sur tuyauterie: TÜV · SV · 10-414 · 6 · F · G · p Type cartouche: TÜV · SV · 10-697 · 6 · F · G · p
Pression de service max.	330 bar
Débit évacué G [l/min] et p_{nom} bar	voir tableaux pages 3 ... 4
Fluide	Huiles minérales selon la norme DIN 51 524 et fluides difficilement inflammables selon VDMA 24 317/24 320
Plage de température de service	-15 °C ... +80 °C
Plage de viscosité	10 ... 380 mm ² /s
Courbes Δp -Q	voir page 6

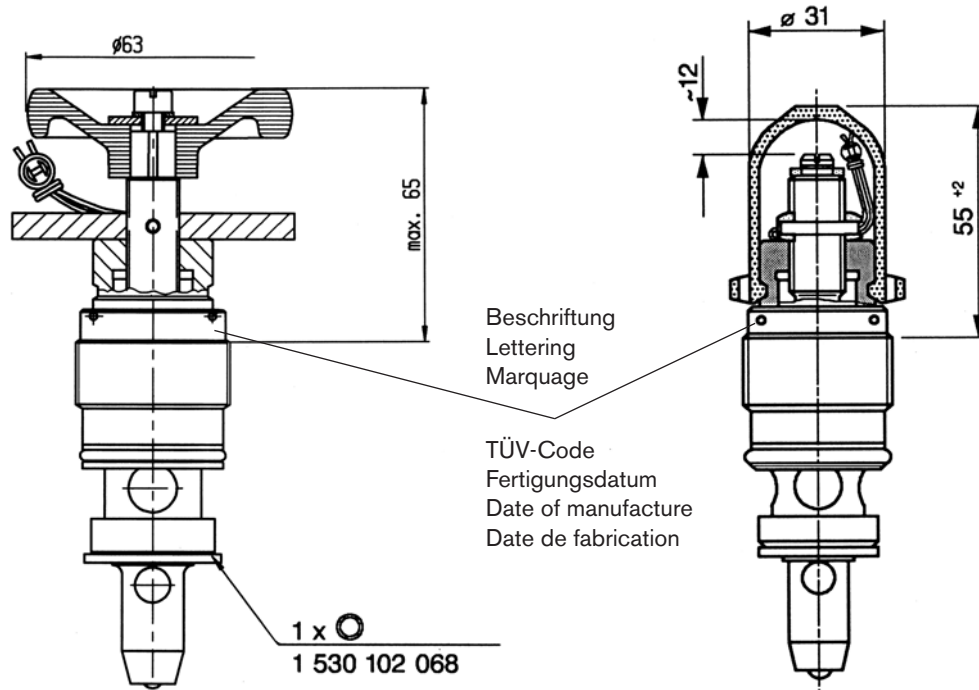
Kennlinien
Performance curves
Courbes caractéristiques
 $v = 35 \text{ mm}^2/\text{s}$



Abmessungen für Leitungseinbau
Dimensions for pipe connection
Cotes d'encombrement pour montage sur tuyauterie



Abmessungen für Blockeinbau
Dimensions for cartridge type
Cotes d'encombrement pour type cartouche



Einbaubohrung

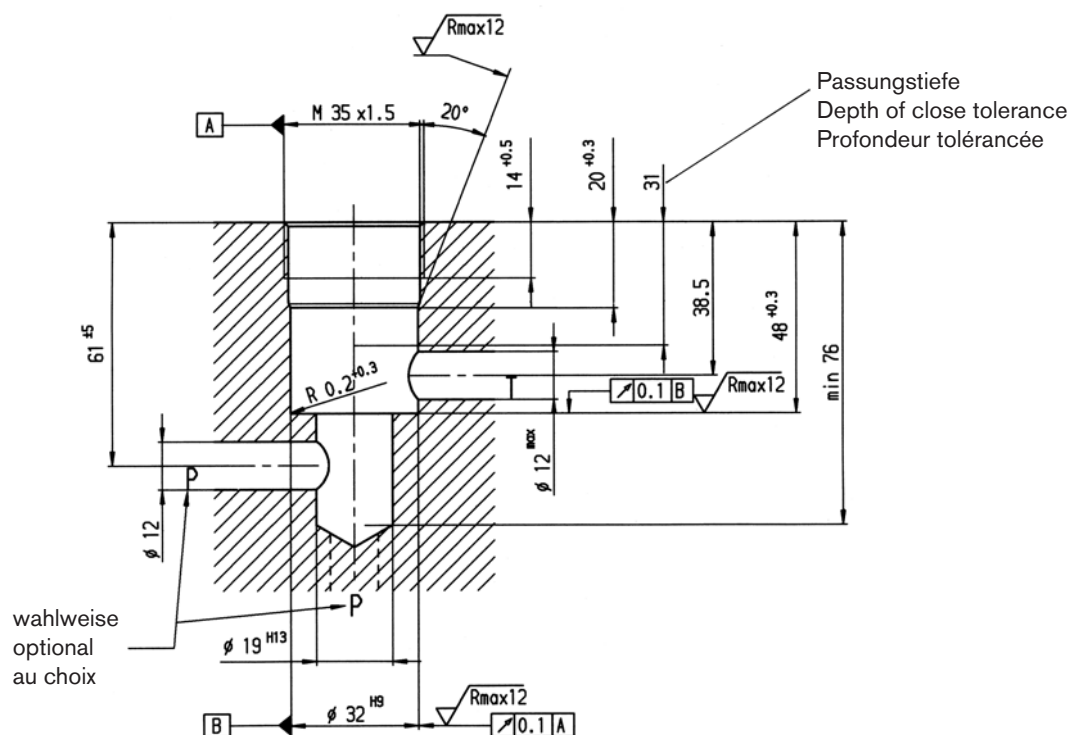
Gestaltung der Zu- und Ablaufleitungen gemäß AD-Merkblatt A 2, Pkt. 6
 Werkstoffqualität des Blockes mindestens 35 S 20 bzw. GGG 40.

Mounting dimensions

Inlet and outlet lines in accordance with AD-Merkblatt A 2, para 6
 Material quality of block a least 35 S 20 or GGG 40 (cast iron).

Cotes d'implantation

Conception des conduites d'arrivée et de retour selon fiche AD A 2, § 6.
 Matière du bloc au moins 35 S 20 ou GGG 40.



Nach der Reparatur muss das Ventil neu plombiert werden.

The valve is to be re-sealed after repair.

Plomber à nouveau la valve après réparation.

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Filters

Designation	Type	Data sheet	Page
Breather filters			
Vent and bleed filter, water-absorbing	BFSK	51456	409
Breather filter	FEF, BFS	51413	423
Breather filter	BF, BS, BE, B	51414	429
Tank breathing filters	TLF	51415	435
Tank mounted filters/return line filters			
Tank mounted return line filter with filter element according to DIN 24550	10 TE(N)	51424	449
Tank mounted return line filter with filter element according to Bosch Rexroth standard	25TE	51472	479
Inline filters			
Inline filter with filter element according to DIN 24550	50 LE(N)	51447	505
Inline filter with filter element according to DIN 24550	110 LE(N)	51448	525
Inline filter with filter element according to DIN 24550	245 LE(N)	51421	547
Inline filter with filter element according to DIN 24550	350 LE(N)	51422	569
Inline filter with filter element according to DIN 24550	445 LEN	51423	593
Block mounting filters			
Block mounting filter, for vertical flange-mounting	450 PBF(N)	51417	621
Block mounting filter, for lateral flange-mounting	245 PSF(N)	51418	639
Block mounting filter, for lateral flange-mounting	350 PSF(N)	51419	657
Side mounted, flanged manifold filter with filter element according to DIN 24550	450FEN	51467	675
Block mounting filter, for sandwich plate mounting	320 PZR	51468	699

For the latest information on filters, please visit our website:
www.boschrexroth.com/filter

Filters

Designation	Type	Data sheet	Page
Replacement cartridge filters			
Spin-on filter according to Bosch Rexroth standard	50 SL	51476	719
Spin-on filter according to Bosch Rexroth standard	7 SL; 7 SLS	51426	731
Spin-on elements	80.; 81. and 82.	51478	751
Filter systems			
Filter cooler unit with inline filter according to DIN24550	ABUKG	50125	767
Filter unit with inline Filter	ABUFG	50124	785
Filter elements			
Filter elements	1.; 2.; 4.; 6.; 7.; 20.	51420	795
Filter accessories			
Maintenance indicator for filters	WE, WO	51450	825

Vent and bleed filter, water-absorbing

Type BFSK 25 to 125

RE 51456

Edition: 2014-11

Replaces: 05.13



BR231012_124_W

- ▶ Sizes 25 to 125
- ▶ Component series 2X
- ▶ Maximum operating pressure 1 bar [14.5 psi]
- ▶ Connection G 3/8 to G 1 1/4 BSP; (ISO 228) with adapter plate: Ø58 x 2.5 (DIN 24557)
- ▶ Operating temperature 0 °C ... 85 °C [-18 °F ... 185 °F]

Features

- ▶ Highly efficient, special filter material
- ▶ Filtration of ultra-fine particles and high dirt retention capacity
- ▶ Adsorption of air humidity
- ▶ Minimizes the risk of corrosion in the hydraulic tank
- ▶ Filter cartridge as well as water-absorbing granules exchangeable
- ▶ Optional check valves to avoid air exchange during no-load operation
- ▶ Optional adapter plate including check valve for discharge air from tank, without filtration
- ▶ Combines air filtration and dehumidification in fluid systems

Contents

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Spare parts	12
Assembly, commissioning and maintenance	13
Tightening torques	14
Directives and standardization	14

Ordering code

Filters

01	02	03	04	05	06	07					
BFSK		-	2X	/	H3V3	-	M	-		-	

Series

01	Air filter with water-absorbing granules	BFSK
----	--	-------------

Size

02	BFSK	25
		40
		80
		125

Component series

03	Component series 20 to 29 (20 to 29: unchanged installation and connection dimensions)	2X
----	--	-----------

Filter rating in µm

04	Glass fiber material, not cleanable, 3 µm	H3V3
----	---	-------------

Seal

05	NBR seals	M
----	-----------	----------

Material

06	Plastic version – male thread for size 25 (steel double nipple)	0
	Stainless steel version – male thread for sizes 40 - 125	S

Check valve

07	Without check valve (standard)	0
	With check valve, cracking pressure of anti-cavitation valve 0.02 bar [0.29 psi], cracking pressure of preload valve 0.02 bar [0.29 psi]	CV

Order example: BFSK25-2X/H3V3-M-0-CV

Preferred types

Vent and bleed filter, water-absorbing	Material no.	Material no. Replacement cartridge	Material no. Refill granules
BFSK25-2X/H3V3-M-0-0	R928049169	R928049574	R928049182
BFSK40-2X/H3V3-M-S-0	R928049173	R928049575	R928049184
BFSK80-2X/H3V3-M-S-0	R928049175	R928049576	R928049185
BFSK125-2X/H3V3-M-S-0	R928049177	R928049577	R928049186

Accessories

Ordering codes, visual maintenance indicator ¹⁾

01 02 03

W	O	-	V01
----------	----------	----------	------------

01	Maintenance indicator	W
02	visual indicator	O

Design

04	Vacuum differential, design 01	V01
----	--------------------------------	------------

Type	Material no.
WO-V01	R928049181

¹⁾ only in connection with adapter plate (AP1, AP2 or APCV)

Ordering codes, adapter plate

01 02 03 04 05

ACC	-		-		-	2X	/	M
------------	----------	--	----------	--	----------	-----------	----------	----------

01	Accessories	ACC
----	-------------	------------

Design

02	Adapter plate size 1 for sizes 25 ²⁾ and 40	AP1
	Adapter plate size 2 for sizes 80 and 125	AP2
	Adapter plate with check valves	APCV

Series/size

03	Adapter plate 1	BFSK25-40
	Adapter plate 2 or adapter plate CV	BFSK80-125

Component series

04	Component series 20 to 29 (20 to 29: unchanged installation and connection dimensions)	2X
----	--	-----------

Seal

05	NBR seals	M
----	-----------	----------

Order example: ACC-AP1-BFSK25-40-2X/M

²⁾ NG 25 only possible in connection with reducing fitting (R900183367 G3/4 - G3/8 (ISO228)). The fitting must be ordered separately.

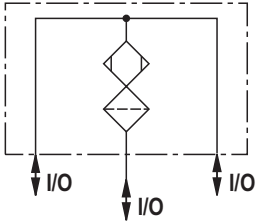
Type	Material no.
ACC-AP1-BFSK25-40-2X/M	R928049178
ACC-AP2-BFSK80-125-2X/M	R928049179
ACC-APCV-BFSK80-125-2X/M	R928049180

Size	Adapter plate		
	AP1	AP2	APCV
25	X	-	-
40	●	-	-
80	-	●	●
125	-	●	●

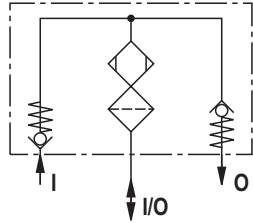
●	Standard
X	possible if a reducing fitting is used
-	not possible

Symbols

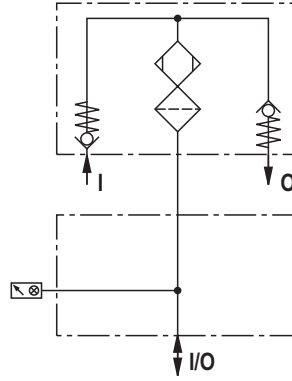
Vent and bleed filter without valves



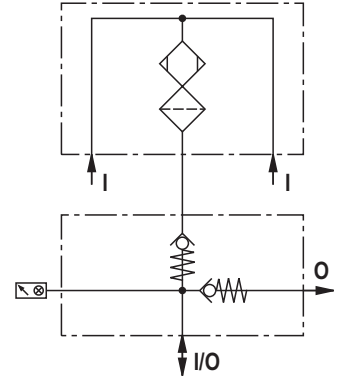
Vent and bleed filter with valves



Vent and bleed filter with valves, maintenance indicator and adapter plate (AP1; AP2)



Vent and bleed filter with maintenance indicator and adapter plate (APCV) with integrated valves.



Function, section

In hydraulics, air exchange at the fluid tank must be ensured at all times. Depending on the machine cycles, air is sucked into the tank and pressed out again. The air contains miniature particles as well as water vapor. Due to temperature variations, the exchanged air condenses and stimulates the oxidation process of the oil. This leads to corrosion resulting in damage to the fluid tank.

By means of the Rexroth BFSK vent and bleed filter, the fluid tank can suck in and give off clean and dry air. It is intended to be directly attached to a tank.

The BFSK vent and bleed filters essentially consist of an unscrewable replacement cartridge (1) with an integrated, pleated filter element (2) and an air filter housing (3). The air filter housing (3) is filled with water-absorbing granules (WA granules) (4).

The WA granules contain red indicator beads. The water saturation is indicated when their color changes from red to orange. Optionally, check valves (5) can be integrated. The BFSK vent and bleed filter is available with and without integrated check valves. The version with integrated check valves prevents air exchange during no-load operation.

Furthermore, the optional visual maintenance indicator provides information on the filter status. The maintenance indicator (7) is connected via an adapter plate (6) that can be purchased separately. In addition, the adapter plate makes a direct connection to the fluid tank possible.

Standard version without check valve (Figure 1):

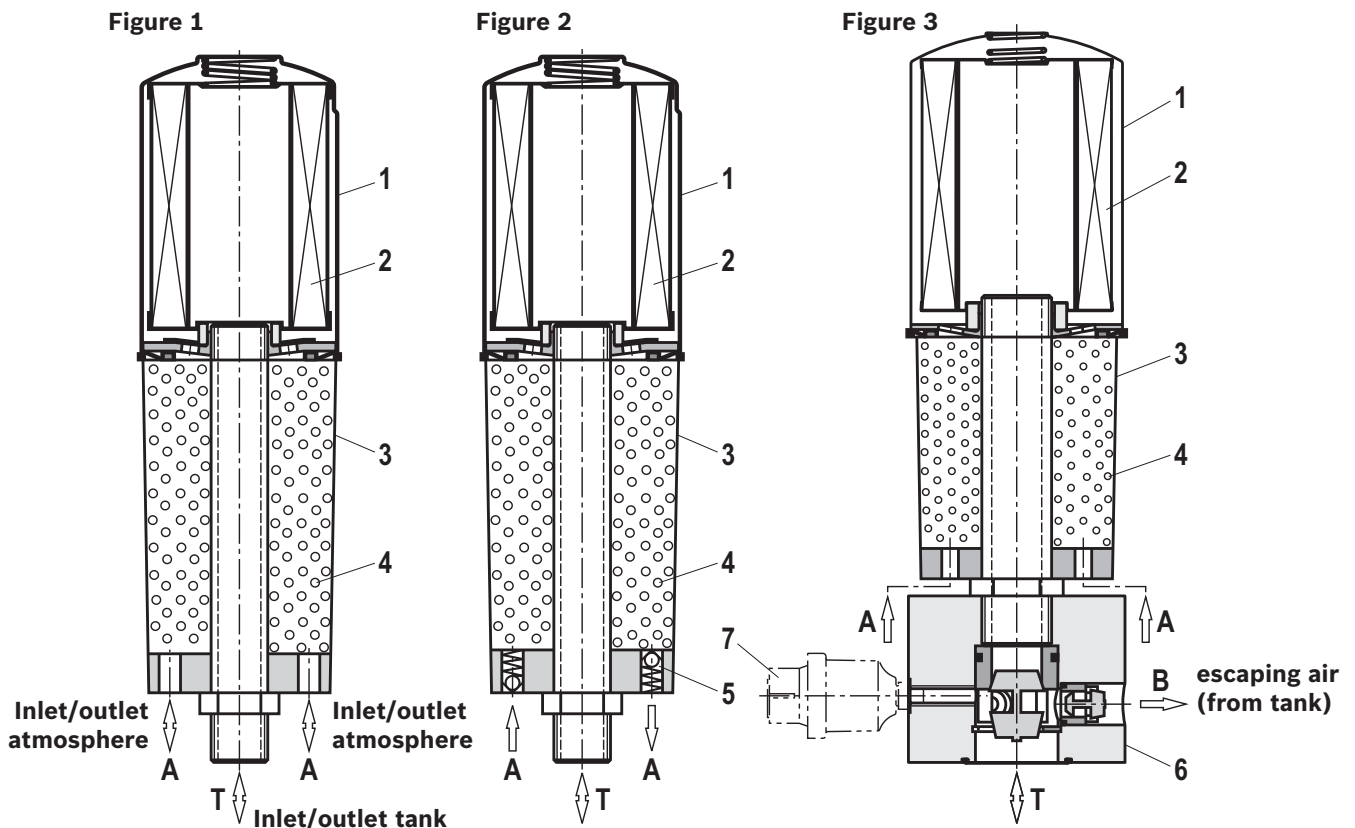
The contaminated air is transported to the WA granules (4) via opening A, is dried there and then flows through the pleated filter element. Solid dirt particles are captured here. Via connection T, only dried and filtered air gets into the tank. Air exiting the system in the opposite direction is dried as well.

Version with check valve (5) in BFSK (Figure 2):

Functions in the same way as the standard version; but includes check valves (5) to prevent air exchange during no-load operation.

Version with check valve in the adapter plate (6) (Figure 3):

Functions in the same way as the standard version; but the escaping air, which may be mixed with oil mist, is diverted directly from the tank upstream of the filter **via connection B** into the environment.



Technical data

(For applications outside these parameters, please consult us!)

General					
Weight	Size	25	40	80	125
	kg [lbs]	0.4 [0.9]	1.5 [3.3]	2.92 [6.4]	4.1 [9.0]
Installation position	vertical				
Ambient temperature range	°C [°F]	-40 ... +85 [-40... +185]			
Storage conditions	°C [°F]	+5 ... +40 [+41 ... +104]; max. relative air humidity 65%			
Operating temperature	°C [°F]	0 ... +85 [-18...+185]			
Material	Replacement cartridge	Steel			
	Air filter housing	Polymethyl methacrylate			
	Adapter plate	Anodized aluminum			
	Visual maintenance indicator	Housing made of polycarbonate			

Cracking pressure of check valve	bar [psi]	0.01 [0.15]
Type of pressure measurement of the maintenance indicator	Underpressure	
Response pressure of the maintenance indicator	bar [psi]	0.05 [0.73]

Filter element		
Micro glass H3V3	µm	3, Single-use element on the basis of inorganic fiber
Admissible pressure differential	bar [psi]	1 [14.5]

Approved fluids	Classification	Suitable sealing materials	Standards
Mineral oil	HLP	NBR	DIN 51524
Biodegradable – insoluble in water	HETG	NBR	VDMA 24568

**Important information on hydraulic fluids:**

- For more information and data on the use of other hydraulic fluids, please refer to data sheet 90220 or contact us.

Filter material (WA granules)					
Volume	Size	25	40	80	125
	cm ³ [in ³]	100 [6.1]	600 [36.6]	1000 [61.0]	2000 [122.0]
Max. water absorption	l [US gal]	0.028 [0.0074]	0.172 [0.0454]	0.288 [0.07608]	0.576 [0.1521]

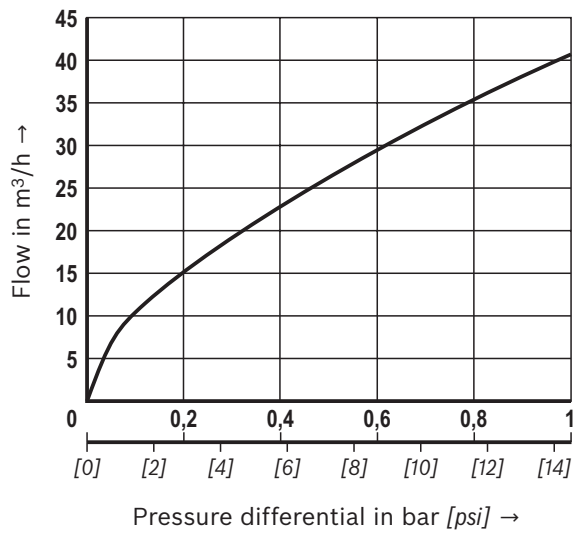
The following table displays the operating ranges of the water-absorbing vent and bleed filters in hydraulic systems.

Type	Max. air flow at a starting pressure differential of 0.01 bar in l/min
BFSK25	50
BFSK40	120
BFSK80	300
BFSK125	300
BFSK25....CV	25
BFSK40....CV	80
BFSK80....CV	160
BFSK125....CV	110

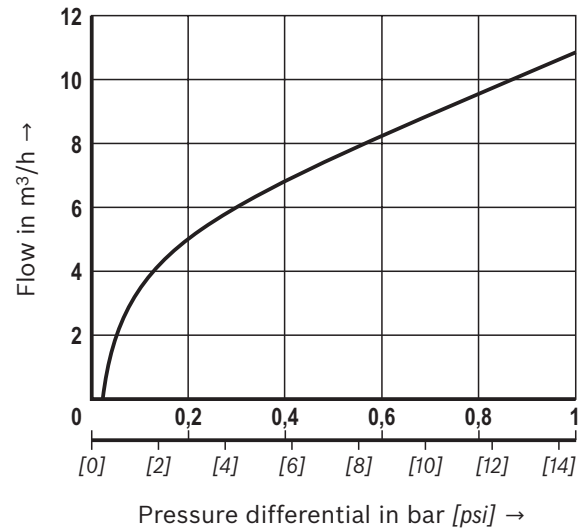
When air humidity is very high it is recommended to select the next highest variant with the aim of achieving a longer service life.

Characteristic curves

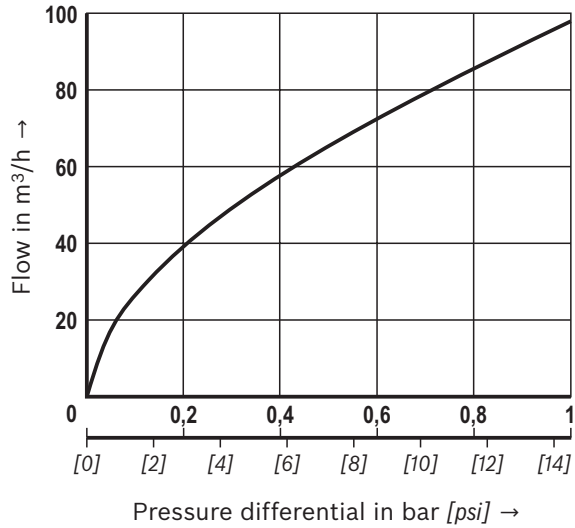
BFSK25-2X / H3V3-M-O-O
without check valve



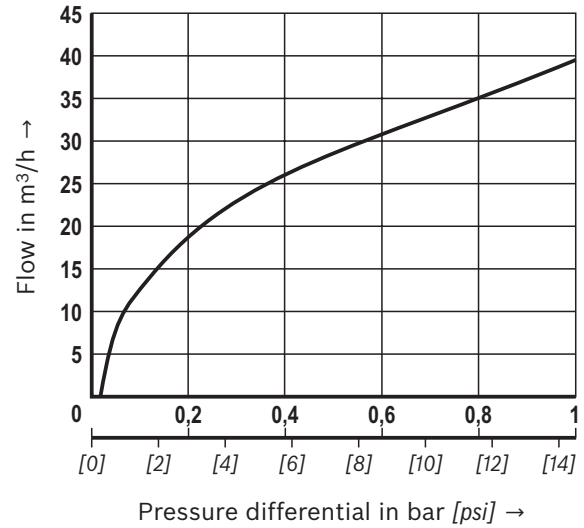
BFSK25-2X / H3V3-M-O-CV
with check valve



BFSK40-2X / H3V3-M-S-O
without check valve

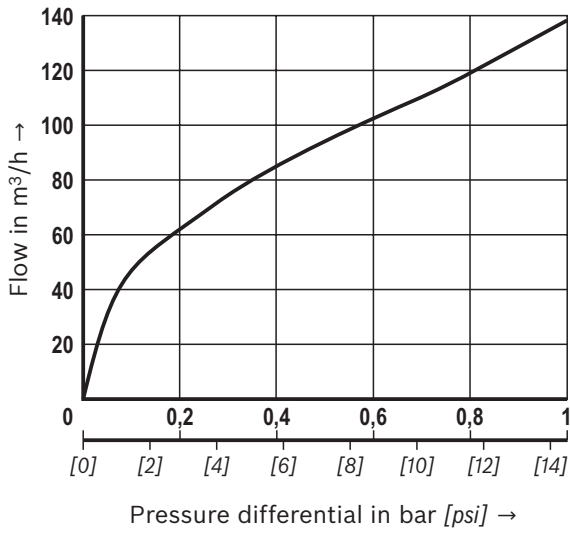


BFSK40-2X / H3V3-M-S-CV
with check valve

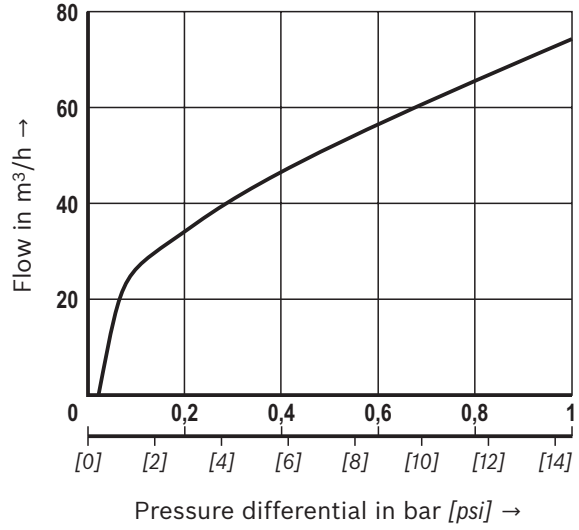


Characteristic curves

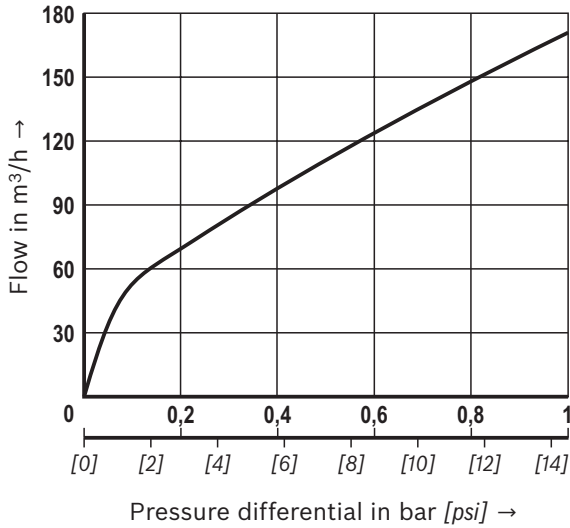
BFSK80-2X / H3V3-M-S-O
without check valve



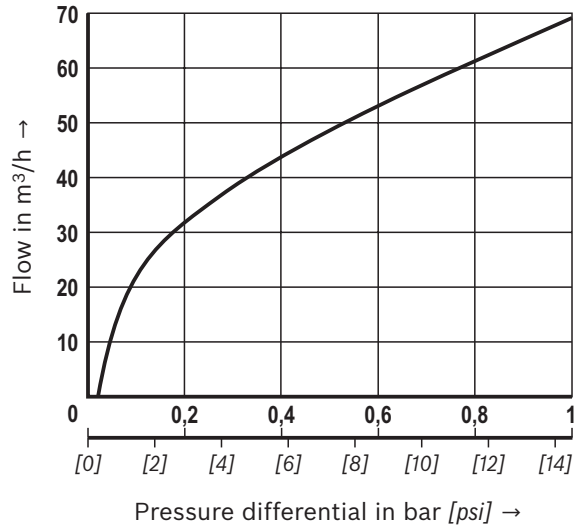
BFSK80-2X / H3V3-M-S-CV
with check valve



BFSK125-2X / H3V3-M-S-O
without check valve



BFSK125-2X / H3V3-M-S-CV
with check valve

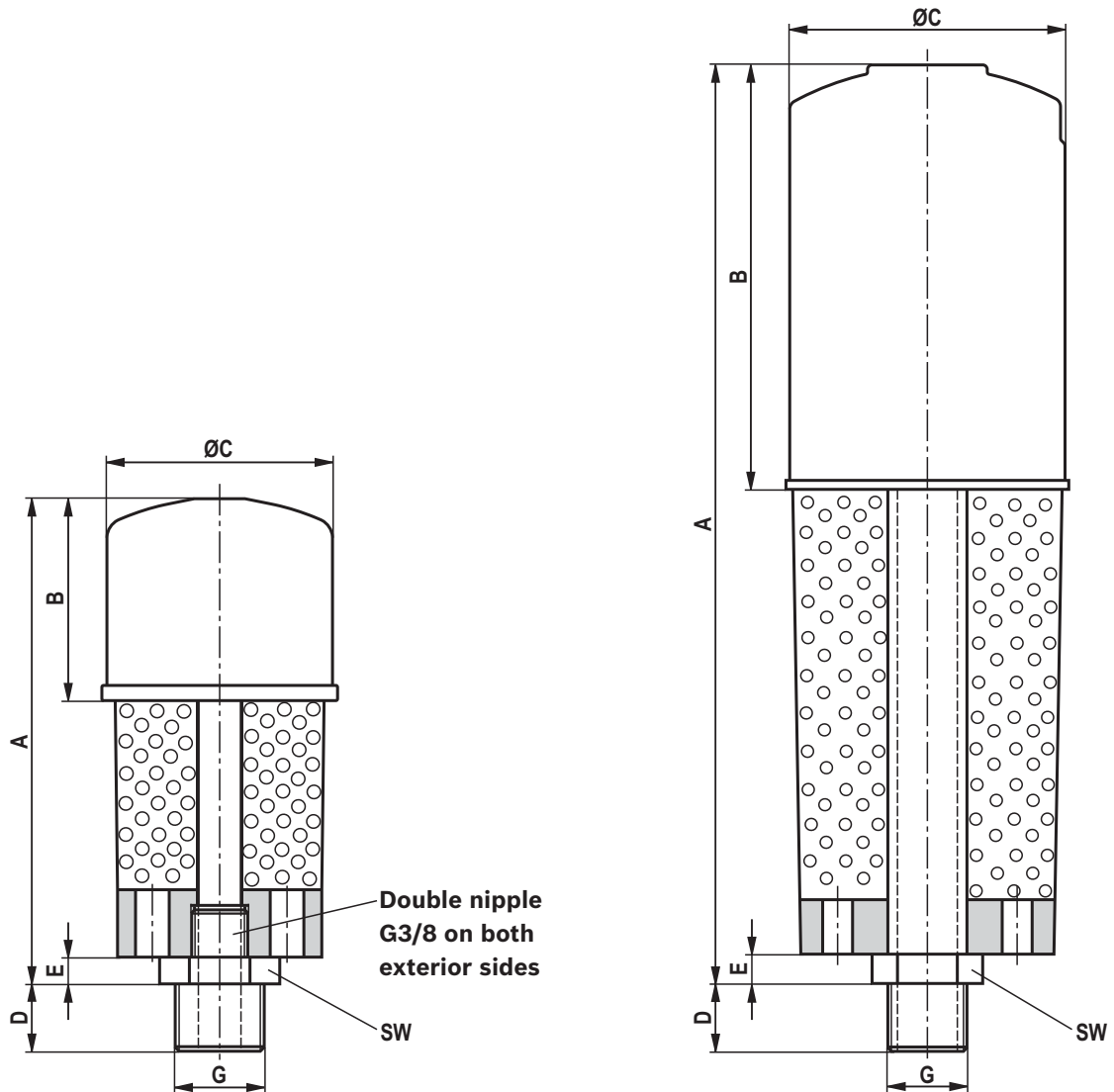


Dimensions: Vent and bleed filter

(dimensions in mm [inch])

BFSK25

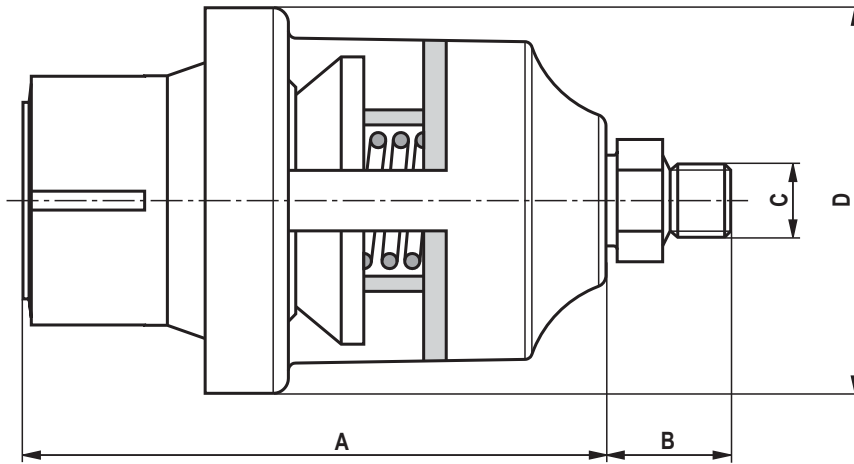
BFSK40 ... 125



Filter types

Type BFSK...	A	B	ØC	D	E	G	SW
25	146 [5.75]	60 [2.36]	70 [2.76]	12 [0.47]	~10 [-0.39]	G3/8	22 [0.87]
40	281 [11.06]	121 [4.76]	97 [3.82]	23 [0.91]	~10 [-0.39]	G3/4	32 [1.26]
80	335 [13.19]	181 [7.13]	130 [5.12]	30 [1.18]	~11 [-0.43]	G1 1/4	50 [1.97]
125	495 [19.49]	231 [9.09]	130 [5.12]	27 [1.06]	~11 [-0.43]	G1 1/4	50 [1.97]

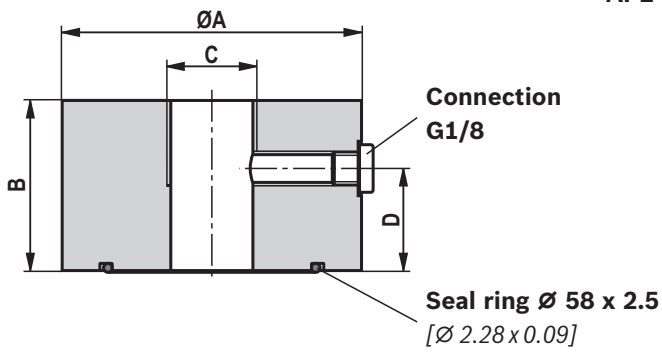
Dimensions: Maintenance indicator, visual
 (dimensions in mm [*inch*])



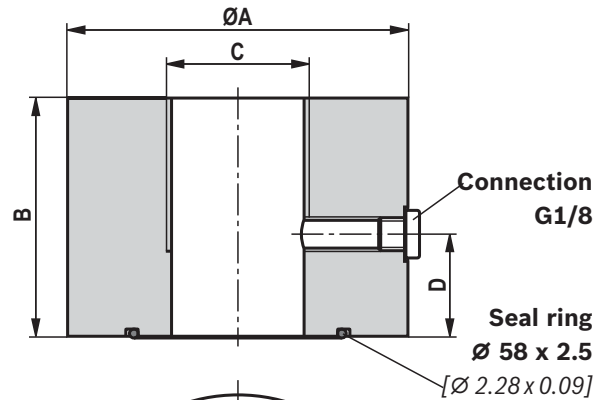
Type	A	B	C	D
WO-V01	70 [2.76]	16,5 [0.65]	G1/8	50 [1.97]

Dimensions: Adapter plates
(dimensions in mm [inch])

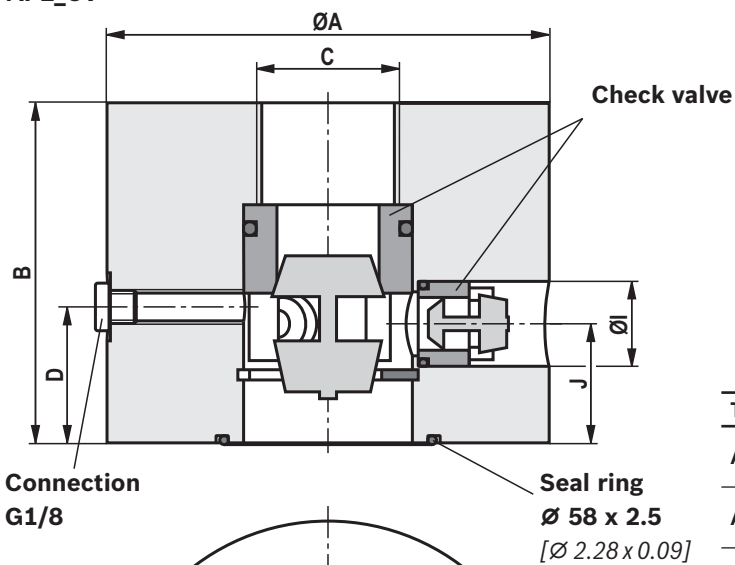
AP1



AP2

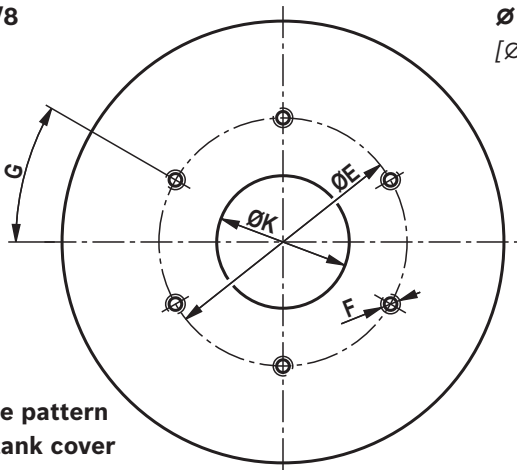


AP2_CV



Type	ØA	B	C	D	ØE
AP1	88 [3.46]	50 [1.97]	G3/4	30 [1.18]	73 [2.87]
AP2	100 [3.94]	70 [2.76]	G1 1/4	30 [1.18]	
AP2_CV	130 [5.12]	100 [3.94]	G1 1/4	40 [1.57]	

Hole pattern of tank cover



Type	ØF	G	ØI	J	ØK
AP1	M5 x 10	30°	-	-	50 [1.97]
AP2			-	-	
AP2_CV			25 [0.98]	35 [1.38]	

Spare parts**Ordering code, replacement cartridge and refill pack**

01	02	03	04	05	06	07					
89.		-	2X	/	H3V3	-	S00	-	0	-	M

Filter cartridge

01	Design	89.
----	--------	------------

Size

02	BFSK	25
		40
		80
		125

03	Component series 20 to 29 (20 to 29: unchanged installation and connection dimensions)	2X
----	--	-----------

Filter rating in µm absolute

04	Glass fiber material, not cleanable, 3 µm	H3V3
----	---	-------------

Pressure differential

05	Standard	S00
----	----------	------------

Bypass valve

06	Without check valve	0 ¹⁾
----	----------------------------	------------------------

Seal

07	NBR seals	M
----	-----------	----------

¹⁾ Always 0 with replacement cartridge

Order example: 89.25-2X/H3V3-S00-0-M

Vent and bleed filter, water-absorbing	Replacement cartridge	Refill granules (incl. 2 foam pads)
BFSK25-2X/H3V3-M-0-0	R928049574	R928049182
BFSK40-2X/H3V3-M-S-0	R928049575	R928049184
BFSK80-2X/H3V3-M-S-0	R928049576	R928049185
BFSK125-2X/H3V3-M-S-0	R928049577	R928049186

Assembly, commissioning and maintenance

Installation

The connection thread of the filter must correspond to the connection thread of the tank cap. If an adapter plate is used, the hole pattern (DIN 24557-2) of the tank cap must be compared to the dimensions from the "Dimensions" chapter prior to installation. Please remove the sealing foil (air inlet A) and the end cap of the filter connection prior to use. Screw the filter into the tank bore or the adapter plate respectively. When installing the filter, the required servicing height of the replacement cartridge (approx. 50 mm [1.97 inch]) must be taken into account. For servicing reasons, we recommend installing the filter in a standing position. All filter components must be screwed on hand-tight.

Commissioning

It is not necessary to commission the filter.

Maintenance

Exchanging the replacement cartridge

It is necessary to exchange the replacement cartridge once the red marking of the maintenance indicator has been reached. Since the ambient conditions are very different depending on the place of installation, we recommend regular exchange of the replacement cartridge according to the specific installation conditions for BFSK filters that are designed without a maintenance indicator.

Exchanging the WA granules

If the indicator beads of the WA granules change their color from red to orange, the granules must be exchanged. The material numbers of the corresponding spare parts are indicated on the name plate of the complete filter. They must correspond to the material numbers on the replacement cartridge or the refill pack.

Maintenance instructions:

- ▶ Remove the complete vent and bleed filter by turning the air filter housing manually counter-clockwise.
- ▶ Remove the replacement cartridge by turning it counter-clockwise (hold tank port downwards).
- ▶ The WA granules are protected against falling out by a foam pad. In case of incorrect handling (shaking, turning upside down, ...) the granules might fall out.
- ▶ Remove foam pad prior to exchanging the WA granules.
- ▶ Dispose of the used WA granules and foam pads in accordance with environmental and applicable local requirements. Waste code: 150202
- ▶ Insert new bottom foam pad, fill in fresh WA granules and insert new upper foam pad.
- ▶ Screw air filter housing on tank port, put new seal ring (part of spare replacement cartridge) over air filter housing, center and install replacement cartridge (hand-tight) clockwise.

Do not forget to reset the visual maintenance indicator. This is done by pressing the RESET button.

Note:

Servicing should not take place below 10 °C. Should this still be necessary, however, special care must be taken when working with the plastic housing.

Tightening torques

Adapter plates	AP1	AP2	APCV
Tightening torque, at $\mu_{total} = 0.14$	5 Nm \pm 1 Nm		
Quantity	6		
Screw x length	M5 x 60	M5 x 80	M5 x 110
Recommended property class of screw	8.8		

Directives and standardization

Classification according to the Pressure Equipment Directive

Bosch Rexroth BFSK water-absorbing vent and bleed filters according to 51456 are not classified as devices or components for the purpose of the Pressure Equipment Directive 97/23/EC (PED).

Directive 94/9/EC (ATEX)

According to the assessment of the risk of ignition, Bosch Rexroth BFSK vent and bleed filters must not be used in explosive areas.

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Breather filter

RE 51413/02.09
Replaces: 08.08

1/6

Types FEF 0, FEF 1; BFS 7..., BFS 20...

Nominal size: 0 and 1; 7 and 20
Connections up to DN 55
Operating temperature -20 °C to +100 °C



H7625

Table of contents

Content	Page
Application	1
Design, maintenance intervals, and spare parts	2
Unit dimensions	3, 4
Ordering details	3, 4
Characteristic curves	5

Application

- Filtration and dehumidification of the intake air of industrial systems.
- Avoidance of initial damage in pumps and bearings and system components.

Design

FEF 0, FEF 1:

Combination of flange-on filling filter (screen basket 500 µm) and cap removable via bayonet lock as breather with internal filter element 40 µm. The filter element must be exchanged together with the cap. The breather cap is secured against loss by means of a chain.

Materials as per spare parts list.

BFS 7..., BFS 20...:

Compact housing for ventilation with pleated filter element of paper.

Materials as per spare parts list.

Maintenance intervals

Fields of application of the filter	Environmental conditions average dust content	Maintenance interval
General mechanical engineering	9...25 mg/m ³	4,000 h
Heavy industry	50...80 mg/m ³	3,000 h
Mobile hydraulics	30...100 mg/m ³	3,000 h

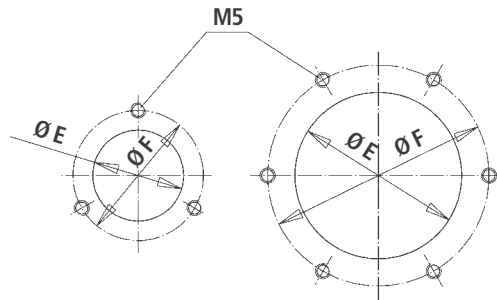
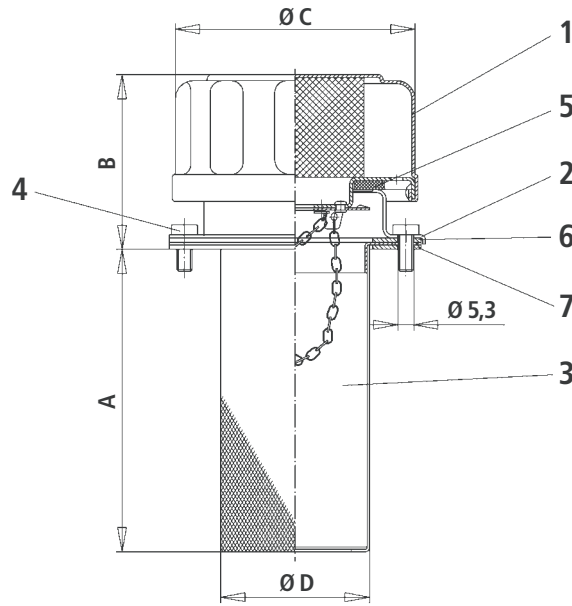
Spare parts list

Size				FEF 1	FEF 0
Part	Piece	Description	Material		
1	1	Cover	various	Indicate the ordering information "Filter"	—
2	1	Flange	Steel		
3	1	Filling screen	Steel		
4	6	Socket head cap screw	5	Part No. 5770	
5	1	Seal	NBR	Indicate the ordering information "Filter"	
6	1	Seal	Fiber		
7	1	Seal	Fiber		

All part nos. BRFS.specific.

Size				BFS 7	BFS 20
Part	Piece	Description	Material		
10	1	Seal	Fiber	Indicate the ordering information "Filter"	

Unit dimensions FEF 0 and FEF 1 (dimensions in mm)



Hole pattern FEF 0 Hole pattern FEF 1
lockable upon request

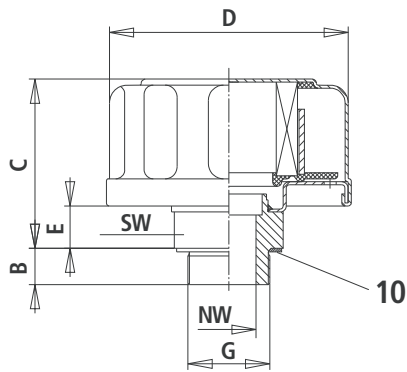
	FEF 0	FEF 1
A	64	98
B	38	58
Ø C	48	81
Ø D	27	49
Ø E	30	55
Ø F	41	73

Ordering details FEF 0 and FEF 1

	FEF	F	0	0	
Design Filling and breather filter	= FEF				Complementary details without
Nom. size		= 0		0 =	
		= 1			Material Standard
Filtration rating in µm nominal Paper, non-cleanable P10, P25			= P...		Seal Fiber (series)
absolute (ISO 16889) Micro glass, non-cleanable H10XL			= H10XL		
				F =	

Ordering example:
FEF 0 P10-F00

Unit dimensions BFS 7... and BFS 20... (dimensions in mm)



	BFS 7	BFS 20
Weight in kg	0.03	0.3
B	11	12
C	41	56
D	Ø 46	Ø 81
E	6	14
G	G1/4	G3/4
SW	17	32
NW	Ø 7	Ø 18

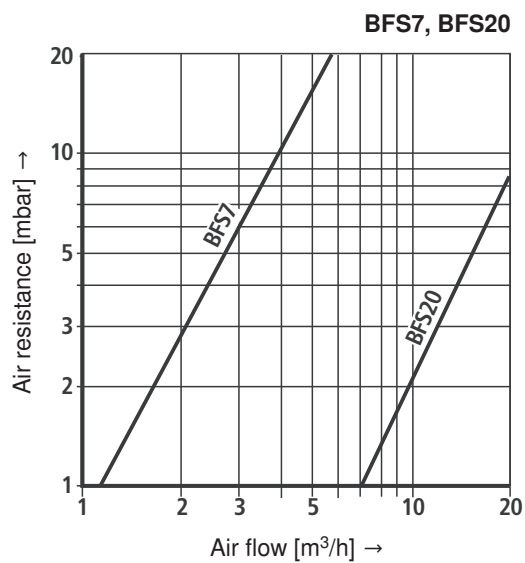
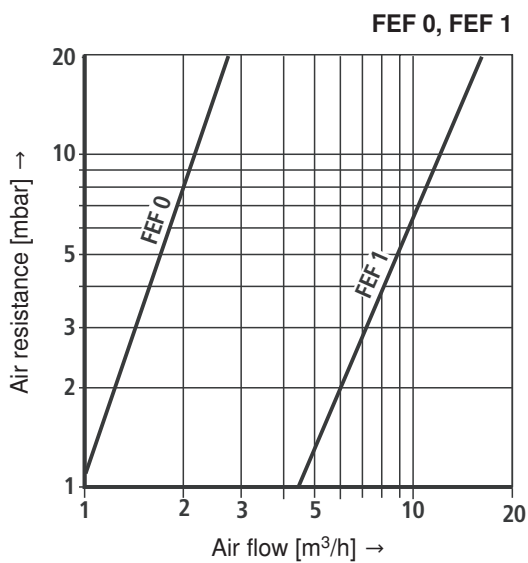
Ordering details BFS 7... and BFS 20...

BFS		F		0		0	
Design Breather filter with filter element	= BFS						
Nom. size	= 7 = 20						Complementary details without
Filtration rating in µm nominal Paper, non-cleanable P5, P10, P25	= P...						Material Standard
absolute (ISO 16889) Micro glass, non-cleanable H10XL	= H10XL						Seal Fiber (series)
				F =			

Ordering example:

BFS 7 P10-F00

Characteristic curves (measured at test temperature = 20 °C, filter material P10)



Notes

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Breather filter

RE 51414/02.09
Replaces: 08.08

1/6

Types BF 7 SL...; BS 7 SL...; BE 7 SL...; B 7 SL

Nominal size: BF 7 SL 45/21, 90, 130;
BS 7 SL 45/21, 90, 130;
BE 7 SL 45/21;
B 7 SL 45/21

Connections up to DN 32
Operating temperature -20 °C to +100 °C



H7612

Table of contents

Content	Page
Application	1
Design, maintenance intervals, and spare parts	2
Unit dimensions	3
Ordering details	4
Characteristic curves	5

Application

- Filtration and dehumidification of the intake air of industrial systems.
- Avoidance of initial damage in pumps and bearings and system components.

Design

BF 7 SL..., BS 7 SL...:

Breather filter with screw-off exchange filter cartridge and internal pleated filter element of filter paper P or micro glass H10XL.

Design with flange connection (BF 7 SL...) and/or welding socket (BS 7 SL...).

B 7 SL..., BE 7 SL...:

Breather filter with screw-off exchange filter cartridge and internal pleated filter element of filter paper P or micro glass H10XL.

Connection possibility for a clogging indicator (B 7 SL) and/or attachment of a filling filter (screen basket 500 µm). Materials as per spare parts list.

Maintenance intervals

Fields of application of the filter	Environmental conditions average dust content	Maintenance interval
General mechanical engineering	9...25 mg/m ³	4,000 h
Heavy industry	50...80 mg/m ³	3,000 h
Mobile hydraulics	30...100 mg/m ³	3,000 h

Spare parts list

Size				BF 7 SL 45/21	BF 7 SL 90 and 130, BS 7 SL 45/21, BS 7 SL 90 and 130, B 7 SL 45/21	BE 7 SL 45/21
Part	Piece	Description	Material			
1	1	Filter cartridge	various	Please indicate ordering information "Filter Cartridge"		
2	1	Seal ring	Fiber	Please indicate ordering information "Filter"		
3	1	Seal	Klingsil C4400	-	Please indicate the ordering information "Filter"	-
	2				-	Please indicate the ordering information "Filter"
	1		NBR	Please indicate the ordering information "Filter"	-	-
4	1	Filling screen	Steel	-		Part No. 5379
5	1	Seal	Cu			Please indicate the ordering information "Filter"
6	1	Countersunk screw	4.8			Part No. 4285

All part numbers BRFs specific.

Ordering details of the filter

		— S — 0 0 0 — 00 M 0 0										
Design												Complementary details
Breather with flange	= BF 7 SL											0 = without
Breather with welding socket	= BS 7 SL											Material
Breather with filler	= BE 7 SL											0 = Standard
Breather without filler	= B 7 SL											Seal
Nom. size												M = NBR seal
BF 7 SL	= 45/21 90 130											Connection
BS 7 SL	= 45/21 90 130											00 = Standard
BE 7 SL	= 45/21											Connection in B 7 SL welding socket
B 7 SL	= 45/21											Clogging indicator
Filtration rating in µm nominal												0 = without
Paper, non-cleanable												Bypass valve
P10, P25	= P...											0 = without
absolute (ISO 16889)												Solenoid
Micro glass, non-cleanable												0 = without
H10XL	= H10XL											
Pressure differential												
Max. admissible pressure differential of the filter element												
Standard	= S											
Element model												
Standard adhesive T = 100 °C	= 0...											
Standard material	= ...0											

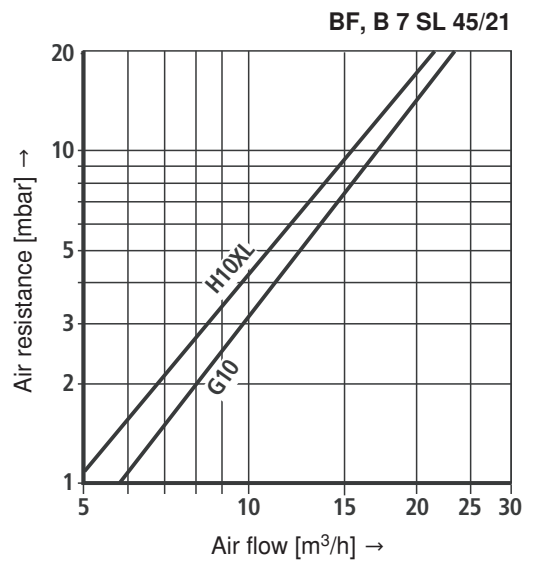
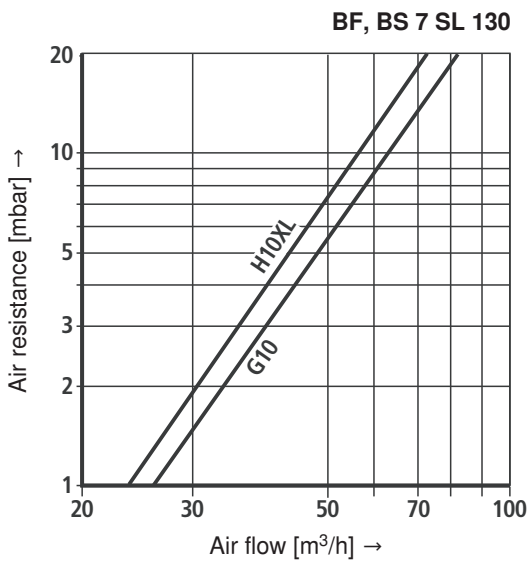
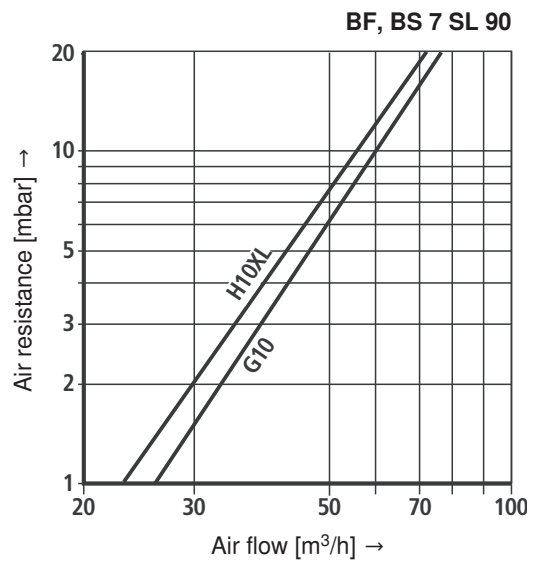
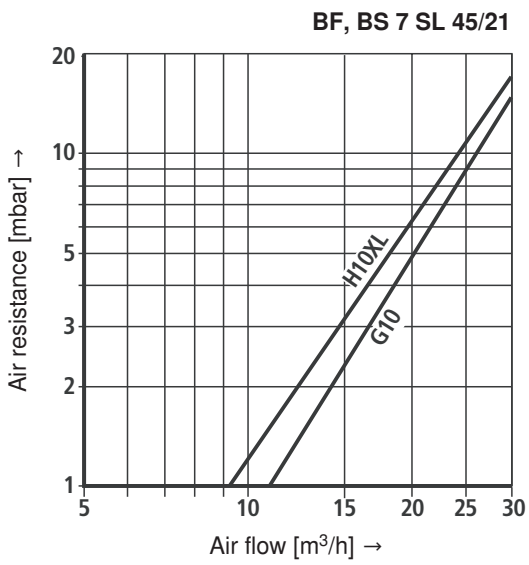
Ordering example:
BF 7 SL 90 P10-S00-000-00M00

Ordering details of the filter cartridge

		80. — S — 0 — M						
Filter cartridge								Seal
Design	= 80.							NBR seal
Nom. size								Bypass valve
BF 7 SL	= 45/21 90 130							0 = without
BS 7 SL	= 45/21 90 130							Element model
BE 7 SL	= 45/21							0... = Standard adhesive T = 100 °C
B 7 SL	= 45/21							...0 = Standard material
Filtration rating in µm nominal								Pressure differential
Paper, non-cleanable								Max. admissible pressure differential of the filter element
P10, P25	= P...							S = Standard
absolute (ISO 16889)								
Micro glass, non-cleanable								
H10XL	= H10XL							

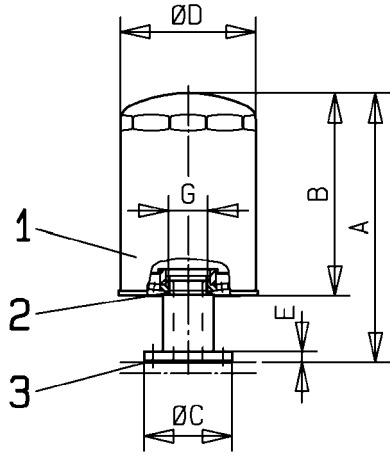
Ordering example:
80. 90 P10-S00-0-M

Characteristic curves (measured at test temperature = 20 °C)

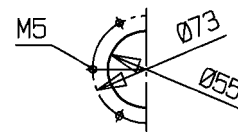
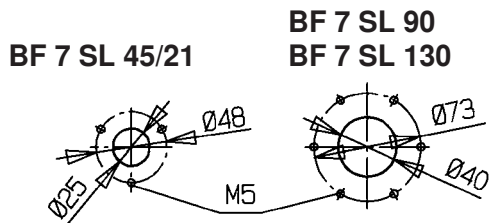
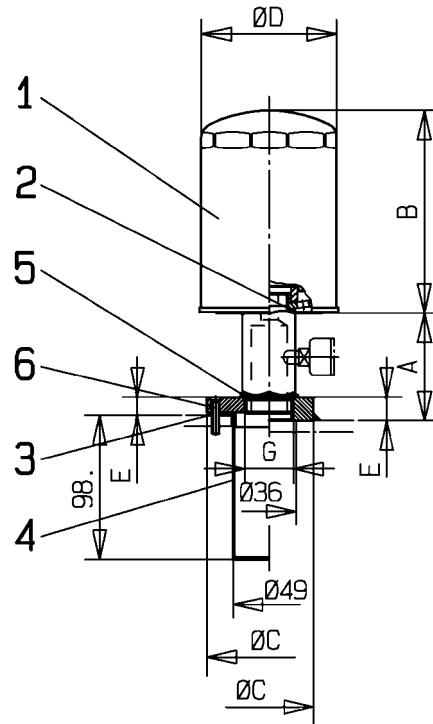


Unit dimensions (dimensions in mm)

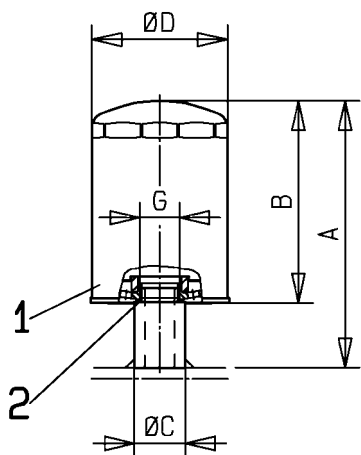
BF 7 SL 45/21
BF 7 SL 90
BF 7 SL 130



BE 7 SL 45/21
B 7 SL 45/21



BS 7 SL 45/21
BS 7 SL 90
BS 7 SL 130



Size	Weight in kg	A	B	Ø C	Ø D	E	G
BF 7 SL 45/21	0.8	189	146	60	92	7	G 3/4
BF 7 SL 90	1.4	231	183	85	128	9.5	G 1 1/4
BF 7 SL 130	1.5	279	231				
BS 7 SL 45/21	0.7	189	146	35	92	-	G 3/4
BS 7 SL 90	1.3	231	183	50	128		G 1 1/4
BS 7 SL 130	1.4	279	231				
BE 7 SL 45/21	1.3	67	146	85	92	11.5	G 1
B 7 SL 45/21	1.2	73		60		16	

Notes

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Tank breathing filters

Type TLF I 1-25 to 8-250; TLF II 1-25 to 6-80;
 TLF III 1-25 to 7-125

RE 51415

Edition: 2015-06



- ▶ Size according to **Bosch Rexroth standard:**
 1 - 25 to 8-250
- ▶ Connection G1 to DN250
- ▶ Operating temperature -40 °C to $+100\text{ °C}$ [-40 °F to 212 °F]

Features

The breathing filters are used in hydraulic systems for breathing and bleeding air from the hydraulic tank. They are mounted directly on the tank.

They distinguish themselves by the following:

- ▶ Highly efficient, special filter material
- ▶ Filtration of ultra-fine particles and high dirt holding capacity
- ▶ Use of Aquasorb filter material minimizes the risk of corrosion in the hydraulic tank
- ▶ Standard filling strainer in version TLF III
- ▶ Replaceable filter element

Contents

Features	1
Ordering code filter	2, 3
Preferred types	4
Symbol	4
Function, section	5
Technical data	6
Compatibility with permitted hydraulic fluids	6
Characteristic curves	7
Dimensions	8 ... 11
Ordering code spare parts	12
Assembly, commissioning, maintenance	13
Tightening torques	14
Directives and standardization	14

Ordering code filter

Size 1-25 to 6-80

	01	02	03	04	05	06	07	08	09	10	11	12	
TLF				-	S00	-	0	0	0	-	00	0	0

Series

01	Tank breathing filters	TLF
----	------------------------	-----

Connection

02	Internal thread	I
	Male thread	II
	Male thread and filling strainer	III

Size

03	TLF ...	1-25 2-32 3-40 4-50 5-65 6-80
----	---------	--

Filter rating in µm

04	Glass fiber material, not cleanable	Air retention, ASHRAE 52.1, test dust SAE fine: 95% for particles > 0.3 µm	H10XL
	Nominal Filter paper, not cleanable	Air retention, ASHRAE 52.1, test dust SAE fine: 95% for particles > 1.24 µm	P10

Pressure difference

05	Max. admissible pressure differential of the filter element of 1 bar [14.5 psi]	S00
----	---	-----

Solenoid

06	Without solenoid	0
----	------------------	---

Valve

07	Without valve	0
----	---------------	---

Maintenance indicator

08	Without maintenance indicator	0
----	-------------------------------	---

Connection

09	Frame size	1-25	2-32	3-40	4-50	5-65	6-80	00
	Connection	G1	G1 1/4	G1 1/2	G2	G2 1/2	G3	

Seal

10	NBR seal	M
	FKM seal	V

Material

11	Standard	0
----	----------	---

Supplementary information

12	Without supplementary information	0
----	-----------------------------------	---

Order example:

TLF III 3-40 P10-S00-000-00M00

Material no. R928018862

Further versions are available on request.

Ordering code filter

Size 7-125 to 8-250

	01	02	03	04		05	06	07	08		09	10	11	12	
TLF					-	S00	-	0	0	0	-	00		0	0

Series

01	Tank breathing filters	TLF
----	------------------------	------------

Connection

02	DIN flange	I
	DIN-flange and filling strainer	III

Size

03	TLF I; TLF III	7-125
	TLF I	8-250

Filter rating in µm

04	Glass fiber material, not cleanable	Air retention, ASHRAE 52.1, test dust SAE fine: 95% for particles > 0.3 µm	H10XL
	Nominal		
	Filter paper, not cleanable	Air retention, ASHRAE 52.1, test dust SAE fine: 95% for particles > 1.24 µm	P10

Pressure difference

05	Max. admissible pressure differential of the filter element of 1 bar [14.5 psi]	S00
----	---	------------

Solenoid

06	Without solenoid	0
----	-------------------------	----------

Valve

07	Without valve	0
----	----------------------	----------

Maintenance indicator

08	Without maintenance indicator	0
----	--------------------------------------	----------

Connection

09	Frame size	7-125	8-250	00
	Connection	DIN 2573 DN125	DIN 2573 DN250	

Seal

10	NBR seal	M
	FKM seal	V

Material

11	Standard	0
----	----------	----------

Supplementary information

12	Without supplementary information	0
----	--	----------

Order example:

TLF I 8-250 P10-S00-000-00M00

Material no. R928018835

Further versions are available on request.

Preferred types

Tank breathing filters TLF I, filter rating **paper 10 µm**

Type	Material no. Filter	Material no. Replacement element
TLF I 1-25 P10-S00-000-00M00	R928018814	R928039681
TLF I 2-32 P10-S00-000-00M00	R928018817	R928039681
TLF I 3-40 P10-S00-000-00M00	R928018820	R928016621
TLF I 4-50 P10-S00-000-00M00	R928040890	R928016621
TLF I 5-65 P10-S00-000-00M00	R928018826	R928016621
TLF I 6-80 P10-S00-000-00M00	R928018829	R928016624
TLF I 7-125 P10-S00-000-00M00	R928018832	R928016627
TLF I 8-250 P10-S00-000-00M00	R928018835	R928016630

Tank breathing filters TLF II, filter rating **paper 10 µm**

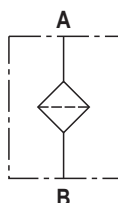
Type	Material no. Filter	Material no. Replacement element
TLF II 1-25 P10-S00-000-00M00	R928018838	R928039681
TLF II 2-32 P10-S00-000-00M00	R928018841	R928039681
TLF II 3-40 P10-S00-000-00M00	R928040622	R928016621
TLF II 4-50 P10-S00-000-00M00	R928018847	R928016621
TLF II 5-65 P10-S00-000-00M00	R928018850	R928016621
TLF II 6-80 P10-S00-000-00M00	R928018853	R928016624

Tank breathing filters TLF III, filter rating **paper 10 µm**

Type	Material no. Filter	Material no. Replacement element
TLF III 1-25 P10-S00-000-00M00	R928018856	R928039681
TLF III 2-32 P10-S00-000-00M00	R928018859	R928039681
TLF III 3-40 P10-S00-000-00M00	R928018862	R928016621
TLF III 4-50 P10-S00-000-00M00	R928018865	R928016621
TLF III 5-65 P10-S00-000-00M00	R928018868	R928016621
TLF III 6-80 P10-S00-000-00M00	R928018871	R928016624
TLF III 7-125 P10-S00-000-00M00	R928028258	R928016627

Symbol

Tank breathing filters



Function, section

The tank breathing filter guarantees air exchange in the fluid tank. Depending on the machine cycles, air can be pulled into the tank with contamination when a breather filter is not used. A tank breather filter will accomplish both the pressure equalization and air filtration preventing contamination from entering the tank through the air exchange. It basically consists of a threaded cover (1), a filter element (2) and a bottom housing (3) to accommodate the filter element.

The contaminated air is transported through the filter element into the hydraulic tank (T) via the opening (A). Only filtered air enters the tank. Escaping air is also directed through the filter element.

Version TLF I 1-25 to 8-250

Sizes 1-25 to 6-80 have an internal thread, sizes 7-125 and 8-250 have a flange.

Version TLF II 1-25 to 6-80

All sizes have a male thread.

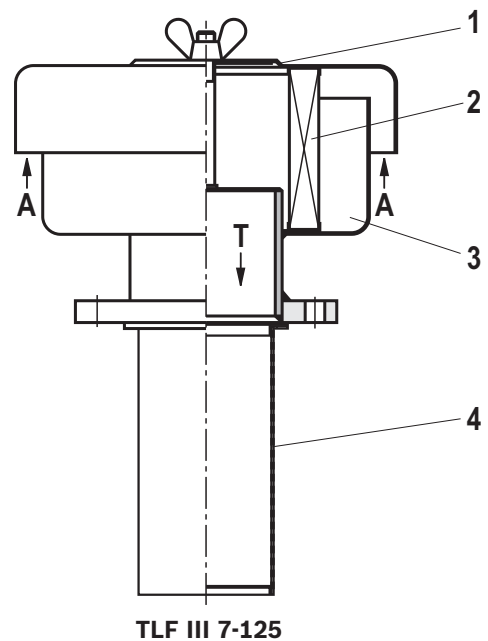
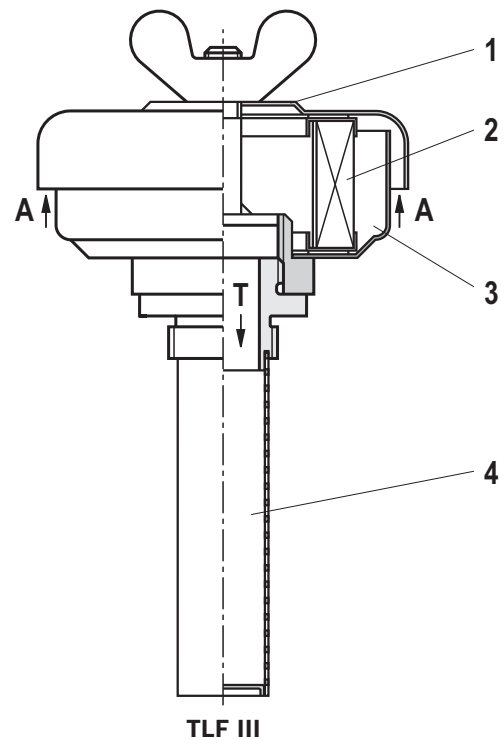
Design TLF III 1-25 to 7-125

Sizes 1-25 to 6-80 have a male thread, sizes 7-125 and 8-250 have a flange.

Version III also has a 130 µm filling strainer (4).

When air humidity is high or when there are large temperature variations, the exchanged air may condense and promote the oxidation process of the oil. This leads to corrosion and damage to the fluid tank.

In this case, we recommend use of our "AS10" water-absorbent filter material to dry the incoming air.



Technical data

(For applications outside these parameters, please consult us!)

General									
Installation position		Tank structure							
Operating temperature		°C [°F]	-40 °C ... +100 °C [-40 °F... 212 °F]						
Ambient temperature range		°C [°F]	-40 ... +65 [-40 ... +149]						
Storage conditions		▶ NBR seal	°C [°F] -40 ... +65 [-40 ... +149]; max. relative air humidity of 65%						
		▶ FKM seal	°C [°F] -20 ... +65 [-4 ... +149]; max. relative air humidity of 65%						
Weight		Size	TLF I 1-25	TLF I 2-32	TLF I 3-40	TLF I 4-50	TLF I 5-65	TLF I 6-80	TLF I 7-125
		kg	0.5	0.6	2.0	1.6	1.5	2.4	11.4
		[lbs]	[1.1]	[1.3]	[4.4]	[3.5]	[3.3]	[5.3]	[25.1]
		Size	TLF II 8-250	TLF II 1-25	TLF II 2-32	TLF II 3-40	TLF II 4-50	TLF II 5-65	TLF II 6-80
		kg	51.0	0.6	0.7	2.3	1.7	1.8	2.7
		[lbs]	[112.4]	[1.3]	[1.5]	[5.1]	[3.8]	[4.0]	[6.0]
		Size	TLF III 1-25	TLF III 2-32	TLF III 3-40	TLF III 4-50	TLF III 5-65	TLF III 6-80	TLF III 7-125
		kg	0.7	0.8	2.4	1.8	1.6	2.5	11.6
		[lbs]	[1.5]	[1.8]	[5.3]	[4.0]	[3.5]	[5.5]	[25.6]
Material		▶ Filter cover	Polyamide (sizes 1-25 and 2-32), tin-coated steel (NG 3-40 to 8-250)						
		▶ Lower filter part	Tin-coated steel (version I), aluminum / tin-coated steel (versions II and III)						
		▶ Filling strainer	Stainless steel / aluminum						
		▶ Seals	NBR or FKM						

Compatibility with permitted hydraulic fluids**TLF II, TLF III 1-25 to 7-125**

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oil	HLP	NBR	DIN 51524

Other fluids upon request**TLF I**

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oil	HLP	NBR	DIN 51524
Bio-degradable	- insoluble in water	HETG	VDMA 24568
		HEES	
	- soluble in water	HEPG	VDMA 24568
Flame-resistant	- water-free	HFDU, HFDR	VDMA 24317
	- containing water	HFAS	DIN 24320
		HFAE	
	HFC	NBR	VDMA 24317

**Important information on hydraulic fluids:**

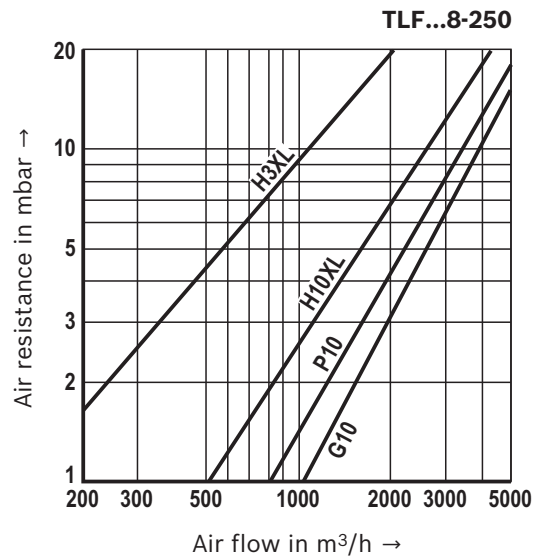
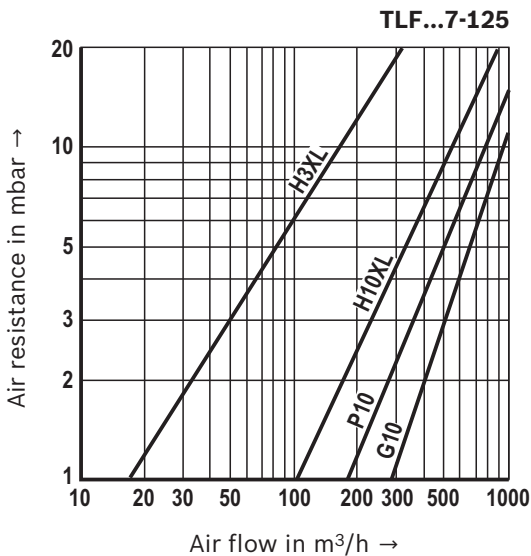
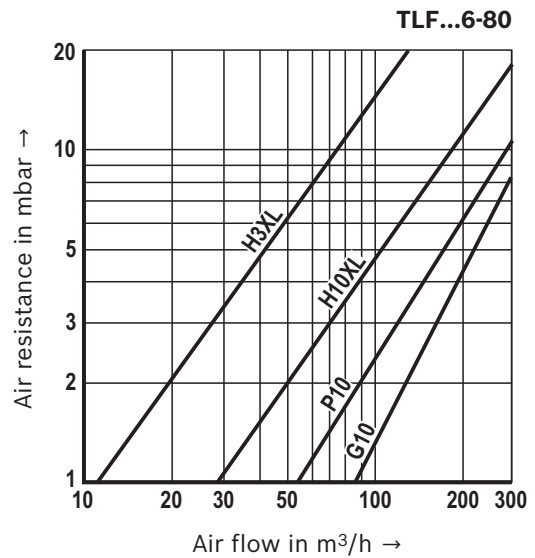
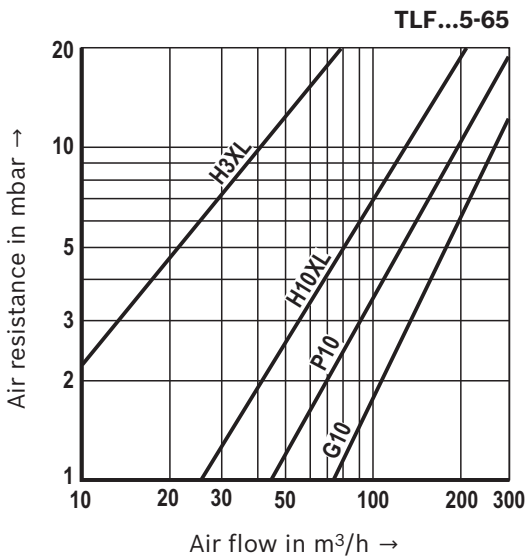
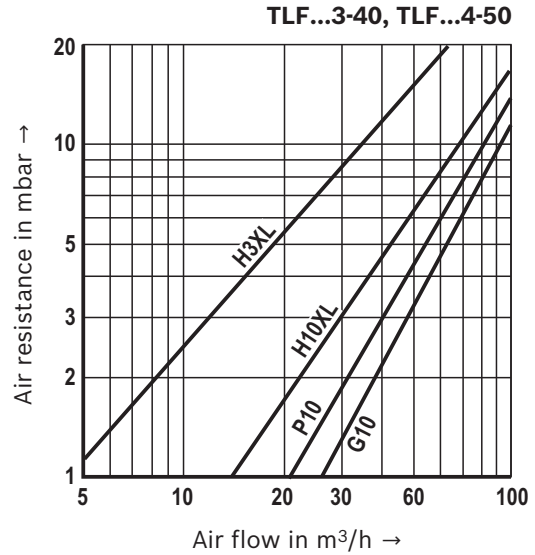
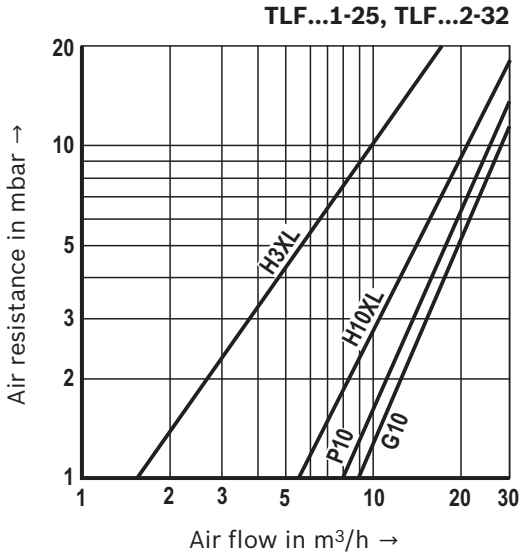
- ▶ For more information and data on the use of other hydraulic fluids, please refer to data sheet 90220 or contact us.
- ▶ **Flame-resistant - containing water:** due to possible chemical reactions with materials or surface coatings of machine and system components, the service life with these hydraulic fluids may be less than expected.

Filter materials made of filter paper (cellulose) must not be used, filter elements with glass fiber material must be used instead.

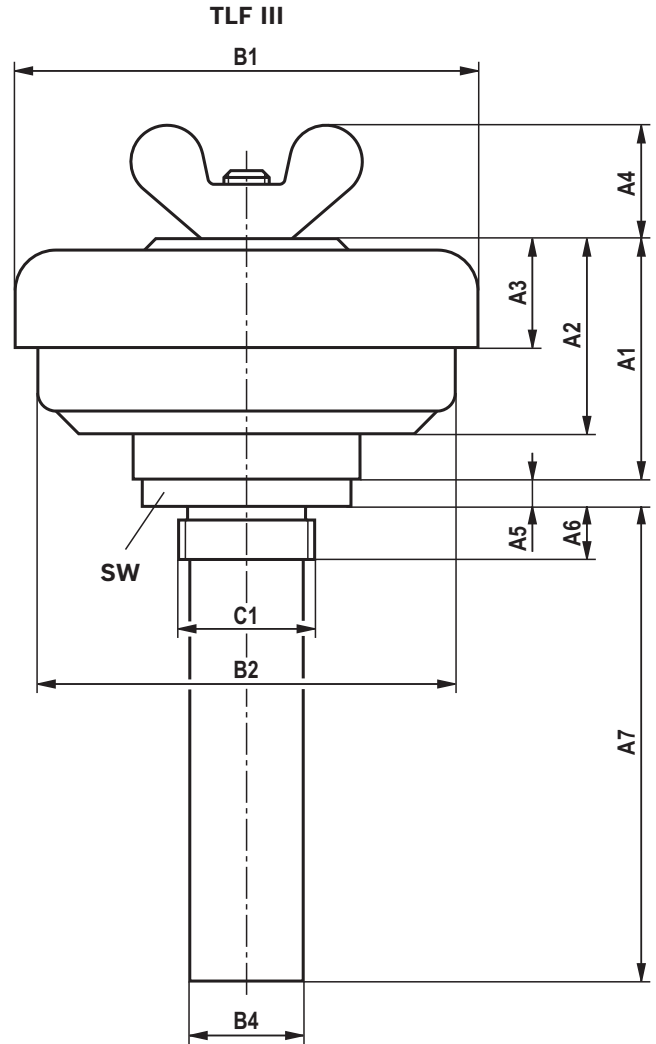
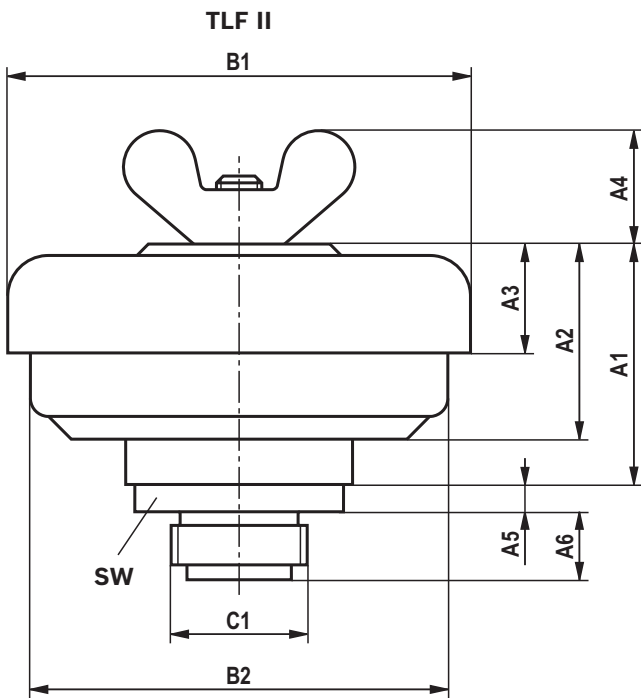
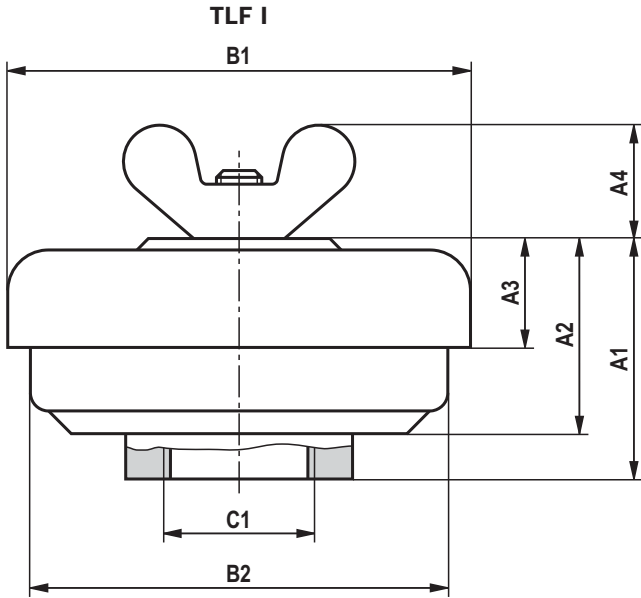
- ▶ **Bio-degradable:** If filter materials made of filter paper are used, the filter life may be shorter than expected due to material incompatibility and swelling.

Characteristic curves

(measured at test temperature = 20 °C [68 °F])



Dimensions: TLF I; II; III size 1-25 to 6-80
 (dimensions in mm [in])

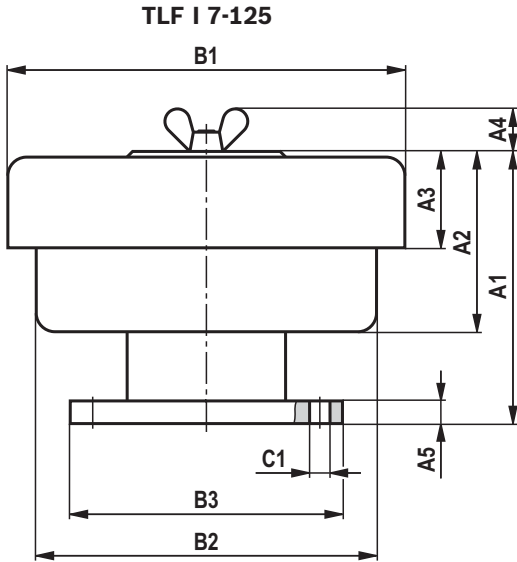


Dimensions: TLF I; II; III size 1-25 to 6-80

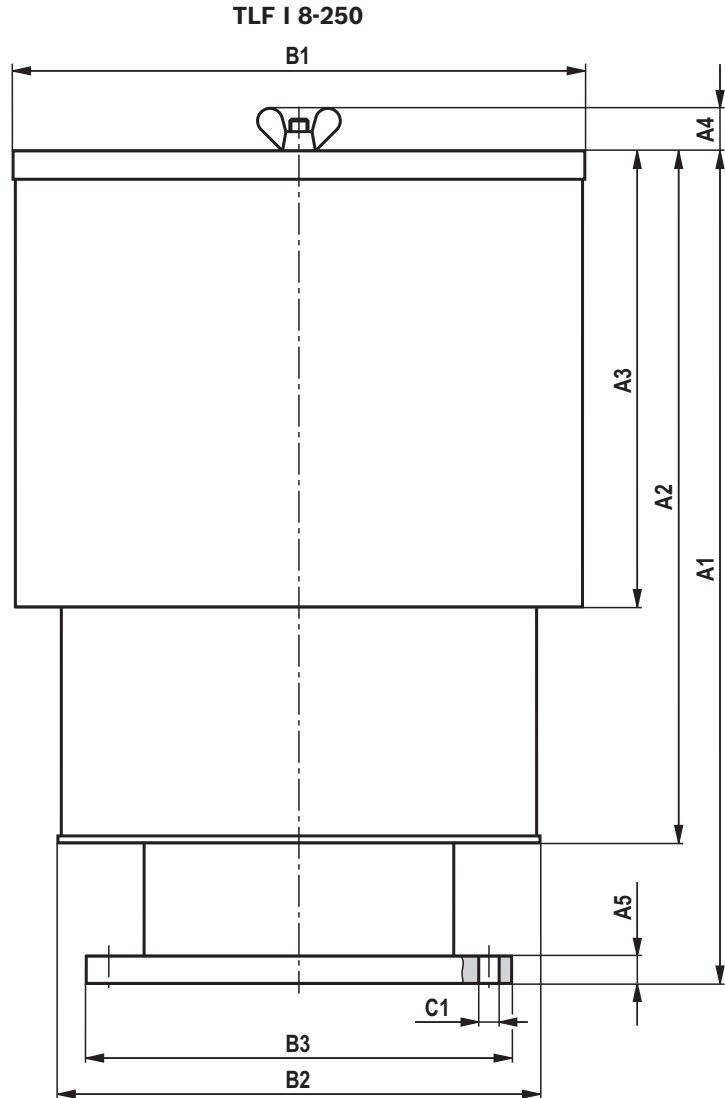
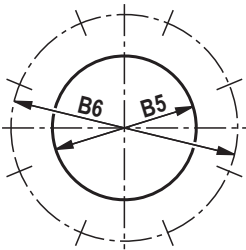
(dimensions in mm [in])

Type	A1	A2	A3	A4	A5	A6	A7	Ø B1	Ø B2	Ø B3	Ø B4	C1	SW						
TLF I 1-25	53 [2.09]	43 [1.69]	24 [0.94]	25 [0.98]	-	-	-	104 [4.09]	92 [3.62]	-	-	G1	-						
TLF I 2-32	63 [2.48]											G1 1/4							
TLF I 3-40	90 [3.54]	80 [3.15]	46 [1.81]					G1 1/2											
TLF I 4-50								G2											
TLF I 5-65								G2 1/2											
TLF I 6-80	88 [3.46]	78 [3.07]	45 [1.77]					210 [8.27]	190 [7.48]			240 [9.45]		G3					
TLF II 1-25	53 [2.09]	43 [1.69]	24 [0.94]	25 [0.98]	6 [0.24]	25 [0.98]	-	104 [4.09]	92 [3.62]	-	-	G1	46 [1.81]						
TLF II 2-32	63 [2.48]											G1 1/4	55 [2.17]						
TLF II 3-40	90 [3.54]	80 [3.15]	46 [1.81]					7 [0.28]	26 [1.02]			-	177 [6.97]	162 [6.38]	-	-	-	G1 1/2	60 [2.36]
TLF II 4-50																		G2	75 [2.95]
TLF II 5-65																		8 [0.31]	28 [1.10]
TLF II 6-80	88 [3.46]	78 [3.07]	45 [1.77]					9 [0.35]	30 [1.18]			210 [8.27]	190 [7.48]	G3	105 [4.13]				
TLF III 1-25	53 [2.09]	43 [1.69]	24 [0.94]	25 [0.98]	6 [0.24]	17 [0.67]	107 [4.21]	104 [4.09]	92 [3.62]	-	-	G1	28 [1.10]	46 [1.81]					
TLF III 2-32	63 [2.48]						131 [5.16]						34 [1.34]	G1 1/4	55 [2.17]				
TLF III 3-40	90 [3.54]	80 [3.15]	46 [1.81]				7 [0.28]	18 [0.71]	155 [6.10]			177 [6.97]	162 [6.38]	-	-	-	G1 1/2	42 [1.65]	60 [2.36]
TLF III 4-50									185 [7.28]								53 [2.09]	G2	75 [2.95]
TLF III 5-65									8 [0.31]								20 [0.79]	217 [8.54]	67 [2.64]
TLF III 6-80	88 [3.46]	78 [3.07]	45 [1.77]				9 [0.35]	22 [0.87]	254 [10.00]			210 [8.27]	190 [7.48]	82 [3.23]	G3	105 [4.13]			

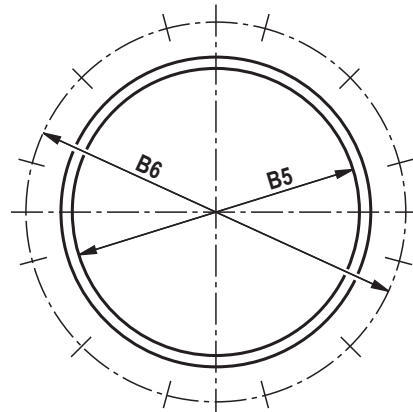
Dimensions: TLF I 7-125, 8-250
(dimensions in mm [in])



hole pattern

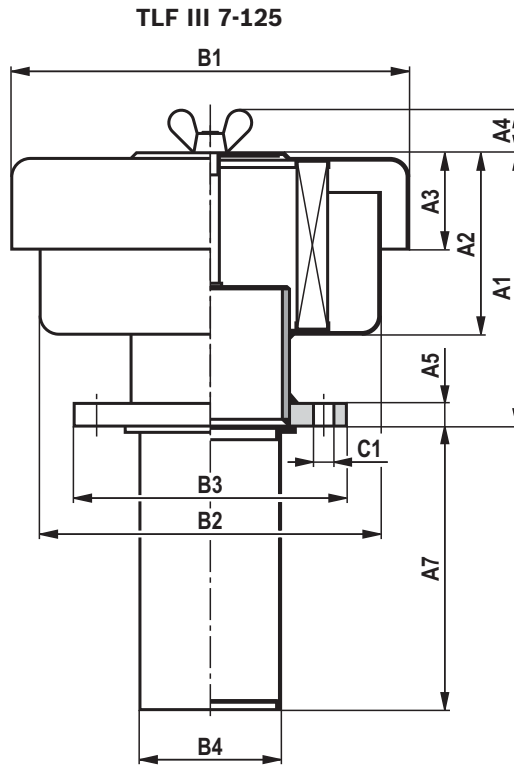


hole pattern

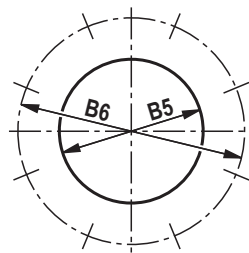


Type	A1	A2	A3	A4	A5	Ø B1	Ø B2	Ø B3	Ø B5	Ø B6	C1
TLF I 7-125	263 [10.35]	154 [6.06]	85 [3.35]	36 [1.42]	20 [0.79]	350 [13.78]	300 [11.81]	375 [14.76]	130 [5.12]	200 [7.87]	8x Ø 18 [8xØ0.71]
TLF I 8-250	734 [28.90]	620 [24.41]	402 [15.83]	37.5 [1.48]	24 [0.94]	502 [19.76]	419 [16.50]	-	253 [9.96]	335 [13.19]	12x Ø 18 [12xØ0.71]

Dimensions: TLF III 7-125
(dimensions in mm [in])



hole pattern



Type	A1	A2	A3	A4	A5	A7	Ø B1	Ø B2	Ø B3	Ø B4	Ø B5	Ø B6	C1
TLF III 7-125	263 [10.35]	154 [6.06]	85 [3.35]	36 [1.42]	20 [0.79]	250 [9.84]	350 [13.78]	300 [11.81]	240 [9.45]	124 [4.88]	130 [5.12]	200 [7.87]	8x Ø 18 [8x Ø 0.71]

Ordering code spare parts

Filter element

01	02	03	04	05	06
7.			- S00 -	0 -	

Filter element

01	Design	7.
----	--------	----

Size

02	TLF ... 1-25; 2-32	002
	TLF ... 3-40; 4-50; 5-65	004
	TLF ... 6-80	006
	TLF I 7-125; TLF III 7-125	007
	TLF I 8-250	008

Filter rating in μm

Air retention, ASHRAE 52.1, test dust SAE fine

03	Glass fiber material, not cleanable	95% for particles > 0.3 μm	H10XL
	Nominal Filter paper, not cleanable	95% for particles > 1.24 μm	P10

Pressure difference

04	Max. admissible pressure differential of the filter element of 1 bar [14.5 psi]	S00
----	---	-----

Bypass valve

05	Without bypass valve	0
----	-----------------------------	---

Seal

06	NBR seal	M
	FKM seal	V

Order example:

7.002 P10-S00-0-M

Material no.: R928039681

For detailed information on Rexroth filter elements please refer to data sheet 51420.

Preferred program replacement elements

Filter element type	Filter material/material no. P10
7.002 P10-S00-0-M	R928039681
7.004 P10-S00-0-M	R928016621
7.006 P10-S00-0-M	R928016624
7.007 P10-S00-0-M	R928016627
7.008 P10-S00-0-M	

Assembly, commissioning, maintenance

Assembly

- ▶ The filter connection must correspond to the tank connection.
- ▶ If the size is TLF ... 7 or the TLF I 8 version is used (version with DIN flanges), the hole pattern (DIN 2573) of the tank must be compared to the dimensions from the “Dimensions” chapter prior to installation.
- ▶ Install the filter on the tank.
- ▶ When installing the filter, the required servicing height of the replacement filter must be taken into account.
- ▶ For servicing reasons, we recommend installing the filter in a vertical position.
- ▶ All filter components must be tightened manually.

Commissioning

- ▶ It is not necessary to commission the filter.

Maintenance

Exchange of the filter element

- ▶ No maintenance indicator is provided, but the filter element must be changed at minimum every 6 months.
- ▶ Since the ambient conditions are very different depending on the place of installation, we recommend considering more frequent replacement of the filter element according to the specific installation conditions for TLF tank breathing filters.

Notice:

Vacuum switch (upon request) for monitoring the suction pressure can be mounted on the tank separately.

WARNING!

- ▶ The filter must not be operated without a filter element

Notes:

- ▶ All work on the filter must be performed by trained specialists.
- ▶ Proper function and safety are only guaranteed if original Bosch Rexroth filter elements and spare parts are used.
- ▶ Warranty becomes void if the delivered item is changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental condition that do not comply with the installation conditions.

Tightening torques

Series		TLF I 1-25 -6-80	TLF II 1-25 -6-80	TLF I 7-125 and 8-250; TLF III 7-125
Breathing filter Tightening torque with $\mu_{\text{total}} = 0.14$	Nm [lbf-ft]	Tighten by hand	Max. 20 [14.8]	80 ± 8 [59 ± 5.9]
Wing nut		Tighten by hand		

Directives and standardization

Classification according to the Pressure Equipment

Directive

Off-line tank breathing filters according to 51415 are not classified as devices or components for the purpose of the Pressure Equipment Directive 97/23/EC (PED).

Directive 94/9/EC (ATEX)

According to the assessment of the risk of ignition, the tank breathing filters must not be used in explosive areas.

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It must be remembered that our products are subject to a natural process of wear and aging.

Tank mounted return line filter with filter element according to DIN 24550

Type 10TEN0040 to 1000; 10TE2000 and 2500

RE 51424

Edition: 2014-05

Replaces: 06.11



H7855_d

- ▶ Size according to **DIN 24550**: 0040 to 1000
- ▶ additional sizes: 2000, 2500
- ▶ Nominal pressure 10 bar [145 psi]
- ▶ Connection up to 4"
- ▶ Operating temperature -10 °C to $+100\text{ °C}$ [14 °F to 212 °F]

Features

The tank mounted return line filters are designed for installation on fluid tanks. Their function is to separate solid materials from fluids.

They distinguish themselves by the following:

- ▶ Filter for tank mounting
- ▶ Special highly efficient filter materials
- ▶ Filtration of very fine particles and high dirt holding capacity across a broad pressure differential range
- ▶ High collapse resistance of the filter elements
- ▶ Optionally equipped with mechanical optical maintenance indicator with memory function
- ▶ Available as an option with different electrical switching elements, modular design
- ▶ By default, the filters are equipped with a bypass valve integrated in the filter housing
- ▶ Optional measuring port

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Ordering code filter

Sizes 0040 to 0100

01	02	03		04	05		06		07		08		09		09		09		09
10TE	N		-		A00	-		-		-		-		-		-		-	

Series

01	Return line filter, simple 10 bar [145 psi]	10TE
----	---	------

Filter element

02	With filter element according to DIN 24550	N
----	--	---

Size

03	TEN... Filter element according to DIN 24550	0040 0063 0100
----	---	----------------------

Filter rating in µm

04	Nominal	Paper, not cleanable	P10 P25
	Nominal	Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100
	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$)	Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$)	Water-absorbing, not cleanable	AS3 AS6 AS10 AS20

Pressure differential

05	Max. admissible pressure differential of the filter element 30 bar [435 psi] – Filter with bypass valve	A00
----	--	-----

Maintenance indicator

06	Without maintenance indicator – bypass cracking pressure 3.5 bar [51 psi]	0
	Pressure gauge ¹⁾ 0...6 bar [0...87 psi] right – bypass cracking pressure 3.5 bar [51 psi]	MR
	Maintenance indicator, aluminum, mech.-optical, switching pressure 2.2 bar [32 psi], with additional pressure gauge ¹⁾ 0...6 bar [0...87 psi] right – bypass cracking pressure 3.5 bar [51 psi]	MRV2,2
	Maintenance indicator, polyamide, mech./optical, switching pressure 2.2 bar [32 psi] – bypass cracking pressure 3.5 bar [51 psi]	P2.2
	Maintenance indicator, aluminum, mech./optical, switching pressure 0.8 bar [11.6 psi] – bypass cracking pressure 3.5 bar [51 psi]	V0.8
	Maintenance indicator, aluminum, mech./optical, switching pressure 1.5 bar [21.8 psi] – bypass cracking pressure 3.5 bar [51 psi]	V1.5
	Maintenance indicator, aluminum, mech./optical, switching pressure 2.2 bar [32 psi] – bypass cracking pressure 3.5 bar [51 psi]	V2.2

Seal

07	NBR seal	M
	FKM seal	V

¹⁾ When using a pressure gauge, the maximum permissible operating pressure is reduced to 6 bar [87 psi].

Ordering code filter

Sizes 0040 to 0100

01	02	03	04	05	06	07	08	09	09	09	09
10TE	N		-	A00	-	-	-	-	-	-	-

Main inlet

08	Frame size	0040	0063-0100	
	Connection			
	G 3/4	●	X	R3
	G 1	X	●	R4
	1 1/16-12 UN -2B [SAE 12]	X	X	U4
	1 5/16-12 UN -2B [SAE 16]	X	X	U9
<input checked="" type="checkbox"/> Standard connection <input type="checkbox"/> Alternative connection				

Supplementary information (Multiple specifications possible)

09	Breathing filter	F
	Ventilation filter with surge protection	FN
	Threaded coupling right (not possible with pressure gauge right)	MR
	without bypass valve	NB
	Outlet pipe L110 mm [10.92 cm]	R110
	Outlet pipe L150 mm [5,9 in]	R150
	Outlet pipe L250 mm [9.8 inch]	R250

Order example:

10TEN0040-H10XLA00-P2,2-M-R3

Further versions (filter materials, connections,...) are available on request.

Ordering code filter

sizes 0160 to 2500

01	02	03	04	05	06	07	08	09	09
10TE				- A00	-	-	-	-	-

Series

01	Return line filter, simple 10 bar [145 psi]	10TE
----	---	------

Filter element

02	With filter element according to DIN 24550 (only with frame size 0160 - 1000)	N
----	--	---

Size

03	TEN... Filter element according to DIN 24550	0160 0250 0400 0630 1000
	TE... (Filter elements according to Bosch Rexroth standard)	2000 2500

Filter rating in μm

04	Nominal Paper, not cleanable	P10 P25
	Nominal Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100
	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$) Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$) Water-absorbing, not cleanable	AS3 AS6 AS10 AS20

Pressure differential

05	Max. admissible pressure differential of the filter element 30 bar [435 psi] – Filter with bypass valve	A00
----	--	-----

Maintenance indicator

06	Without maintenance indicator – bypass cracking pressure 3.5 bar [51 psi]	0
	Pressure gauge ¹⁾ 0...6 bar [0...87 psi] right – bypass cracking pressure 3.5 bar [51 psi]	ML
	Maintenance indicator, aluminum, mech.-optical, switching pressure 2.2 bar [32 psi], with additional pressure gauge ¹⁾ 0...6 bar [0...87 psi] right – bypass cracking pressure 3.5 bar [51 psi]	MLV2.2
	Maintenance indicator, polyamide, mech./optical, switching pressure 2.2 bar [32 psi] – bypass cracking pressure 3.5 bar [51 psi]	P2.2
	Maintenance indicator, aluminum, mech./optical, switching pressure 0.8 bar [11.6 psi] – bypass cracking pressure 3.5 bar [51 psi]	V0.8
	Maintenance indicator, aluminum, mech./optical, switching pressure 1.5 bar [21.8 psi] – bypass cracking pressure 3.5 bar [51 psi]	V1.5
	Maintenance indicator, aluminum, mech./optical, switching pressure 2.2 bar [32 psi] – bypass cracking pressure 3.5 bar [51 psi]	V2.2

Seal

07	NBR seal	M
	FKM seal	V

¹⁾ When using a pressure gauge, the maximum permissible operating pressure is reduced to 6 bar [87 psi].

Ordering code filter

sizes 0160 to 2500

01	02	03	04	05	06	07	08	09	09					
10TE				-	A00	-		-		-		-		

Main inlet

08	Frame size	0160	0250	0400	0630	1000	2000	2500	
	Connection								
	G 1 1/4	●	X						R5
	G 1 1/2	X	●						R6
	SAE 1 1/4" - 3000 psi	X	X			-			S5
	SAE 1 1/2" - 3000 psi	X	X						S6
	1 7/8-12 UN 2B [SAE 24]	X	X						U6
	SAE 2" - 3000 psi			●	X				S8
	SAE 2 1/2" - 3000 psi			X	●				S9
	SAE 3" - 3000 psi					●	X	X	S10
	SAE 4" - 3000 psi					X	●	●	S12
<p>● Standard connection</p> <p>X Alternative connection</p>									

Supplementary information (Multiple specifications possible)

09	Threaded coupling left (not possible with pressure gauge left)	ML
	without bypass valve	NB

Order example:

10TEN0630-H10XLA00-P2,2-M-S9

Further versions (filter materials, connections,...) are available on request.

Preferred types

Filter rating 3 µm, 6 µm, 10 µm and 20 µm

Filter type	Flow in l/min [gpm] with $v = 30 \text{ mm}^2/\text{s}$ [142 SUS] and $\Delta p = 0.5 \text{ bar}$ [7.25 psi] ¹⁾	Connection	Material no.	Connection	Material no.
10TEN0040-H3XLA00-P2,2-M-...	23 [6.1]	..R3	R928041292	..U4	R928041293
10TEN0063-H3XLA00-P2,2-M-...	35 [9.2]	..R4	R928041294	..U9	R928041295
10TEN0100-H3XLA00-P2,2-M-...	52 [13.7]	..R4	R928041296	..U9	R928041297
10TEN0160-H3XLA00-P2,2-M-...	105 [27.7]	..R5	R928041298	..S5	R928041299
10TEN0250-H3XLA00-P2,2-M-...	160 [42.3]	..R6	R928041300	..S6	R928041301
10TEN0400-H3XLA00-P2,2-M-...	290 [76.6]	..S8	R928041302	..S9	R928041303
10TEN0630-H3XLA00-P2,2-M-...	410 [108.3]	..S9	R928041304	..S8	R928041305
10TEN1000-H3XLA00-P2,2-M-...	560 [147.9]	..S10	R928041306	..S12	R928041307
10TE2000-H3XLA00-P2,2-M-...	900 [237.7]	..S12	R928041308	..S10	R928041309
10TE2500-H3XLA00-P2,2-M-...	1100 [290.6]	..S12	R928041310	..S10	R928041311
10TEN0040-H6XLA00-P2,2-M-...	40 [10.6]	..R3	R928052853	..U4	R928052854
10TEN0063-H6XLA00-P2,2-M-...	58 [15.3]	..R4	R928052855	..U9	R928052856
10TEN0100-H6XLA00-P2,2-M-...	76 [20.1]	..R4	R928052857	..U9	R928052858
10TEN0160-H6XLA00-P2,2-M-...	179 [47.3]	..R5	R928044990	..S5	R928053324
10TEN0250-H6XLA00-P2,2-M-...	248 [65.5]	..R6	R928046782	..S6	R928048118
10TEN0400-H6XLA00-P2,2-M-...	442 [116.8]	..S8	R928046816	..S9	R928052860
10TEN0630-H6XLA00-P2,2-M-...	545 [144.0]	..S9	R928044949	..S8	R928044930
10TEN1000-H6XLA00-P2,2-M-...	910 [240.4]	..S10	R928046825	..S12	R928052861
10TEN2000-H6XLA00-P2,2-M-...	1310 [346.1]	..S12	R928052862	..S10	R928052264
10TEN2500-H6XLA00-P2,2-M-...	1440 [380.4]	..S12	R928052863	..S10	R928044973
10TEN0040-H10XLA00-P2,2-M-...	43 [11.3]	..R3	R928041271	..U4	R928041272
10TEN0063-H10XLA00-P2,2-M-...	62 [16.4]	..R4	R928041273	..U9	R928041274
10TEN0100-H10XLA00-P2,2-M-...	80 [21.1]	..R4	R928041275	..U9	R928041276
10TEN0160-H10XLA00-P2,2-M-...	190 [50.2]	..R5	R928041277	..S5	R928041278
10TEN0250-H10XLA00-P2,2-M-...	260 [68.7]	..R6	R928041279	..S6	R928041280
10TEN0400-H10XLA00-P2,2-M-...	460 [121.5]	..S8	R928041281	..S9	R928041282
10TEN0630-H10XLA00-P2,2-M-...	560 [147.9]	..S9	R928041283	..S8	R928041284
10TEN1000-H10XLA00-P2,2-M-...	970 [256.2]	..S10	R928041285	..S12	R928041286
10TE2000-H10XLA00-P2,2-M-...	1350 [356.6]	..S12	R928041288	..S10	R928041289
10TE2500-H10XLA00-P2,2-M-...	1450 [383.0]	..S12	R928041290	..S10	R928041291
10TEN0040-H20XLA00-P2,2-M-...	62 [16.4]	..R3	R928041199	..U4	R928041200
10TEN0063-H20XLA00-P2,2-M-...	80 [21.1]	..R4	R928041201	..U9	R928041202
10TEN0100-H20XLA00-P2,2-M-...	95 [25.1]	..R4	R928041203	..U9	R928041204
10TEN0160-H20XLA00-P2,2-M-...	260 [68.7]	..R5	R928041205	..S5	R928041206
10TEN0250-H20XLA00-P2,2-M-...	320 [84.5]	..R6	R928041208	..S6	R928041209
10TEN0400-H20XLA00-P2,2-M-...	560 [147.9]	..S8	R928041210	..S9	R928041211
10TEN0630-H20XLA00-P2,2-M-...	630 [166.4]	..S9	R928041223	..S8	R928041224
10TEN1000-H20XLA00-P2,2-M-...	1270 [335.5]	..S10	R928041225	..S12	R928041226
10TE2000-H20XLA00-P2,2-M-...	1600 [422.7]	..S12	R928041228	..S10	R928041229
10TE2500-H20XLA00-P2,2-M-...	1680 [443.8]	..S12	R928041230	..S10	R928041231

¹⁾ An appropriate differential pressure via the filter and measuring device according to ISO 3968. The differential pressure measured on the maintenance indicator is lower.

Ordering code accessories

Electronic switching element for maintenance indicators

If an electronic switching element with signal suppression up to 30 °C [86 °F] is used (WE-2SPSU-M12 X 1, **R928028411**), it has to be ensured that the aluminum version of the mechanical-optical maintenance indicator must be used. These maintenance indicators are referred

to in the filter type key as “V0.8”, “V1.5” or “V2.2”. Also refer to the chapter "Spare parts and accessories".

The temperature-controlled signal processing does not work with mechanical-optical maintenance indicators made of polyamide.

01	02	03
WE	-	-

Maintenance indicator

01	electronic switching element	WE
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Type of signal

02	1 switching point	1SP
	2 switching points, 3 LED	2SP
	2 switching points, 3 LED and signal suppression up to 30 °C [86 °F]	2SPSU

Connector

03	Round plug-in connection M12 x 1, 4-pole	M12x1
	Rectangular connector, 2-pole, design A according to EN-175301-803, only possible with “1SP” type of signal.	EN175301-803

Material numbers of the electronic switching elements

With the “mechanical-optical maintenance indicator” option (V..., P...), two mechanical optical maintenance indicators are installed at the factory. So you must always order two electric switching elements as optional accessories.

Material no.	Type	Signal	Switching points	Connector	LED
R928028409	WE-1SP-M12 x 1	Changeover	1	M12 x 1	No
R928028410	WE-2SP-M12 x 1	Normally open (at 75%) / normally closed contact (at 100%)	2		3 pieces
R928028411	WE-2SPSU-M12 x 1				
R928036318	WE-1SP-EN175301-803	Normally closed contact	1	EN 175301-803	No

Ordering code accessories

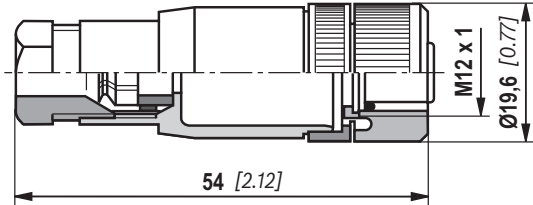
(dimensions in mm [inch])

Mating connectors according to IEC 60947-5-2

for electronic switching element with round plug-in connection M12 x 1

Mating connector suitable for K24 4-pole, M12 x 1 with screw connection, cable gland Pg9.

Material no. R900031155

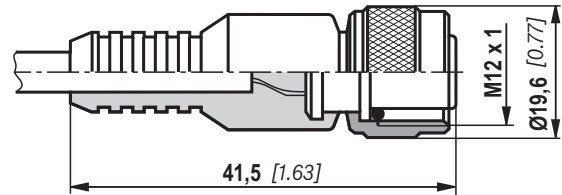


Mating connector suitable for K24-3m 4-pole, M12 x 1 with potted-in PVC cable, 3 m long.

Line cross-section: 4 x 0.34 mm²

Core marking: 1 brown 2 white
3 blue 4 black

Material no. R900064381



For more round plug-in connections and technical data refer to data sheet 08006.

Order example:

Tank mounted return line filter with mechanical-optical maintenance indicator for $p_{nom.} = 10 \text{ bar [145 psi]}$, size 0100, with filter element 10 μm and electronic switching element M12 x 1 with 1 switching point for hydraulic fluid mineral oil HLP according to DIN 51524.

Filter with mech. optical maintenance indicator:	10TEN0100-H10XLA00-P2,2-M-R4	Material no.: R928041275
Switching element:	WE-1SP-M12 x 1	Material no.: R928028409
Mating connector:	Mating connector suitable for K24 4-pin, M12 x 1 with screw connection, Cable gland Pg9	Material no.: R900031155

Ordering code accessories

(dimensions in mm [inch])

Outlet pipes

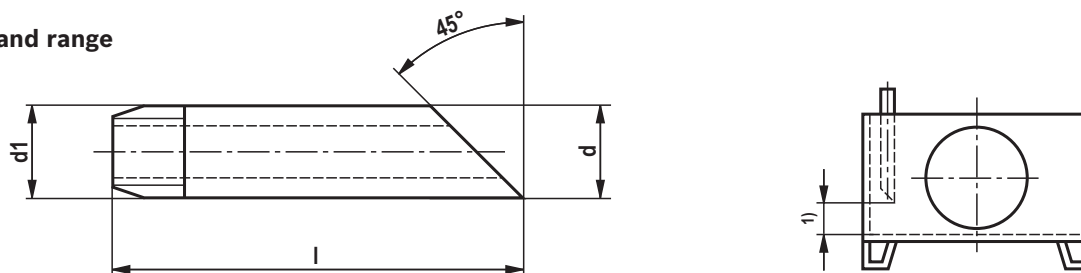
Outlet pipe, pluggable, size 0040-0100

The outlet pipes are plugged onto the filter bowl outlet piece. Correct seat is confirmed by an audible click. After plug-on, the outlet pipe can no longer be removed.

Material no.	Description
R928038744	ACC-R-10TEN0040-0100-R110
R928038745	ACC-R-10TEN0040-0100-R150
R928038746	ACC-R-10TEN0040-0100-R250

Outlet pipe, with threaded connection from size 0160

Dimensions and range



- 1) Recommended distance to tank bottom (unless otherwise specified): 60...160 mm [2.4...6.3 inch]
From a pipe length of 400 mm [15.75 inch], we strongly recommend fixing the outlet pipe by means of a tank-internal pipe bracket.

DN	d	Dimensions d1	l	galvanized	ES (stainless)	
				Description: PIPE AB23-03/R...	Description: PIPE AB23-03/R... -ES	
				Material no.	Material no.	
40 [1.57]	48.3 [1.90]	R 1 1/2	250 [9.84]	1 1/2 L = 250	R900109501	R900062066
			400 [15.75]	1 1/2 L = 400	R900083146	R900074878
			800 [31.50]	1 1/2 L = 800	R900029854	-
			1300 [51.18]	1 1/2 L = 1300	R900302230	-
			2000 [78.74]	1 1/2 L = 2000	R900229461	-
50 [1.97]	60.3 [2.37]	R 2	400 [15.75]	2 L = 400	R900727174	R900987657
			800 [31.50]	2 L = 800	R900029856	R900226706
80 [3.15]	88.9 [3.50]	R 3	160 [6.30]	3 L = 160	R900062845	-
			200 [7.87]	3 L = 200	R900061785	R900062067
			350 [13.78]	3 L = 350	R900084137	-
			650 [25.59]	3 L = 650	R900076923	R900757513
			800 [31.50]	3 L = 800	R900029838	R900987653

Thread:

Whitworth pipe thread according to DIN 2999 part 1, poppet 1:16

Material/surface treatment:

St 33-1 according to DIN 17100/galvanized (B) according to DIN 2444
1.4541

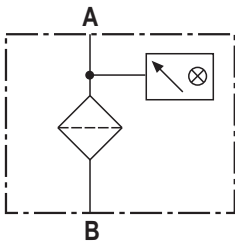
Order example/search term

Pipe according to DIN 2440 (ISO 65) with thread R 1 1/2 and L = 250 mm [9.84 inch], galvanized:

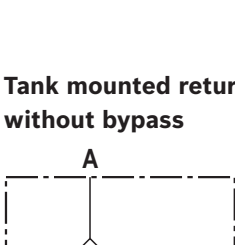
PIPE AB23-03/R 1 1/2 L = 250 material no. R900109501

Symbols

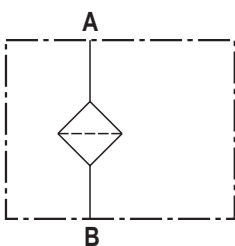
Tank mounted return line filter without bypass and with mechanical indicator



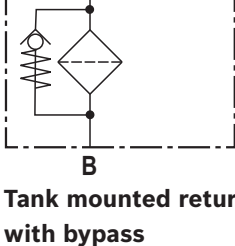
Tank mounted return line filter with bypass and mechanical indicator



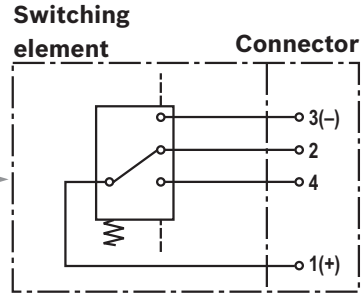
Tank mounted return line filters without bypass



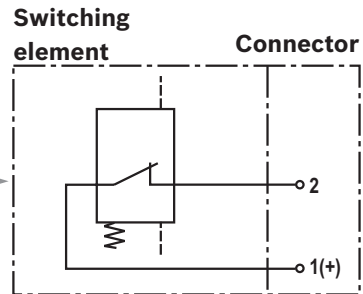
Tank mounted return line filters with bypass



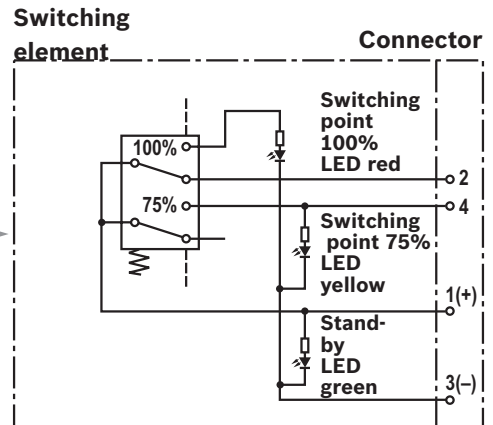
Electronic switching element for maintenance indicator



WE-1SP-M12 x 1

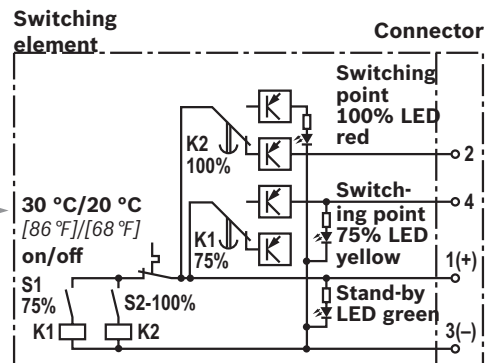


WE-1SP-EN175301-803



WE-2SP-M12 x 1

Circuit diagram drawn in plugged condition (operating state)



WE-2SPSU-M12 x 1

Circuit diagram drawn in plugged condition at temperature > 30 °C [86 °F] (operating state)

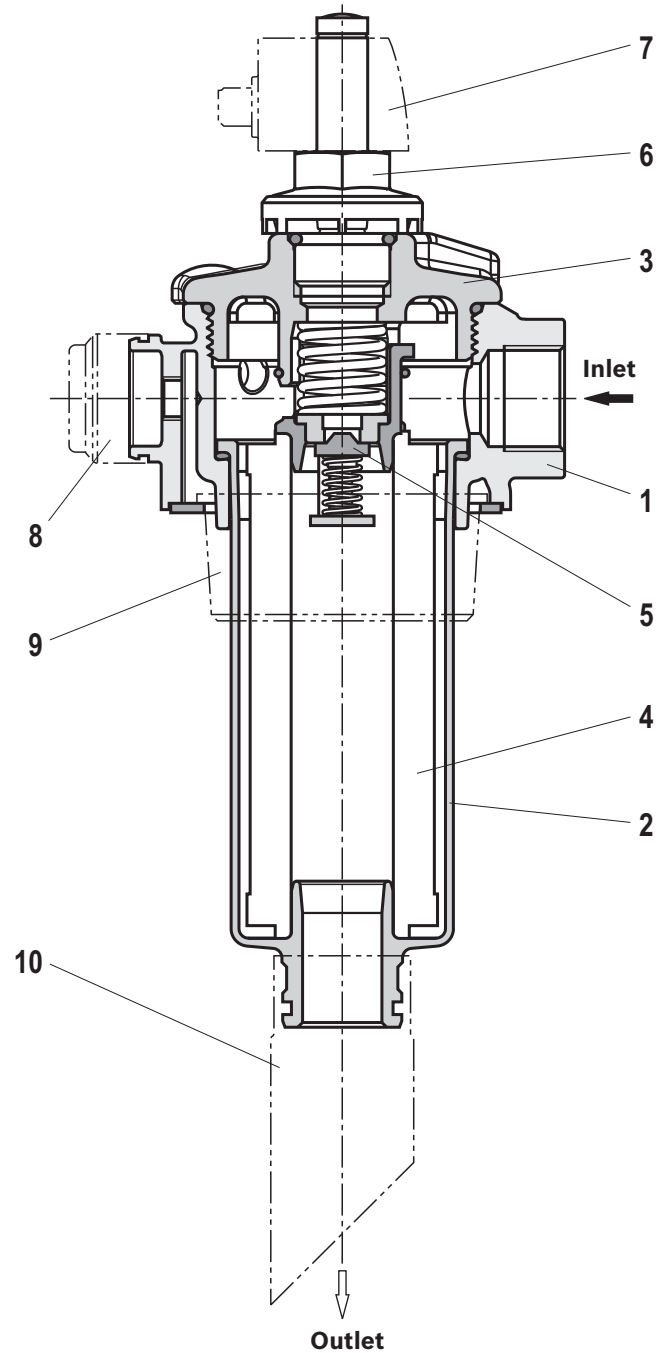
Function, section

The tank mounted return line filter is provided in the return line for direct attachment onto the tank of a hydraulic or lubrication system. It can also be used as filling or bypass filter. The filter basically consists of filter head (1) filter head (2), cover (3), filter element (4), as well as a bypass valve (5).

Optionally, the filter is equipped with mechanical optical maintenance indicator (6). The electronic maintenance indicator is connected via the electronic switching element (7) with 1 or 2 switching points (see p. 7), which has to be ordered separately.

During operation, the hydraulic fluid reaches the filter housing via the inlet; here, it flows through the filter element (4) from the outside to the inside and is cleaned according to the filter rating. The dirt particles filtered out settle in the filter head (2) and in the filter element (4). Via the outlet, the filtered hydraulic fluid enters the tank. In case of contamination, the necessary filter element exchange is displayed by the maintenance indicator (6). The electronic switching element (7) is attached to the mechanical optical maintenance indicator (6) and held by means of a locking ring.

Depending on the filter size, more additional functions are available (only for size 0040 - 0100) - e.g. a breathing filter (8), surge protection (9) or return pipes (10) in different lengths – also refer to the chapter “Ordering Codes Accessories”.



Type 10TEN0063

Technical data (For applications outside these parameters, please consult us!)

General							
Size	Size		0040	0063	0100	0160	0250
Weight	kg [lbs]		1.4 [3.09]	1.6 [3.53]	1.8 [3.97]	4.5 [9.92]	5.0 [11.03]
Size	Size		0400	0630	1000	2000	2500
Weight	kg [lbs]		8.0 [17.64]	10.0 [22.05]	18 [39.7]	21.5 [47.42]	27 [59.55]
Installation position			vertical				
Ambient temperature range	°C [°F]		-10 ... +65[+14...+149] (shortly down to -30 [-22])				
Storage conditions	- NBR seal	°C [°F]	-40 ... +65[-40... +149]; max. relative air humidity 65%				
	- FKM seal	°C [°F]	-20 ... +65[-4... +149]; max. relative air humidity 65%				
Material	- Filter cover		Carbon fiber reinforced plastic (sizes 0040...0100) Aluminum (sizes 0160...2500)				
	- Filter head		Aluminum				
	- Filter bowl		Carbon fiber reinforced plastic (sizes 0040...0630) Steel aluminized (sizes 1000...2500)				
	- Bypass valve		Plastic				
	- Visual Maintenance indicator (P2.2) (V...)		Plastic PA6				
	- Electronic switching element		Aluminum				
	- Pressure gauge		Plastic PA6				
	- Seals		Plastic				
	- Seals		NBR / FKM				
Surface requirement tank opening	- Roughness depth	R_z max.	µm	25 (10TDN0040...0100) and 6.3...16 (from 10TDN0160)			
	- Flatness	t_E max.	µm	0.3...0.5 (10TDN0040...0100) and 0.2 (from 10TDN0160)			
Hydraulic							
Maximum operating pressure	bar [psi]		10 [145]				
Hydraulic fluid temperature range	°C [°F]		-10...+100 [+14...+212]				
Minimum conductivity of the medium	pS/m		300				
Fatigue strength according to ISO 10771	Load cycles		> 10 ⁵ with max. operating pressure				
Type of pressure measurement of the maintenance indicator			Back pressure				
Assignment: Response pressure of the maintenance indicator / cracking pressure of the bypass valve	bar [psi]		Response pressure of the maintenance indicator		Cracking pressure of the bypass valve		
			without maintenance indicator		3.5 ± 0.35 [50.8 ± 5.1]		
			with pressure gauge				
			V0.8 ± 0.15 [11.6 ± 2.2]				
			V1.5 ± 0.2 [21.8 ± 2.9]				
			V2.2 ± 0.3 [31.9 ± 4.4]				
	P2.2 +0.45/-0,25 [31.9(+6.4/-3,6)]						
Filtration direction			From the outside to the inside				

Technical data

(For applications outside these parameters, please consult us!)

Electric (electronic switching element)				
Electrical connection	Round plug-in connection M12 x 1, 4-pole			Standard connection EN 175301-803
Version	1SP-M12 x 1	2SP-M12 x 1	2SPSU-M12 x 1	1SP-EN175301-803
Contact load, direct voltage	$A_{max.}$	1		
Voltage range	$V_{max.}$	150 (AC/DC)	10-30 (DC)	250 (AC)/200 (DC)
max. switching power with resistive load	W	20		70
Switching type	- 75% signal	-	Normally open contact	-
	- 100% signal	Changeover	Normally closed contact	Normally closed contact
	- 2SPSU		Signal interconnection at 30 °C [86 °F], return switching at 20 °C [68 °F]	
Display via LEDs in the electronic switching element 2SP...		Stand-by (LED green); 75 % switching point (LED yellow) 100 % switching point (LED red)		
Protection class according to EN 60529 IP 65		IP 67		IP 65
Ambient temperature range	°C [°F]	-25...+85 [-13...+185]		
For direct voltage above 24 V, spark extinguishing is to be provided for protecting the switching contacts.				
Weight	electronic switching element: - with round plug-in connection M12x1	kg [lbs]	0,1 [0.22]	

Filter element				
Glass fiber material H.XL	Single-use element on the basis of inorganic fiber			
		Filtration ratio according to ISO 16889 up to $\Delta p = 5 \text{ bar [72.5 psi]}$	Achievable oil cleanliness according to ISO 4406 (SAE-AS 4059)	
Particle separation	H20XL	$\beta_{20(c)} \geq 200$	19/16/12 ... 22/17/14	
	H10XL	$\beta_{10(c)} \geq 200$	17/14/10 ... 21/16/13	
	H6XL	$\beta_{6(c)} \geq 200$	15/12/10 ... 19/14/11	
	H3XL	$\beta_{5(c)} \geq 200$	13/10/8 ... 17/13/10	
admissible pressure differential A	bar [psi]	30 [435]		

Compatibility with permitted hydraulic fluids

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oil	HLP	NBR	DIN 51524
Biodegradable	- insoluble in water	HETG	VDMA 24568
		HEES	
	- soluble in water	HEPG	VDMA 24568
Flame-resistant	- water-free	HFDU, HFDR	VDMA 24317
	- containing water	HFAS	DIN 24320
		HFAE	
		HFC	
		NBR	VDMA 24317



Important information on hydraulic fluids!

- For more information and data on the use of other hydraulic fluids, please refer to data sheet 90220 or contact us!
- **Flame-resistant – containing water:** due to possible chemical reactions with materials or surface coatings of machine and system components, the service life with these hydraulic fluids may be less than expected.

Filter materials made of filter paper (P) may not be used, filter elements with glass fiber material have to be used instead.

- **Biodegradable:** If filter materials made of filter paper are used, the filter life may be shorter than expected due to material incompatibility and swelling.

Characteristic curves: H3XL

(measured with mineral oil HLP46 according to DIN 51524)

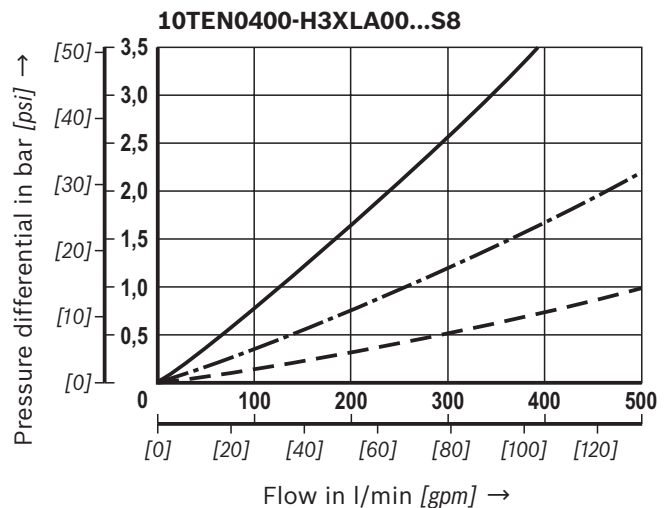
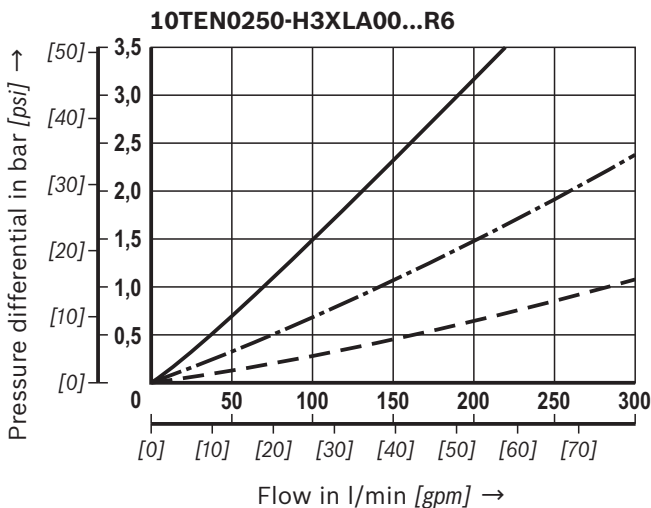
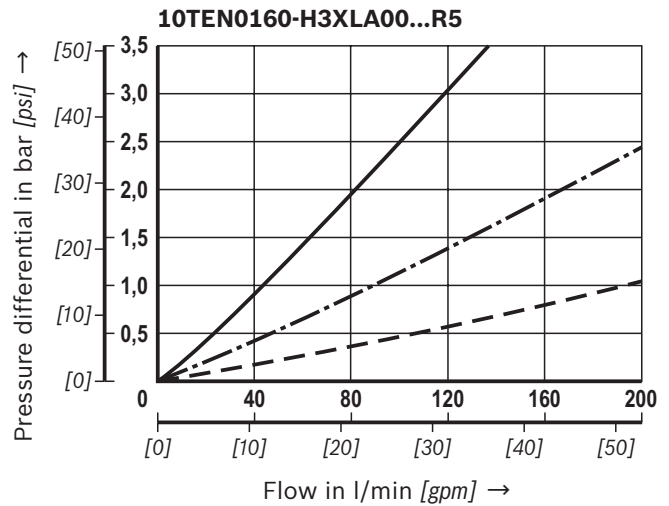
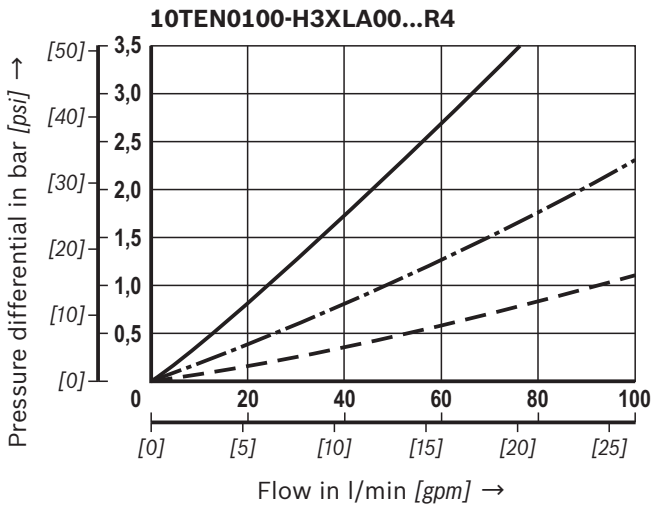
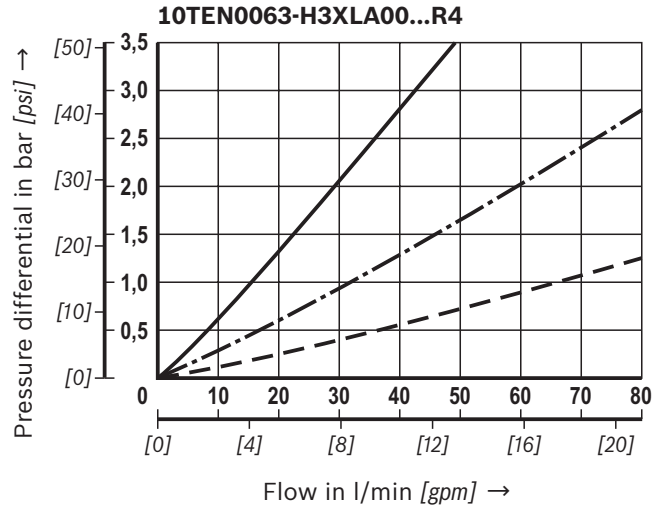
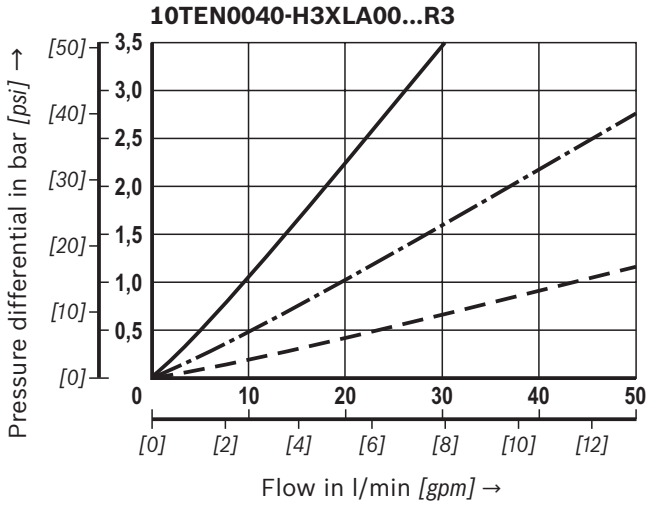
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filter

recommended initial Δp for design = 0.5 bar [7.25 psi]

Selection of the perfect filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 — 140 mm²/s [649 SUS]
 - · - 68 mm²/s [315 SUS]
 - - - 30 mm²/s [142 SUS]



Characteristic curves: H3XL

(measured with mineral oil HLP46 according to DIN 51524)

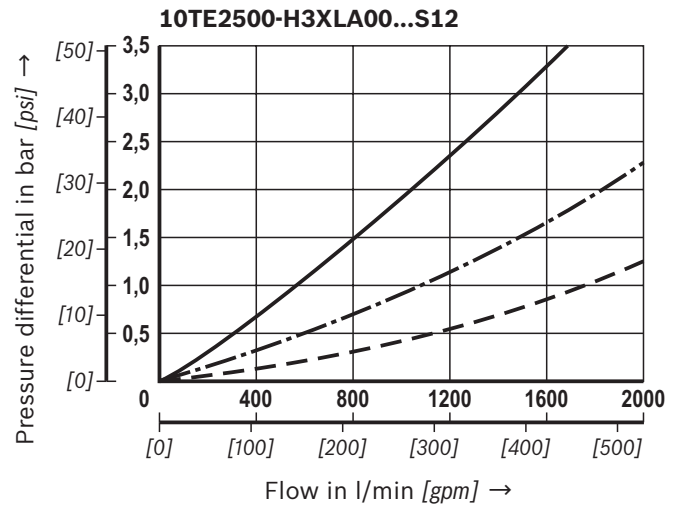
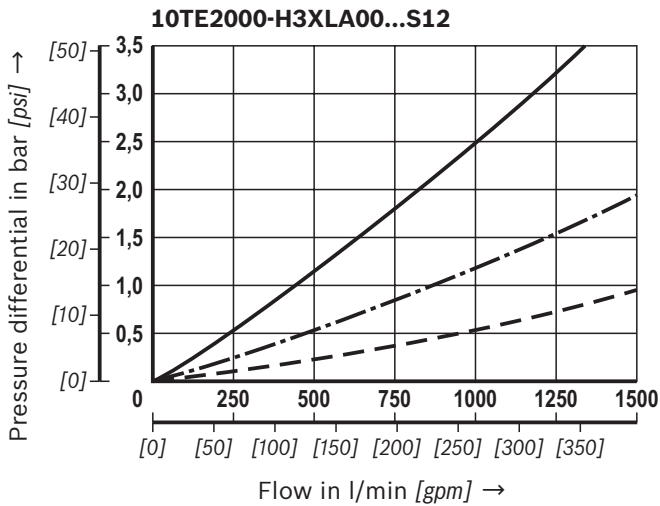
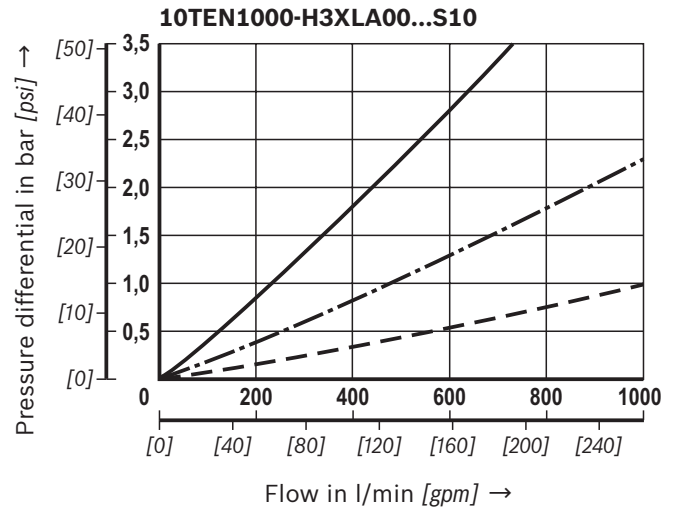
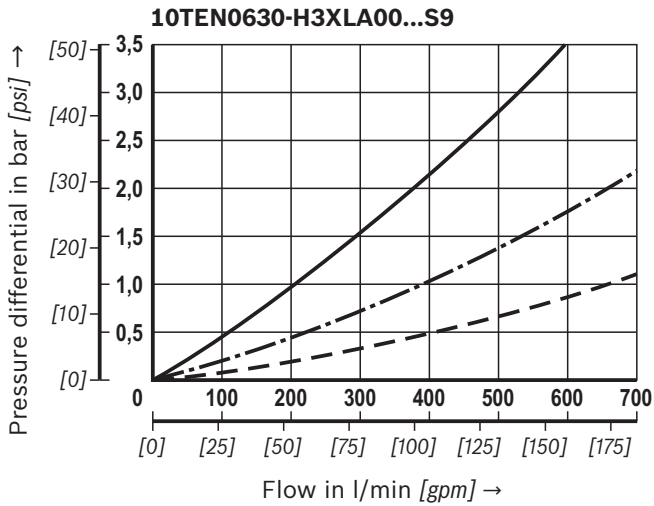
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filter

recommended initial Δp for design = 0.5 bar [7.25 psi]

Selection of the perfect filter is made possible by our online “Bosch Rexroth FilterSelect” design software.

Oil viscosity:
 — 140 mm²/s [649 SUS]
 - · - 68 mm²/s [315 SUS]
 - - - 30 mm²/s [142 SUS]



Characteristic curves: H10XL

(measured with mineral oil HLP46 according to DIN 51524)

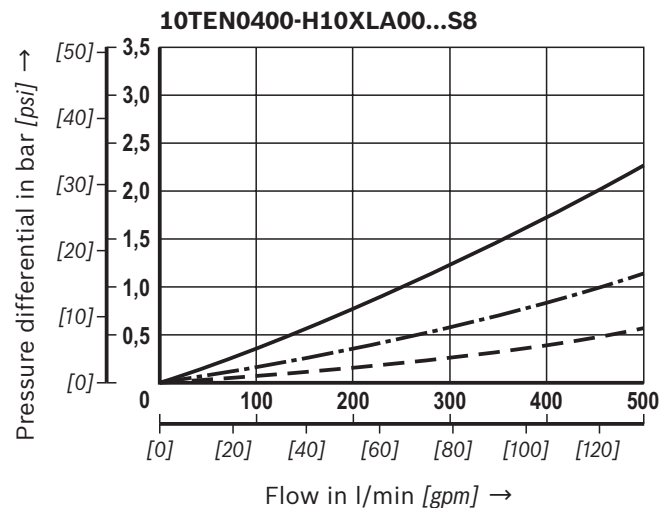
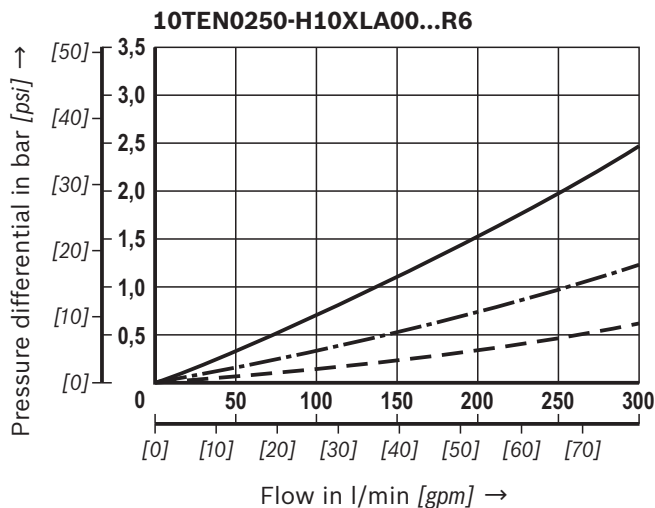
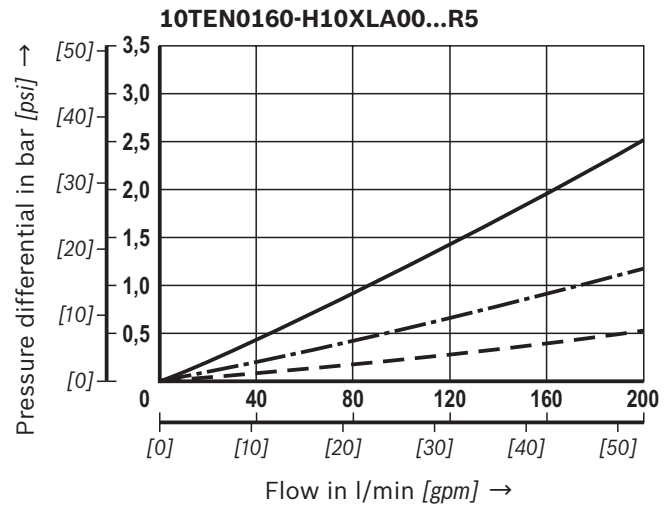
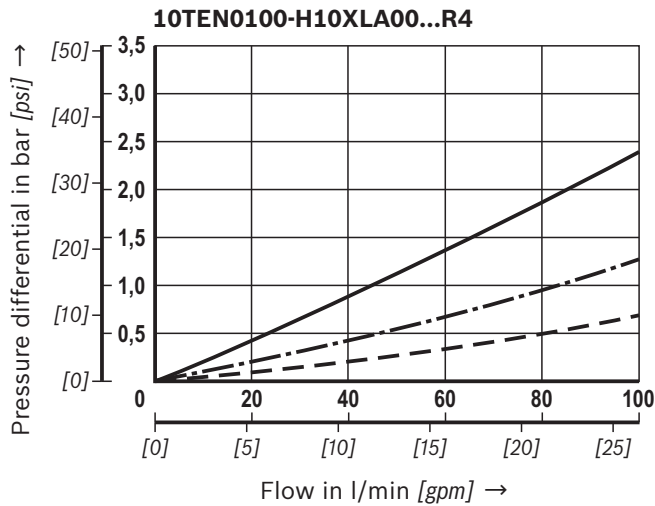
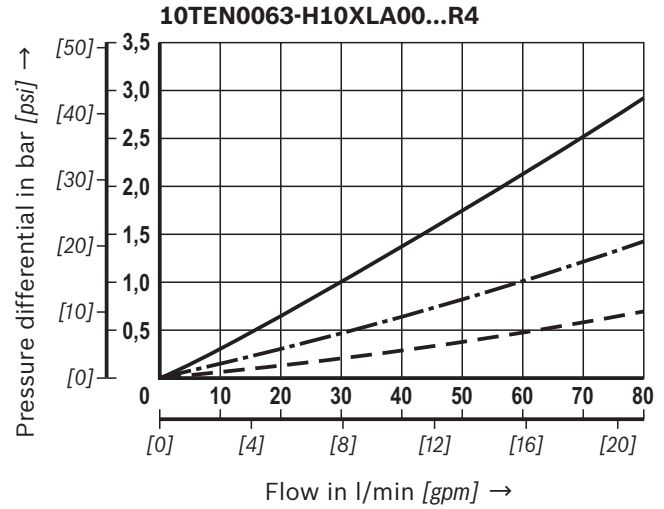
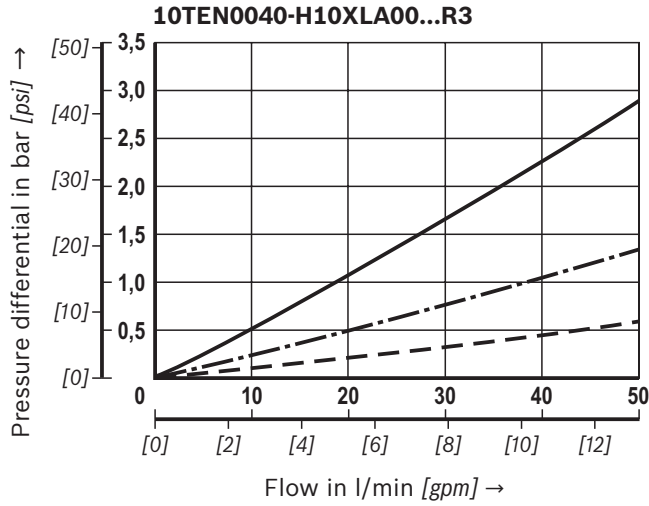
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filter

recommended initial Δp for design = 0.5 bar [7.25 psi]

Selection of the perfect filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 — 140 mm²/s [649 SUS]
 - · - 68 mm²/s [315 SUS]
 - - - 30 mm²/s [142 SUS]



Characteristic curves: H10XL

(measured with mineral oil HLP46 according to DIN 51524)

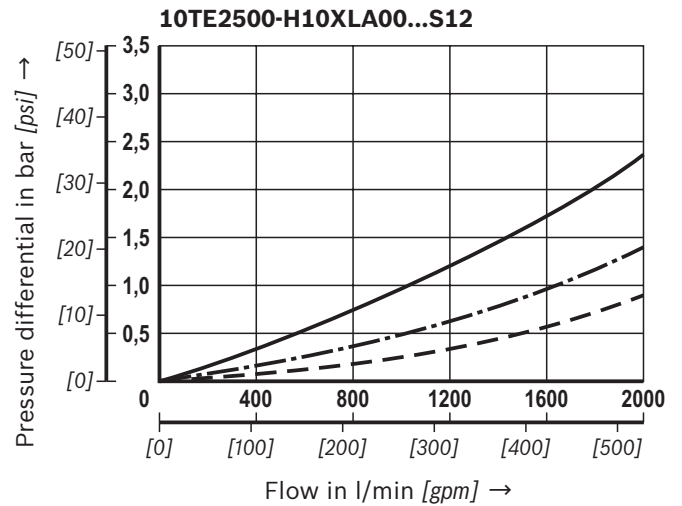
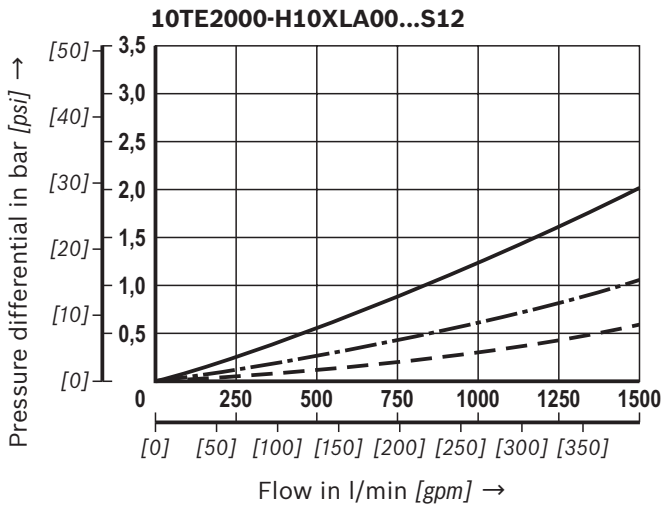
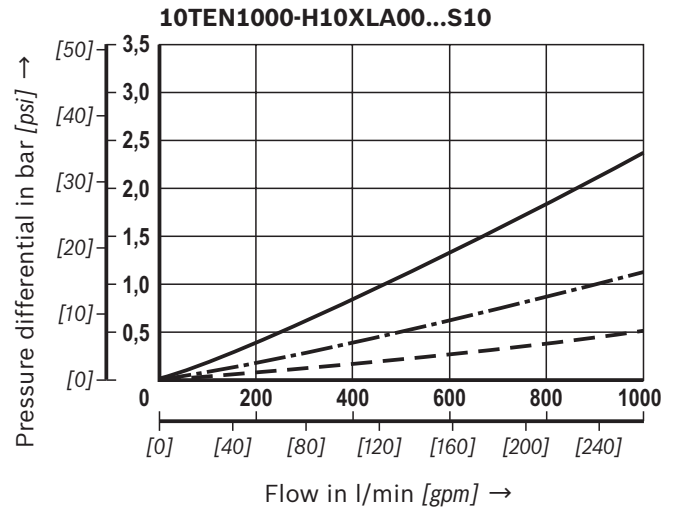
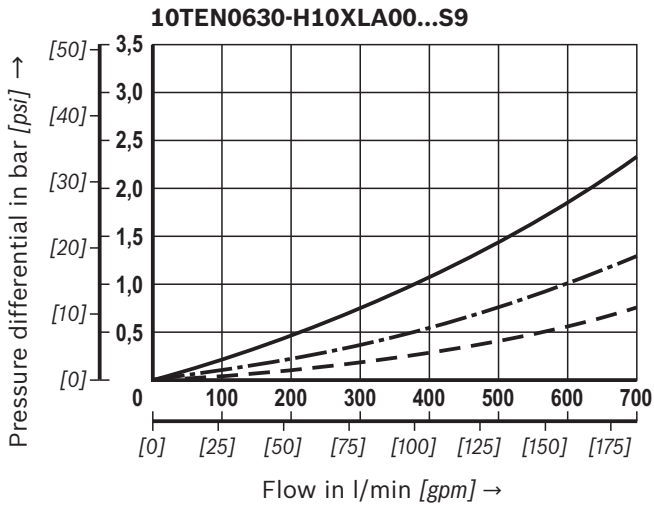
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filter

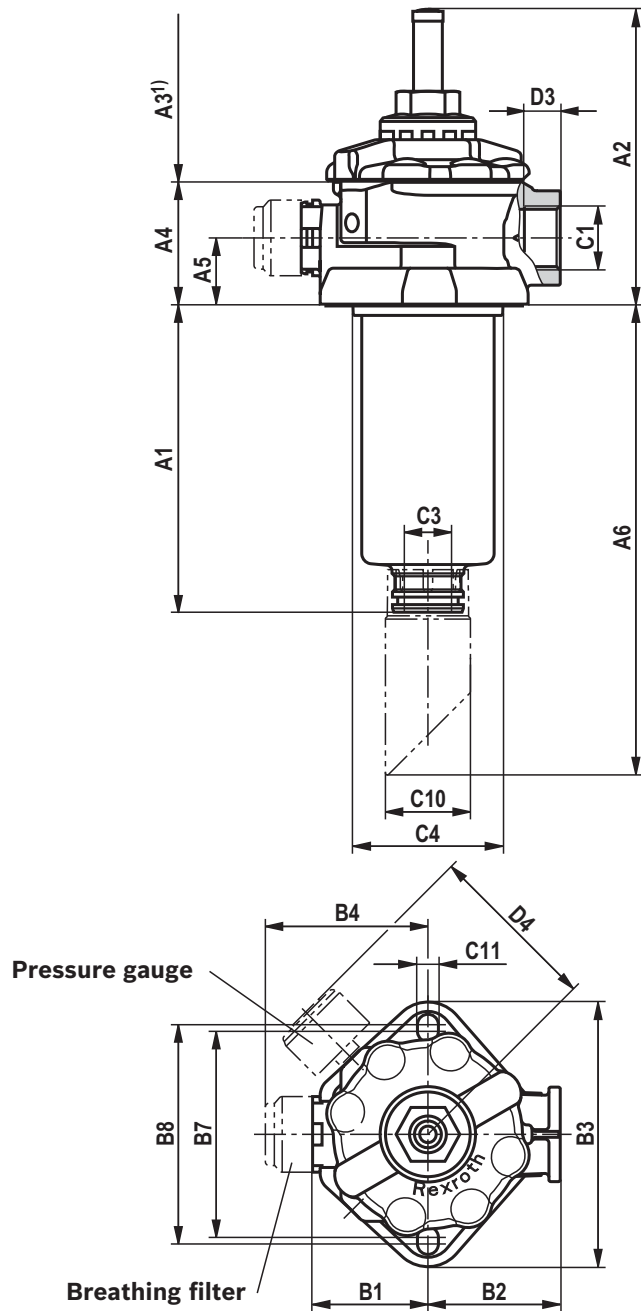
recommended initial Δp for design = 0.5 bar [7.25 psi]

Selection of the perfect filter is made possible by our online “Bosch Rexroth FilterSelect” design software.

Oil viscosity:
 — 140 mm²/s [649 SUS]
 - - 68 mm²/s [315 SUS]
 - - - 30 mm²/s [142 SUS]



Dimensions: 10TEN0040, 0063, 0100
(dimensions in mm [inch])

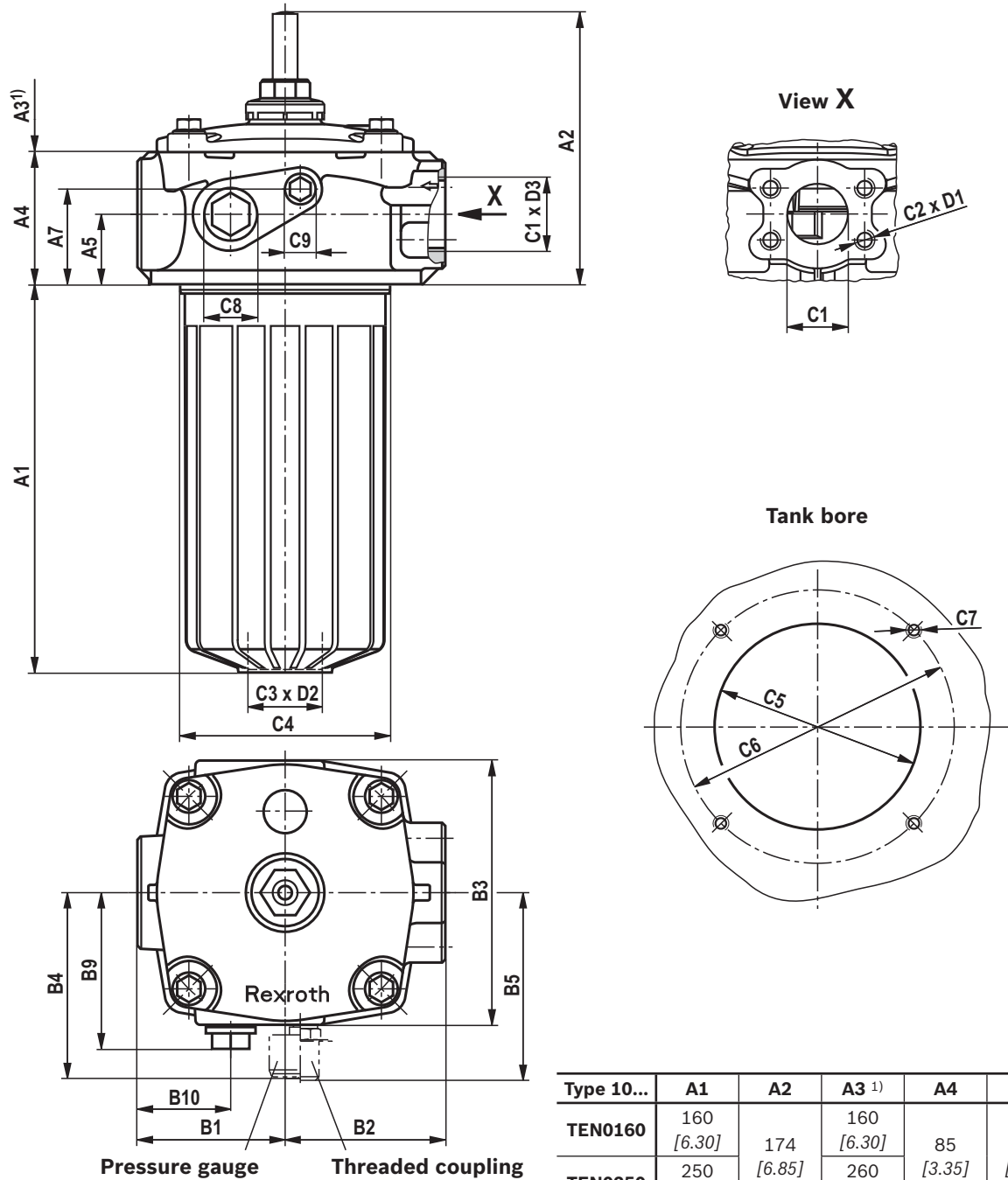


Type 10...	A1	A2	A3 ¹⁾	A4	A5	A6	
TEN0040	103 [4.06]		100 [3.94]			R110	190 [7.38]
						R150	230 [9.06]
						R250	330 [12.99]
TEN0063	163 [6.42]	155 [6.10]	160 [6.30]	65 [2.56]	35 [1.38]	R110	250 [9.84]
						R150	290 [11.42]
						R250	390 [15.35]
TEN0100	253 [9.96]		250 [9.84]			R110	340 [13.39]
						R150	380 [14.96]
						R250	480 [18.90]

¹⁾ Servicing height for filter element exchange

Type 10...	B1	B2	B3	B4	B7	B8	C1 connection		C3	ØC4	ØC5	ØC6	C7	ØC10	C11	D3	D4
							Standard	Optional									
TEN0040							G 3/4	G 1 1 1/16-12 UN-2B 1 5/16-12 UN-2B									
TEN0063	61 [2.40]	70 [2.76]	140 [5.51]	86 [3.39]	109 [4.29]	116 [4.57]	G 1	G 3/4 1 1/16-12 UN-2B 1 5/16-12 UN-2B	NW 25	80 [3.15]	90 [3.54]	115 [4.53]	M10	45 [1.77]	11 [0.43]	19 [0.75]	90 [3.54]
TEN0100							G 1	G 3/4 1 1/16-12 UN-2B 1 5/16-12 UN-2B									

Dimensions: 10TEN0160, 0250
(dimensions in mm [inch])



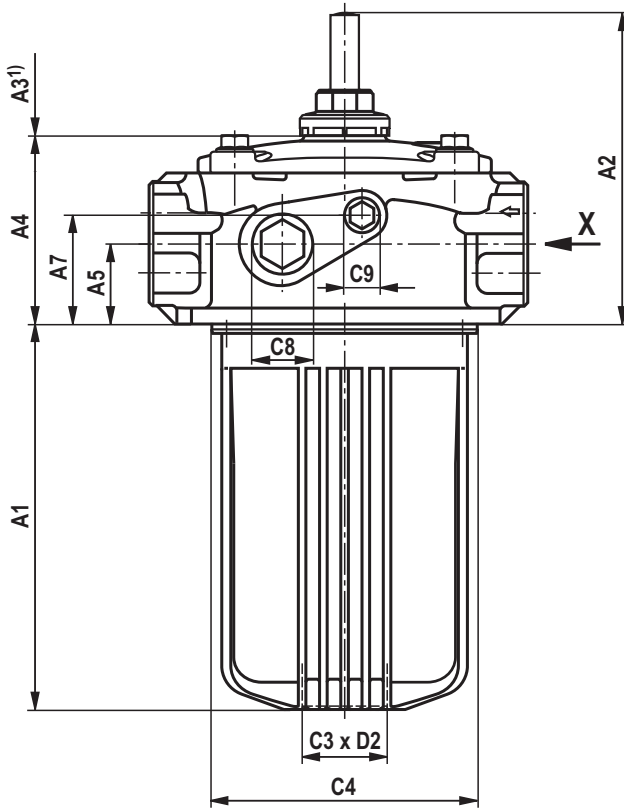
Type 10...	A1	A2	A3 ¹⁾	A4	A5	A7
TEN0160	160 [6.30]	174 [6.85]	160 [6.30]	85 [3.35]	45 [1.77]	60 [2.36]
TEN0250	250 [9.84]		260 [10.24]			

¹⁾ Servicing height for filter element exchange

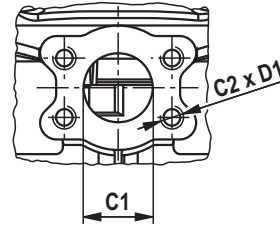
Type 10...	B1	B2	B3	B4	B5	B6	B9	B10	C1 connection		
									Standard	Optional	
TEN0160	95 [3.74]	103 [4.06]	170 [6.69]	120 [4.72]	116 [4.57]	153 [6.02]	100.5 [3.96]	60 [2.36]	G 1 1/4	G 1 1/2 SAE 1 1/2" 3000 psi SAE 1 1/2" 3000 psi	SAE 1 1/4" 3000 psi 1 7/8-12 UN-2B
TEN0250									G 1 1/2	G 1 1/4 SAE 1 1/2" 3000 psi	SAE 1 1/4" 3000 psi 1 7/8-12 UN-2B

Type 10...	C2	C3	ØC4	ØC5	ØC6	C7	C8	C9	D1	D2	D3
TEN0160	M12 M10	G 1 1/2	135 [5.31]	140 [5.51]	185 [7.28]	M10	G 3/4	G 1/4	20 (24) [0.79 (0.94)] 26 (30) [1.02 (1.18)]	26 [1.02]	22,5 [0.89]
TEN0250	M12 M10								20 (24) [0.79 (0.94)] 26 (30) [1.02 (1.18)]		

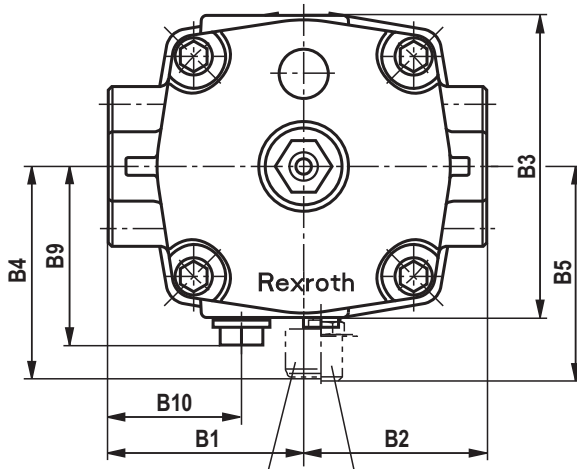
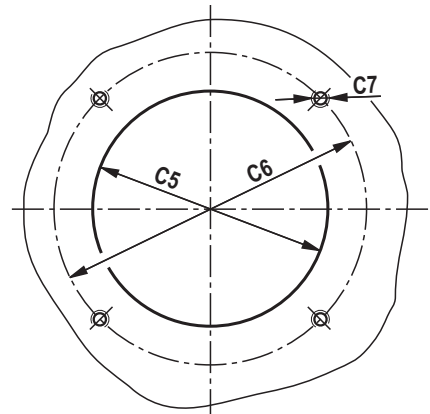
Dimensions: 10TEN0400, 0630
(dimensions in mm [inch])



View X



Tank bore



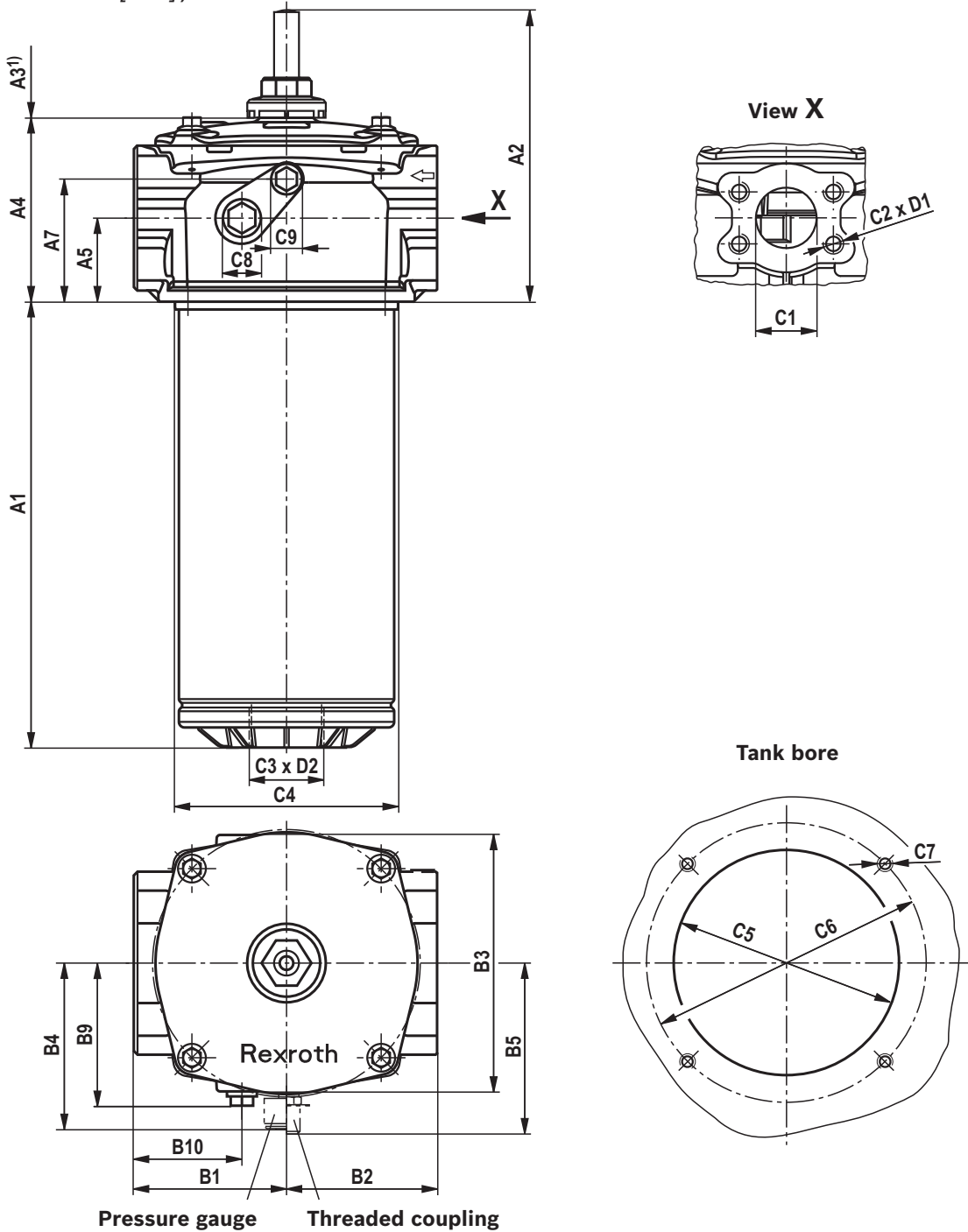
Pressure gauge Threaded coupling

¹⁾ Servicing height for filter element exchange

Type 10...	A1	A2	A3 ¹⁾	A4	A5	A7	B1	B2	B3	B4	B5	B6	B9	B10
TEN0400	255 [10.04]	199 [7.83]	250 [9.84]	131 [5.16]	60 [2.36]	85 [3.35]	117 [4.61]	115 [4.53]	210 [8.27]	138 [5.43]	134 [5.28]	171 [6.73]	120 [4.72]	77 [3.03]
TEN0630	405 [15.94]		400 [15.75]											

Type 10...	C1 connection		C2	C3	ØC4	ØC5	ØC6	C7	C8	C9	D1	D2
	Standard	Optional										
TEN0400	SAE 2" 3000 psi	SAE 2 1/2" - 3000 psi	M12	G 2	175 [6.89]	178 [7.01]	220 [8.66]	M10	G 3/4	G 1/4	20 (24) [0.79 (0.94)]	25,5 [1.00]
TEN0630	SAE 2 1/2" - 3000 psi	SAE 2" 3000 psi										

Dimensions: 10TEN1000, 10TE2000, 10TE2500
(dimensions in mm [inch])

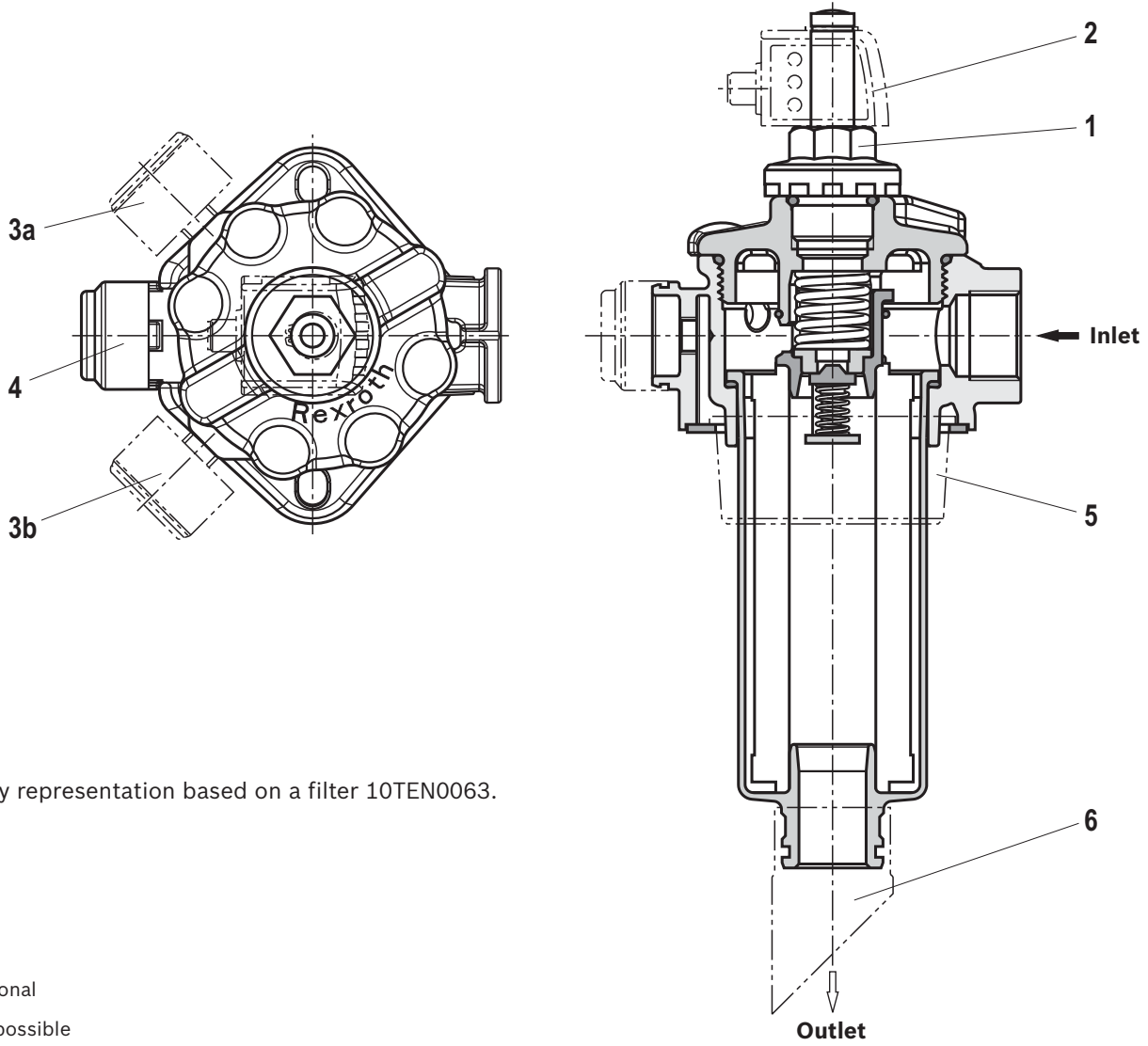


¹⁾ Servicing height for filter element exchange

Type 10...	A1	A2	A3 ¹⁾	A4	A5	A7	B1	B2	B3	B4	B5	B6	B9	B10
TEN1000	400 [15.75]	158 [6.22]	530 [20.87]	165 [6.50]	75 [2.95]	110 [4.33]	137 [5.39]	135 [5.31]	235 [9.25]	149 [5.87]	146 [5.75]	183 [7.20]	130,5 [5.14]	97 [3.82]
TE2000	758 [29.84]		880 [34.65]											
TE2500	993 [39.09]		1130 [44.49]											

Type 10...	C1 connection		C2	C3	ØC4	ØC5	ØC6	C7	C8	C9	D1	D2
	Standard	Optional										
TEN1000	SAE 3" 3000 psi	SAE 4" 3000 psi	M16	G 3	200 [7.87]	202 [7.95]	250 [9.84]	M10	G 3/4	G 1/4	26 (30) [1.02 (1.18)]	35 [1.38]
TE2000	SAE 4" 3000 psi	SAE 3" 3000 psi										
TE2500												

Options



Exemplary representation based on a filter 10TEN0063.

- Optional
- not possible

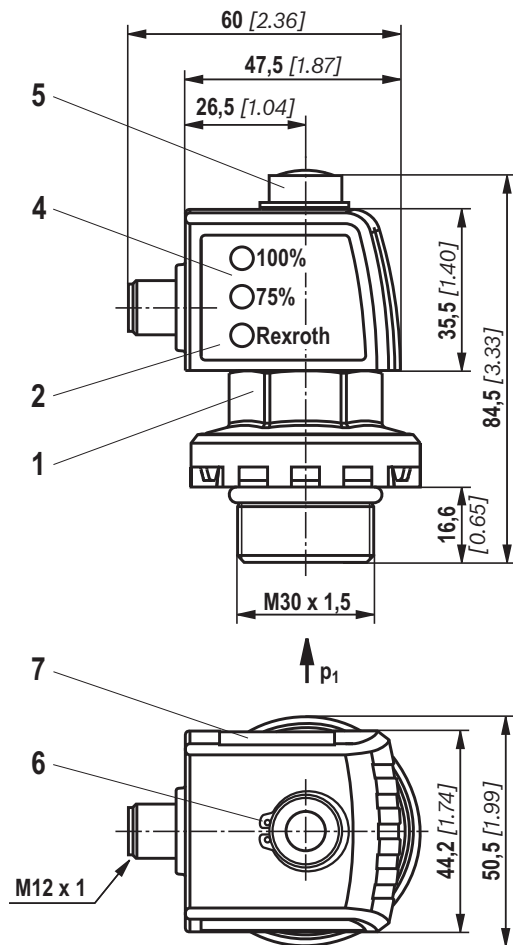
Ordering code	Maintenance indicator options	Item	Frame size	
			0040-0100	0160-2500
P2,2; V0,8; V1,5; V2,2	Mechanical optical maintenance indicator	1	●	●
MR	Pressure gauge right	3a	●	-
ML	Pressure gauge left	3b	-	●
V2,2MR	Mechanical optical maintenance indicator + pressure gauge right	1 + 3a	●	-
V2,2ML	Mechanical optical maintenance indicator + pressure gauge left	1 + 3b	-	●
plus R928...	Electronic switching element	See chapter "Accessories"		

Ordering code	Supplementary information options	Item	Frame size	
			0040-0100	0160-2500
F	Breathing filter	4	●	-
FN	Ventilation filter with surge protection	4 + 5	●	-
MR	Threaded coupling right (not possible with pressure gauge right)	3a	●	-
ML	Threaded coupling left (not possible with pressure gauge left)	3b	-	●
NB	Without bypass valve		●	●
R110	Outlet pipe 110 cm	6	● ¹⁾	-
R150	Outlet pipe 150 cm	6	● ¹⁾	-
R250	Outlet pipe 250 cm	6	● ¹⁾	-

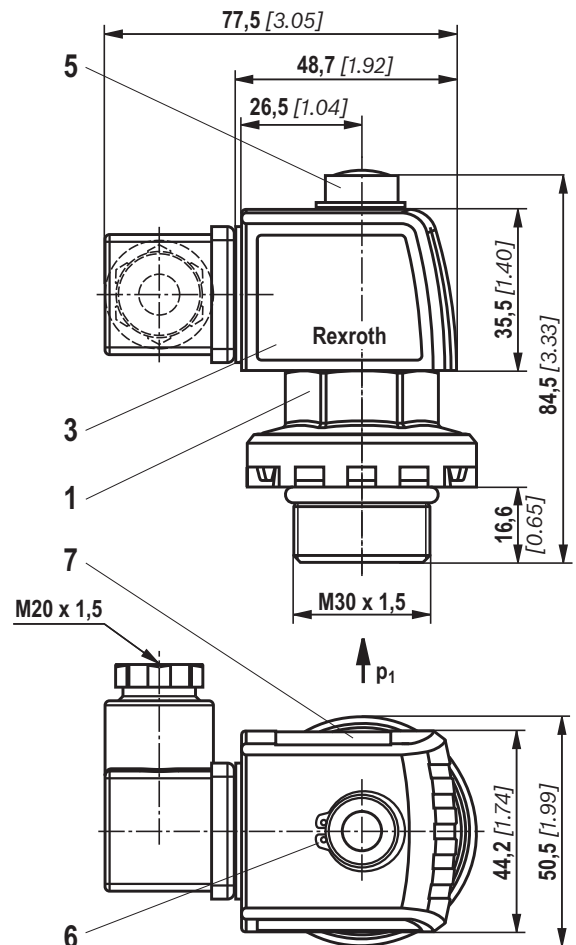
¹⁾ Outlet pipes for sizes 0040...0100 are to be ordered preferably pre-assembled over the complete filter.
 Outlet pipes for other sizes must be ordered separately and are not pre-assembled.
 See chapter "Order Code Accessories".

Maintenance indicator (dimensions in mm [inch])

Electronic switching element with round plug-in connection M12 x 1, 4-pole



Electronic switching element with rectangular plug-in connection EN 175301-803



- 1 Mechanical optical maintenance indicator; max. tightening torque $M_{A \max} = 50 \text{ Nm}$ [36.88 lb-ft]
Tightening torque for back pressure indicator in PA6.6 $M_{A \max} = 35 \text{ Nm}$ [25.82 lb-ft]
- 2 Switching element with locking ring for electrical maintenance indicator (rotatable by 360°); plug-in connection M12 x 1, 4-pole
- 3 Switching element with locking ring for electrical maintenance indicator (rotatable by 360°); plug-in connection EN175301-803
- 4 Housing with three LEDs: 24V = green: Stand-by
yellow: Switching point 75%
red: Switching point 100%
- 5 Optical indicator bistable
- 6 Locking ring DIN 471-16 x 1,
Material no. R900003923
- 7 Name plate

Notices:

Representation contains mechanical optical maintenance indicator (1) and electronic switching element (2) (3).

If an electronic switching element with signal suppression up to 30 °C [86 °F] is used (WE-2SPSU-M12 X 1, **R928028411**), it has to be ensured that the aluminum version of the mechanical-optical maintenance indicator must be used. These maintenance indicators are referred to in the filter type key as "V0.8", "V1.5" or "V2.2".

See chapter "Order Code Spare Parts".

The temperature-controlled signal processing does not work with mechanical-optical maintenance indicators made of polyamide.

Ordering code spare parts

Filter element

01	02	03	04	05	06
1.			- A00	- 0	-

01	Design	1.
----	--------	----

Size

02	TEN... (Filter elements according to DIN 24550)	0040 0063 0100 0160 0250 0400 0630 1000
	TE... (Filter elements according to Bosch Rexroth standard)	2000 2500

Filter rating in μm

03	Nominal Paper, not cleanable	P10 P25
	Nominal Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100
	Absolute (ISO 16889); $\beta_{x(c)} \geq 200$ Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
	Absolute (ISO 16889); $\beta_{x(c)} \geq 200$ Water-absorbing, not cleanable	AS3 AS6 AS10 AS20

Pressure differential

04	Maximum admissible pressure differential of the filter element: 30 bar [435 psi]	A00
----	--	-----

Bypass valve

05	without bypass valve	0
----	----------------------	---

Seal

06	NBR seal	M
	FKM seal	V

Order example:

1,0100 H3XL-A00-0-M

For detailed information on Rexroth filter elements please refer to data sheet 51420.

Ordering code spare parts

Preferred program Replacement elements

Filter element type	Filter material/material no.			
	H3XL	H6XL	H10XL	H20XL
1.0040 ...A00-0-M	R928005835	R928005836	R928005837	R928005838
1.0063 ...A00-0-M	R928005853	R928005854	R928005855	R928005856
1.0100 ...A00-0-M	R928005871	R928005872	R928005873	R928005874
1.0160 ...A00-0-M	R928005889	R928005890	R928005891	R928005892
1.0250 ...A00-0-M	R928005925	R928005926	R928005927	R928005928
1.0400 ...A00-0-M	R928005961	R928005962	R928005963	R928005964
1.0630 ...A00-0-M	R928005997	R928005998	R928005999	R928006000
1.1000 ...A00-0-M	R928006033	R928006034	R928006035	R928006036
1.2000 ...A00-0-M	R928041312	R928048158	R928040797	R928041313
1,2500 ...A00-0-M	R928041314	R928046806	R928040800	R928041315

Mechanical optical maintenance indicator

01	02	03	04	05	06	07
W	O	-	S01	-	-	-
					10	

01	Maintenance indicator	W
----	-----------------------	---

02	mechanical optical indicator	O
----	------------------------------	---

Design

03	Back pressure, modular design	S01
----	-------------------------------	-----

Switching pressure

04	0.8 bar [12 psi] (not possible with plastic version)	0,8
	1.5 bar [22 psi] (not possible with plastic version)	1,5
	2.2 bar [32 psi]	2,2

Seal

05	NBR seal	M
	FKM seal	V

Max. nominal pressure

06	10 bar [145 psi]	10
----	------------------	----

Housing material

07	Plastic only 2.2 bar [32 psi] possible	PA
	Aluminum	without information

Mechanical optical maintenance indicator

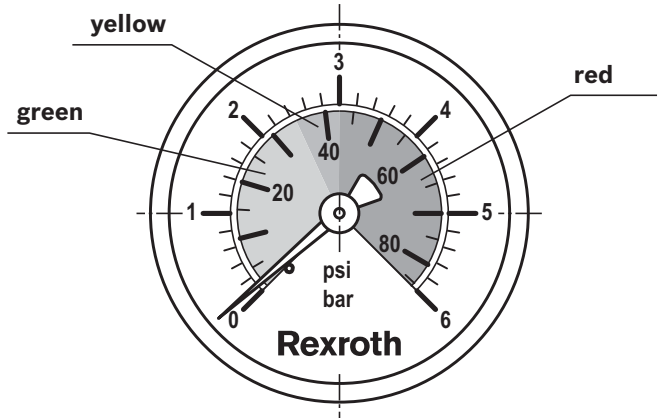
Material no.	Description
R928038773	WO-S01-0.8-M-10
R928038772	WO-S01-0.8-V-10
R928038776	WO-S01-1.5-M-10
R928038774	WO-S01-1.5-V-10
R901025310	WO-S01-2.2-M-10
R901066232	WO-S01-2.2-V-10
R928038771	WO-S01-2.2-M-10-PA
R928038769	WO-S01-2.2-V-10-PA

**Ordering code
spare parts**

Pressure gauge ¹⁾

Material no.	Description
R928019224	M010 0-6 bar [0-87 psi], fluid connection R1/4, Ø 50 mm

¹⁾ When using a pressure gauge, the maximum permissible operating pressure is reduced to 6 bar [87 psi].



Breathing filter element

(only for 10TEN0040-0100) incl. plastic cap

Material no.	Description
R928019705	71.001 P5-S00-0-0

Seal kit

01	02	03	04	05
D	10TE		-	-

01	Seal kit	D
02	Series	10TE

Size

03	0040-0100	N0040-0100
	0160-0250	N0160-0250
	0400-0630	N0400-0630
	1000	N1000
	2000-2500	2000-2500

Seal

04	NBR seal	M
	FKM seal	V

Supplementary information

05	Breathing filter with oil mist separator (only for size 0040-0100)	FN
----	--	----

Seal kit

Material no.	Description
R928028013	D10TEN0040-0100-M
R928028014	D10TEN0160-0250-M
R928028015	D10TEN0400-0630-M
R928039806	D10TEN1000-M
R928039807	D10TE2000-2500-M
R928048445	D10TEN0040-0100-V

Material no.	Description
R928052864	D10TEN0160-0250-V
R928052765	D10TEN0400-0630-V
R928052865	D10TEN1000-V
R928052866	D10TE2000-2500-V
R928048707	D10TEN0040-0100-M-FN
R928048709	D10TEN0040-0100-V-FN

Assembly, commissioning, maintenance

Installation

- ▶ The max. operating pressure of the system must not exceed the max. admissible operating pressure of the filter (see type plate).
- ▶ Before the assembly, the hole pattern of the tank must be compared to the dimensions from the “Dimensions” chapter.
- ▶ Drain pipes as of a length of approx. 500 mm must be carried in a bracket in order to avoid oscillations caused by the fluid flow in the tank. It is moreover to be ensured that in case of maintenance works, the filter bowl and the outlet pipe are pulled out of the filter head together.
- ▶ During assembly of the filter (see also chapter “Tightening torque”), the flow direction (direction arrows) and the required servicing height of the filter element (see chapter “Dimensions”) are to be considered.
- ▶ Perfect functioning is only guaranteed in the installation position filter bowl vertically downwards and **on** the tank.
- ▶ The maintenance indicator must be arranged in a well visible way.
- ▶ Remove the plastic plugs in the filter inlet and outlet.
- ▶ Ensure that the system is assembled without tension stress.
- ▶ The optional electronic maintenance indicator is connected via the electronic switching element with 1 or 2 switching points, which is attached to the mechanical optical maintenance indicator and held by means of the locking ring. More details see data sheet 51450

Commissioning

Commission the system.

Notice:

There is no bleeding provided at the filter.

Maintenance

- ▶ If at operating temperature, the red indicator pin reaches out of the mechanical optical maintenance indicator and/or if the switching process in the electronic switching element is triggered, the filter element is contaminated and needs to be replaced and cleaned respectively. More details see data sheet 51420.
- ▶ The material number of the corresponding replacement filter element is indicated on the name plate of the complete filter. It must comply with the material number on the filter element.
- ▶ Switch off the system, discharge the filter on the pressure side.
- ▶ Screw off the filter cover (NG0040-0100) and/or loosen the screws (from NG0160) and remove the filter over upwards.

Notice:

Note that with lower ratings, it may take slightly longer to discharge the residual oil. If the filter element is removed before running off residue oil, dirty oil can occur on the clean side.

- ▶ Remove the filter element including the filter bowl. From frame size 0160, the filter bowls are equipped with removal brackets.
- ▶ Remove the filter element from the spigot in the filter bowl by rotating it slightly.
- ▶ Clean the filter components, if necessary.
- ▶ Check the seals at filter cover and filter bowl for damage and renew them, if necessary. For suitable seal kits refer to chapter “Order Codes Spare Parts”.
- ▶ Filter elements made of wire mesh can be cleaned. For detailed cleaning instructions refer to data sheet 51420.
- ▶ Install the new or cleaned filter element on the spigot again by slightly rotating it.
- ▶ The filter is to be assembled in reverse order. The torque specifications (“Tightening torques” chapter) are to be observed.

Assembly, commissioning, maintenance

WARNING!

- ▶ Assembly and disassembly only with depressurized system! For the filter element exchange refer to “Maintenance”.
- ▶ Tank is under pressure!
- ▶ Do not exchange the optical/mechanical maintenance indicator while the filter is under pressure!

Notices:

- ▶ All works at the filter only be trained specialists.
- ▶ Functioning and safety are only guaranteed if original Bosch Rexroth filter elements and spare parts are used.
- ▶ Warranty becomes void if the delivered item is changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental condition that do not comply with the installation conditions.

Tightening torques (dimensions in mm [inch])

Tank mounting

Series 10...	TEN0040	TEN0063	TEN0100	TEN0160	TEN0250	TEN0400	TEN0630	TEN1000	TE2000	TE2500
Screw	M10 x 30		M10 x 25				M12 x 25			
Tank mounting										
Quantity	2		4							
Recommended property class of screw			8.8							
Tightening torque with $\mu_{total} = 0.14$			21 Nm \pm 10%				37 Nm \pm 10%			

Connection flange SAE 3000 psi

Series 10...	TEN0040	TEN0063	TEN0100	TEN0160	TEN0250	TEN0400	TEN0630	TEN1000	TE2000	TE2500
Connection variant	Thread			SAE 1 1/4" / SAE 1 1/2"		SAE 2" / SAE 2 1/2"		SAE 3" / SAE 4"		
Tank mounting screw				M10 / M12		M12		M16		
Quantity						4				
Recommended property class of screw	-					8.8				
Tightening torque with $\mu_{total} = 0.14$				33 Nm \pm 10 % / 60 Nm \pm 10 %		60 Nm \pm 10%		137 Nm \pm 10%		

Filter cover

Series 10...	TEN0040	TEN0063	TEN0100	TEN0160	TEN0250	TEN0400	TEN0630	TEN1000	TE2000	TE2500
Screw	Re-tighten by hand until stop, if necessary using an open-end wrench (SW19).			M10		M12				
Filter cover										
Quantity	-					4				
Recommended property class of screw	-					8.8				
Tightening torque with $\mu_{total} = 0.14$	-			21 Nm \pm 10%		37 Nm \pm 10%				

Maintenance indicator

Series	10TEN0040...10TEN1000, 10TE2000, 10TE2500
Tightening torque maintenance indicator, mechanical optical, aluminum, V...	50 Nm \pm 5 Nm
Tightening torque maintenance indicator, mechanical optical, PA, P2,2	35 Nm \pm 3 Nm
Tightening torque cubic connector screw switching element EN-175301-803	M3/0.5 Nm

Directives and standardization

classification according to Pressure Equipment Directive 97/23/EC

The return line filters for hydraulic applications according to 51424 are pressure holding equipment according to article 1, section 2.1.4 of the Pressure Equipment Directive 97/23/EC (PED). However, on the basis of the exception in article 1, section 3.6 of the PEG, hydraulic filters

are exempt from the PED if they are not classified higher than category I (guideline 1/19).

The fluids from the chapter “Compatibility with approved pressure fluids” were considered for the classification. They do not receive a CE mark.

Use in explosive areas according to directive 94/9/EC (ATEX)

The tank mounted return line filters according to 51424 are not equipment or components in the sense of directive 94/9/EC and are not provided with a CE mark. It has been proven with the ignition risk analysis that these inline filters do not have own ignition sources acc. to DIN EN 13463-1:2009.

According to DIN EN 60079-11:2012, electronic maintenance indicators with a switching point:

WE-1SP-M12 x 1 R928028409

WE-1SP-EN175301-803 R928036318

are simple, electronic operating equipment that do not

have an own voltage source. This simple, electronic operating equipment may - according to DIN EN 60079-14:2012 - in intrinsically safe electric circuits (Ex ib) be used in systems without marking and certification.

The tank mounted return line filters and the electronic maintenance indicators described here can be used for the following explosive areas:

	zone suitability	
Gas	1	2
Dust	21	22

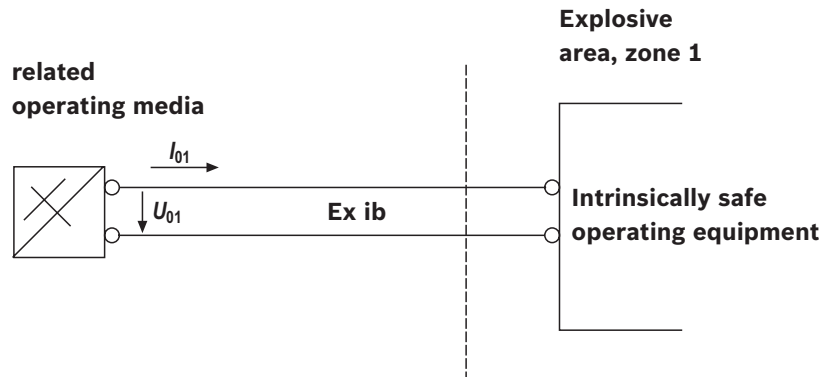
Complete filter with mech./opt. Maintenance indicator			
Use /assignment		Gas 2G	Dust 2D
Assignment		Ex II 2G c IIC T6	Ex II 2D c IIC T6
Conductivity of the medium	pS/m	min	300
Dust accumulation		max	0.5 mm

electronic switching element in the intrinsically safe electric circuit			
Use /assignment		Gas 2G	Dust 2D
Assignment		Ex II 2G Ex ib IIB T4 Gb	Ex II 2D Ex ib IIIC T100°C Db
perm. intrinsically safe electric circuits		Ex ib IIC, Ex ic IIC	Ex ib IIIC
Technical data		Values only for intrinsically safe electric circuit	
Switching voltage	Ui	max	150 V AC/DC
Switching current	Ii	max	1.0 A
Switching power	Pi	max	1.3 W T4 T _{max} 40 °C
		max	1.0 W T4 T _{max} 80 °C
Surface temperature ¹⁾		max	100 °C
inner capacity	Ci		negligible
inner inductivity	Li		negligible
Dust accumulation		max	0.5 mm

¹⁾ The temperature depends on the temperature of the medium in the filter and must not exceed the value specified here.

Directives and standardization

Possible circuit according to DIN EN 60079-14



⚠ WARNING!

- ▶ Explosion hazard due to high temperature!
The temperature depends on the temperature of the medium in the hydraulic circuit and must not exceed the value specified here. Measures are to be taken so that in the explosive area, the max. admissible ignition temperature is not exceeded.
- ▶ When using the tank mounted return line filters according to 51424 in explosive areas, appropriate equipotential bonding has to be ensured. The filter is preferably to be earthed via the mounting screws. It has to be noted in this connection that paintings and oxidic protective layers are not electrically conductive.
- ▶ During filter element exchanges, the packaging material is to be removed from the replacement element outside the explosive area

👉 Notices:

- ▶ Maintenance only by specialists, instruction by the machine end-user acc. to DIRECTIVE 1999/92/EC appendix II, section 1.1
- ▶ Functional and safety warranty only applicable when using genuine Rexroth spare parts

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Tank mounted return line filter with filter element according to Bosch Rexroth standard

Type 25TE0101 to 1051

RE 51472

Edition: 2014-10



- ▶ Size according to **Bosch Rexroth standard:** 0101 to 1051
- ▶ Component series 2X
- ▶ Nominal pressure max. 25 bar [362 psi]
- ▶ Connection up to 3"
- ▶ Operating temperature $-10\text{ °C} \dots +100\text{ °C}$ [$14\text{ °F} \dots 212\text{ °F}$]

Features

The tank mounted return line filters are designed for installation on fluid tanks. Their function is to separate solid materials from fluids.

They distinguish themselves by the following:

- ▶ Filters for tank mounting and inline installation
- ▶ Special highly efficient filter materials
- ▶ Filtration of very fine particles and high dirt holding capacity across a broad pressure differential range
- ▶ High collapse resistance of the filter elements
- ▶ Optional equipment with different back pressure indicator
- ▶ Bypass valve in the filter element
- ▶ Filter element with integrated dirt retainer

Contents

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Ordering code filter

01	02	03	04	05	06	07	08	09	09	09						
25TE		-	2X	/		E00	-		-		-		-		-	

Series

01	Return line filter 25 bar [362 psi]	25TE
----	-------------------------------------	------

Size

02	TE... (Filter elements according to Bosch Rexroth standard)	0101 0201 0351 1051
----	--	------------------------------

03	Component series 20 ... 29 (20 ... 29: unchanged installation and connection dimensions)	2X
----	--	----

Filter rating in μm

04	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$)	Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
		Water-adsorbent, not cleanable	AS6 AS10 AS20
	Nominal	Paper, not cleanable	P10 P25
		Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100

Pressure differential

05	Max. admissible pressure differential of the filter element 20 bar [290 psi] (with bypass valve)	E00
----	--	-----

Maintenance indicator (1 unit per filter side)

06	Without maintenance indicator - bypass release pressure 3.0 bar [43 psi]	0
	Back pressure switch, optical, switching pressure 2.2 bar – bypass release pressure 3.0 bar [43 psi] ¹⁾	A2.2
	Back pressure switch, electrical, or optical-electrical, switching pressure 2.2 bar – bypass release pressure 3.0 bar [43 psi] ²⁾	B2.2
	Back pressure switch, electrical, ATEX, switching pressure 2.2 bar – bypass release pressure 3.0 bar [43 psi]	F2.2

Seal

07	NBR seal	M
	FKM seal	V

Port

08	Frame size	0101	0201	0351	1051	
	Port					
	G1	●				R4
	G1 1/2		●			R6
	SAE2" - 3000 psi			●		S8
	SAE3" - 3000 psi				●	S10
	● Standard connection					

1) When using an optical back pressure switch, the maximum permissible operating pressure is reduced to 10 bar [87 psi].

2) The mating connectors, with or without circuitry, must be ordered separately. See chapter "Accessories"

Ordering code filter

01	02	03	04	05	06	07	08	09	09	09						
25TE		-	2X	/		E00	-		-		-		-		-	

Supplementary information

09	Threaded coupling for venting, only if used as an inline filter, instead of a maintenance indicator	M
	Without bypass valve	NB
	Manufacturer's inspection certificate M according to DIN 55350-T18	Z1

Order example:

25TE0101-2X/H10XLE00-B2.2-M-R4

Further versions (filter materials, connections etc.) are available on request.

Preferred types

NBR seal, with bypass, flow specifications for 30 mm²/s [142 SUS]

Filter rating 3 µm, 6 µm, 10 µm and 20 µm

Filter type	Flow in l/min [gpm] with $v = 30 \text{ mm}^2/\text{s}$ [142 SUS] and $\Delta p = 0.5 \text{ bar}$ [7.25 psi] ¹⁾	Material no.	Material no. replacement element
25TE0101-2X/H3XLE00-B2.2-M-R4	24 [6.34]	R928054007	R928054019
25TE0201-2X/H3XLE00-B2.2-M-R6	69 [18.23]	R928054010	R928054022
25TE0351-2X/H3XLE00-B2.2-M-S8	99 [26.15]	R928054013	R928054025
25TE1051-2X/H3XLE00-B2.2-M-S10	203 [53.63]	R928054016	R928054028
25TE0101-2X/H6XLE00-B2.2-M-R4	29 [7.66]	R928054008	R928054020
25TE0201-2X/H6XLE00-B2.2-M-R6	82 [21.66]	R928054011	R928054023
25TE0351-2X/H6XLE00-B2.2-M-S8	148 [39.10]	R928054014	R928054026
25TE1051-2X/H6XLE00-B2.2-M-S10	238 [62.78]	R928054017	R928054029
25TE0101-2X/H10XLE00-B2.2-M-R4	36 [9.51]	R928053165	R928053667
25TE0201-2X/H10XLE00-B2.2-M-R6	105 [27.74]	R928053167	R928053669
25TE0351-2X/H10XLE00-B2.2-M-S8	176 [46.49]	R928053169	R928053671
25TE1051-2X/H10XLE00-B2.2-M-S10	260 [68.68]	R928053170	R928053672
25TE0101-2X/H20XLE00-B2.2-M-R4	53 [14.00]	R928054009	R928054021
25TE0201-2X/H20XLE00-B2.2-M-R6	134 [35.40]	R928054012	R928054024
25TE0351-2X/H20XLE00-B2.2-M-S8	222 [58.65]	R928054015	R928054027
25TE1051-2X/H20XLE00-B2.2-M-S10	314 [82.95]	R928054018	R928054030

The matching mating connector can be selected as a separate order item in Section "Ordering Data Accessories".

¹⁾ Measured back pressure across filter and measuring equipment according to ISO3968. The measured back pressure at the maintenance indicator is lower.



Ordering code accessories
(dimensions in mm [inch])

With the option “electrical maintenance indicator” (B ...) an electrical service indicator is installed at the factory. The following mating connectors can be selected as an optional accessory:

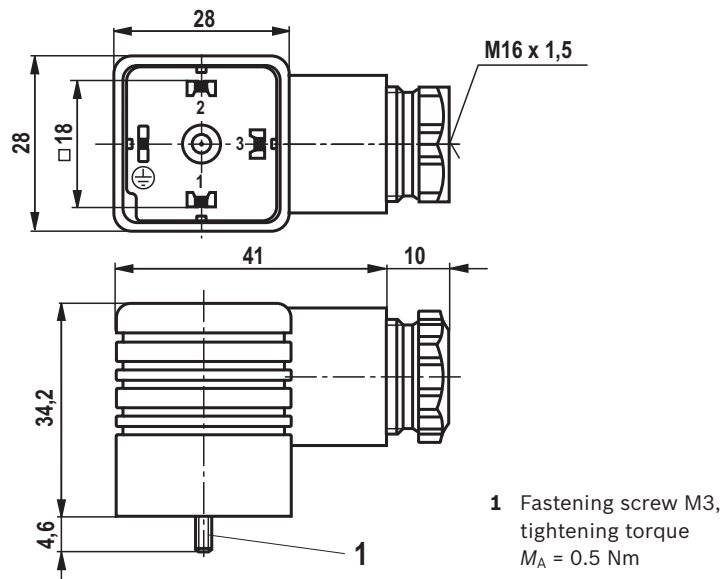
Mating connectors according to DIN EN 175301-803

For mechanical pressure switches with connector “K14”, according to EN 175301-803 and ISO 4400, 3-pole + PE, “large cubic connector”

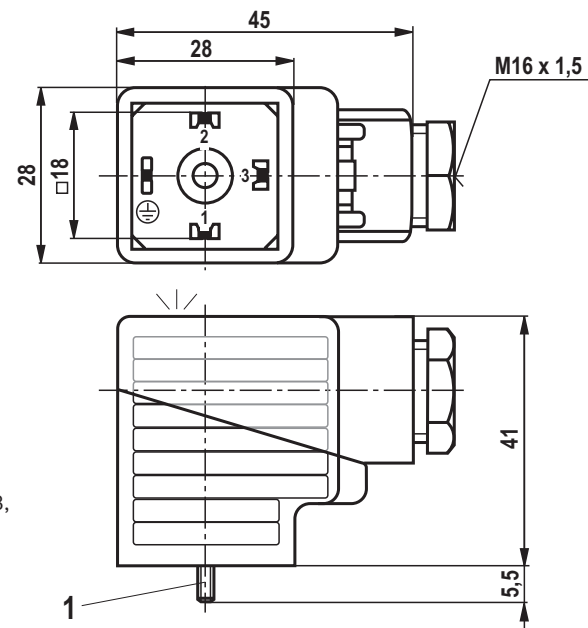
Mating connector 3-pole + PE

Material no.	Designation	Fitting	Number of poles	Type of connection	Max. line cross-section	Circuitry	Figure
R901017012	4P Z14 M SW SPEZ	M16 x 1.5	3 + PE	Screw connection	1.5 mm ² with wire end ferrule	Without circuitry: Z14	
R901017048	4P Z15L M 24 V SPEZ	M16 x 1.5	3 + PE	Screw connection	1.5 mm ² with wire end ferrule	With indicator light: Z15L	
R901017037	4P Z15L M 220 V SPEZ	M16 x 1.5	3 + PE	Screw connection	1.5 mm ² with wire end ferrule	With indicator light: Z15L	

Dimensions mating connector Z14



Dimensions mating connector Z15L



For further mating connectors, refer to data sheet 08006.

Order example:
 Tank mounted return line filter with electrical maintenance indicator for $p_{nom.} = 25 \text{ bar [362 psi]}$, size 0101, with filter element $10 \mu\text{m}$ and mating connector with 1 switching point.

Filter with back pressure switch, electrical: 25TE0101-2X/H10XLE00-B2.2-M-R4 **Material no.:** R928053165

Mating connector: 4P Z14 M SW SPEZ **Material no.:** R901017012

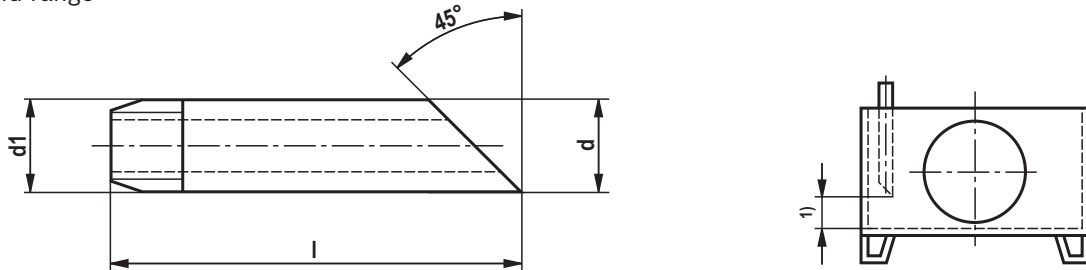
Ordering code accessories

(dimensions in mm [inch])

Outlet pipe

Outlet pipe with threaded connection

Dimensions and range



- ¹⁾ Recommended distance to tank bottom (unless otherwise specified): 60...160 mm [2.4...6.3 inch]
From a pipe length of 400 mm [15.75 inch], we strongly recommend fixing the outlet pipe with an internal tank pipe bracket.

DN	Dimensions			Material		
				galvanized	ES (stainless)	
d	d1	l	Description: PIPE AB23-03/R...	Description: PIPE AB23-03/R... -ES	Material no.	Material no.
25 [0.98]	33.7 [1.33]	R1	120 [4.72]	1 L = 120	R900720647	-
			160 [6.30]	1 L = 160	R900152595	R900033168
			250 [9.84]	1 L = 250	R900105615	-
			400 [15.75]	1 L = 400	R900063899	-
			450 [17.72]	1 L = 450	R900104909	-
			800 [31.50]	1 L = 800	R900029849	-
			1500 [59.06]	1 L = 1500	R900766109	-
40 [1.57]	48.3 [1.90]	R1 1/2	250 [9.84]	1 1/2 L = 250	R900109501	R900062066
			400 [15.75]	1 1/2 L = 400	R900083146	R900074878
			800 [31.50]	1 1/2 L = 800	R900029854	-
			1300 [51.18]	1 1/2 L = 1300	R900302230	-
			2000 [78.74]	1 1/2 L = 2000	R900229461	-
50 [1.97]	60.3 [2.37]	R2	400 [15.75]	2 L = 400	R900727174	R900987657
			800 [31.50]	2 L = 800	R900029856	R900226706
80 [3.15]	88.9 [3.50]	R3	160 [6.30]	3 L = 160	R900062845	-
			200 [7.87]	3 L = 200	R900061785	R900062067
			350 [13.78]	3 L = 350	R900084137	-
			650 [25.59]	3 L = 650	R900076923	R900757513
			800 [31.50]	3 L = 800	R900029838	R900987653

Thread:

Whitworth pipe thread according to DIN 2999 part 1, poppet 1:16

Material/surface treatment:

St 33-1 according to DIN 17100/galvanized (B) according to DIN 2444 1.4541

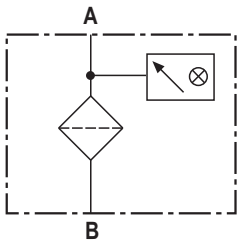
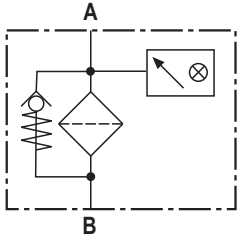
Order example/search term

Pipe according to DIN 2440 (ISO 65) with thread R1 1/2 and L = 250 mm [9.84 inch], galvanized:

PIPE AB23-03/R1 1/2 L = 250 material no. R900109501

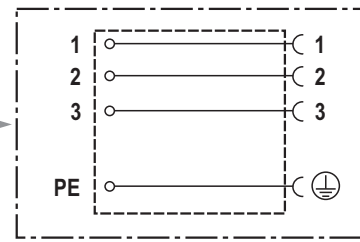
Symbols

Tank mounted return line filter
with bypass and with mechanical indicator



Tank mounted return line filter
without bypass and with mechanical indicator

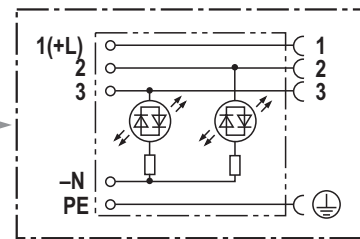
Switching element **Connector**



Z14

12 ... 240 V
Material no. R901017012

Switching element **Connector**



Z15L

16 ... 30 V
Material no. R901017048

180 ... 240 V
Material no. R901017037

Function, section

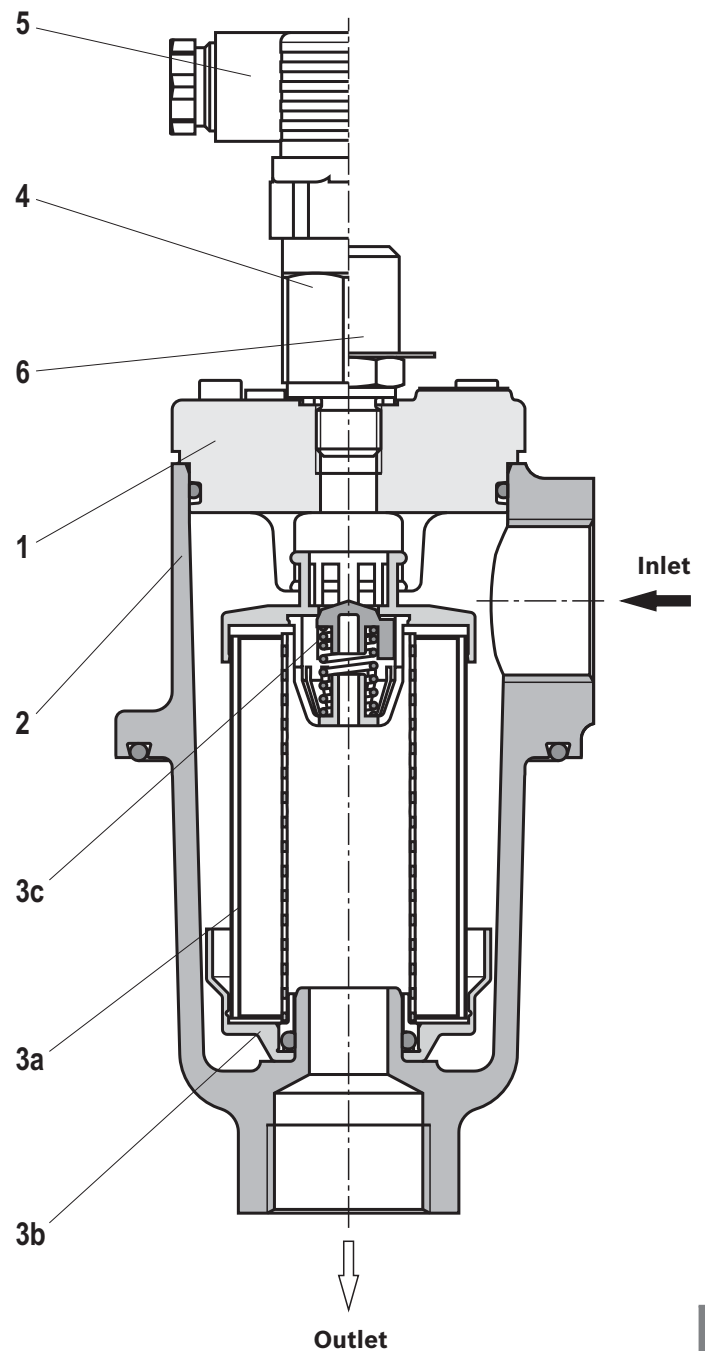
The tank mounted return line filter is located in the return line for direct attachment onto the tank of a hydraulic or lubrication system. Optionally, the filter can also be installed as an inline filter in a pipeline.

The filter basically consists of filter cover (1), filter housing (2), filter element (3), as well as a bypass valve (3c). Optionally, the filter is equipped with maintenance indicator (4). With an electrical maintenance indicator the connection can be carried out via different mating connectors (5). If the filter is used as an inline filter, a threaded ring (6) must be configured with the order data - additional data "M" and a maintenance indicator waived. If necessary, the customer must provide an external differential pressure measurement.

During operation, the hydraulic fluid reaches the filter housing via the inlet; here, it flows through the filter element (3a) from the outside to the inside and is cleaned according to the filter rating. The dirt particles filtered out collect in the dirt retainer (3b) and in the filter element (3a). Via the outlet, the filtered hydraulic fluid enters the tank. When the element becomes fully contaminated, the required element change is signaled by the maintenance indicator (4 or 5). There are several maintenance indicators to choose from:

1. Mechanical visual maintenance indicator
2. Electrical maintenance indicator with three possible mating connectors (mating connectors are to be ordered separately)
3. Electrical maintenance indicator ATEX with pre-assembled mating connector

Refer to the chapter "Maintenance indicator" for details.



Type 25TE0101

Technical data

(For applications outside these parameters, please consult us!)

General					
Weight	NS	0101	0201	0351	1051
	kg [lbs]	3.0 [6.6]	5.8 [12.79]	12.0 [26.46]	21.5 [47.40]
Volume	NS	0101	0201	0351	1051
	l [US gal]	0.5 [0.13]	1.0 [0.26]	2.5 [0.66]	6.2 [1.64]
Installation position	Vertical				
Ambient temperature range	°C [°F]	-10 ... +65 [14...+149] (short periods down to -30 [-22])			
Storage conditions	▶ NBR seal	°C [°F]	-40 ... +65 [-40 ... +149]; max. relative air humidity 65 %		
	▶ FKM seal	°C [°F]	-20 ... +65 [-4 ... +149]; max. relative air humidity 65 %		
Material	▶ Filter cover		Grey cast iron (Size 0101 ... 0351) Ductile iron (Size 1051)		
	▶ Filter housing		Grey cast iron (Size 0101 ... 0351) Ductile iron (Size 1051)		
	▶ Maintenance indicator	A2.2	Aluminum		
		B2.2	Brass		
		F2.2	Stainless steel		
	▶ Bypass valve		Plastic PA 6		
	▶ Mating connector		Plastic		
▶ Seals		NBR / FKM			
Surface requirement for tank opening	▶ Roughness depth R_z max.	µm	25		
	▶ Flatness t_E max.	µm	200		

Hydraulic					
Maximum operating pressure	bar [psi]	25 [362]			
Hydraulic fluid temperature range	°C [°F]	-10 ... +100 [+14 ... +212]			
Minimum conductivity of the medium	pS/m	300			
Fatigue strength according to ISO 10771	Load cycles	> 10 ⁶ with max. operating pressure			
Type of pressure measurement of the maintenance indicator	Back pressure				
Assignment: Response pressure of the maintenance indicator / cracking pressure of the bypass valve	bar [psi]	Response pressure of the maintenance indicator		Cracking pressure of the bypass valve	
		without maintenance indicator		3.0 ± 0.3 [43.5 ± 4.4]	
		with pressure gauge			
		A2.2 ± 0.3 [31.9 ± 4.4]			
		B2.2 ± 0.3 [31.9 ± 4.4]			
F2.2 ± 0.3 [31.9 ± 4.4]					
Filtration direction	From the outside to the inside				

Technical data

(For applications outside these parameters, please consult us!)

Electric (mating connector or electrical maintenance indicator)					
Electrical connection		Standard connection EN 175301-803			Standard connection EN 175301-803 ATEX
Version		WE-S02-...-1X/K4			WE-S02-...-1X/EN-XH
Mating connectors		R901017012	R901017048	R901017037	Pre-assembled
Voltage range	$V_{max.}$	12 ... 250 (DC/AC)	16 ... 30 (DC/AC)	180 ... 250 (DC/AC)	–
Current	$A_{max.}$	16	4		
Display via LEDs in the electronic switching element ¹⁾		–	Stand-by (LED green); 100 % switching point (LED yellow)		–
Electric maintenance indicator					
Voltage	$V_{max.}$	14 VDC	14 VDC	250 VAC	20 (DC/AC)
Current with inductive (resistive) load	$A_{max.}$	5 (4)	5 (4)	5 (1)	0.2
Voltage	$V_{max.}$	30 VDC	30 VDC		
Current with inductive (resistive) load	$A_{max.}$	4 (3)	4 (3)		
Voltage	$V_{max.}$	125 VAC			
Current with inductive (resistive) load	$A_{max.}$	5 (3)			
Voltage	$V_{max.}$	250 VAC			
Current with inductive (resistive) load	$A_{max.}$	5 (1)			
Switching type		Changeover	Changeover	Changeover	Changeover
Display via LEDs in the mating connector ¹⁾		–	Stand-by (LED green); 100 % switching point (LED yellow)		–
Protection class according to EN 60529 2 with assembled mating connector	IP	65			
Ambient temperature range maintenance indicator	°C [°F]	–40 ... +65 [–40 ... +149]			
Ambient temperature range Mating connector	▶ without LED	°C [°F] –40...+125 [–40... +257]			
	▶ with LED	°C [°F] –20...+60 [–4... +140]			
For direct voltage above 24 V, spark extinguishing is to be provided for protecting the switching contacts.					
Mass mating connector	kg [lbs]	0.03 [0.07]			–
Mass maintenance indicator	kg [lbs]	0.14 [0.31]			
Filter element					
Glass fiber material H.XL		Single-use element on the basis of inorganic fiber			
		Filtration ratio according to ISO 16889 up to $\Delta p = 5 \text{ bar [72.5 psi]}$		Achievable oil cleanliness according to ISO 4406 (SAE-AS 4059)	
Particle separation	H20XL	$\beta_{20(c)} \geq 200$		19/16/12 ... 22/17/14	
	H10XL	$\beta_{10(c)} \geq 200$		17/14/10 ... 21/16/13	
	H6XL	$\beta_{6(c)} \geq 200$		15/12/10 ... 19/14/11	
	H3XL	$\beta_{5(c)} \geq 200$		13/10/8 ... 17/13/10	
Admissible pressure differential E00	bar [psi]	20 [290]			

¹⁾ Functionality

Maintenance indicator for monitoring the maximum differential pressure. When operating voltage is applied, the green LED lights up. On reaching the switching point contact 1–3 opens, and contact 1–2 close. The yellow LED lights up.

Compatibility with permitted hydraulic fluids

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oil	HLP	NBR	DIN 51524
Bio-degradable	– insoluble in water	HETG	VDMA 24568
		HEES	
Flame-resistant	– soluble in water	HEPG	VDMA 24568
	– water-free	HFDU, HFDR	FKM
– containing water		HFAS	NBR
		HFAE	NBR
	HFC	NBR	VDMA 24317



Important information on hydraulic fluids:

- ▶ For more information and data on the use of other hydraulic fluids, please refer to data sheet 90220 or contact us!
- ▶ **Flame-resistant – containing water:** Due to possible chemical reactions with materials or surface coatings of machine and system components, the service life with these hydraulic fluids may be less than expected.

Filter materials made of filter paper may not be used, filter elements with glass fiber material or wire mesh have to be used instead.

- ▶ **Bio-degradable:** If filter materials made of filter paper are used, the filter life may be shorter than expected due to material incompatibility and swelling.

Characteristic curves: H3XL

(measured with mineral oil HLP46 according to DIN 51524)

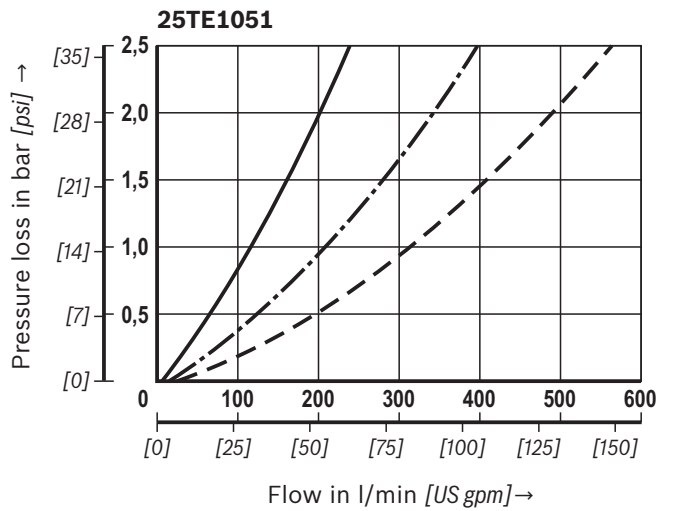
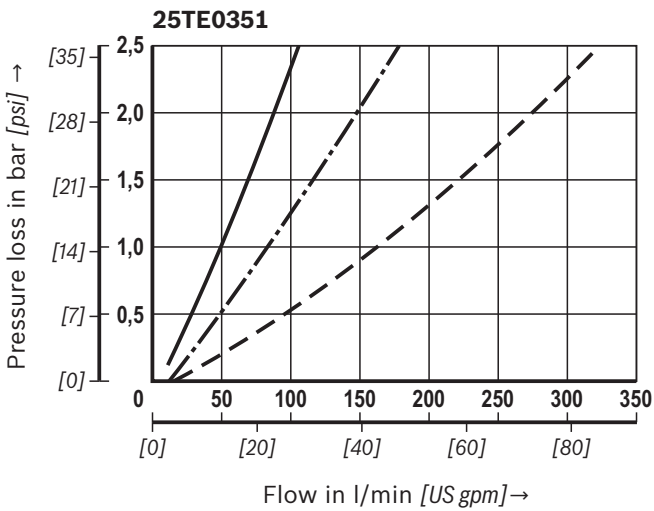
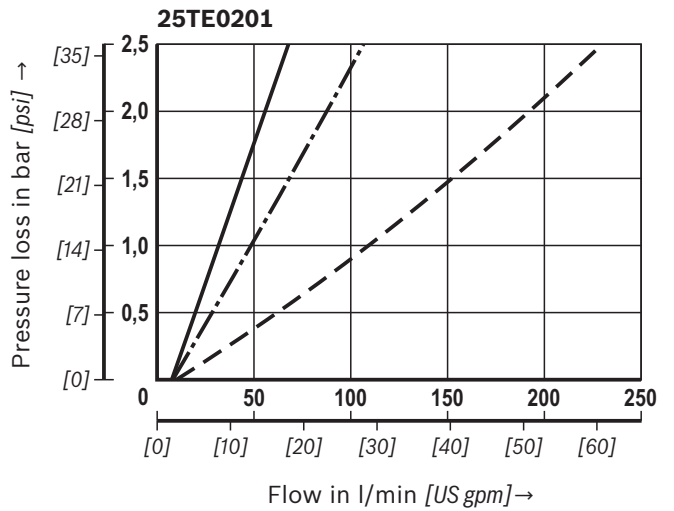
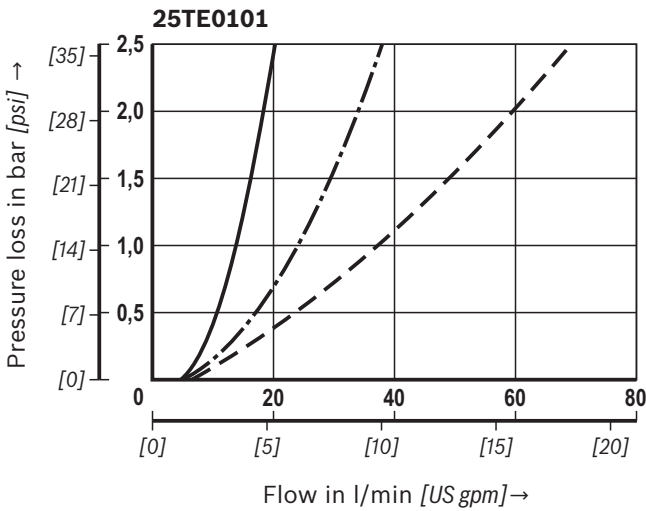
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filter

Recommended initial Δp for design = 0.5 bar [7.25 psi]

Selection of the perfect filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Characteristic curves: H6XL

(measured with mineral oil HLP46 according to DIN 51524)

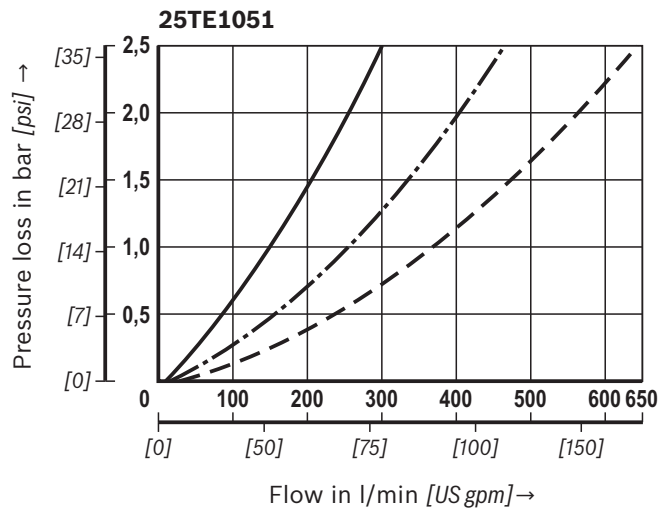
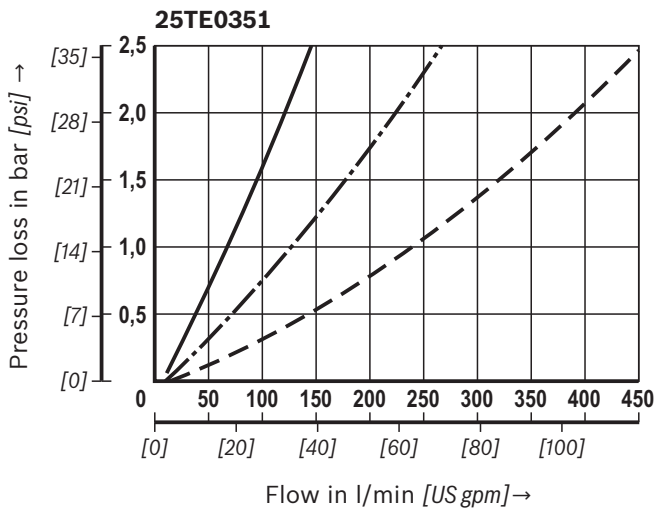
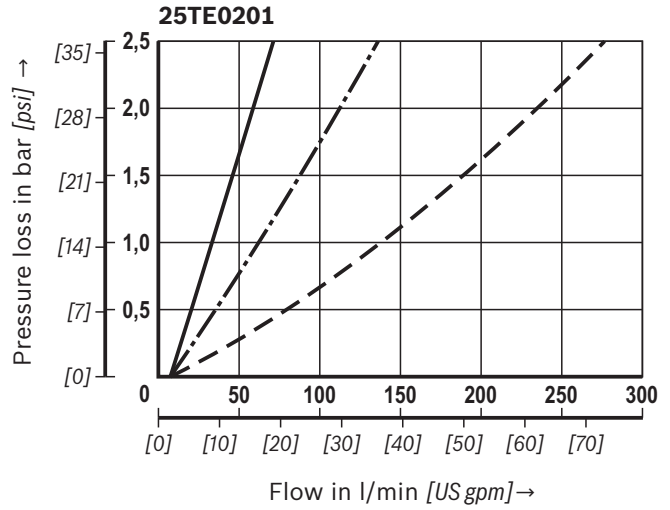
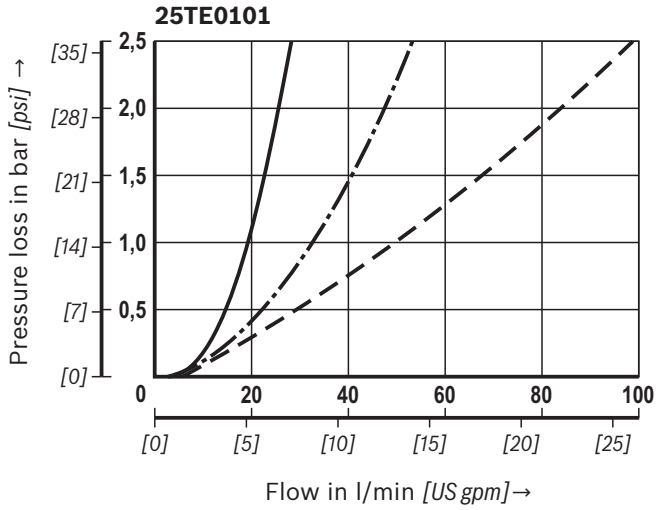
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filter

Recommended initial Δp for design = 0.5 bar [7.25 psi]

Selection of the perfect filter is made possible by our online “Bosch Rexroth FilterSelect” design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Characteristic curves: H10XL

(measured with mineral oil HLP46 according to DIN 51524)

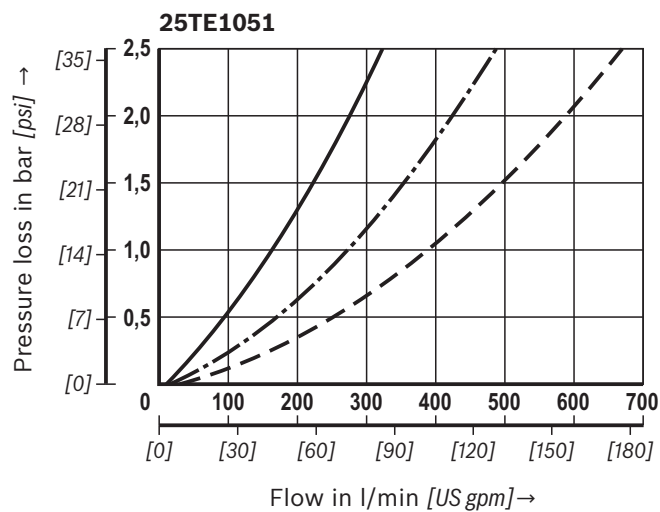
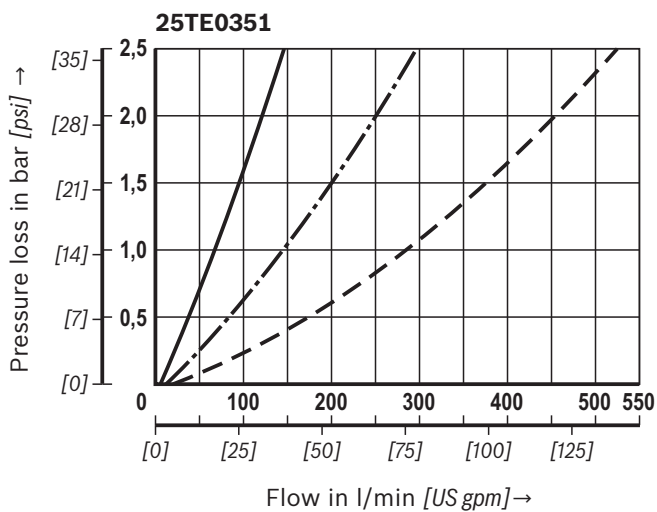
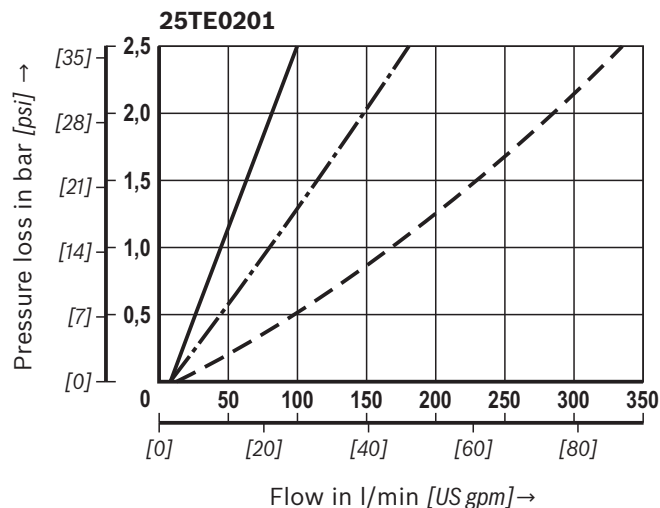
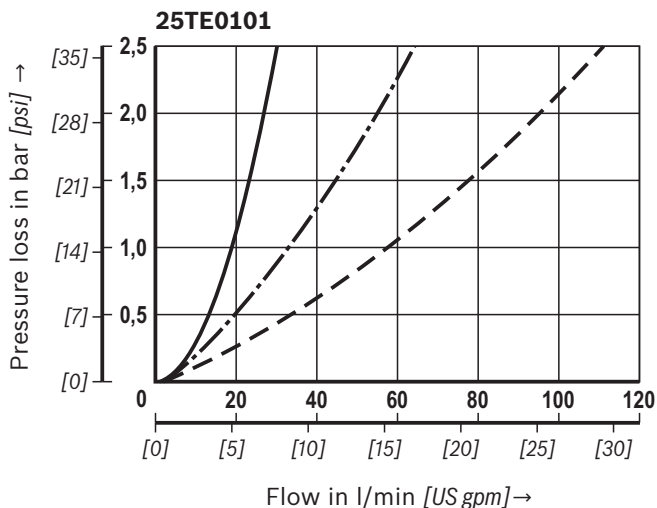
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filter

Recommended initial Δp for design = 0.5 bar [7.25 psi]

Selection of the perfect filter is made possible by our online “Bosch Rexroth FilterSelect” design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Characteristic curves: H20XL

(measured with mineral oil HLP46 according to DIN 51524)

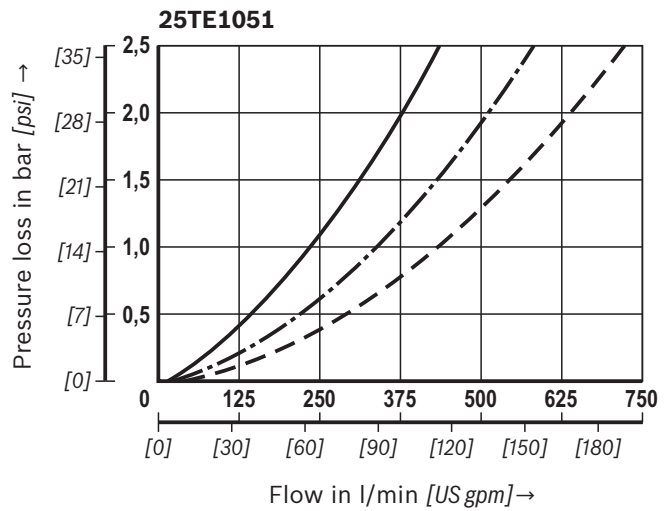
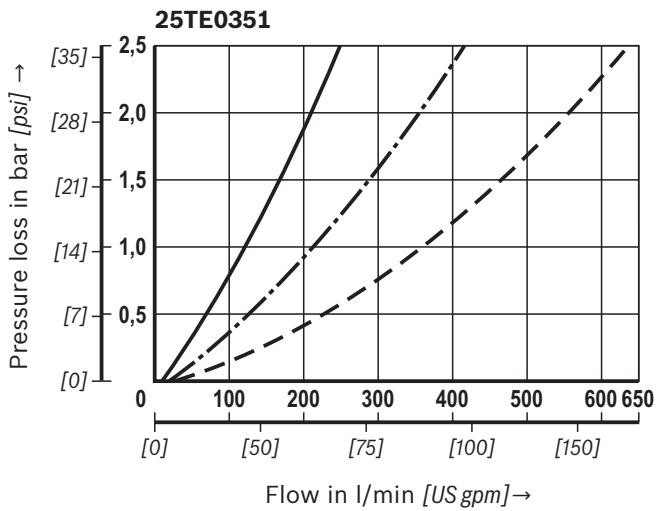
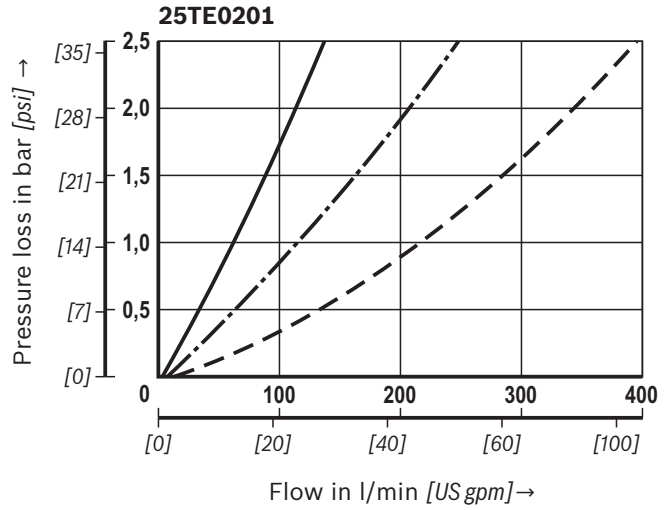
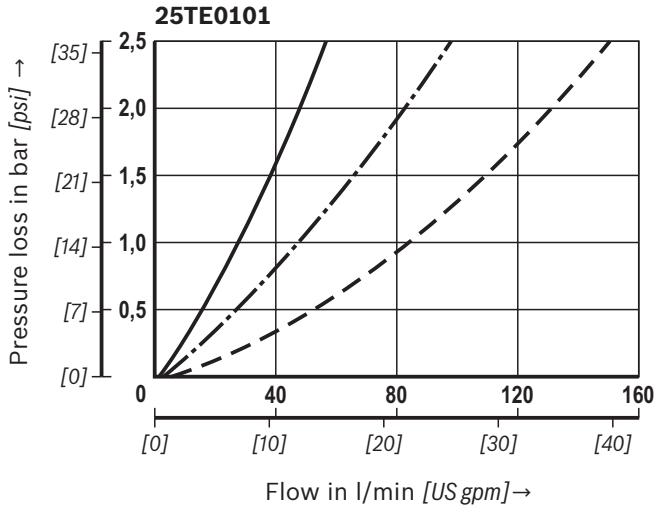
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filter

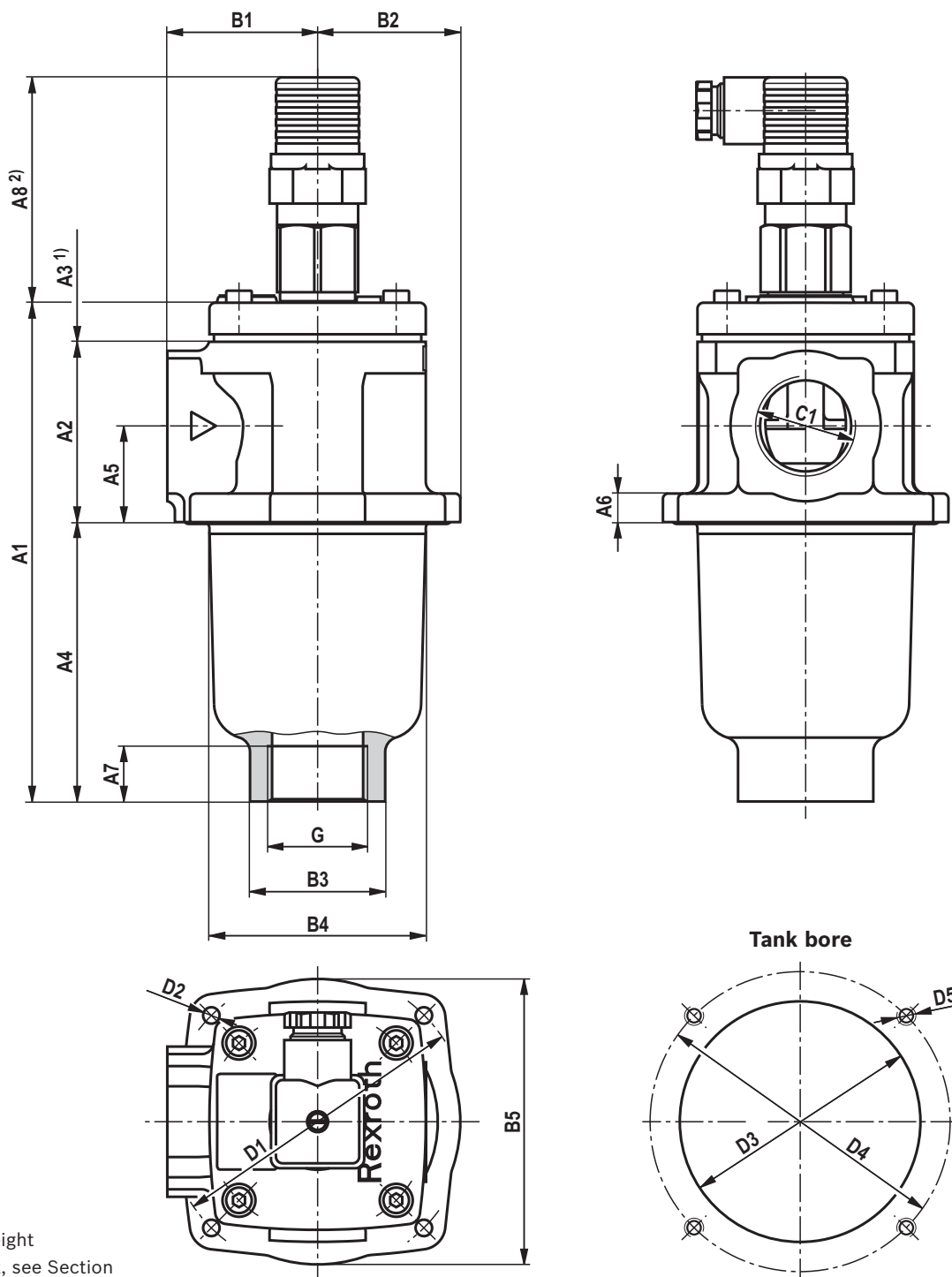
Recommended initial Δp for design = 0.5 bar [7.25 psi]

Selection of the perfect filter is made possible by our online “Bosch Rexroth FilterSelect” design software.

Oil viscosity:
 — 140 mm²/s [649 SUS]
 - · - 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Dimensions: 25TEN0101, 0201
(dimensions in mm [inch])

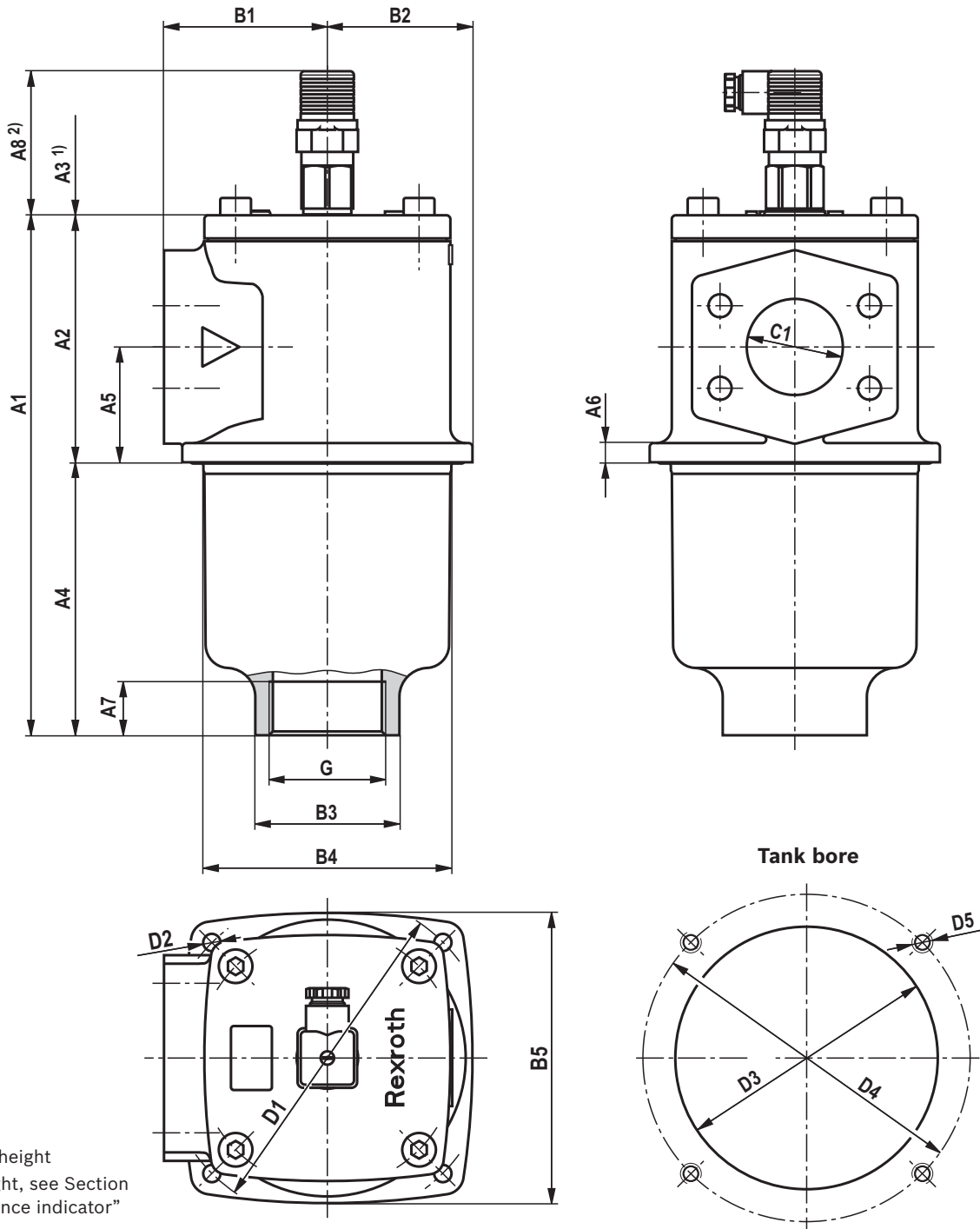


- 1) Servicing height
2) Exact height, see Section "Maintenance indicator"

Type	Lengths / heights							
	A1	A2	A3 ¹⁾	A4	A5	A6	A7	A8 ²⁾
25TE0101	166 [6.54]	60 [2.36]	105 [4.13]	93 [3.66]	32 [1.26]	9.5 [0.37]	18 [0.71]	approx. 75 [2.95]
25TE0201	209 [8.23]	73 [2.87]	145 [5.71]	123 [4.84]	37 [1.46]	8 [0.31]	22 [0.87]	

Type	Widths					Ports		Mounting / Tank bore				
	B1	B2	ØB3	ØB4	B5	C1	G	ØD1	ØD2	ØD3	ØD4	D5
25TE0101	50 [1.97]	47.5 [1.87]	45 [1.77]	72 [2.83]	95 [3.74]	G1	G1	100 [3.94]	5.5 [0.22]	80 [3.15]	100 [3.94]	M5
25TE0201	66 [2.60]	60 [2.36]	58 [2.28]	88 [3.46]	120 [4.72]	G1 1/2	G1 1/2	135 [5.31]	6.6 [0.26]	106 [4.17]	135 [5.31]	M6

Dimensions: 25TEN0351, 1051
(dimensions in mm [inch])



- 1) Servicing height
- 2) Exact height, see Section "Maintenance indicator"

Type	Lengths / heights							
	A1	A2	A3 ¹⁾	A4	A5	A6	A7	A8 ²⁾
25TE0351	270.5 [10.65]	115 [4.53]	200 [7.87]	142 [5.59]	60 [2.36]	10 [0.39]	27 [1.06]	approx. 75 [2.95]
25TE1051	411 [16.81]	152 [5.98]	333 [13.11]	246 [9.69]	80 [3.15]	10 [0.39]	32 [1.26]	

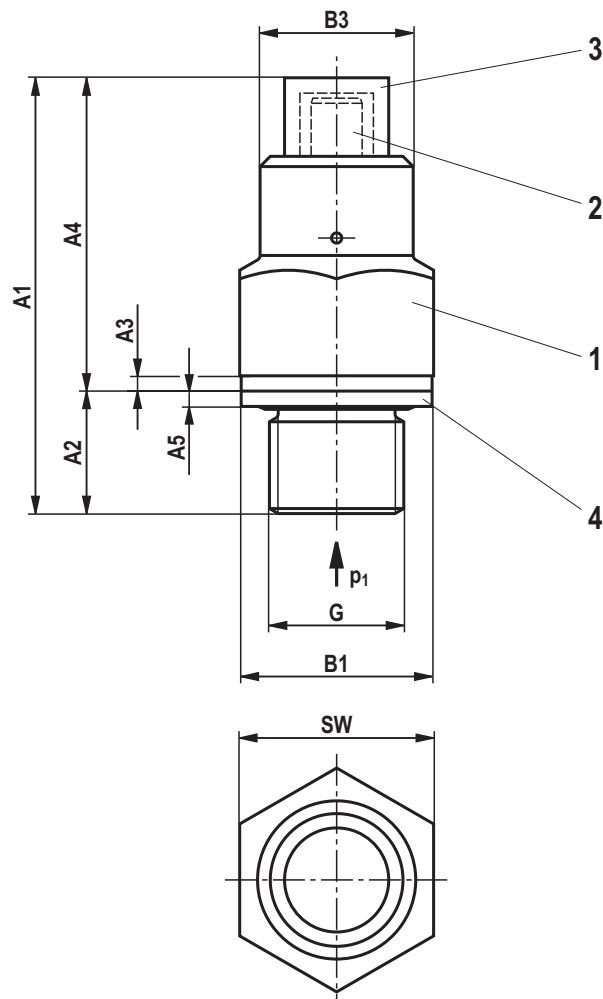
Type	Widths					Ports		Mounting / Tank bore				
	B1	B2	ØB3	ØB4	B5	C1	G	ØD1	ØD2	ØD3	ØD4	D5
25TE0351	85 [3.35]	75.5 [2.97]	75 [2.95]	129 [5.08]	151 [5.94]	SAE2" 3000 psi	G2	170 [6.69]	9 [0.35]	135 [5.31]	170 [6.69]	M8
25TE1051	110 [4.33]	97.5 [3.84]	110 [4.33]	166 [6.54]	195 [7.68]	SAE3" 3000 psi	G3	220 [8.66]	14 [0.55]	180 [7.09]	220 [8.66]	M12

Maintenance indicator

(dimensions in mm [inch])

Mechanical optical maintenance indicator

WO-S02-...-10-G1/4-1SP-1X/



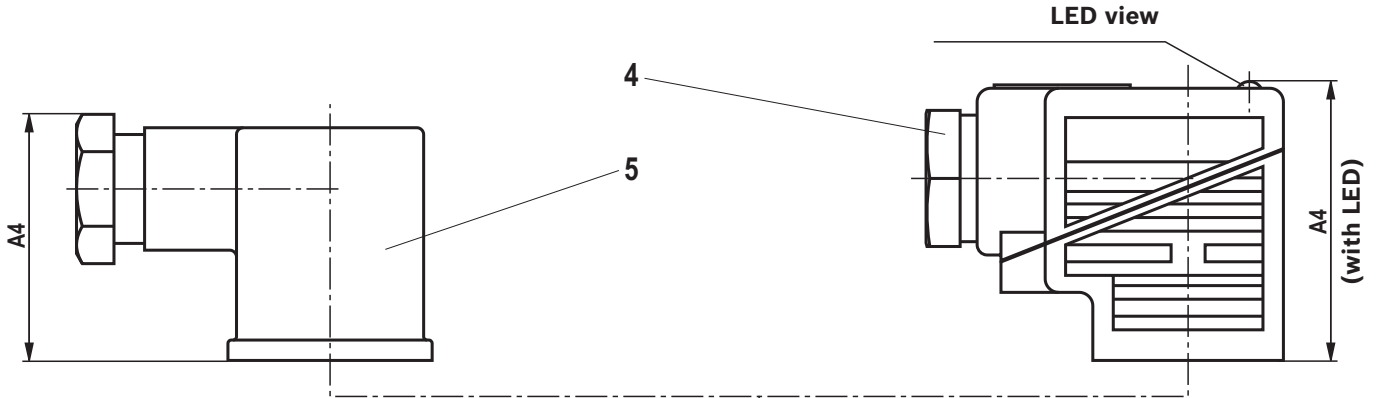
- 1 Mechanical optical maintenance indicator; monostable
max. tightening torque $M_{A \max} = 30 \text{ Nm} \pm 3 \text{ Nm}$ [22.13 ± 2.21 lb-ft]
- 2 Signal pin red, switching point 100 % when fully extended
- 3 Transparent plastic cap
- 4 USIT ring

Dimensions

Type	A1	A2	A3	A4	A5	ØB1	B2	ØB3	B4	G	SW
WO-S02	approx. 42.7 [1.68]	12 [0.47]	1.5 [0.06]	30.7 ± 0.3 [1.21 ± 0.01]	1.5 [0.06]	18.7 [0.74]	-	15 [0.59]	-	G1/4	19 [0.75]

Maintenance indicator
(dimensions in mm [inch])

Electric maintenance indicator



- 1 Electric maintenance indicator;
max. tightening torque brass
 $M_{A\max} = 40 \text{ Nm [29.50 lb-ft]}$
max. tightening torque stainless steel
 $M_{A\max} = 70 \text{ Nm [51.63 lb-ft]}$

2 Membrane

3 Bolt seal USIT

4 Mating connector with two LEDs:

Green: stand-by

Yellow: switching point 100 %

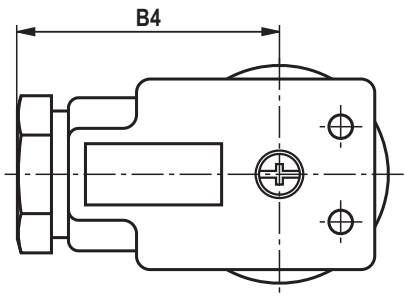
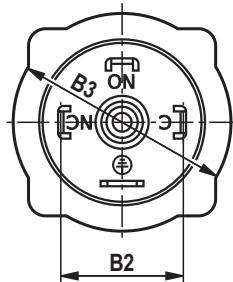
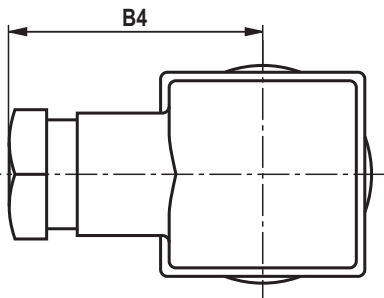
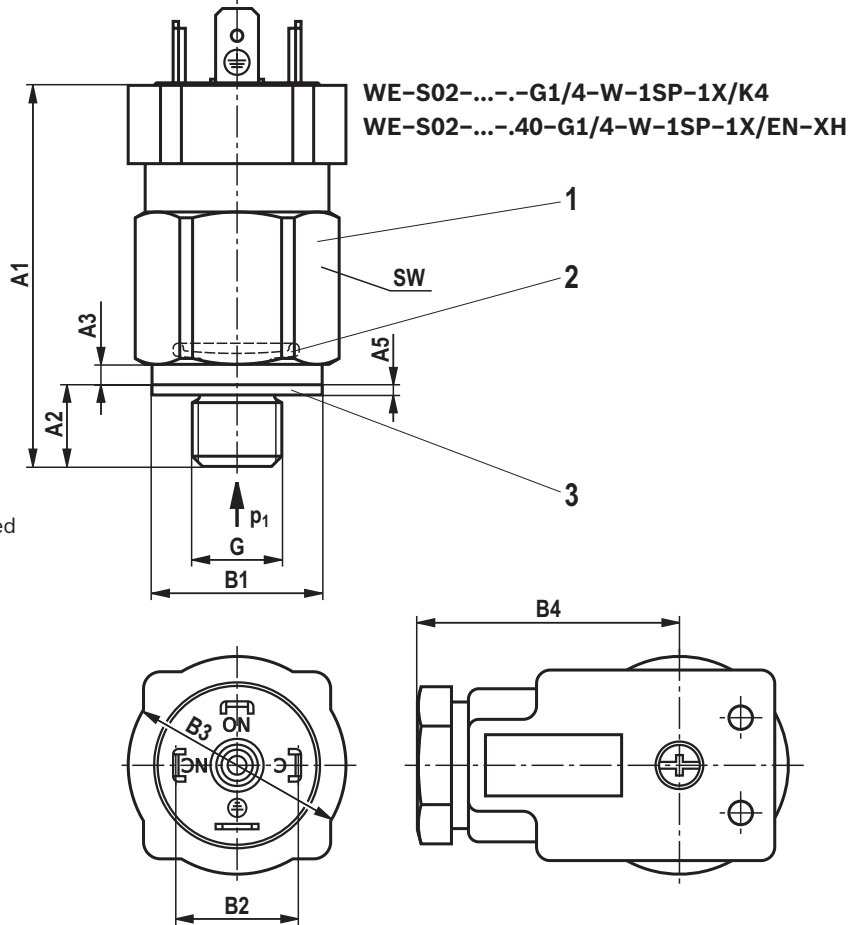
Various voltage ranges available:

R901017048 16 ... 30 (DC/AC), to be ordered separately

R901017037 180 ... 250 (DC/AC), to be ordered separately

5 Mating connector without LED

R901017012 standard version 12 ... 250 (DC/AC), to be ordered separately, ATEX version, pre-assembled at the factory



Thread dimensions with mating connector 25TE

Type	A1	A2	A3	A4	A5	ØB1	B2	ØB3	B4	G	SW
WE-S02				-			18 [0.71]		-		
WE-S02 + R901017012	approx. 56 [2.20]	12 [0.47]	3 [0.12]	36.2 [1.43]	1.5 [0.06]	25 [0.98]	-	32 [1.26]	37.25 [1.47]	G1/4	27 [1.06]
WE-S02 + R901017037				41 [1.61]					38.5 [1.52]		
WE-S02 + R901017048				40.5 [1.59]							

Ordering code spare parts

Filter element

01	02	03	04	05	06
20.			- E00	- 6	-

01	Design	20.
----	--------	-----

Size

02	TE... (Filter elements according to Bosch Rexroth standard)	0101 0201 0351 1051
----	--	------------------------------

Filter rating in μm

03	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$)	Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
		Water-adsorbent, not cleanable	AS6 AS10 AS20
	Nominal	Paper, not cleanable	P10 P25
		Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100

Pressure differential

04	Maximum admissible pressure differential of the filter element: 20 bar [290 psi]	E00
----	--	-----

Bypass valve

05	Bypass valve release pressure 3.0 bar [43 psi]	6
----	--	---

Seal

06	NBR seal	M
	FKM seal	V

Order example:

20.0101 H10XL-E00-6-M

Preferred program replacement elements

Filter element type	Filter material/material no.			
	H3XL	H6XL	H10XL	H20XL
20.0101 ...-E00-6-M	R928054019	R928054020	R928053667	R928054021
20.0201 ...-E00-6-M	R928054022	R928054023	R928053669	R928054024
20.0351 ...-E00-6-M	R928054025	R928054026	R928053671	R928054027
20.1051 ...-E00-6-M	R928054028	R928054029	R928053672	R928054030

Ordering code spare parts

Mechanical optical maintenance indicator

01	02	03	04	05	06	07	08	09							
W	O	-	S02	-	2.2	-	-	10	-	G1/4	-	1SP	-	1X	/

01	Maintenance indicator	W
----	-----------------------	---

02	Mechanical optical indicator ¹⁾	O
----	--	---

Version

03	Back pressure, compact design	S02
----	-------------------------------	-----

Switching pressure

04	2.2 bar [32 psi]	2.2
----	------------------	-----

Seal

05	NBR seal	M
	FKM seal	V

Max. nominal pressure

06	10 bar [145 psi]	10
----	------------------	----

Connection thread

07	Connection thread fluid, G1/4	G1/4
----	-------------------------------	------

Type of signal

08	One switching point	1SP
----	---------------------	-----

09	Component series 10 ... 19 (10 ... 19: unchanged installation and connection dimensions)	1X
----	--	----

Material no.	Description
R928053491	WO-S02-2.2-M-10-G1/4-1SP-1X/
R928053492	WO-S02-2.2-V-10-G1/4-1SP-1X/

¹⁾ When using an optical back pressure switch, the maximum permissible operating pressure is reduced to 10 bar [87 psi].

Ordering code spare parts

Electric maintenance indicator

01	02	03	04	05	06	07	08	09	10	11								
W	E	-	S02	-	2.2	-	-	40	-	G1/4	-	1SP	-	1X	/	EN	-	XH

01	Maintenance indicator	W
----	-----------------------	---

02	Electronic displays	E
----	---------------------	---

Version

03	Back pressure, compact design	S02
----	-------------------------------	-----

Switching pressure

04	2.2 bar [32 psi]	2.2
----	------------------	-----

Seal

05	NBR seal	M
	FKM seal	V

Max. nominal pressure

06	40 bar [580 psi]	40
----	------------------	----

Connection thread

07	Connection thread fluid, G1/4	G1/4
----	-------------------------------	------

Type of signal

08	One switching point	1SP
----	---------------------	-----

09	Component series 10 ... 19 (10 ... 19: unchanged installation and connection dimensions)	1X
----	--	----

Supplementary information

10	Rectangular plug-in connection according to EN175301-803	EN
----	--	----

11	ATEX with type certificate, II 1GD Ex ia IIC TX Ex ia IIIC TX°C X	XH
----	---	----

Material no.	Description
R928053346	WE-S02-2.2-M-40-G1/4-W-1SP-1X/K4
R928053347	WE-S02-2.2-V-40-G1/4-W-1SP-1X/K4
R928053348	WE-S02-2.2-M-40-G1/4-W-1SP-1X/EN-XH
R928053349	WE-S02-2.2-V-40-G1/4-W-1SP-1X/EN-XH

Ordering code spare parts

Seal kit

01	02	03	04	05
D	25TE		- 2X / -	

01	Seal kit	D
02	Series	25TE

Size

03	0101	0101
	0201	0201
	0351	0351
	1051	1051
04	Component series 20 ... 29 (20 ... 29: unchanged installation and connection dimensions)	2X

Seal

05	NBR seal	M
	FKM seal	V

Material no.	Description
R961010189	D25TE0101-2X/-M
R961010193	D25TE0101-2X/-V
R961010190	D25TE0201-2X/-M
R961010194	D25TE0201-2X/-V
R961010191	D25TE0351-2X/-M
R961010195	D25TE0351-2X/-V
R961010192	D25TE1051-2X/-M
R961010196	D25TE1051-2X/-V

Thread coupling for venting when used as an inline filter

Material no.	Description	Seal
R900009090	MCS20-SDS-E-G1/4-ST3N00Z-M	NBR
R900001264	MCS20-SDS-E-G1/4-ST3F00Z-M	FKM

Assembly, commissioning, maintenance

Assembly

- ▶ The max. operating pressure of the system must not exceed the max. admissible operating pressure of the filter (see type plate).
- ▶ Before the assembly, the hole pattern of the tank must be compared to the dimensions from the “Dimensions” chapter.
- ▶ It is strongly recommended to secure drain pipes longer than 500 mm with an inside tank mount bracket in order to avoid vibrations due to fluid flow in the tank. Additionally, it is necessary for maintenance work to ensure the filter housing and the outlet pipe are pulled out of the container together.
- ▶ During assembly of the filter (see also chapter “Tightening torque”), the flow direction (direction arrows) and the required servicing height of the filter element (see chapter “Dimensions”) are to be considered.
- ▶ Perfect functioning is only guaranteed in the installation position filter bowl vertically downwards and ON the tank.
- ▶ The maintenance indicator must be arranged so it is easily viewed during operation.
- ▶ Remove the plastic plugs in the filter inlet and outlet.
- ▶ Ensure that the system is assembled without tension stress.
- ▶ The connection of the electrical maintenance indicator is via a mating connector that is attached to the maintenance indicator contacts and held by a screw. The transport guard must be removed. The electrical maintenance indicator (ATEX) is delivered with the relevant mating connector.

Commissioning

- ▶ Commission the system.

Notice:

There is no bleeding provided at the filter. A vent is available only in the inline filter version.

Maintenance

- ▶ If at operating temperature, the red indicator pin reaches out of the mechanical optical maintenance indicator or if the switching process in the electronic switching element is triggered, the filter element is contaminated and needs to be replaced or cleaned respectively.
- ▶ The material number of the corresponding replacement filter element is indicated on the name plate of the complete filter. It must comply with the material number on the filter element.
- ▶ Unscrew the filter cover and loosen the screws and remove the filter over upwards.

Notice:

Note that elements with lower filtration ratings may take slightly longer to discharge the residual oil.

- ▶ Remove the filter element from the spigot in the filter bowl by rotating it slightly.
- ▶ Remove filter element. From frame size 0351, the filter elements are equipped with removal brackets.
- ▶ Clean the filter components, if necessary.
- ▶ Check the seals at the filter cover for damage and replace them, if necessary. For suitable seal kits refer to chapter “Spare parts”.
- ▶ Filter elements made of wire mesh can be cleaned. For detailed cleaning instructions refer to data sheet 51420.
- ▶ Install the new or cleaned filter element on the spigot again by slightly rotating it.
- ▶ The filter is to be assembled in reverse order.
- ▶ The torque specifications (“Tightening torques” chapter) are to be observed.

Assembly, commissioning, maintenance**⚠ WARNING!**

- ▶ Assemble and disassemble only with depressurized system! For the filter element exchange refer to "Maintenance".
- ▶ Filter is pressurized!
- ▶ Do not exchange the maintenance indicator while the filter is under pressure!
- ▶ If the flow direction is not considered during assembly, the filter element will be destroyed. Contamination will enter the system and damage the downstream components.

👉 Notices:

- ▶ All work on the filter must be performed by trained specialists only.
- ▶ Functional and safety warranty only applicable when using genuine Bosch Rexroth spare parts!
- ▶ Warranty becomes void if the delivered item is changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental condition that do not comply with the installation conditions.

Tightening torques
(dimensions in mm [*inch*])**Mounting filter cover**

Series 25TE	0101	0201	0351	1051	
Screw cover fastening	M5 x 20	M8 x 20	M10 x 25	M16 x 25	
Quantity	4				
Recommended property class of screw	8.8				
Tightening torque with $\mu_{\text{total}} = 0.14$	Nm [<i>lbf-ft</i>]	6 ± 0.6 [4.43 ± 0.44]	25 ± 2.5 [18.4 ± 1.84]	50 ± 5.0 [36.9 ± 3.69]	215 ± 21.5 [158.6 ± 15.9]

Tank mounting

Series 25TE	0101	0201	0351	1051	
Tank mounting screw	M5	M6	M8	M12	
Quantity	4				
Recommended property class of screw	8.8				
Tightening torque with $\mu_{\text{total}} = 0.14$	Nm [<i>lbf-ft</i>]	7 ± 0.7 [5.16 ± 0.52]	13 ± 1.3 [9.6 ± 0.96]	18 ± 1.8 [13.3 ± 1.33]	60 ± 6 [44.3 ± 4.43]

Maintenance indicator

Series 25TE	0101	0201	0351	1051
Mechanical optical maintenance indicator	Nm [<i>lbf-ft</i>]	30 ± 3 [22.1 ± 2.21]		
Electric maintenance indicator; brass	Nm [<i>lbf-ft</i>]	max 40 [29.5]		
Electric maintenance indicator; stainless steel ATEX	Nm [<i>lbf-ft</i>]	max 70 [51.6]		
Cubic connector screw M3 switching element EN-175301-803	Nm [<i>lbf-ft</i>]	0.5 - 0.6 [0.37 - 0.44]		
Threaded coupling for venting	Nm [<i>lbf-ft</i>]	max 40 [29.5]		

Directives and standardization

Classification according to the Pressure Equipment

Directive

The tank mounted return line filters for hydraulic applications according to 51472 are pressure holding equipment according to article 1, section 2.1.4 of the Pressure Equipment Directive 97/23/EC (PED). However, based on the

exception in article 1, section 3.6 of the PED, hydraulic filters are exempt from the PED if they are not classified higher than category I (guideline 1/19).

They do not receive a CE mark.

Use in potentially explosive areas according to directive 94/9/EC (ATEX)

The tank mounted return line filters according to 51472 are not equipment or components in the sense of directive 94/9/EC and are not provided with a CE mark. It has been proven with the ignition risk analysis that these return line filters do not have own ignition sources acc. to DIN EN 13463-1:2009.

According to DIN EN 60079-11:2012, the electronic maintenance indicators WE-S02-2.2-...-40-G1/4-W-1SP-1X/K4 are simple electronic operating equipment not having an own voltage source. This simple, electronic operating equipment may - according to DIN EN 60079-14:2012 -

in intrinsically safe electric circuits (Ex ib) be used in systems.

The tank mounted return line filters with the electronic maintenance indicators described here can be used for the following explosive areas:

	Zone suitability ²⁾	
Gas	1	2
Dust	21	22

Complete filter with mech./opt. Maintenance indicator			
Use /assignment		Gas 2G	Dust 2D
Assignment ¹⁾		Ex II 2G c IIC TX	Ex II 2D c IIC TX
Conductivity of the medium	pS/m	min	300
Dust accumulation		max	0.5 mm

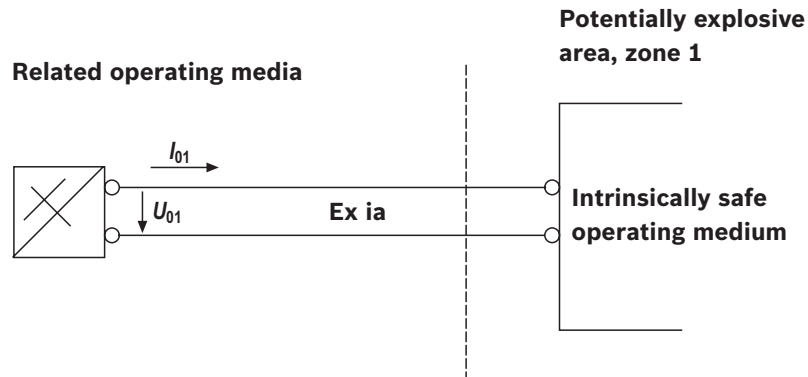
Electronic maintenance indicator in the intrinsically safe electric circuit			
Use/assignment		Gas 1G	Dust 1D
Assignment		II 1GD Ex ia IIC TX Ex ia IIIC TX°C X	
Perm. intrinsically safe electric circuits		Ex ia IIC	Ex ia IIIC
Technical data		Values only for intrinsically safe electric circuit	
Switching voltage	Ui	max	20 V AC/DC
Switching current	Ii	max	200 mA
Switching power	Pi	max	1 W
Surface temperature ¹⁾		max	100 °C
Inner capacity	Ci		negligible
Inner inductivity	Li		negligible
Dust accumulation		max	0.5 mm

¹⁾ The temperature depends on the temperature of the medium in the filter and must not exceed the value specified here.

²⁾ By mounting the maintenance indicators (zone suitability 0/20) on the tank mounted return line filter (zone suitability 1/21) of the assembly is assigned the zone 1/21.

Directives and standardization

Possible circuit according to DIN EN 60079-14



⚠ WARNING!

- ▶ Explosion hazard due to high temperature! The temperature depends on the temperature of the medium in the hydraulic circuit and must not exceed the value specified here. Measures are to be taken so that in the potentially explosive area, the max. admissible ignition temperature is not exceeded.
- ▶ When using the tank mounted return line filters according to 51472 in explosive areas, appropriate

- potential equalization has to be ensured. The filter is preferably to be grounded via the mounting screws. It has to be noted in this connection that paint and protective oxide layers are not electrically conductive.
- ▶ During filter element exchanges, the packaging material is to be removed from the replacement element outside the explosive area

👉 Notices:

- ▶ Maintenance only by specialists, instruction by the machine end-user acc. to DIRECTIVE 1999/92/EC appendix II, section 1.1

- ▶ Functional and safety warranty only applicable when using genuine Rexroth spare parts

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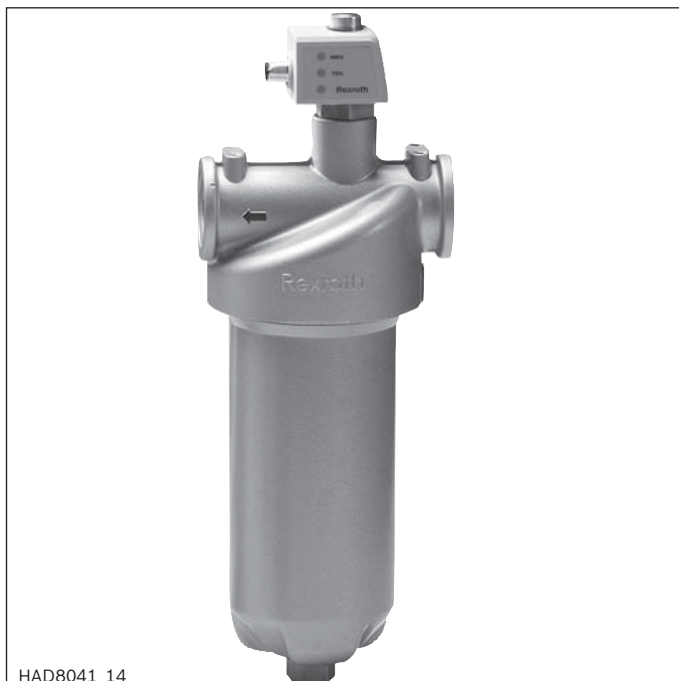
Inline filter with filter element according to DIN 24550

Type 50LEN0040 to 0400; 50LE0130, 0150

RE 51447

Issue: 2014-11

Replaces: 05.14



HAD8041_14

- ▶ Size according to **DIN 24550**: 0040 to 0400
- ▶ additional sizes: 0130, 0150
- ▶ Nominal pressure 50 bar [725 psi]
- ▶ Connection up to 1 1/2"
- ▶ Operating temperature -10 °C to 100 °C [14 °F to 212 °F]

Features

Inline filters are used in hydraulic systems for separating solid materials from the fluids and lubricating oils. They are intended for attachment in pipelines.

They distinguish themselves by the following:

- ▶ Filters for inline installation
- ▶ Special highly efficient filter materials
- ▶ Filtration of very fine particles and high dirt holding capacity across a broad pressure differential range
- ▶ High collapse resistance of the filter elements
- ▶ By default equipped with mechanical optical maintenance indicator with memory function
- ▶ Available as an option with different electronic switching elements, modular design
- ▶ Optional bypass valve integrated in the filter housing

Contents

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Ordering code filter

01	02	03	04	05	06	07	08	09	09
50LE			-		-	-	-	-	-

Series

01	Inline filter 50 bar [725 psi]	50LE
----	--------------------------------	------

Filter element

02	with filter element according to DIN 24550	N
----	---	---

Size

03	LEN... (Filter element according to DIN 24550)	0040 0063 0100 0160 0250 0400
	LE... (Filter element according to Bosch Rexroth standard)	0130 0150

Filter rating in μm

04	Nominal Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100
	Nominal Filter paper, not cleanable	P10 P25
	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$) Non-woven glass fiber media, not cleanable	H3XL H6XL H10XL H20XL

Pressure differential

05	max. admissible pressure differential of the filter element 30 bar [435 psi], with bypass valve	A00
	max. admissible pressure differential of the filter element 330 bar [4786 psi], without bypass valve	B00

Maintenance indicator

06	Maintenance indicator, mech./optical, switching pressure 0.8 bar [11.6 psi] – bypass cracking pressure 2.5 bar [36 psi]	V0.8
	Maintenance indicator, mech./optical, switching pressure 1.5 bar [21.8 psi] – bypass cracking pressure 2.5 bar [36 psi]	V1.5
	Maintenance indicator, mech./optical, switching pressure 2.2 bar [32 psi] – bypass cracking pressure 3.5 bar [51 psi]	V2.2
	Maintenance indicator, mech./optical, switching pressure 5.0 bar [72.5 psi] – bypass cracking pressure 7 bar [102 psi]	V5,0

Seal

07	NBR seal	M
	FKM seal	V

Connection

08	Frame size	0040-0100	0130-0150	0160-0400		
	Connection					
	G 3/4	●			Pipe thread according to ISO 228	R3
	G 1		●			R4
	G 1 1/2			●		R6
	SAE 12	X			Pipe thread according to SAE J1926	U4
	SAE 16		X			U9
	SAE 24			X		U6
	● Standard connection X Alternative connection					

Supplementary information

Bosch Rexroth AG, RE 51447, edition: 2014-11

Ordering code filter

01	02	03	04	05	06	07	08	09	09
50LE			-			-	-		-

09	without bypass valve (only possible in connection with filter element version "A00") ¹⁾	NB
	Manufacturer's inspection certificate M according to DIN 55350 T18	Z1

¹⁾ **Attention:** If this option is selected and the maintenance indicator is not observed, the filter element may collapse in case of operating pressures of more than 30 bar [435 psi].

Order example:

50LEN0100-H3XLA00-V5,0-M-R4

Further versions (filter materials, connections,...) are available on request.

Preferred types**NBR seal, with bypass, flow specifications for 30 mm²/s [143 SUS]**Inline filter 50 LE(N), filter rating **3 µm**

Type	Flow in l/min [gpm] at Δp = 1 bar [14.5 psi]	Material no. Filter				Material no. Replacement filter element
		..R3	R928048449	..U4	R928048452	
50LEN0040-H3XLA00-V2,2-M-..	23 [6.08]	..R3	R928048449	..U4	R928048452	R928006645
50LEN0063-H3XLA00-V2,2-M-..	30 [7.93]	..R3	R928050995	..U4	R928048453	R928006699
50LEN0100-H3XLA00-V2,2-M-..	44 [11.62]	..R3	R928051075	..U4	R928048454	R928006753
50LE0130-H3XLA00-V2,2-M-..	74 [19.55]	..R4	R928050770	..U9	R928048455	R928022274
50LE0150-H3XLA00-V2,2-M-..	89 [23.51]	..R4	R928050850	..U9	R928048456	R928022283
50LEN0160-H3XLA00-V2,2-M-..	132 [34.87]	..R6	R928051152	..U6	R928048457	R928006807
50LEN0250-H3XLA00-V2,2-M-..	190 [50.19]	..R6	R928051232	..U6	R928048458	R928006861
50LEN0400-H3XLA00-V2,2-M-..	250 [66.04]	..R6	R928051312	..U6	R928048459	R928006915

Inline filter 50 LE(N), filter rating **6 µm**

Type	Flow in l/min [gpm] at Δp = 1 bar [14.5 psi]	Material no. Filter				Material no. Replacement filter element
		..R3	R928050930	..U4	R928050931	
50LEN0040-H6XLA00-V5,0-M-..	31 [8.19]	..R3	R928050930	..U4	R928050931	R928006646
50LEN0063-H6XLA00-V5,0-M-..	46 [12.15]	..R3	R928051008	..U4	R928051009	R928006700
50LEN0100-H6XLA00-V5,0-M-..	57 [15.06]	..R3	R928051088	..U4	R928051089	R928006754
50LE0130-H6XLA00-V5,0-M-..	94 [24.83]	..R4	R928050783	..U9	R928050784	R928022275
50LE0150-H6XLA00-V5,0-M-..	103 [27.21]	..R4	R928050863	..U9	R928050864	R928022284
50LEN0160-H6XLA00-V5,0-M-..	175 [46.23]	..R6	R928051165	..U6	R928051166	R928006808
50LEN0250-H6XLA00-V5,0-M-..	226 [59.70]	..R6	R928051245	..U6	R928051246	R928006862
50LEN0400-H6XLA00-V5,0-M-..	282 [74.50]	..R6	R928051325	..U6	R928051326	R928006916

Inline filter 50 LE(N), filter rating **10 µm**

Type	Flow in l/min [gpm] at Δp = 1 bar [14.5 psi]	Material no. Filter				Material no. Replacement filter element
		..R3	R928047959	..U4	R928048460	
50LEN0040-H10XLA00-V2,2-M-..	36 [9.51]	..R3	R928047959	..U4	R928048460	R928006647
50LEN0063-H10XLA00-V2,2-M-..	69 [18.23]	..R3	R928050967	..U4	R928048461	R928006701
50LEN0100-H10XLA00-V2,2-M-..	75 [19.81]	..R3	R928051047	..U4	R928048462	R928006755
50LE0130-H10XLA00-V2,2-M-..	127 [33.55]	..R4	R928050743	..U9	R928048463	R928022276
50LE0150-H10XLA00-V2,2-M-..	150 [39.63]	..R4	R928050822	..U9	R928048464	R928022285
50LEN0160-H10XLA00-V2,2-M-..	210 [55.48]	..R6	R928051125	..U6	R928048465	R928006809
50LEN0250-H10XLA00-V2,2-M-..	260 [68.68]	..R6	R928051204	..U6	R928048466	R928006863
50LEN0400-H10XLA00-V2,2-M-..	300 [79.25]	..R6	R928051284	..U6	R928048467	R928006917

Ordering code accessories
(dimensions in mm [inch])

Electronic switching element for maintenance indicators

01	02	03
WE	-	-

Maintenance indicator

01	electronic switching element	WE
----	------------------------------	----

Type of signal

02	1 switching point	1SP
	2 switching points, 3 LED	2SP
	2 switching points, 3 LED and signal suppression up to 30 °C [86 °F]	2SPSU

Connector

03	Round plug-in connection M12 x 1, 4-pole	M12 x 1
	Rectangular plug-in connection, 2-pole, design A according to EN-175301-803	EN175301-803

Material numbers of the electronic switching elements

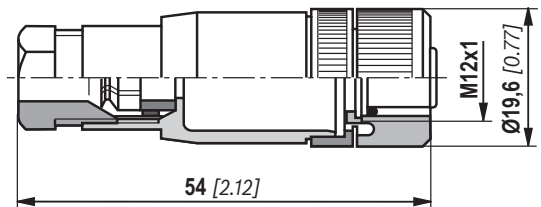
Material no.	Type	Signal	Switching points	Connector	LED
R928028409	WE-1SP-M12 x 1	Changeover	1	M12 x 1	No
R928028410	WE-2SP-M12 x 1	Normally open (at 75%) / normally closed contact (at 100%)	2		3 pieces
R928028411	WE-2SPSU-M12 x 1				
R928036318	WE-1SP-EN175301-803	Normally closed contact	1	EN 175301-803	No

Mating connectors according to IEC 60947-5-2

for electronic switching element with round plug-in connection M12 x 1

Mating connector suitable for K24 4-pole, M12 x 1 with screw connection, cable gland Pg9.

Material no. R900031155

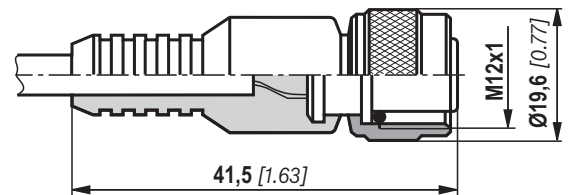


Mating connector suitable for K24-3m 4-pole, M12 x 1 with potted-in PVC cable, 3 m long.

Line cross-section: 4 x 0.34 mm²

Core marking: 1 brown 2 white
3 blue 4 black

Material no. R900064381



For more round plug-in connections and technical data refer to data sheet 08006.

Order example:

Inline filter with mechanical optical maintenance indicator for $p_{nom.} = 50 \text{ bar [725 psi]}$ with bypass valve, size 0160, with filter element 10 μm and electronic switching element M12 x 1 with 1 switching point for hydraulic fluid mineral oil HLP according to DIN 51524.

Filter with mech. optical maintenance indicator: 50LEN0160-H10XLA00-V5,0-M-R6

Material no. R928051126

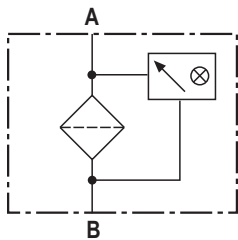
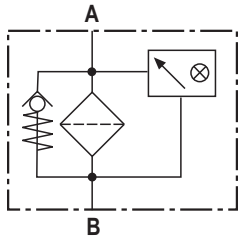
Switching element: WE-1SP-M12 x 1

Material no. R928028409

Mating connector: Mating connector suitable for K24 4-pole, M12 x 1 with screw connection, cable gland Pg9. Material no. R900031155

Symbols

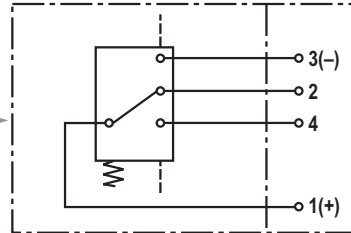
Inline filter with bypass and mechanical indicator



Inline filter without bypass and with mechanical indicator

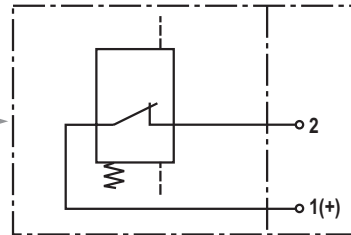
Electronic switching element for maintenance indicator

Switching element Connector



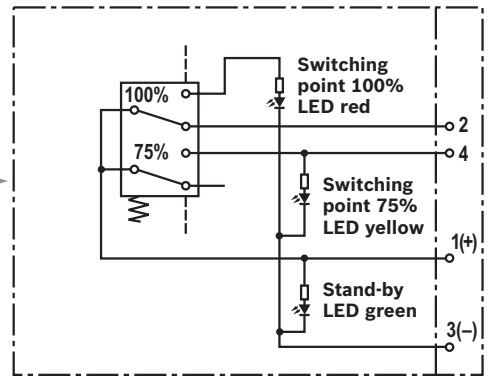
WE-1SP-M12 x 1

Switching element Connector



WE-1SP-EN175301-803

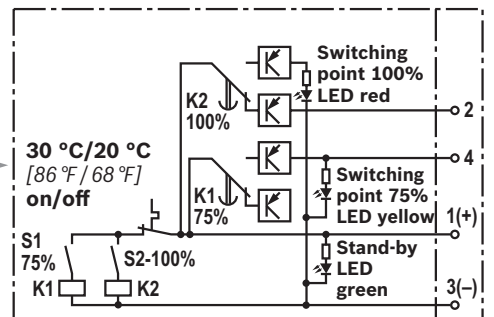
Switching element Connector



WE-2SP-M12 x 1

Circuit diagram drawn in plugged condition (operating state)

Switching element Connector



WE-2SPSU-M12 x 1

Circuit diagram drawn in plugged condition at temperature > 30 °C [86 °F] (operating state)

Function, section

The 50LE(N) inline filter is suitable for direct installation into pressure lines. It is installed upstream components to be protected.

It basically consists of filter head (1), a screwable filter bowl (2), filter element (3) as well as mechanical optical maintenance indicator (4). In case of filters with low-pressure-differential-stable filter elements (= code letter pressure differential A), there is an assembled bypass valve (5) as standard.

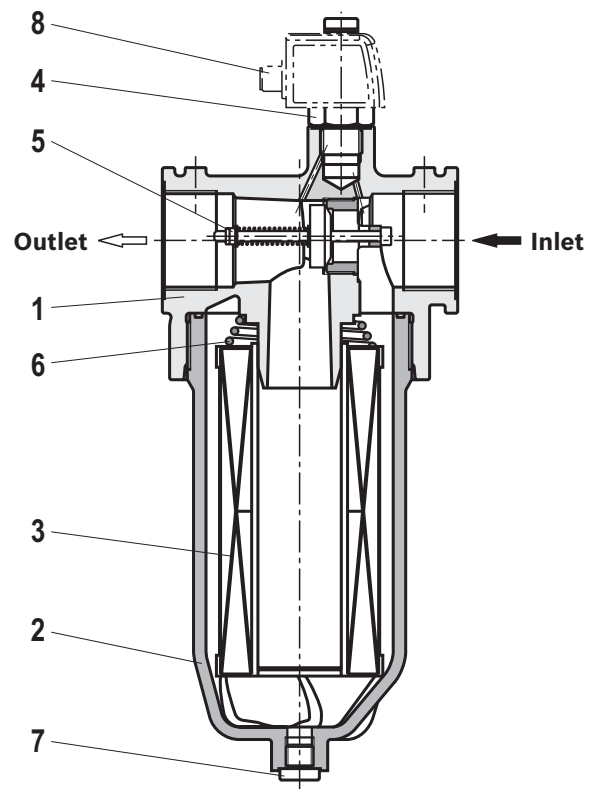
The installed spring (6) prevents possible vibrations of the filter element (3). During disassembly, the contact pressure of the spring (6) holds the filter element in the filter bowl (2).

Via the inlet, the fluid reaches the filter element (3) where it is cleaned. The dirt particles filtered out settle in the filter element (3). Via the outlet, the filtered fluid enters the hydraulic circuit.

The filter housing and all connection elements are designed so that pressure peaks - as they may e.g. occur in case of abrupt opening of large control valves due to the accelerated fluid quantity - can be securely absorbed. As of size 0160, the standard equipment comprises a drain screw (7).

By default, the filter is equipped with mechanical optical maintenance indicator (4). The electronic switching element (8) which has to be ordered separately is attached to the mechanical optical maintenance indicator (4) and held by means of a locking ring.

The electronic switching elements with 1 or 2 switching points are connected via a mating connector according to IEC-60947-5-2 or via a cable connection according to EN17301-803.



Type 50LEN0160

WARNING!

If the maintenance indicator is not observed while the element is exchanged, the bypass valve will open if the pressure differential increases. This means that part of the volume flow enters unfiltered into the clean side of the filter. Effective filtration is therefore no longer guaranteed.

Technical data

(For applications outside these parameters, please consult us!)

General					
Installation position	vertical				
Ambient temperature range	°C [°F]	-10 ... +100 [14 ... +212] (shortly up to -30 [-22])			
Weight	NS	0040	0063	0100	0130
	kg [lbs]	1.05 [2.3]	1.1 [2.4]	1.2 [2.6]	1.91 [4.2]
	NS	0150	0160	0250	0400
	kg [lbs]	2.06 [4.5]	3.1 [6.8]	3.3 [7.3]	3.8 [8.4]
Volume	NS	0040	0063	0100	0130
	l [US gal]	0.27 [0.07]	0.39 [0.1]	0.58 [0.15]	0.89 [0.23]
	NS	0150	0160	0250	0400
	l [US gal]	1.1 [0.29]	1.31 [0.35]	1.89 [0.50]	2.84 [0.75]
Material	- Filter head	Aluminum			
	- Filter bowl	Aluminum			
	- Bypass valve	Aluminum / steel / POM			
	- Seals	NBR or FKM			
	- optical maintenance indicator	V0,8; V1,5; V2,2	Aluminum		
		V5,0	Brass		
Electronic switching element	Plastic PA6				

Hydraulic			
Maximum operating pressure	bar [psi]	50 [725]	
Hydraulic fluid temperature range	°C [°F]	-10 to +100 [+14 to +212]	
Minimum conductivity of the medium	pS/m	300	
Fatigue strength according to ISO 10771	Load cycles	> 10 ⁶ with max. operating pressure	
Type of pressure measurement of the maintenance indicator	Pressure differential		
Assignment: Response pressure of the maintenance indicator / cracking pressure of the bypass valve	bar [psi]	Response pressure of the maintenance indicator	Cracking pressure of the bypass valve
		0.8 ± 0.15 [11.6 ± 2.2]	2.5 ± 0.25 [36.3 ± 3.6]
		1.5 ± 0.20 [21.8 ± 2.9]	2.5 ± 0.25 [36.3 ± 3.6]
		2.2 ± 0.30 [31.9 ± 4.4]	3.5 ± 0.35 [50.8 ± 5.1]
		5.0 ± 0.50 [72.5 ± 7.3]	7.0 ± 0.5 [101.5 ± 7.3]
Filtration direction	From the outside to the inside		

Electric (electronic switching element)					
Electrical connection	Version	Round plug-in connection M12 x 1, 4-pole			Standard connection EN 175301-803
		WE-1SP-M12 x 1	WE-2SP-M12 x 1	WE-2SPSU-M12 x 1	WE-1SP-EN175301-803
Contact load, direct voltage	A _{max.}	1			
Voltage range	V _{max.}	150 (AC/DC)	10-30 (DC)		250 (AC)/200 (DC)
max. switching power with resistive load	W	20			70
Switching type	- 75% signal	-	Normally open contact		-
	- 100% signal	Changeover	Normally closed contact		Normally closed contact
	- 2SPSU			Signal interconnection at 30 °C [86 °F], return switching at 20 °C [68 °F]	
Display via LEDs in the electronic switching element 2SP...			Stand-by (LED green); 75% switching point (LED yellow) 100% switching point (LED red)		
Protection class according to EN 60529		IP 67			IP 65
Ambient temperature range	°C [°F]	-25 to +85 [-13 to +185]			
For direct voltage above 24 V, spark extinguishing is to be provided for protecting the switching contacts.					
Weight	electronic switching element: - with round plug-in connection M12 x 1	kg [lbs]	0.1 [0.22]		

Technical data

(For applications outside these parameters, please consult us!)

Filter element			
Non-woven glass fiber media H..XL		Single-use element on the basis of inorganic fiber	
		Filtration ratio according to ISO 16889 up to $\Delta p = 5 \text{ bar}$ [72.5 psi]	Achievable oil cleanliness according to ISO 4406 [SAE-AS 4059]
	H20XL	$\beta_{20}(c) \geq 200$	19/16/12 – 22/17/14
	H10XL	$\beta_{10}(c) \geq 200$	17/14/10 – 21/16/13
	H6XL	$\beta_6(c) \geq 200$	15/12/10 – 19/14/11
	H3XL	$\beta_3(c) \geq 200$	13/10/8 – 17/13/10
Admissible pressure differential	– A	bar [psi]	30 [435]
	– B	bar [psi]	330 [4785]

Compatibility with hydraulic fluids

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oil	HLP	NBR	DIN 51524
Biodegradable	– insoluble in water	HETG	VDMA 24568
		HEES	
	– soluble in water	HEPG	VDMA 24568
Flame-resistant	– water-free	HFDU, HFDR	VDMA 24317
	– containing water	HFAS	DIN 24320
		HFAE	
		HFC	
		NBR	VDMA 24317



Important information on hydraulic fluids!

- For more information and data on the use of other hydraulic fluids, please refer to data sheet 90220 or contact us!
- **Flame-resistant – containing water:** due to possible chemical reactions with materials or surface coatings of machine and system components, the service life with these hydraulic fluids may be less than expected. Filter materials made of filter paper P

(cellulose) may not be used, filter elements with filter materials made of glass fiber (HydroClean H...XL or wire mesh G) have to be used instead.

- **Biodegradable:** If filter materials made of filter paper are used, the filter life may be shorter than expected due to material incompatibility and swelling.

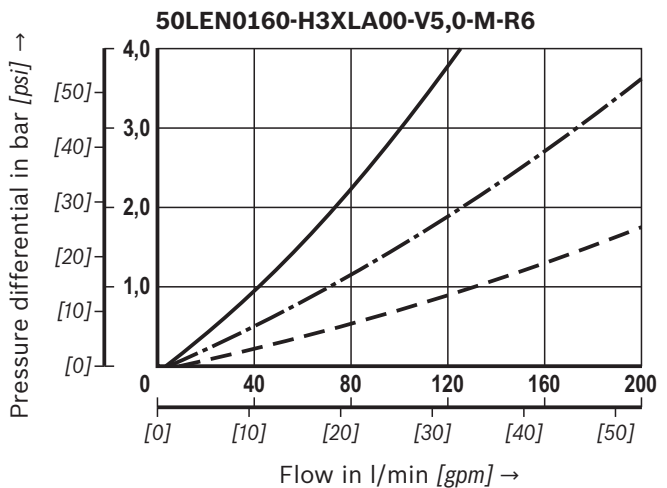
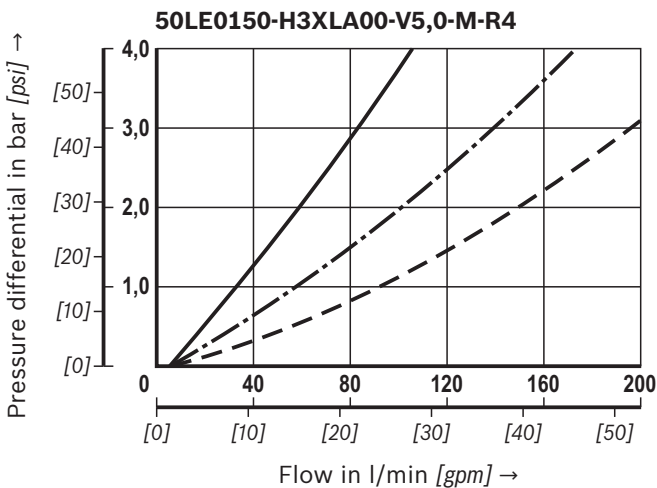
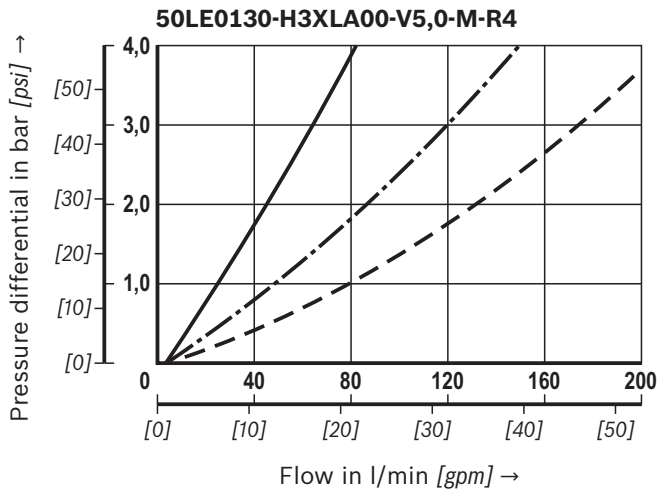
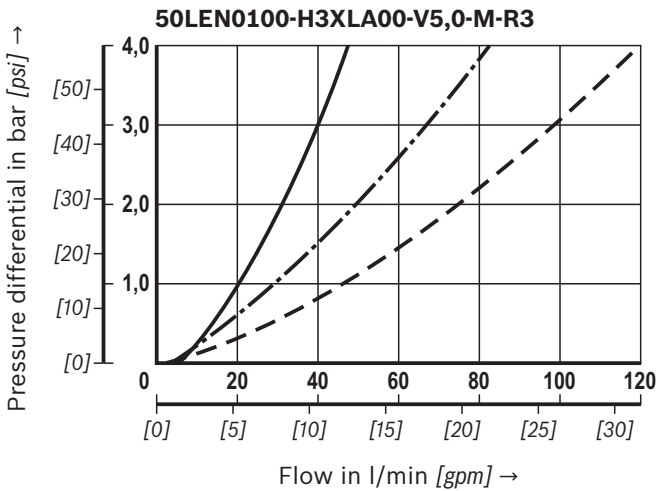
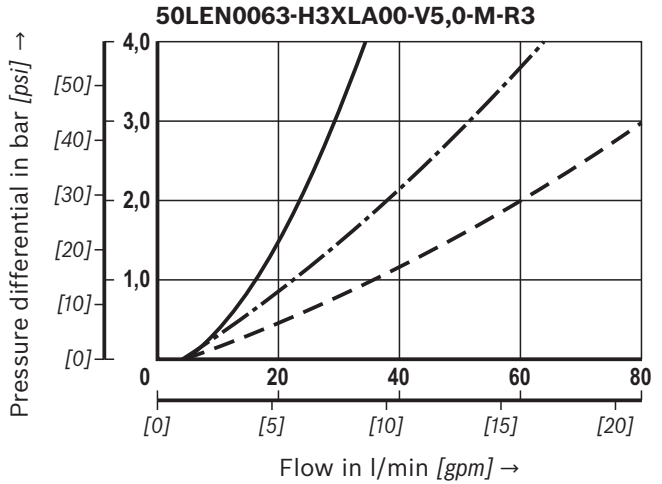
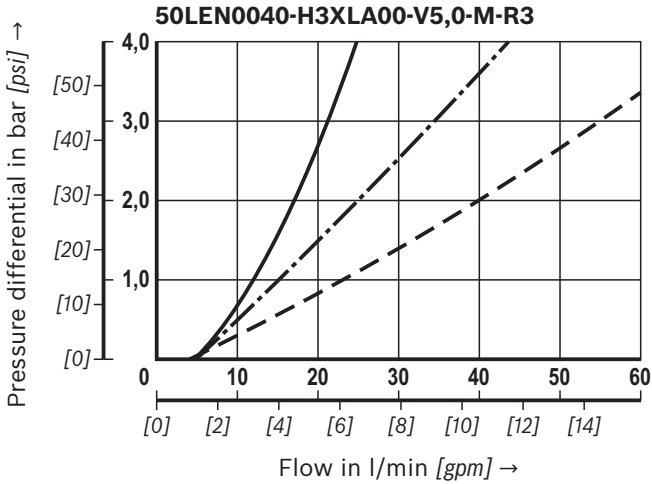
Characteristic curves H3XL

(measured with mineral oil HLP46 according to DIN 51524 at T = 40 °C) [104 °F]

Spec. weight: < 0.9 kg/dm³ Δp -Q-characteristic curves for complete filters recommended initial Δp for design = 1 bar [14.5 psi]

Selection of the perfect filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 — 140 mm²/s [649 SUS]
 - · - 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Characteristic curves H3XL; H10XL

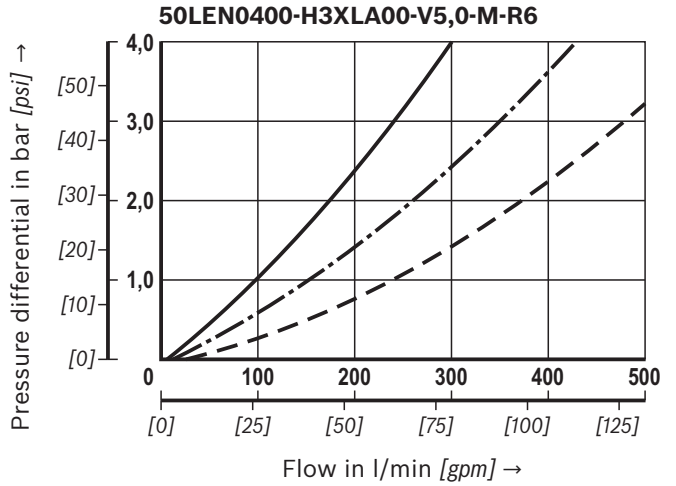
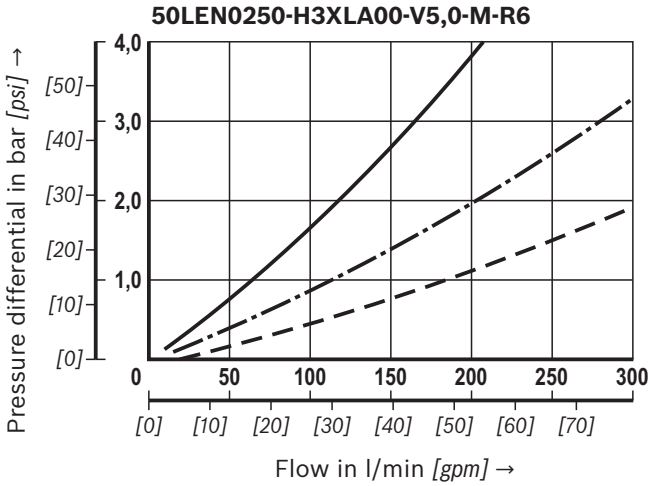
(measured with mineral oil HLP46 according to DIN 51524 at T = 40 °C) [104 °F])

Spec. weight: < 0.9 kg/dm³ Δp -Q-characteristic curves for complete filters recommended initial Δp for design = 1 bar [14.5 psi]

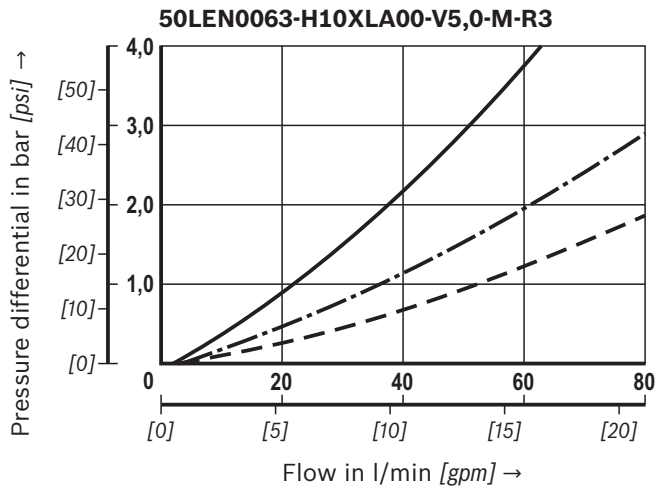
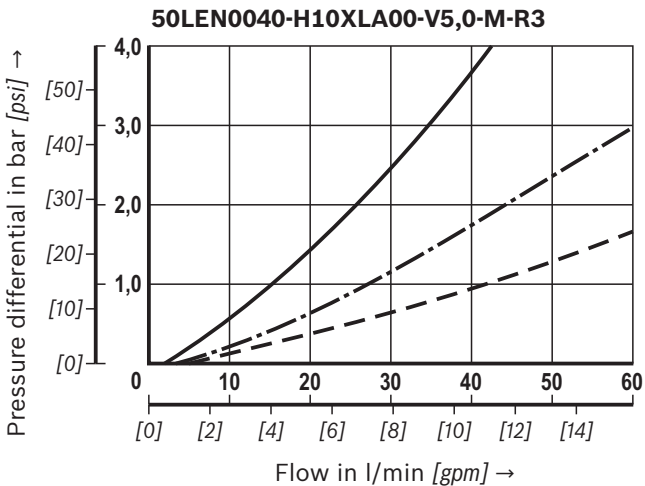
Selection of the perfect filter is made possible by our online “Bosch Rexroth FilterSelect “ design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]

H3XL



H10XL



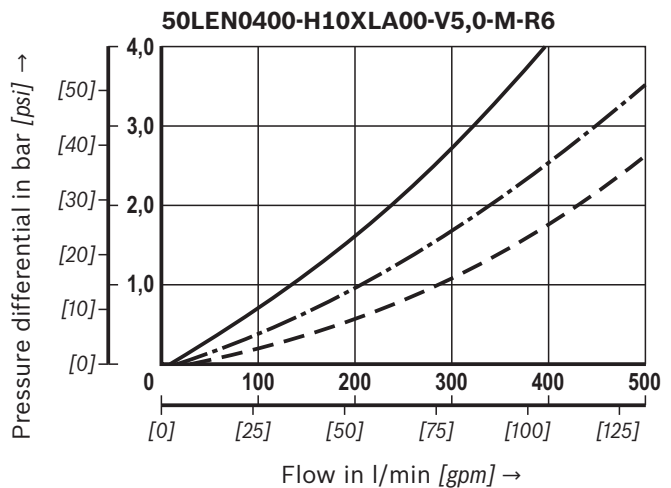
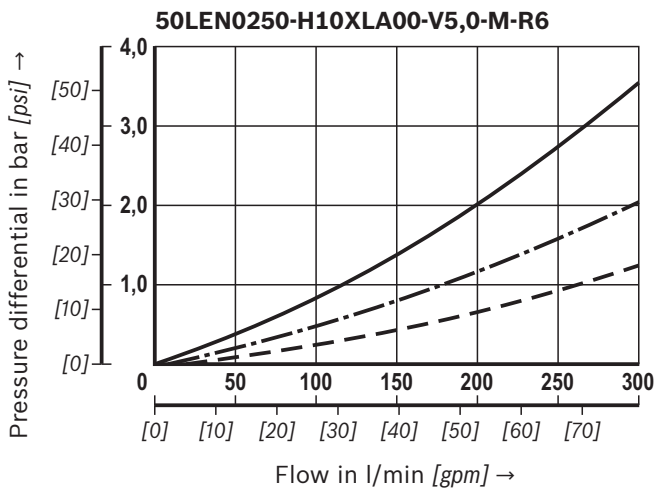
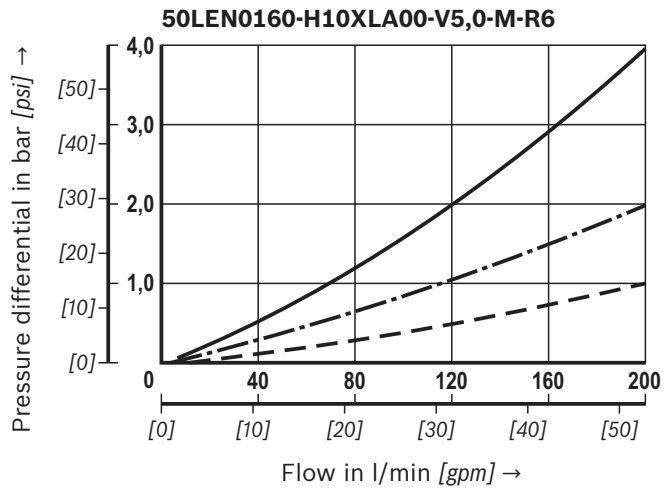
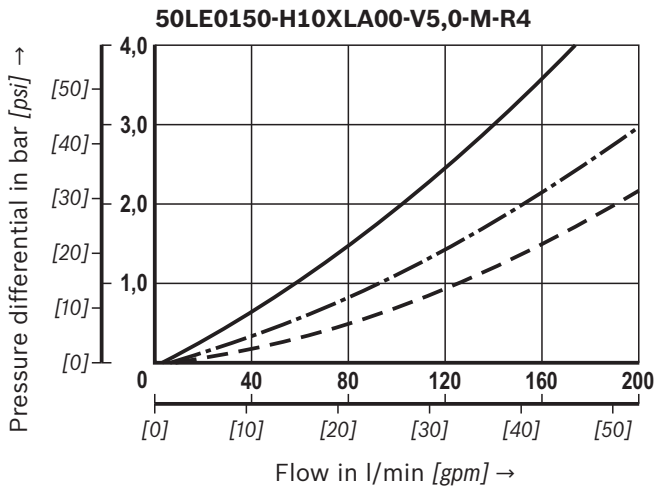
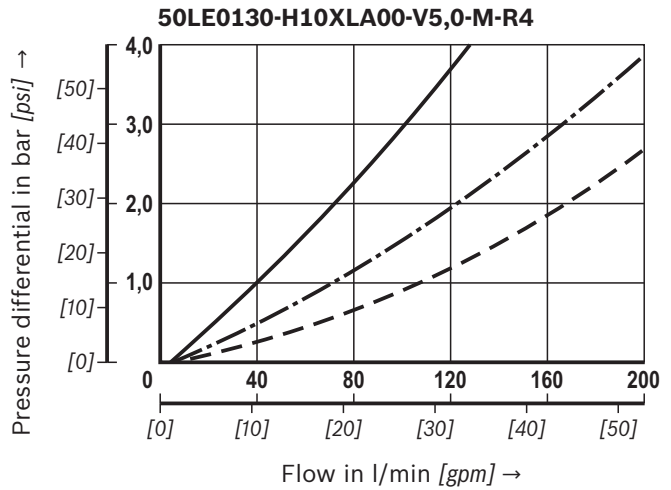
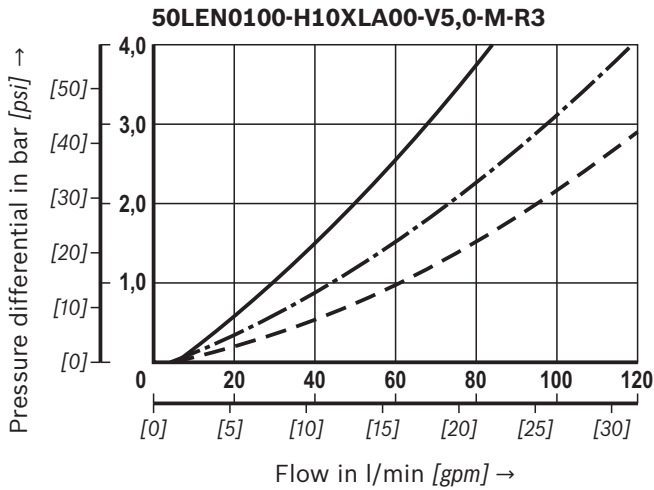
Characteristic curves H10XL

(measured with mineral oil HLP46 according to DIN 51524 at T = 40 °C) [104 °F]

Spec. weight: < 0.9 kg/dm³ Δp -Q-characteristic curves for complete filters recommended initial Δp for design = 1 bar [14.5 psi]

Selection of the perfect filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 — 140 mm²/s [649 SUS]
 - · - 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Dimensions: Size 0040 - size 0400
(dimensions in mm [inch])

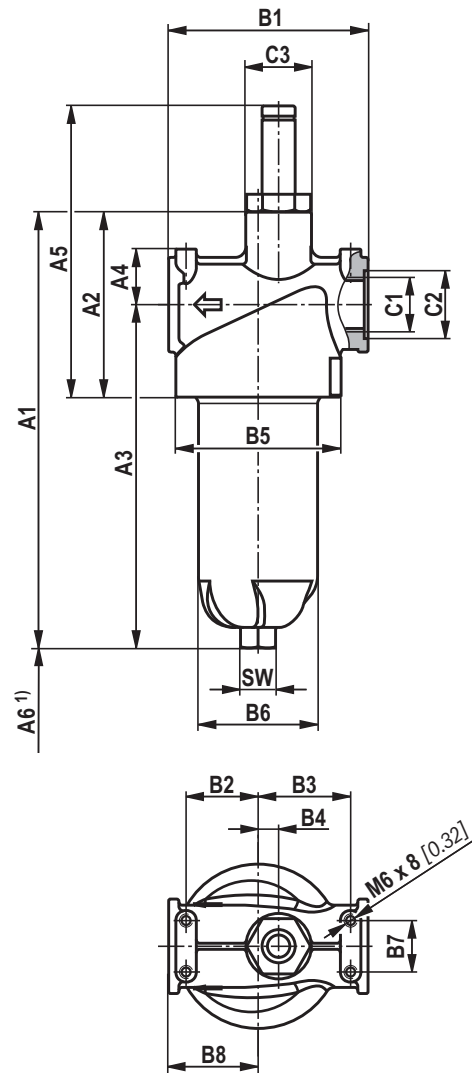
Filter housing for filter elements according to DIN 24550 and according to Rexroth standard

Type 50...	Content in l [US gal]	Weight in kg [lbs]	A1	A2	A3	A4
LEN 0040	0.27 [0.07]	1.05 [2.3]	209 [8.22]		164 [6.46]	
LEN 0063	0.39 [0.1]	1.1 [2.4]	269 [10.59]	87 [3.43]	224 [8.82]	24 [0.94]
LEN 0100	0.58 [0.15]	1.2 [2.6]	359 [14.13]		314 [12.36]	
LE 0130	0.89 [0.23]	1.91 [4.2]	299 [11.77]		251 [9.88]	
LE 0150	1.1 [0.29]	2.06 [4.5]	350 [13.78]	98 [3.86]	302 [11.89]	30 [1.18]
LEN 0160	1.31 [0.35]	3.1 [6.8]	310 [12.20]		255 [10.04]	
LEN 0250	1.89 [0.50]	3.3 [7.3]	400 [15.75]	122 [4.80]	345 [13.58]	35 [1.38]
LEN 0400	2.84 [0.75]	3.8 [8.4]	550 [21.65]		495 [19.49]	

Type 50...	A5	A6	B1	B2	B3	B4	ØB5
LEN 0040							
LEN 0063	139 [5.47]	80 [3.15]	92 [3.62]	27.5 [1.06]	37.5 [1.48]	10 [0.39]	75 [2.95]
LEN 0100							
LE 0130	150 [5.91]	140 [5.51]	122 [4.80]	40 [1.57]	50 [1.97]	14 [0.55]	105 [4.13]
LE 0150							
LEN 0160	174 [6.85]	140 [5.51]	142 [5.59]	50 [1.97]	60 [2.36]	20 [0.79]	125 [4.92]
LEN 0250							
LEN 0400							

Type 50...	ØB6	B7	B8	C1 connection	ØC2	ØC3	SW
LEN 0040							
LEN 0063	58 [2.28]	20 [0.79]	41 [1.61]	G 3/4 1 1/16-12 UN-2B	33 [1.30] 41 [1.61]		
LEN 0100							
LE 0130	82 [3.23]	20 [0.79]	56 [2.20]	G 1 1 5/16-12 UN-2B	41 [1.61] 49 [1.93]	32 [1.26]	17 [0.67]
LE 0150							
LEN 0160	102 [4.02]	30 [1.18]	66 [2.60]	G 1 1/2 1 7/8-12 UN-2B	56 [2.20] 65 [2.56]		
LEN 0250							
LEN 0400							

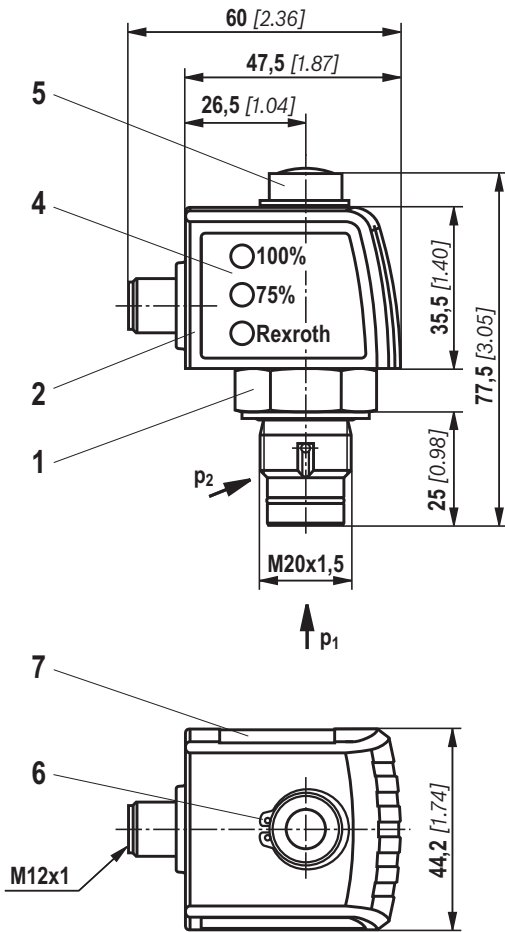
50 LEN 0040-0400



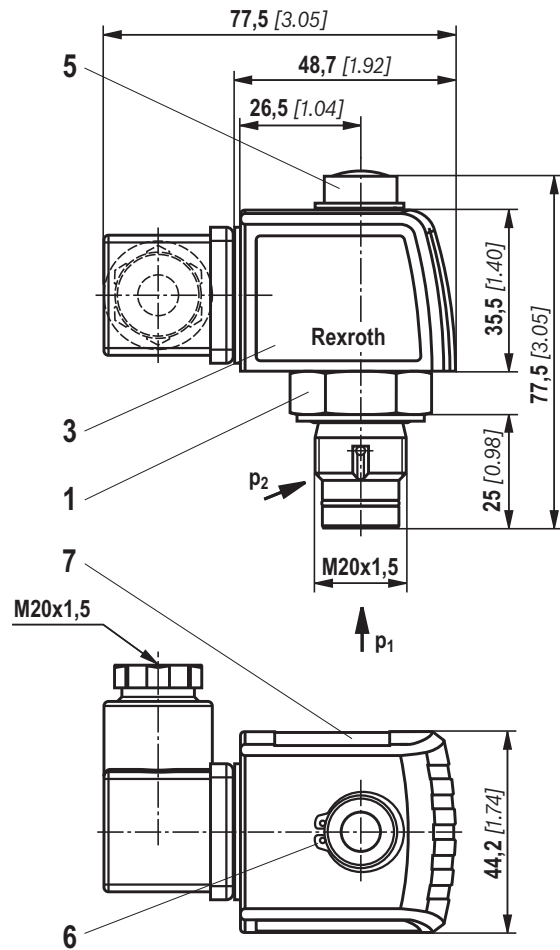
1) Servicing height for filter element exchange

Maintenance indicator
(dimensions in mm [inch])

Pressure differential indicator with mounted switching element M12 x 1



Pressure differential indicator with mounted switching element EN-175301-803



- 1 Mechanical optical maintenance indicator; max. tightening torque $M_{A \max} = 50 \text{ Nm}$ [36.88 lb-ft]
- 2 Switching element with locking ring for electrical maintenance indicator (rotatable by 360°); round plug-in connection M12 x 1, 4-pole
- 3 Switching element with locking ring for electrical maintenance indicator (rotatable by 360°); rectangular plug-in connection EN175301-803
- 4 Housing with three LEDs: 24 V =
green: Stand-by
yellow: Switching point 75%
red: Switching point 100%
- 5 Visual indicator bistable
- 6 Locking ring DIN 471-16 x 1, material no. R900003923
- 7 Name plate

Notices:

Representation contains mechanical optical maintenance indicator (1) and electronic switching element (2) (3). Switching elements with increased switching power upon request.

Ordering code spare parts

Filter element

01	02	03	04	05	06
2.			-	-	0

Filter element

01	Design	2.
----	--------	----

Nominal size

02	LEN... (Filter element according to DIN 24550)	0040 0063 0100 0160 0250 0400
	LE... (Filter elements according to Bosch Rexroth standard)	0130 0150

Filter rating in µm

03	Nominal	Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100
	Nominal	Filter paper, not cleanable	P10 P25
	Absolute (ISO 16889); $\beta_{x(c)} \geq 200$	Non-woven glass fiber media, not cleanable	H3XL H6XL H10XL H20XL

Pressure differential

04	max. admissible pressure differential of the filter element 30 bar [435 psi]	A00
	max. admissible pressure differential of the filter element 330 bar [4786 psi]	B00

Bypass valve

05	Always 0 with filter element	0
----	------------------------------	---

Seal

06	NBR seal	M
	FKM seal	V

Order example:

2.0100 H3XL-A00-0-M

For detailed information on Rexroth filter elements please refer to data sheet 51420.

Preferred program replacement filter element

Replacement filter element 3 micron		Replacement filter element 6 micron		Replacement filter element 10 micron	
R928006645	2.0040 H3XL-A00-0-M	R928006646	2.0040 H6XL-A00-0-M	R928006647	2.0040 H10XL-A00-0-M
R928006699	2.0063 H3XL-A00-0-M	R928006700	2.0063 H6XL-A00-0-M	R928006701	2.0063 H10XL-A00-0-M
R928006753	2.0100 H3XL-A00-0-M	R928006754	2.0100 H6XL-A00-0-M	R928006755	2.0100 H10XL-A00-0-M
R928022274	2.0130 H3XL-A00-0-M	R928022275	2.0130 H6XL-A00-0-M	R928022276	2.0130 H10XL-A00-0-M
R928022283	2.0150 H3XL-A00-0-M	R928022284	2.0150 H6XL-A00-0-M	R928022285	2.0150 H10XL-A00-0-M
R928006807	2.0160 H3XL-A00-0-M	R928006808	2.0160 H6XL-A00-0-M	R928006809	2.0160 H10XL-A00-0-M
R928006861	2.0250 H3XL-A00-0-M	R928006862	2.0250 H6XL-A00-0-M	R928006863	2.0250 H10XL-A00-0-M
R928006915	2.0400 H3XL-A00-0-M	R928006916	2.0400 H6XL-A00-0-M	R928006917	2.0400 H10XL-A00-0-M

Ordering code spare parts

Mechanical optical maintenance indicator

01	02	03	04	05	06
W	O	-	D01	-	-

01	Maintenance indicator	W
02	Mechanical optical indicator	O

Design

03	Pressure differential, design 01	D01
----	----------------------------------	-----

Switching pressure

04	0.8 bar [12 psi]	0,8
	1.5 bar [22 psi]	1,5
	2.2 bar [32 psi]	2,2
	5.0 bar [72.5 psi]	5,0

Seal

05	NBR seal	M
	FKM seal	V

max. nominal pressure

06	Switching pressure 0.8 bar [11.6 psi], 160 bar [2321 psi]	160
	Switching pressure 1.5 bar [21.8 psi], 160 bar [2321 psi]	160
	Switching pressure 2.2 bar [31.9 psi], 160 bar [2321 psi]	160
	Switching pressure 5.0 bar [72.5 psi], 450 bar [6527 psi]	450

Mechanical optical maintenance indicator

Material no.	Description
R928038779	WO-D01-0.8-M-160
R928038778	WO-D01-0.8-V-160
R928038781	WO-D01-1.5-M-160
R928038780	WO-D01-1.5-V-160
R901025312	WO-D01-2.2-M-160
R901066233	WO-D01-2.2-V-160
R901025313	WO-D01-5,0-M-450
R901066235	WO-D01-5,0-V-450

Ordering code spare parts

Seal kit

01	02	03	04
D	50/110LE		-

01	Seal kit	D
02	Series 50LE and 110LE	50/110LE

Nominal size

03	0040-0100	N0040-0100
	0130-0150	0130-0150
	0160-0400	N0160-0400

Seal

04	NBR seal	M
	FKM seal	V

Seal kit

Material no.	Description
R928046935	D50/110LEN0040-0100-M
R928046936	D50/110LE0130-0150-M
R928046937	D50/110LEN0160-0400-M
R928051951	D50/110LEN0040-0100-V
R928051952	D50/110LE0130-0150-V
R928051953	D50/110LEN0160-0400-V

Assembly, commissioning, maintenance

Installation

The max. operating pressure of the system must not exceed the max. admissible operating pressure of the filter (see type plate).

During assembly of the filter (see also chapter “Tightening torque”), the flow direction (direction arrows) and the required servicing height of the filter element (see chapter “Dimensions”) are to be considered.

Easy filter element exchange is guaranteed in the installation position filter bowl vertically downwards. The maintenance indicator must be arranged in a well visible way.

Remove the plastic plugs in the filter inlet and outlet.

Ensure that the system is assembled without tension stress.

The optional electronic maintenance indicator is connected via the electronic switching element with 1 or 2 switching points, which is attached to the mechanical optical maintenance indicator and held by means of the locking ring.

Commissioning

Commission the system.

Notice:

There is no bleeding provided at the filter.

Maintenance

- ▶ If at operating temperature, the red indicator pin reaches out of the mechanical optical maintenance indicator and/or if the switching process in the electronic switching element is triggered, the filter element is contaminated and needs to be replaced and cleaned respectively.

WARNINGS!

- ▶ Assembly and disassembly only with depressurized system!
- ▶ Tank is under pressure!
- ▶ Maintenance only be specialists.
- ▶ Remove the filter bowl only if it is not under pressure!
- ▶ Do not exchange the maintenance indicator while the filter is under pressure!

- ▶ The material number of the corresponding replacement filter element is indicated on the name plate of the complete filter. It must comply with the material number on the filter element.
- ▶ Decommission the system.
- ▶ The operating pressure is to be built up on the system side.

Notice:

There is no bleeding provided at the filter.

- ▶ Via the drain screw (from size 0160 fitted by default), the oil on the dirt side can be drained.
- ▶ Screw off the filter bowl.
- ▶ Remove the filter element from the spigot by rotating it slightly.
- ▶ Clean the filter components, if necessary.
- ▶ Check the seals at the filter bowl for damage and renew them, if necessary.
For suitable seal kits refer to chapter “Spare parts”.
- ▶ Filter elements made of wire mesh can be cleaned. The efficiency of the cleaning process depends on the type of dirt and the amount of the pressure differential before the filter element exchange.
If the pressure differential after the filter element exchange exceeds 150% of the value of a brand-new filter element, the filter element made of wire mesh (G...) also needs to be replaced. For detailed cleaning instructions refer to data sheet 51420.
- ▶ Install the new or cleaned filter element on the spigot again by slightly rotating it.
- ▶ The filter is to be assembled in reverse order.
- ▶ The torque specifications (“Tightening torques” chapter) are to be observed.
- ▶ Commission the system.

- ▶ Functional and safety warranty only applicable when using genuine Bosch Rexroth spare parts!
- ▶ Warranty becomes void if the delivered item is changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental condition that do not comply with the installation conditions.

Tightening torques

(dimensions in mm [inch])

Mounting

Series 50 ...	LEN0040	LEN0063	LEN0100	LE0130	LE0150	LEN0160	LEN02	LEN0400
Screw/tightening torque with $\mu_{\text{total}} = 0.14$	M6/4.5 Nm \pm 10 %							
Quantity	4							
Recommended property class of screw	8.8							
Minimum screw-in depth	6 mm + 1 mm							

Filter bowl and maintenance indicator

Series 50 ...	LEN0040	LEN0063	LEN0100	LE0130	LE0150	LEN0160	LEN02	LEN0400
Tightening torque filter bowl	50 Nm + 10 Nm							
Tightening torque maintenance indicator	50 Nm							
Tightening torque cubic connector screw switching element EN-175301-803	M3/0.5 Nm							

Directives and standardization

Classification according to the Pressure Equipment

Directive

The inline filters for hydraulic applications according to 51447 are pressure holding equipment according to article 1, section 2.1.4 of the Pressure Equipment Directive 97/23/EC (PED).

However, on the basis of the exception in article 1, section 3.6 of the PEG, hydraulic filters are exempt from the PED if they are not classified higher than category I (guideline 1/19). They do not receive a CE mark.

Use in potentially explosive areas according to directive 94/9/EC (ATEX)

The inline filters according to 51447 are no equipment or components in the sense of directive 94/9/EC and are not provided with a CE mark. It has been proven with the ignition risk analysis that these inline filters do not have own ignition sources acc. to DIN EN 13463-1:2009.

According to DIN EN 60079-11:2012, the electronic maintenance indicators WE-1SP-M12x1 and WE-1SP-EN175301-803 are simple, electronic operating equipment not having an own voltage source. This simple, electronic operating equipment may - according to DIN

EN 60079-14:2008 - in intrinsically safe electric circuits (Ex ib) be used in systems without marking and certification.

The inline filters and the electronic maintenance indicators described here can be used for the following potentially explosive areas:

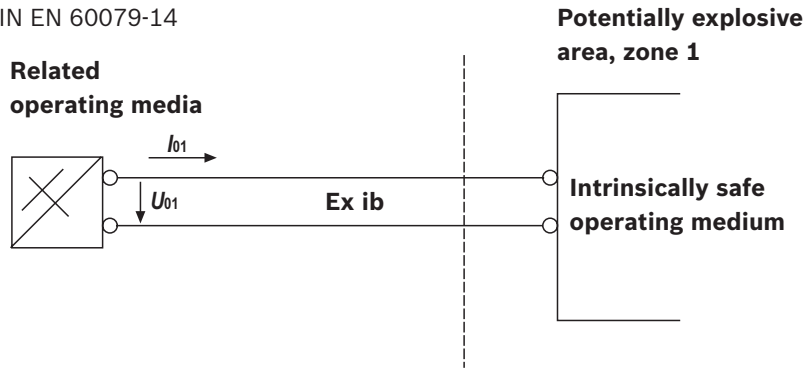
	zone suitability	
Gas	1	2
Dust	21	22

Directives and standardization

Complete filter with mech./opt. Maintenance indicator			
Use /assignment		Gas 2G	Dust 2D
Assignment		Ex II 2G c IIC TX	Ex II 2D c IIC TX
Conductivity of the medium	pS/m min	300	
Dust accumulation	max	-	0.5 mm

Electronic switching element in the intrinsically safe electric circuit			
Use /assignment		Gas 2G	Dust 2D
Assignment		Ex II 2G Ex ib IIB T4 Gb	Ex II 2D Ex ib IIIC T100 °C Db
Perm. intrinsically safe electric circuits		Ex ib IIC, Ex ic IIC	Ex ib IIIC
Technical data		Values only for intrinsically safe electric circuit	
Switching voltage	Ui max	150 V AC/DC	
Switching current	Ii max	1.0 A	
Switching power	Pi max	1.3 W T4 T _{max} 40 °C	750 mW T _{max} 40 °C
		1.0 W T4 T _{max} 80 °C	550 mW T _{max} 100 °C
Surface temperature ¹⁾	max	-	100 °C
Inner capacity	Ci	negligible	
Inner inductivity	Li	negligible	
Dust accumulation	max	-	0.5 mm

Possible circuit according to DIN EN 60079-14



⚠ WARNING!

- ▶ Explosion hazard due to high temperature! The temperature depends on the temperature of the medium in the hydraulic circuit and must not exceed the value specified here. Measures are to be taken so that in the potentially explosive area, the max. admissible ignition temperature is not exceeded.
- ▶ When using the inline filters in accordance with 51447 in potentially explosive areas, appropriate equipotential bonding has to be ensured. The filter is preferably to be earthed via the mounting screws. It has to be

- noted in this connection that paintings and oxidic protective layers are not electrically conductive.
- ▶ Maintenance only by specialists, instruction by the machine end-user acc. to DIRECTIVE 1999/92/EC appendix II, section 1.1
- ▶ During filter element exchanges, the packaging material is to be removed from the replacement element outside the potentially explosive area
- ▶ Functional and safety warranty only applicable when using genuine Rexroth spare parts

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Inline filters with filter element according to DIN 24550

Type 110LEN0040 to 0400; 110LE0130, 0150

RE 51448

Issue: 2014-05

Replaces: 02.14



- ▶ Sizes according to **DIN 24550**: 0040 to 0400
- ▶ additional sizes: 0130, 0150
- ▶ Nominal pressure 110 bar [1595 psi]
- ▶ Connection up to 1 1/2"
- ▶ Operating temperature -10 °C to +100 °C [14 °F to 212 °F]

Features

Inline filters are used in hydraulic systems for separating solid materials from the fluids and lubricating oils. They are intended for attachment in pipelines.

They distinguish themselves by the following:

- ▶ Filters for inline installation
- ▶ High filtration performance due to the tangential cyclone-effect flow path
- ▶ Special highly efficient filter materials
- ▶ Filtration of very fine particles and high dirt holding capacity across a broad pressure differential range
- ▶ High collapse resistance of the filter elements
- ▶ By default equipped with mechanical optical maintenance indicator with memory function
- ▶ Available as an option with different electronic switching elements, modular design
- ▶ Optional bypass valve integrated in the filter housing
- ▶ Optional measuring port

Contents

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Ordering code

Filters

01	02	03	04	05	06	07	08	09	09	09					
110LE			-			-		-		-		-			

Series

01	Inline filter 110 bar [1595 psi]	110LE
----	----------------------------------	-------

Filter element

02	with filter element according to DIN 24550	N
----	---	---

Size

03	LEN... (with filter element according to DIN 24550)	0040 0063 0100 0160 0250 0400
	LE... (Filter element according to Bosch Rexroth standard)	0130 0150

Filter rating in μm

04	Nominal Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100
	Nominal Filter paper, not cleanable	P10 P25
	Absolute (ISO 16889; $\beta_x(c) \geq 200$) Non-woven glass fiber media, not cleanable	H3XL H6XL H10XL H20XL

Pressure differential

05	max. admissible pressure differential of the filter element 30 bar [435 psi], with bypass valve	A00
	max. admissible pressure differential of the filter element 330 bar [4786 psi], without bypass valve	B00

Maintenance indicator

06	Maintenance indicator, mech./optical, switching pressure 1.5 bar [21.8 psi] – bypass cracking pressure 2.5 bar [36 psi]	V1.5
	Maintenance indicator, mech./optical, switching pressure 2.2 bar [32 psi] – bypass cracking pressure 3.5 bar [51 psi]	V2.2
	Maintenance indicator, mech./optical, switching pressure 5.0 bar [72.5 psi] – bypass cracking pressure 7 bar [102 psi]	V5,0

Seal

07	NBR seal	M
	FKM seal	V

Connection

Ordering code Filters

01	02	03	04	05	06	07	08	09	09	09
110LE			-			-		-		-

08	Frame size	0040	0063-0100	0130-0150	0160-0400		
	Connection						
	G 3/4	●	X			Pipe thread according to ISO 228	R3
	G 1	X	●	X			R4
	G 1 1/4			●			R5
	G 1 1/2				●		R6
	SAE 12	X	X			Pipe thread according to SAE J1926	U4
	SAE 16			X			U9
	SAE 24				X		U6
	<input checked="" type="checkbox"/> Standard connection <input type="checkbox"/> Alternative connection						

Supplementary information

09	additional threaded couplings, G 1/4, lateral at clean and dirt side (from size 0130)	M
	without bypass valve (only possible in connection with filter element version "A00") ¹⁾	NB
	Manufacturer's inspection certificate M according to DIN 55350 T18	Z1

¹⁾ **Attention:** If this option is selected and the maintenance indicator is not observed, the filter element may collapse in case of pressure differentials of more than 30 bar [435 psi].

Order example:

110LEN0100-H3XLA00-V5,0-M-R4

Further versions (filter materials, connections,...) are available on request.

Preferred typesNBR seal, with bypass, flow specifications for 30 mm²/s [143 SUS]**Inline filter 110 LE(N), filter rating 3 µm**

Type	Volume flow in l/min [gpm] at $\Delta p = 1$ bar [14.5 psi]	Material no. Filters			Material no. Spare filter element	
110LEN0040-H3XLA00-V5,0-M-..	24 [6.34]	..R3	R928046899	..U4	R928046914	R928006645
110LEN0063-H3XLA00-V5,0-M-..	32 [8.45]	..R4	R928046901	..U4	R928046915	R928006699
110LEN0100-H3XLA00-V5,0-M-..	46 [12.15]	..R4	R928046903	..U4	R928046916	R928006753
110LE0130-H3XLA00-V5,0-M-..	90 [23.78]	..R5	R928046909	..U9	R928046917	R928022274
110LE0150-H3XLA00-V5,0-M-..	92 [24.31]	..R5	R928046910	..U9	R928046918	R928022283
110LEN0160-H3XLA00-V5,0-M-..	115 [30.38]	..R6	R928046911	..U6	R928046919	R928006807
110LEN0250-H3XLA00-V5,0-M-..	152 [40.16]	..R6	R928046912	..U6	R928046920	R928006861
110LEN0400-H3XLA00-V5,0-M-..	250 [66.04]	..R6	R928046913	..U6	R928046921	R928006915

Inline filter 110 LE(N), filter rating 6 µm

Type	Volume flow in l/min [gpm] at $\Delta p = 1$ bar [14.5 psi]	Material no. Filters			Material no. Spare filter element	
110LEN0040-H6XLA00-V5,0-M-..	31 [8.19]	..R3	R928050256	..U4	R928050257	R928006646
110LEN0063-H6XLA00-V5,0-M-..	47 [12.42]	..R4	R928050336	..U4	R928050337	R928006700
110LEN0100-H6XLA00-V5,0-M-..	57 [15.06]	..R4	R928050416	..U4	R928050417	R928006754
110LE0130-H6XLA00-V5,0-M-..	94 [24.83]	..R5	R928050076	..U9	R928050078	R928022275
110LE0150-H6XLA00-V5,0-M-..	103 [27.21]	..R5	R928050172	..U9	R928050174	R928022284
110LEN0160-H6XLA00-V5,0-M-..	184 [48.61]	..R6	R928050507	..U6	R928050509	R928006808
110LEN0250-H6XLA00-V5,0-M-..	236 [62.34]	..R6	R928050603	..U6	R928050605	R928006862
110LEN0400-H6XLA00-V5,0-M-..	283 [74.76]	..R6	R928050699	..U6	R928050701	R928006916

Inline filter 110 LE(N), filter rating 10 µm

Type	Volume flow in l/min [gpm] at $\Delta p = 1$ bar [14.5 psi]	Material no. Filters			Material no. Spare filter element	
110LEN0040-H10XLA00-V5,0-M-..	33 [8.72]	..R3	R928046922	..U4	R928046923	R928006647
110LEN0063-H10XLA00-V5,0-M-..	50 [14.53]	..R4	R928041640	..U4	R928046924	R928006701
110LEN0100-H10XLA00-V5,0-M-..	61 [16.12]	..R4	R928041641	..U4	R928046925	R928006755
110LE0130-H10XLA00-V5,0-M-..	100 [26.42]	..R5	R928037470	..U9	R928046926	R928022276
110LE0150-H10XLA00-V5,0-M-..	127 [33.55]	..R5	R928041642	..U9	R928046927	R928022285
110LEN0160-H10XLA00-V5,0-M-..	192 [50.73]	..R6	R928037471	..U6	R928046928	R928006809
110LEN0250-H10XLA00-V5,0-M-..	243 [64.20]	..R6	R928041643	..U6	R928046929	R928006863
110LEN0400-H10XLA00-V5,0-M-..	300 [79.25]	..R6	R928041644	..U6	R928046930	R928006917

Ordering code**Accessories**

(dimensions in mm [inch])

Electronic switching element for maintenance indicators

01	02	03
WE	-	-

Maintenance indicator

01	electronic switching element	WE
----	------------------------------	----

Type of signal

02	1 switching point	1SP
	2 switching points, 3 LED	2SP
	2 switching points, 3 LED and signal suppression up to 30 °C [86 °F]	2SPSU

Connector

03	Round plug-in connection M12x1, 4-pole	M12 x 1
	Rectangular plug-in connection, 2-pole, design A according to EN-175301-803	EN175301-803

Material numbers of the electronic switching elements

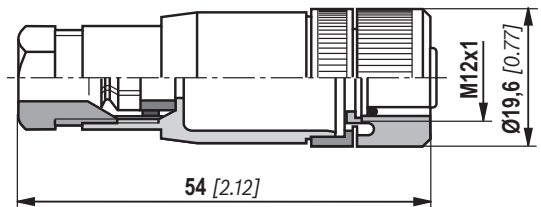
Material no.	Type	Signal	Switching points	Connector	LED
R928028409	WE-1SP-M12x1	Changeover	1	M12x1	No
R928028410	WE-2SP-M12x1	Normally open (at 75 %) / normally closed contact (at 100 %)	2		3 pieces
R928028411	WE-2SPSU-M12x1				
R928036318	WE-1SP-EN175301-803	Normally closed contact	1	EN 175301-803	No

Mating connectors according to IEC 60947-5-2

for electronic switching element with round plug-in connection M12x1

Mating connector suitable for K24 4-pin, M12x1
with screw connection, cable gland Pg9.

Material no. R900031155

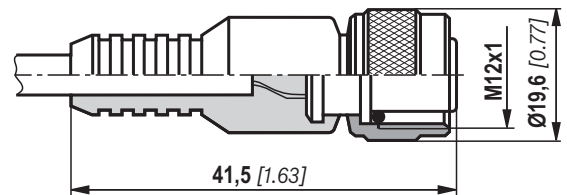


Mating connector suitable for K24-3m 4-pin, M12x1
with potted-in PVC cable, 3 m long.

Line cross-section: 4 x 0.34 mm²

Core marking: **1** brown **2** white
 3 blue **4** black

Material no. R900064381



For more round plug-in connections and technical data refer to data sheet 08006.

Order example:

Inline filter with mechanical optical maintenance indicator for $p_{nom.} = 110 \text{ bar}$ [1595 psi] with bypass valve, size 0160, with filter element 10 µm and electronic switching element M12x1 with 1 switching point for hydraulic fluid mineral oil HLP according to DIN 51524.

**Filter with mech. optical
maintenance indicator:**

110LEN0160-H10XLA00-V5,0-M-R6

Material no. R928037471

Switching element:

WE-1SP-M12x1

Material no. R928028409

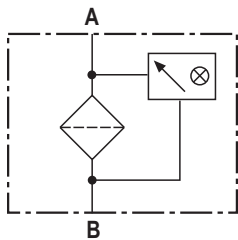
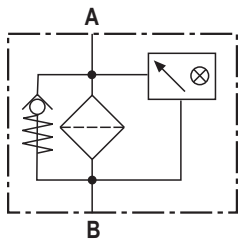
Mating connector:

Mating connector suitable for K24 4-pole,
M12x1 with screw connection, cable gland Pg9.

Material no. R900031155

Symbols

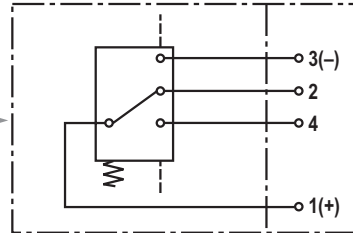
Inline filter with bypass and mechanical indicator



Inline filter without bypass and with mechanical indicator

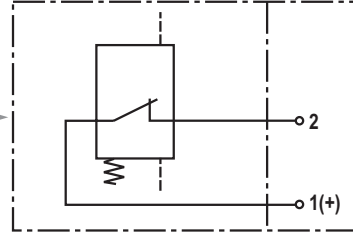
electronic switching element
for maintenance indicator

Switching element Connector



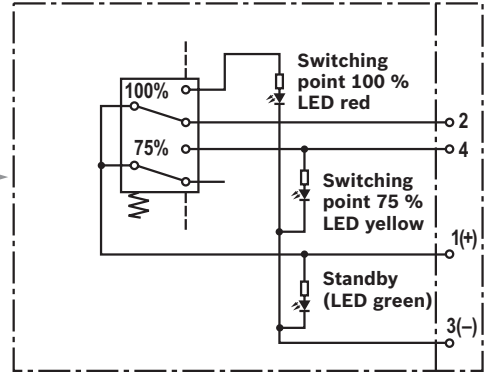
WE-1SP-M12x1

Switching element Connector



WE-1SP-EN175301-803

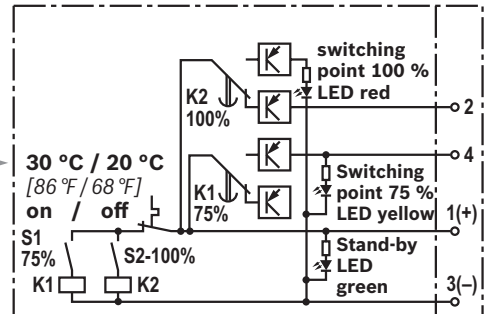
Switching element Connector



WE-2SP-M12x1

Circuit diagram drawn in plugged condition
(operating state)

Switching element Connector



WE-2SPSU-M12x1

Circuit diagram drawn in plugged condition
at temperature $> 30\text{ }^{\circ}\text{C}$ [$86\text{ }^{\circ}\text{F}$]
(operating state)

Function, section

The 110LE(N) inline filter is suitable for direct installation into pressure lines. It is installed upstream components to be protected.

It basically consists of filter head (1), a screwable filter bowl (2), filter element (3) as well as mechanical optical maintenance indicator (4). In case of filters with low-pressure-differential-stable filter elements (= code letter pressure differential A), there is an assembled bypass valve (5) as standard.

The installed spring (6) prevents possible vibrations of the filter element (3). During disassembly, the contact pressure of the spring (6) holds the filter element in the filter bowl (2).

Via the inlet, the fluid reaches the filter element (3) where it is cleaned. The dirt particles filtered out settle in the filter bowl (2) and in the filter element (3). Via the outlet, the filtered fluid enters the hydraulic circuit.

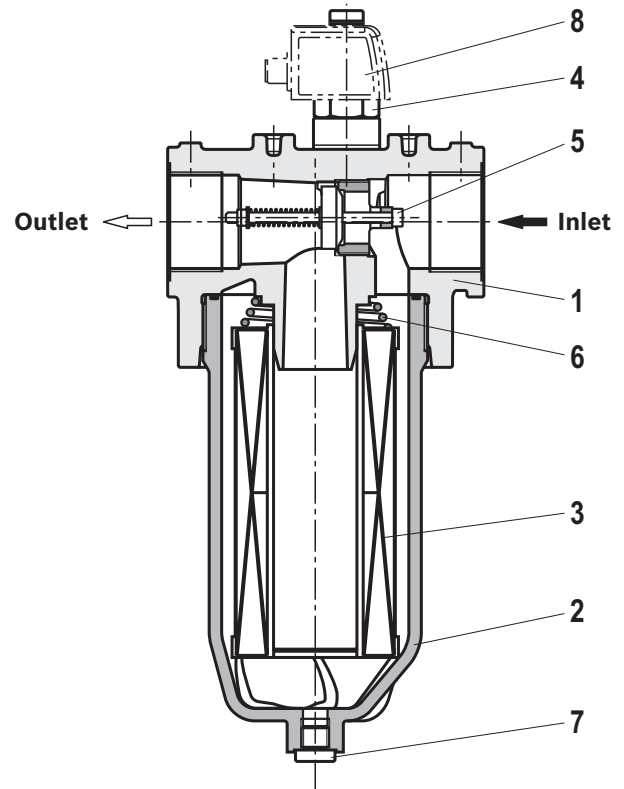
The filter housing and all connection elements are designed so that pressure peaks - as they may e.g. occur in case of abrupt opening of large control valves due to the accelerated fluid quantity - can be securely absorbed. As of size 0160, the standard equipment comprises a drain screw (7).

By default, the filter is equipped with mechanical optical maintenance indicator (4). The electronic switching element (8) which has to be ordered separately is attached to the mechanical optical maintenance indicator (4) and held by means of a locking ring.

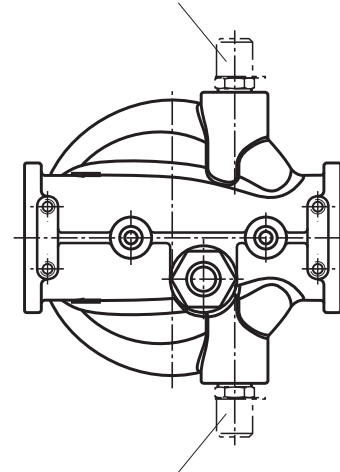
The electronic switching elements with 1 or 2 switching points are connected via a mating connector according to IEC-60947-5-2 or via a cable connection according to EN17301-803.

As of size 0130, it is possible to order the filters with threaded couplings for separate pressure differential measurement. Only then will the filter head be drilled accordingly.

High filtration performance due to the tangential cyclone-effect flow path in the filter housing in connection with a slowdown zone at the bottom of the filter bowl.



Dirt side from size 0130 optional threaded couplings



Clean side from size 0130 optional threaded couplings

Type 110LEN0160

WARNING!

If the maintenance indicator is not observed while the element is exchanged, the bypass valve will open if the pressure differential increases. This means that part of the volume flow enters unfiltered into the clean side of the filter. Effective filtration is therefore no longer guaranteed.

Technical data

(For applications outside these parameters, please consult us!)

General						
Installation position	vertical					
Ambient temperature range	°C [°F]	-10 ... +100 [14 ... +212] (shortly up to -30 [-22])				
Weight	NS	0040	0063	0100	0130	
	kg [lbs]	1.1 [2.4]	1.3 [2.9]	1.5 [3.3]	2.5 [5.5]	
	NS	0150	0160	0250	0400	
	kg [lbs]	2.6 [5.7]	3.5 [7.7]	4.0 [8.8]	4.9 [10.8]	
Volume	NS	0040	0063	0100	0130	
	l [US gal]	0.3 [0.08]	0,4 [0.11]	0.6 [0.16]	0.9 [0.24]	
	NS	0150	0160	0250	0400	
	l [US gal]	1.1 [0.29]	1.3 [0.34]	1.9 [0.50]	2.9 [0.77]	
Material	- Filter head	Aluminum				
	- Filter bowl	Aluminum				
	- Bypass valve	Aluminum / steel / POM				
	- Seals	NBR or FKM				
	- Visual maintenance indicator	V1.5; V2.2	Aluminum			
		V5.0	Brass			
-Electronic switching element	Plastic PA6					

Hydraulic			
Maximum operating pressure	bar [psi]	110 [1595]	
Hydraulic fluid temperature range	°C [°F]	-10 to +100 [+14 to +212]	
Minimum conductivity of the medium	pS/m	300	
Fatigue strength according to ISO 10771	Load cycles	> 10 ⁶ with max. operating pressure	
Type of pressure measurement of the maintenance indicator	Pressure differential		
Assignment: Response pressure of the maintenance indicator / cracking pressure of the bypass valve	bar [psi]	Response pressure of the maintenance indicator	Cracking pressure of the bypass valve
		1.5 ± 0.2 [21.8 ± 2.9]	2.5 ± 0.25 [36.3 ± 3.6]
		2.2 ± 0.3 [31.9 ± 4.4]	3.5 ± 0.35 [50.8 ± 5.1]
		5.0 ± 0.5 [72.5 ± 7.3]	7.0 ± 0.5 [101.5 ± 7.3]
Filtration direction	From the outside to the inside		

Technical data

(For applications outside these parameters, please consult us!)

electric (electronic switching element)				
Electrical connection		Round plug-in connection M12x1, 4-pole		Standard connection EN 175301-803
	Version	WE-1SP- M12x1	WE-2SP- M12x1	WE-2SPSU- M12x1
Contact load, direct voltage	A _{max.}	1		
Voltage range	V _{max.}	150 (AC/DC)	10-30 (DC)	250 (AC)/200 (DC)
max. switching power with resistive load	W	20		70
Switching type	- 75 % signal	-	Normally open contact	
	- 100 % signal	Changeover	Normally closed contact	
	- 2SPSU			Signal inter-connection at 30 °C [86 °F], return switching at 20 °C [68 °F]
Display via LEDs in the electronic switching element 2SP...			Stand-by (LED green); 75 % switching point (LED yellow) 100 % switching point (LED red)	
Protection class according to EN 60529		IP 67		IP 65
Ambient temperature range	°C [°F]	-25 to +85 [-13 to +185]		
For direct voltage above 24 V, spark extinguishing is to be provided for protecting the switching contacts.				
Weight electronic switching element: - with round plug-in connection M12x1	kg [lbs]	0.1 [0.22]		

Filter element				
Non-woven glass fiber media H..XL		Single-use element on the basis of inorganic fiber		
		Filtration ratio according to ISO 16889 up to $\Delta p = 5 \text{ bar [72.5 psi]}$	Achievable oil cleanliness according to ISO 4406 [SAE-AS 4059]	
	H20XL	$\beta_{20(c)} \geq 200$	19/16/12 – 22/17/14	
	H10XL	$\beta_{10(c)} \geq 200$	17/14/10 – 21/16/13	
	H6XL	$\beta_6(c) \geq 200$	15/12/10 – 19/14/11	
	H3XL	$\beta_3(c) \geq 200$	13/10/8 – 17/13/10	
admissible pressure differential	- A	bar [psi]	30 [435]	
	- B	bar [psi]	330 [4785]	

Compatibility with hydraulic fluids

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oil	HLP	NBR	DIN 51524
Biodegradable	- insoluble in water	HETG	VDMA 24568
		HEES	
Flame-resistant	- soluble in water	HEPG	VDMA 24568
	- water-free	HFDU, HFDR	VDMA 24317
- containing water	HFAS	NBR	DIN 24320
	HFAE	NBR	
	HFC	NBR	
			VDMA 24317

Important information on hydraulic fluids!

- For more information and data on the use of other hydraulic fluids, please refer to data sheet 90220 or contact us!
- **Flame-resistant – containing water:** due to possible chemical reactions with materials or surface coatings of machine and system components, the service life with these hydraulic fluids may be less than expected. Filter materials made of filter paper P

(cellulose) may not be used, filter elements with filter materials made of glass fiber (HydroClean H...XL or wire mesh G) have to be used instead.

- **Biodegradable:** If filter materials made of filter paper are used, the filter life may be shorter than expected due to material incompatibility and swelling.

Characteristic curves

(measured with mineral oil HLP46 according to DIN 51524 at T = 40 °C [104 °F])

H3XL

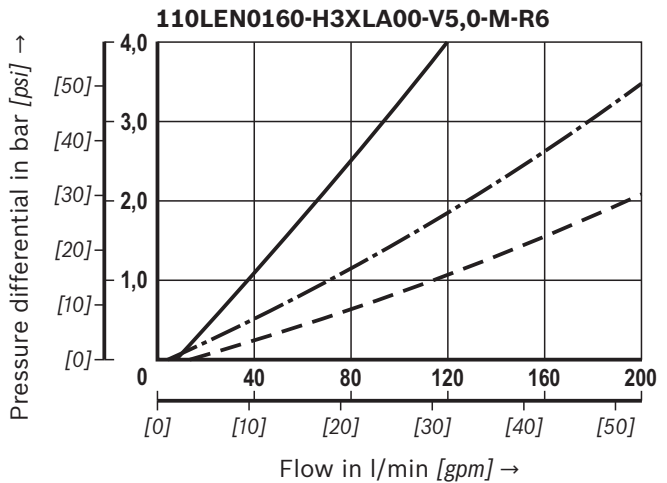
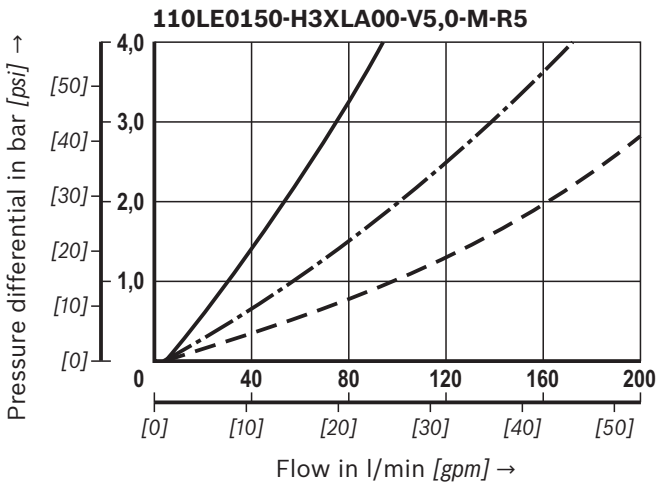
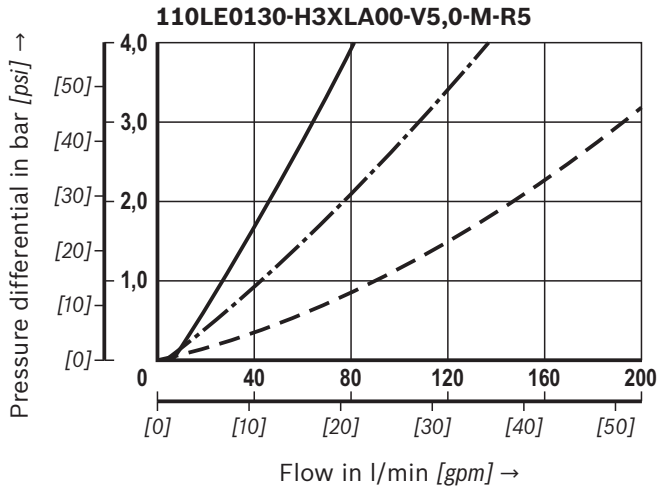
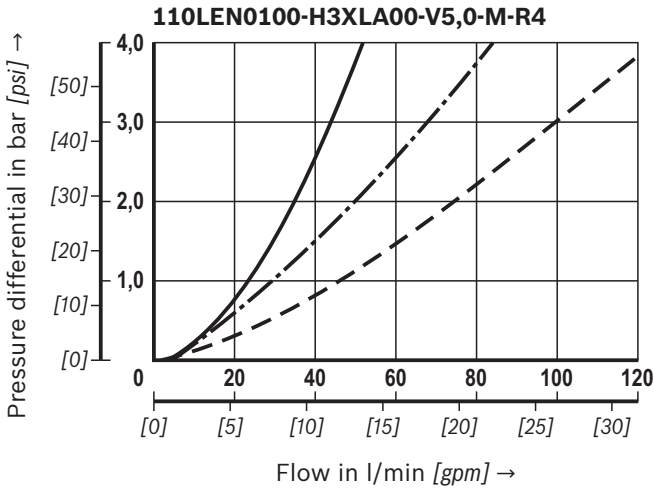
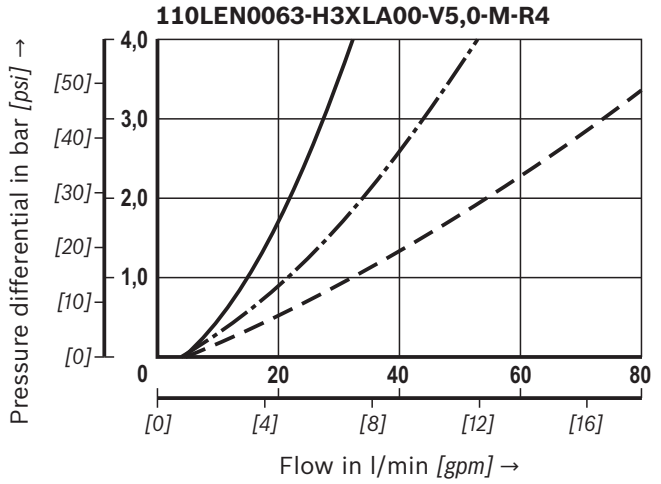
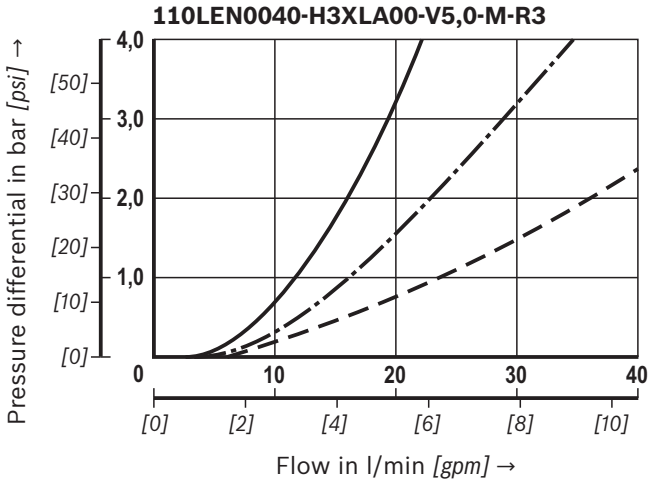
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filter

recommended initial- Δp for design = 1 bar [14.5 psi]

Selection of the perfect filter is made possible by our online “Bosch Rexroth FilterSelect” design software.

Oil viscosity:
 — 140 mm²/s [649 SUS]
 - · - 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Characteristic curves

H3XL, H10XL

(measured with mineral oil HLP46 according to DIN 51524 at T = 40 °C [104 °F])

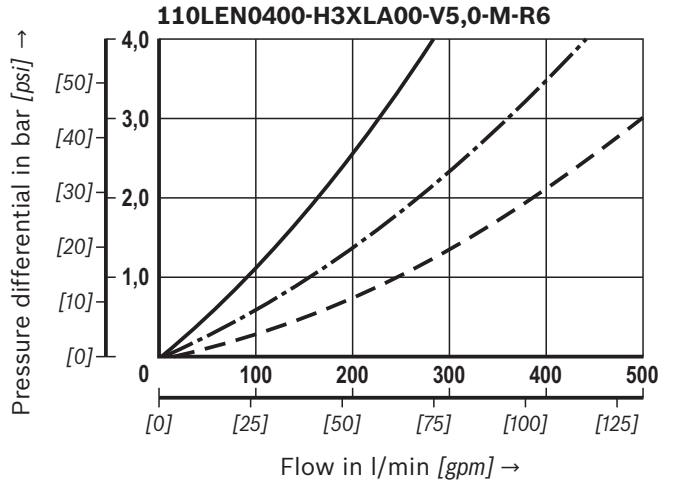
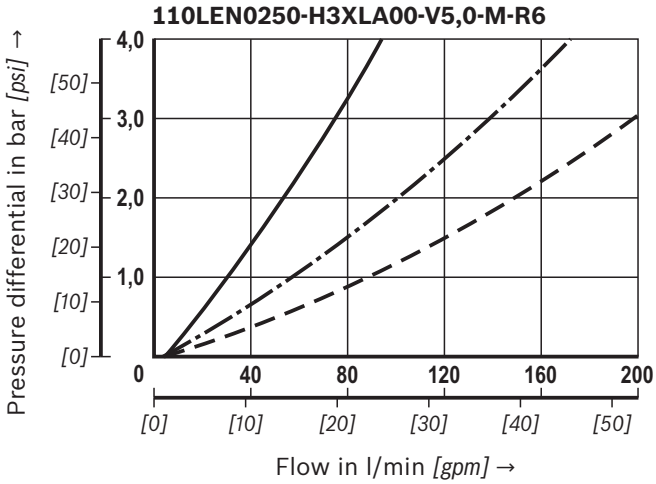
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filter
recommended initial- Δp for design = 1 bar [14.5 psi]

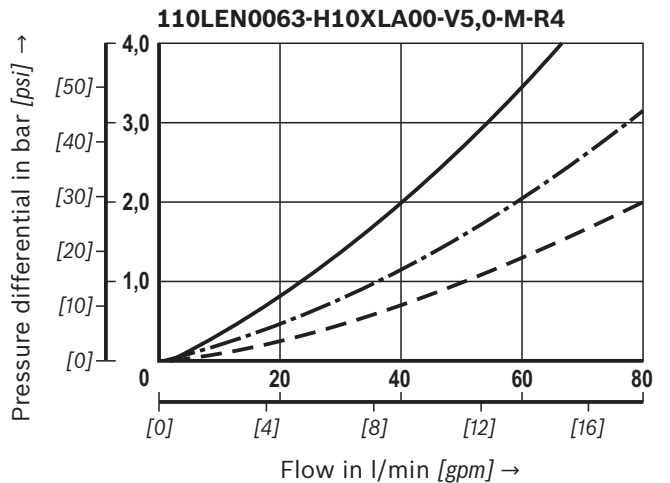
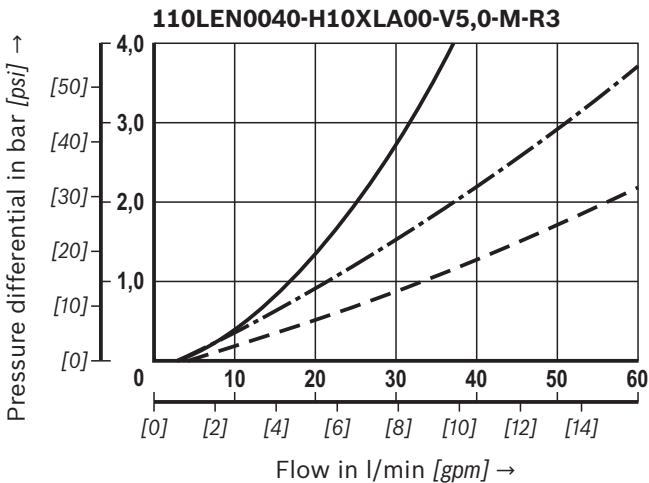
Selection of the perfect filter is made possible by our
online “Bosch Rexroth FilterSelect” design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]

H3XL



H10XL



Characteristic curves

H10XL

(measured with mineral oil HLP46 according to DIN 51524 at T = 40 °C [104 °F])

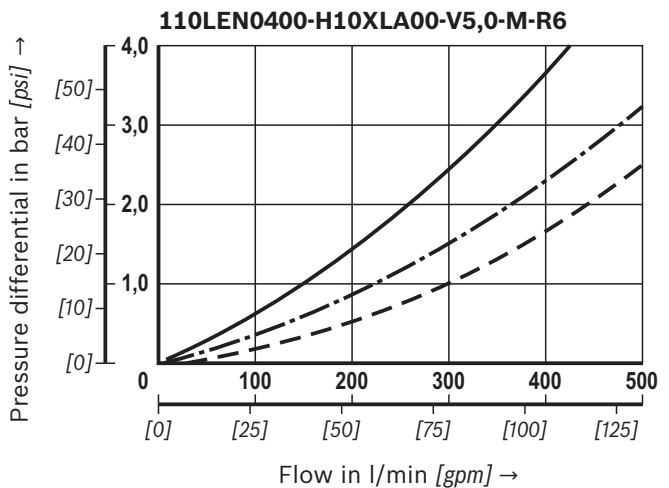
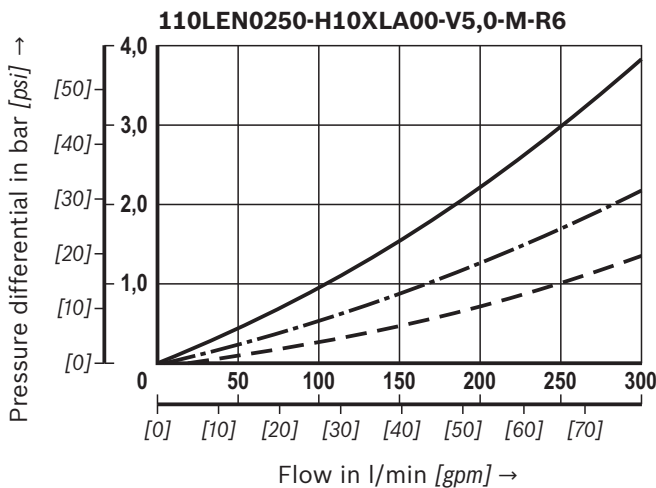
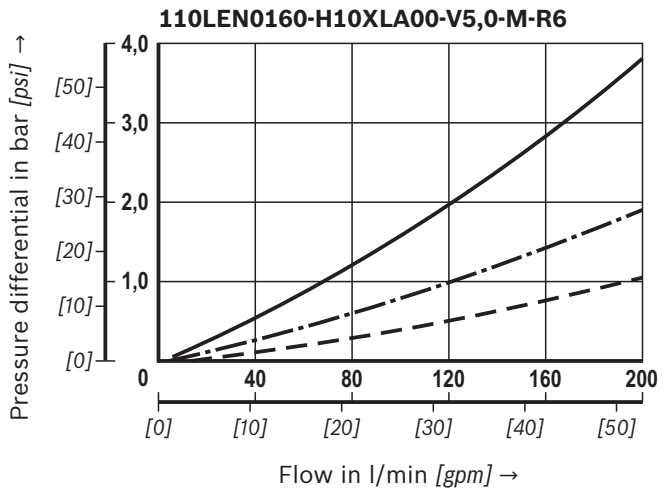
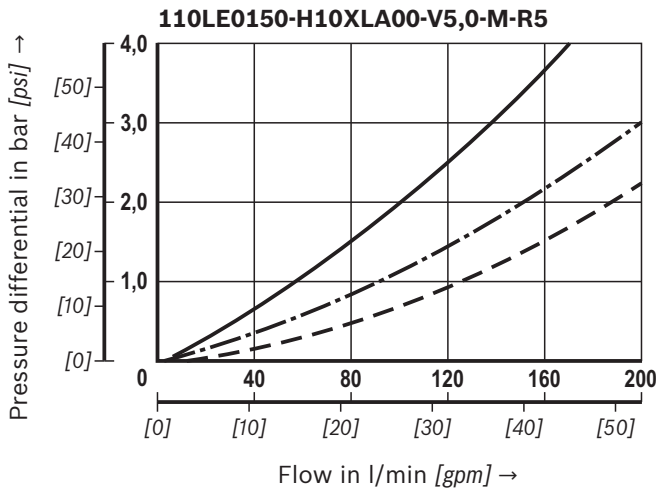
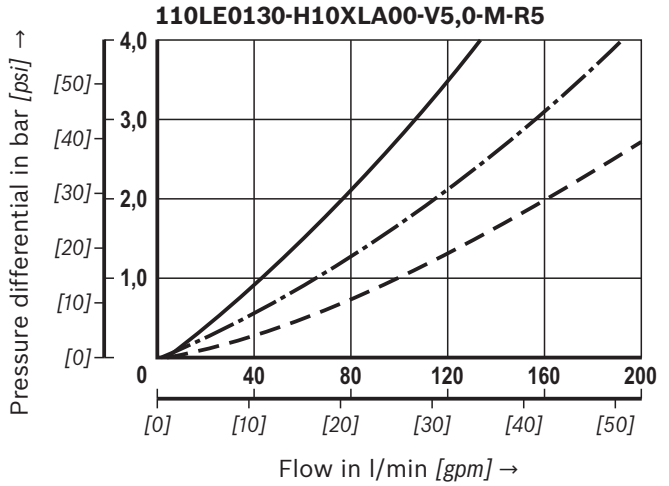
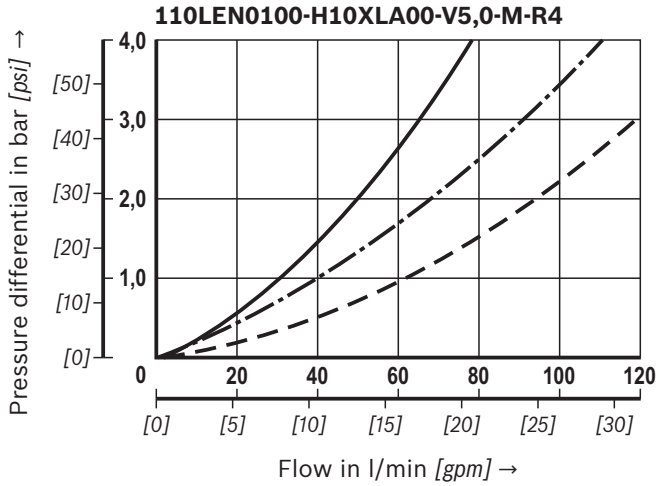
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filter

recommended initial- Δp for design = 1 bar [14.5 psi]

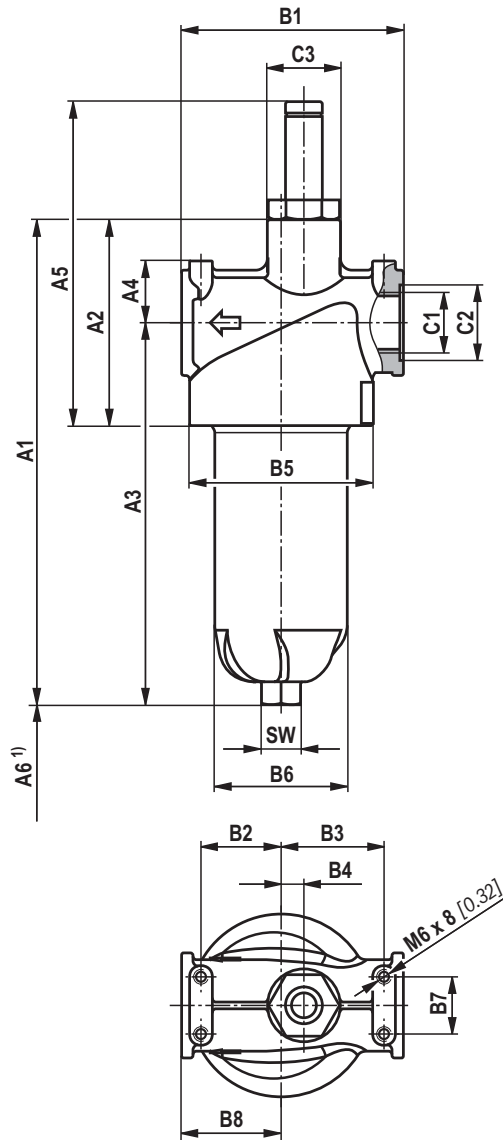
Selection of the perfect filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Dimensions: NG0040 - NG0100
(dimensions in mm [inch])

110 LEN 0040-0100



Filter housing for filter elements in accordance with DIN 24550

Type	Contents in l [US gal]	Weight in kg [lbs]	A1	A2	A3	A4	A5	A6	B1	B2
110LEN0040	0.3 [0.08]	1.1 [2.4]	212 [8.35]	90 [3.54]	167 [6.57]	27 [1.06]	142 [5.59]	80 [3.15]	97 [3.82]	35 [1.38]
110LEN0063	0.4 [0.11]	1.3 [2.9]	272 [10.71]		227 [8.94]					
110LEN0100	0.6 [0.16]	1.5 [3.3]	362 [14.25]		317 [12.48]					

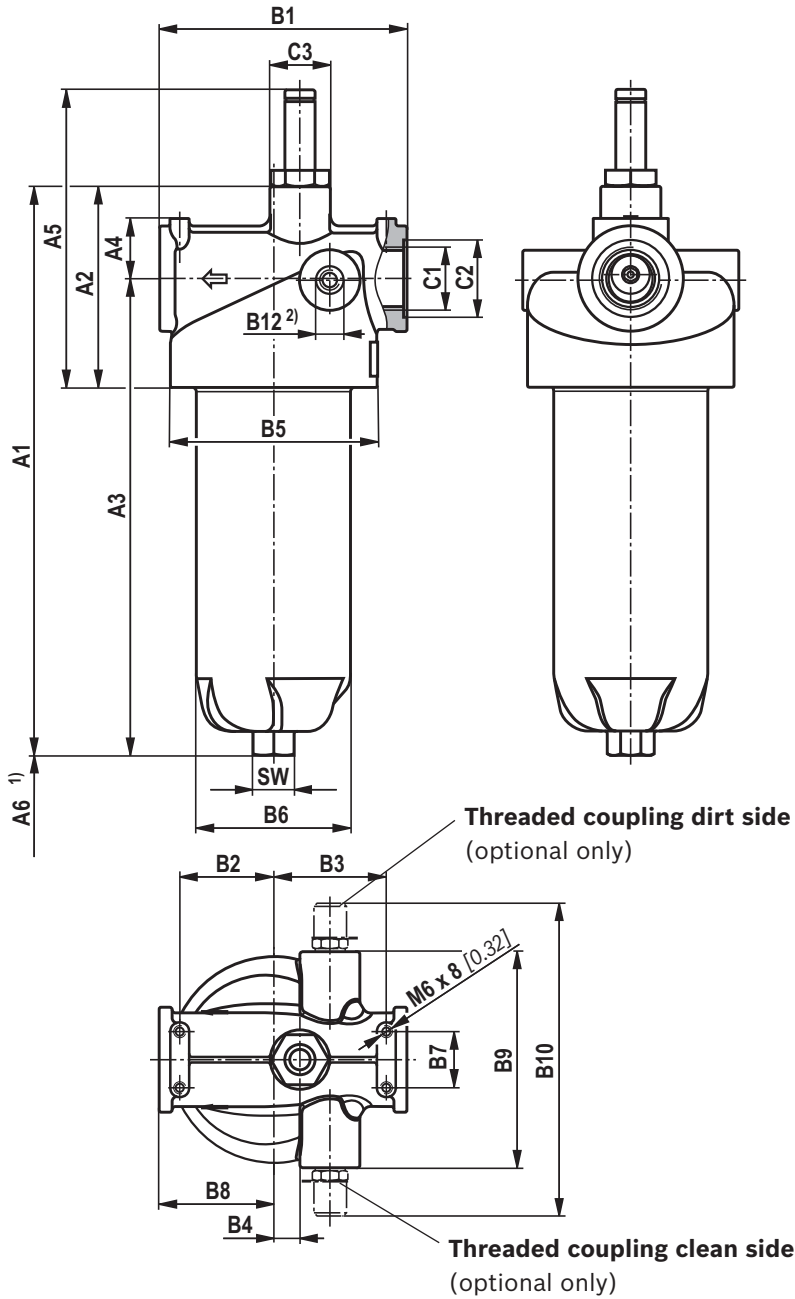
Type	B3	B4	ØB5	ØB6	B7	B8	C1 connection					
							Standard	ØC2	U... (SAE J1926)	ØC2	ØC3	SW
110LEN0040	45 [1.77]	10 [0.39]	80 [3.15]	58 [2.28]	25 [0.98]	43,5 [1.71]	G 3/4	33 [1.30]	SAE 12	41 [1.61]	32 [1.26]	17 [0.67]
110LEN0063							G 1	41 [1.61]				
110LEN0100												

¹⁾ Servicing height for filter element exchange

Dimensions: NG0130 - NG0150

(dimensions in mm [inch])

110 LE 0130-0150



Filter housing for filter elements according to Rexroth standard

Type	Contents in l [US gal]	Weight in kg [lbs]	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4	ØB5
110LE0130	0.9 [0.24]	2.5 [5.5]	303 [11.93]	107	254 [10.00]	32	159	140	132	50	60	14	110
110LE0150	1.1 [0.29]	2.6 [5.7]	354 [13.94]	[4.21]	305 [12.01]	[1.26]	[6.26]	[5.51]	[5.20]	[1.97]	[2.36]	[0.55]	[4.33]

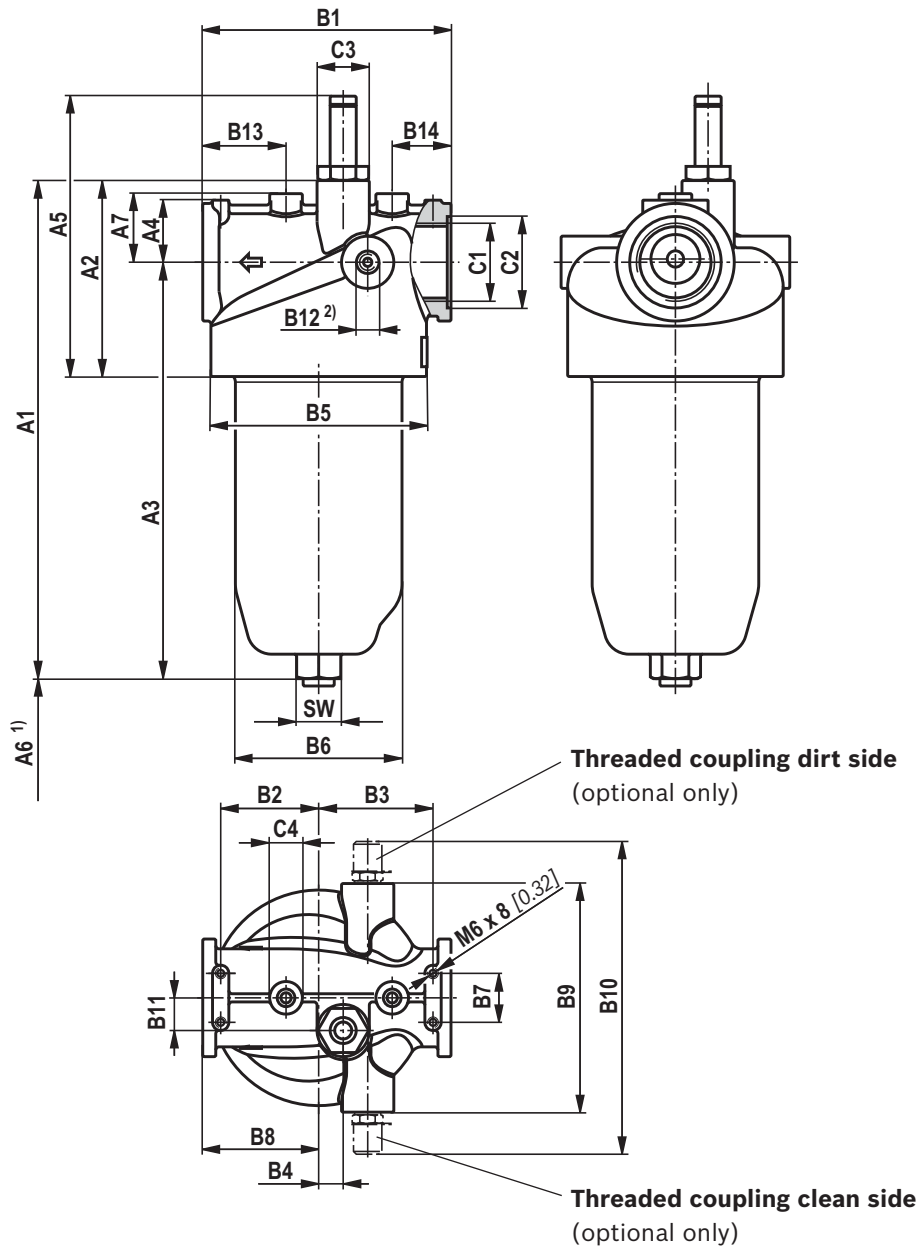
Type	ØB6	B7	B8	B9	B10	B12	Standard	C1 connection				
								ØC2	U... (SAE J1926)	ØC2	ØC3	SW
110LE0130	82	30	61	115	175	G 1/4	G 1	41 [1.61]	SAE 16	49	32	22
110LE0150	[3.23]	[1.18]	[2.40]	[4.53]	[6.89]	G 1/4	G 1 1/4	51 [2.00]	1 5/16-12 UN-2B	[1.93]	[1.26]	[0.87]

¹⁾ Servicing height for filter element exchange

²⁾ Thread only drilled with Minimes connection option

Dimensions: NG0160 - NG0400
(dimensions in mm [inch])

110 LEN 0160-0400



Filter housing for filter elements in accordance with DIN 24550

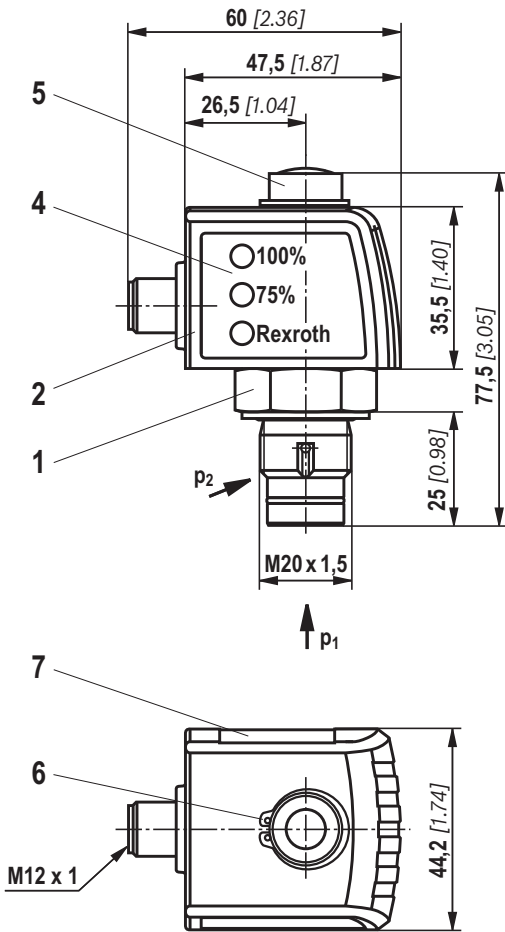
Type	Contents in l [US gal]	Weight in kg [lbs]	A1	A2	A3	A4	A5	A6	A7	B1	B2	B3	B4	ØB5
110LEN0160	1.3 [0.34]	3.5 [7.7]	305 [12.01]	120 [4.72]	255 [10.04]	38 [1.50]	172 [6.77]	140 [5.51]	42 [1.65]	152 [5.98]	60 [2.36]	70 [2.76]	15 [0.59]	132 [5.20]
110LEN0250	1.9 [0.50]	4.0 [8.8]	395 [15.55]		345 [13.58]									
110LEN0400	2.9 [0.77]	4.9 [10.8]	545 [21.46]		495 [19.49]									

Type	ØB6	B7	B8	B9	B10	B11	B12	B13	B14	Standard	C1 connection			SW		
											ØC2	U... (SAE J1926)	ØC2		ØC3	
110LEN0160	102 [4.02]	30 [1.18]	71 [2.80]	140 [5.51]	200 [7.87]	20 [0.79]	G 1/4	51 [2.01]	36 [1.42]	G 1 1/2	56 [2.20]	SAE 24	65 [2.56]	32 [1.26]	27 [1.06]	
110LEN0250																1 7/8-12 UN-2B
110LEN0400																

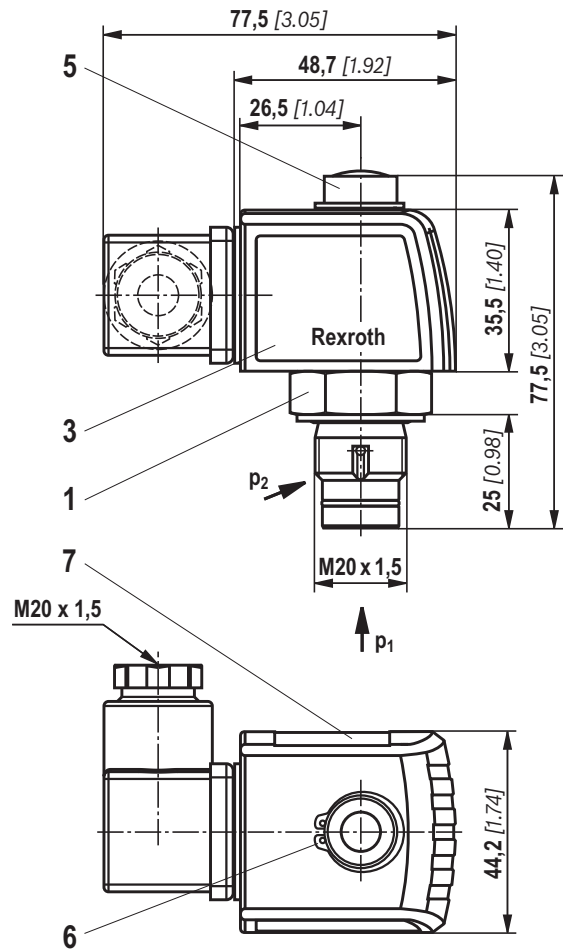
¹⁾ Servicing height for filter element exchange
²⁾ Thread only drilled with Minimes connection option

Maintenance indicator
(dimensions in mm [inch])

**Pressure differential indicator
with mounted switching element M12x1**



**Pressure differential indicator
with mounted switching element EN-175301-803**



- 1 Mechanical optical maintenance indicator;
max. tightening torque $M_{A \max} = 50 \text{ Nm}$ [36.88 lb-ft]
- 2 Switching element with locking ring for
electric maintenance indicator (rotatable by 360°);
Round plug-in connection M12x1, 4-pole
- 3 Switching element with locking ring for
electric maintenance indicator (rotatable by 360°);
rectangular plug-in connection EN175301-803
- 4 Housing with three LEDs: 24V =
green: Stand-by
yellow: Switching point 75 %
red: Switching point 100 %
- 5 Visual indicator bistable
- 6 Locking ring DIN 471-16x1,
Material no. R900003923
- 7 Name plate

Notices:

Representation contains mechanical optical maintenance indicator (1) and electronic switching element (2) (3). Switching elements with increased switching power upon request.

Ordering code Spare parts

Filter element

01	02	03	04	05	06
2.			-	0	-

Filter element

01	Design	2.
----	--------	----

Nominal size

02	LEN... (Filter element according to DIN 24550)	0040 0063 0100 0160 0250 0400
	LE... (Filter elements according to Bosch Rexroth standard)	0130 0150

Filter rating in µm

03	Nominal	Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100
	Nominal	Filter paper, not cleanable	P10 P25
	Absolute (ISO 16889; $\beta_x(c) \geq 200$)	Non-woven glass fiber media, not cleanable	H3XL H6XL H10XL H20XL

Pressure differential

04	max. admissible pressure differential of the filter element 30 bar [435 psi]	A00
	max. admissible pressure differential of the filter element 330 bar [4786 psi]	B00

Bypass valve

05	Always 0 with filter element	0
----	------------------------------	---

Seal

06	NBR seal	M
	FKM seal	V

Order example:

2.0100 H3XL-A00-0-M

For detailed information on Rexroth filter elements please refer to data sheet 51420.

Preferred program replacement filter element

Replacement filter element 3 micron		Replacement filter element 6 micron		Replacement filter element 10 micron	
R928006645	2.0040 H3XL-A00-0-M	R928006646	2.0040 H6XL-A00-0-M	R928006647	2.0040 H10XL-A00-0-M
R928006699	2.0063 H3XL-A00-0-M	R928006700	2.0063 H6XL-A00-0-M	R928006701	2.0063 H10XL-A00-0-M
R928006753	2.0100 H3XL-A00-0-M	R928006754	2.0100 H6XL-A00-0-M	R928006755	2.0100 H10XL-A00-0-M
R928022274	2.0130 H3XL-A00-0-M	R928022275	2.0130 H6XL-A00-0-M	R928022276	2.0130 H10XL-A00-0-M
R928022283	2.0150 H3XL-A00-0-M	R928022284	2.0150 H6XL-A00-0-M	R928022285	2.0150 H10XL-A00-0-M
R928006807	2.0160 H3XL-A00-0-M	R928006808	2.0160 H6XL-A00-0-M	R928006809	2.0160 H10XL-A00-0-M
R928006861	2.0250 H3XL-A00-0-M	R928006862	2.0250 H6XL-A00-0-M	R928006863	2.0250 H10XL-A00-0-M
R928006915	2.0400 H3XL-A00-0-M	R928006916	2.0400 H6XL-A00-0-M	R928006917	2.0400 H10XL-A00-0-M

Ordering code

Spare parts

Mechanical optical maintenance indicator

01	02	03	04	05	06
W	O	-	D01	-	-

01	Maintenance indicator	W
02	mechanical optical indicator	O

Design

03	Pressure differential, design 01	D01
----	----------------------------------	-----

Switching pressure

04	1.5 bar [22 psi]	1,5
	2.2 bar [32 psi]	2,2
	5.0 bar [72.5 psi]	5,0

Seal

05	NBR seal	M
	FKM seal	V

max. nominal pressure

06	Switching pressure 1.5 bar [21.8 psi], 160 bar [2321 psi]	160
	Switching pressure 2.2 bar [31.9 psi], 160 bar [2321 psi]	160
	Switching pressure 5.0 bar [72.5 psi], 450 bar [6527 psi]	450

Mechanical optical maintenance indicator

Material no.	Description
R928038781	WO-D01-1.5-M-160
R928038780	WO-D01-1.5-V-160
R901025312	WO-D01-2.2-M-160
R901066233	WO-D01-2.2-V-160
R901025313	WO-D01-5.0-M-450
R901066235	WO-D01-5.0-V-450

Ordering code Spare parts

Seal kit

01	02	03	04
D	50/110LE		-

01	Seal kit	D
02	Series 50LE and 110LE	50/110LE

Nominal size

03	0040-0100	N0040-0100
	0130-0150	0130-0150
	0160-0400	N0160-0400

Seal

04	NBR seal	M
	FKM seal	V

Seal kit

Material no.	Description
R928046935	D50/110LEN0040-0100-M
R928046936	D50/110LE0130-0150-M
R928046937	D50/110LEN0160-0400-M
R928051951	D50/110LEN0040-0100-V
R928051952	D50/110LE0130-0150-V
R928051953	D50/110LEN0160-0400-V

Assembly, commissioning, maintenance

Installation

The max. operating pressure of the system must not exceed the max. admissible operating pressure of the filter (see type plate).

During assembly of the filter (see also chapter “Tightening torque”), the flow direction (direction arrows) and the required servicing height of the filter element (see chapter “Dimensions”) are to be considered.

Easy filter element exchange is guaranteed in the installation position filter bowl vertically downwards. The maintenance indicator must be arranged in a well visible way.

Remove the plastic plugs in the filter inlet and outlet.

Ensure that the system is assembled without tension stress.

The optional electronic maintenance indicator is connected via the electronic switching element with 1 or 2 switching points, which is attached to the mechanical optical maintenance indicator and held by means of the locking ring.

Commissioning

Commission the system.

Notice:

There is no bleeding provided at the filter. However, some sizes have optional measuring ports which may also be used for bleeding.

Maintenance

- ▶ If at operating temperature, the red indicator pin reaches out of the mechanical optical maintenance indicator and/or if the switching process in the electronic switching element is triggered, the filter element is contaminated and needs to be replaced and cleaned respectively. More details see data sheet 51450.
- ▶ The material number of the corresponding replacement

filter element is indicated on the name plate of the complete filter. It must comply with the material number on the filter element.

- ▶ Decommission the system.
- ▶ The operating pressure is to be built up on the system side.

Notice:

There is no bleeding provided at the filter. However, some sizes have optional measuring ports which may also be used for bleeding.

- ▶ Via the drain screw (from size 0160 fitted by default), the oil on the dirt side can be drained.
- ▶ Screw off the filter bowl.
- ▶ Remove the filter element from the spigot by rotating it slightly.
- ▶ Clean the filter components, if necessary.
- ▶ Check the seals at the filter bowl for damage and renew them, if necessary.
For suitable seal kits refer to chapter “Spare parts”.
- ▶ Filter elements made of wire mesh can be cleaned. The efficiency of the cleaning depends on the type of dirt and the amount of the pressure differential before the filter element exchange.
If the pressure differential after the filter element exchange exceeds 150 % of the value of a brand-new filter element, the filter element made of wire mesh (G...) also needs to be replaced. For detailed cleaning instructions refer to data sheet 51420.
- ▶ Install the new or cleaned filter element on the spigot again by slightly rotating it.
- ▶ The filter is to be assembled in reverse order.
- ▶ The torque specifications (“Tightening torques” chapter) are to be observed.
- ▶ Commission the system.

WARNINGS!

- ▶ Assembly and disassembly only with depressurized system!
- ▶ Tank is under pressure!
- ▶ Maintenance only be specialists.
- ▶ Remove the filter bowl only if it is not under pressure!
- ▶ Do not exchange the maintenance indicator while the filter is under pressure!
- ▶ Functional and safety warranty only applicable when using genuine Bosch Rexroth spare parts!
- ▶ Warranty becomes void if the delivered item is changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental condition that do not comply with the installation conditions.

Tightening torques

(dimensions in mm [inch])

Mounting

Series 110 ...	LEN0040	LEN0063	LEN0100	LE0130	LE0150	LEN0160	LEN0250	LEN0400
Screw/ tightening torque with $\mu_{\text{total}} = 0.14$	M6/4.5 Nm \pm 10 %							
Quantity	4							
Recommended property class of screw	8.8							
Screw-in depth	6 mm + 1 mm							

Filter bowl and maintenance indicator

Series 110 ...	LEN0040	LEN0063	LEN0100	LE0130	LE0150	LEN0160	LEN0250	LEN0400
Tightening torque filter bowl	50 Nm + 10 Nm							
Tightening torque maintenance indicator	50 Nm							
Tightening torque cubic connector screw switching element EN-175301-803	M3/0.5 Nm							

Directives and standardization

Classification according to the Pressure Equipment Directive

The inline filters for hydraulic applications according to 51448 are pressure holding equipment according to article 1, section 2.1.4 of the Pressure Equipment Directive 97/23/EC (PED). However, on the basis of the

exception in article 1, section 3.6 of the PEG, hydraulic filters are exempt from the PED if they are not classified higher than category I (guideline 1/19). They do not receive a CE mark.

Use in explosive areas according to directive 94/9/EC (ATEX)

The inline filters according to 51448 are no equipment or components in the sense of directive 94/9/EC and are not provided with a CE mark. It has been proven with the ignition risk analysis that these inline filters do not have own ignition sources acc. to DIN EN 13463-1:2009.

According to DIN EN 60079-11:2012, the electronic maintenance indicators WE-1SP-M12x1 and WE-1SP-EN175301-803 are simple, electronic operating equipment not having an own voltage source. This simple, electronic operating equipment may - according to DIN EN

60079-14:2008 - in intrinsically safe electric circuits (Ex ib) be used in systems without marking and certification. The inline filters and the electronic maintenance indicators described here can be used for the following explosive areas

	zone suitability	
Gas	1	2
Dust	21	22

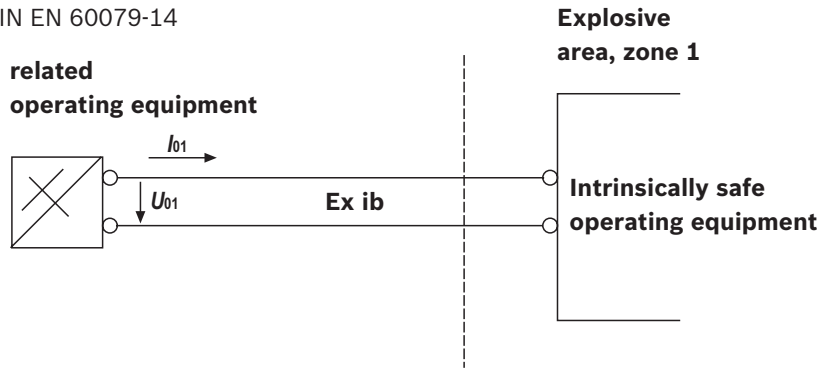
Directives and standardization

Complete filter with mech./opt. Maintenance indicator			
Use /assignment		Gas 2G	Dust 2D
Assignment		Ex II 2G c IIB TX	Ex II 2D c IIB TX
Conductivity of the medium	pS/m	min	300
Dust accumulation		max	-
			0.5 mm

electronic switching element in the intrinsically safe electric circuit			
Use /assignment		Gas 2G	Dust 2D
Assignment		Ex II 2G Ex ib IIB T4 Gb	Ex II 2D Ex ib IIIC T100°C Db
perm. intrinsically safe electric circuits		Ex ib IIC, Ex ic IIC	Ex ib IIIC
Technical data		Values only for intrinsically safe electric circuit	
Switching voltage	Ui	max	150 V AC/DC
Switching current	Ii	max	1.0 A
Switching power	Pi	max	1.3 W T4 T _{max} 40 °C
		max	1.0 W T4 T _{max} 80 °C
Surface temperature ¹⁾		max	-
			100 °C
inner capacity		Ci	negligible
inner inductivity		Li	negligible
Dust accumulation		max	-
			0.5 mm

¹⁾ The temperature depends on the temperature of the medium in the filter and must not exceed the value specified here.

Possible circuit according to DIN EN 60079-14



⚠ WARNING!

- ▶ Explosion hazard due to high temperature!
The temperature depends on the temperature of the medium in the hydraulic circuit and must not exceed the value specified here. Measures are to be taken so that in the explosive area, the max. admissible ignition temperature is not exceeded.
- ▶ When using the inline filters according to 51448 in explosive areas, appropriate equipotential bonding has to be ensured. The filter is preferably to be earthed via the mounting screws.

- ▶ It has to be noted in this connection that paintings and oxidic protective layers are not electrically conductive.
- ▶ Maintenance only by specialists, instruction by the machine end-user acc. to DIRECTIVE 1999/92/EC appendix II, section 1.1
- ▶ During filter element exchanges, the packaging material is to be removed from the replacement element outside the explosive area
- ▶ Functional and safety warranty only applicable when using genuine Rexroth spare parts

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Inline filters with filter element according to DIN 24550

Type 245LEN0040 to 0400; 245LE0130, 0150

RE 51421

Edition: 2014-08

Replaces: 07.11



- ▶ Size according to **DIN 24550**: 0040 to 0400
- ▶ additional sizes: 0130, 0150
- ▶ Nominal pressure 250 bar [3628 psi]
- ▶ Connection up to G1 1/2; SAE 1 1/2; SAE 24
- ▶ Operating temperature: -10 °C to +100 °C [+14 °F to +212 °F]

Features

Inline filters are used in hydraulic systems for separating solid materials from fluids and lubricating oils. They are intended for attachment in pipelines.

They distinguish themselves by the following:

- ▶ Filters for inline installation
- ▶ Special highly efficient filter materials
- ▶ Filtration of very fine particles and high dirt holding capacity across a broad pressure differential range
- ▶ High collapse resistance of the filter elements
- ▶ By default equipped with mechanical optical maintenance indicator with memory function
- ▶ Various, optional electronic switching elements, modular design
- ▶ Optional bypass valve integrated in the filter housing
- ▶ High filtration performance due to the tangential cyclone-effect flow path

Contents

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Ordering code filter

01	02	03	04	05	06	07	08	09		
245LE	N		-			-	-		-	

Series

01	Inline filter 250 bar [3628 psi]	245LE
----	----------------------------------	-------

Filter element

02	With filter element according to DIN 24550	N
----	---	---

Size

03	LEN...	0040 0063 0100 0160 0250 0400
	LE...	0130 0150

Filter rating in μm

04	Absolute (ISO 16889; $\beta_x(c) \geq 200$)	Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
	Nominal	Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100

Pressure differential

05	Max. admissible pressure differential of the filter element 30 bar [435 psi] – Filter with bypass valve	A00
	Max. admissible pressure differential of the filter element 330 bar [4786 psi] – Filter without bypass valve	B00

Maintenance indicator

06	Maintenance indicator, mech./optical, switching pressure 2.2 bar [31.9 psi] – bypass cracking pressure 3.5 bar [51 psi]	V2.2
	Maintenance indicator, mech./optical, switching pressure 5.0 bar [72.5 psi] – bypass cracking pressure 7.0 bar [101 psi]	V5.0

Seal

07	NBR seal	M
	FKM seal	V

Ordering code filter

01	02	03	04	05	06	07	08	09
245LE	N		-		-	-	-	

Connection

08	Frame size		0040	0063-0100	0130-0150	0160-0400		
	Connection							
	G1/2	Pipe thread according to ISO 228	●	X			R2	
	G3/4		X	X			R3	
	G1		X	●	X		R4	
	G1 1/4				●	X	R5	
	G1 1/2				X	●	R6	
	SAE 1 1/2"		SAE flange 6,000 psi				X	S6
	SAE 10	Pipe thread according to SAE J1926	X				U3	
	SAE 12			X			U4	
	SAE 20				X		U5	
	SAE 24					X	U6	
			● Standard connection					
			X Alternative connection					

Supplementary information

09	Manufacturer's inspection certificate M according to DIN 55350 T18	Z1
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Order example:

245LEN0100-H10XLA00-V5,0-M-R4

Further versions (filter materials, connections,...) are available on request.

Preferred types

245LE(N) preferred types, NBR seal, flow specifications for 30 mm²/s [143 SUS]

Inline filter with bypass, filter rating 3 µm

Type	Flow in l/min [gpm] at $\Delta p = 1.5 \text{ bar}$ [21.75 psi] ¹⁾	Material no. Filter				Material no. Replacement element
245LEN0040-H3XLA00-V5,0-M-..	29 [6.1]	..R2	R928030024	..U3	R928030216	R928006645
245LEN0063-H3XLA00-V5,0-M-..	44 [7.9]	..R4	R928030025	..U4	R928030217	R928006699
245LEN0100-H3XLA00-V5,0-M-..	61 [11.6]	..R4	R928030026	..U4	R928030218	R928006753
245LE0130-H3XLA00-V5,0-M-..	101 [19.5]	..R5	R928030027	..U5	R928030219	R928022274
245LE0150-H3XLA00-V5,0-M-..	123 [23.5]	..R5	R928030028	..U5	R928030220	R928022283
245LEN0160-H3XLA00-V5,0-M-..	184 [34.9]	..R6	R928030029	..U6	R928030221	R928006807
245LEN0250-H3XLA00-V5,0-M-..	261 [50.2]	..R6	R928030030	..U6	R928030222	R928006861
245LEN0400-H3XLA00-V5,0-M-..	330 [66.0]	..R6	R928030031	..U6	R928030223	R928006915

Inline filter with bypass, filter rating 6 µm

Type	Flow in l/min [gpm] at $\Delta p = 1.5 \text{ bar}$ [21.75 psi] ¹⁾	Material no. Filter				Material no. Replacement element
245LEN0040-H6XLA00-V5,0-M-..	48 [12.7]	..R2	R928030280	..U3	R928030472	R928006646
245LEN0063-H6XLA00-V5,0-M-..	78 [20.6]	..R4	R928030281	..U4	R928030473	R928006700
245LEN0100-H6XLA00-V5,0-M-..	82 [21.7]	..R4	R928030282	..U4	R928030474	R928006754
245LE0130-H6XLA00-V5,0-M-..	152 [40.2]	..R5	R928030283	..U5	R928030475	R928022275
245LE0150-H6XLA00-V5,0-M-..	170 [45.0]	..R5	R928030284	..U5	R928030476	R928022284
245LEN0160-H6XLA00-V5,0-M-..	245 [64.7]	..R6	R928030285	..U6	R928030477	R928006808
245LEN0250-H6XLA00-V5,0-M-..	310 [81.9]	..R6	R928030286	..U6	R928030478	R928006862
245LEN0400-H6XLA00-V5,0-M-..	400 [105.7]	..R6	R928030287	..U6	R928030479	R928006916

Inline filter with bypass, filter rating 10 µm

Type	Flow in l/min [gpm] at $\Delta p = 1.5 \text{ bar}$ [21.75 psi] ¹⁾	Material no. Filter				Material no. Replacement element
245LEN0040-H10XLA00-V5,0-M-..	58 [15.3]	..R2	R928030536	..U3	R928030728	R928006647
245LEN0063-H10XLA00-V5,0-M-..	98 [18.2]	..R4	R928030537	..U4	R928030729	R928006701
245LEN0100-H10XLA00-V5,0-M-..	84 [22.2]	..R4	R928030538	..U4	R928030730	R928006755
245LE0130-H10XLA00-V5,0-M-..	172 [45.4]	..R5	R928030539	..U5	R928030731	R928022276
245LE0150-H10XLA00-V5,0-M-..	196 [51.8]	..R5	R928030540	..U5	R928030732	R928022285
245LEN0160-H10XLA00-V5,0-M-..	281 [74.2]	..R6	R928030541	..U6	R928030733	R928006809
245LEN0250-H10XLA00-V5,0-M-..	330 [87.2]	..R6	R928030542	..U6	R928030734	R928006863
245LEN0400-H10XLA00-V5,0-M-..	420 [111.0]	..R6	R928030543	..U6	R928030735	R928006917

¹⁾ An appropriate differential pressure via the filter and measuring device according to ISO 3968. The differential pressure measured on the maintenance indicator is lower.

Ordering code accessories
(dimensions in mm [inch])

Electronic switching element for maintenance indicators

01	02	03
WE	-	-

Maintenance indicator

01	Electronic switching element	WE
----	------------------------------	-----------

Type of signal

02	1 switching point	1SP
	2 switching points, 3 LED	2SP
	2 switching points, 3 LED and signal suppression up to 30 °C [86 °F]	2SPSU

Connector

03	Round plug-in connection M12 x 1, 4-pole	M12 x 1
	Rectangular plug-in connection, 2-pole, design A according to EN-175301-803	EN175301-803

Material numbers of the electronic switching elements

Material no.	Type	Signal	Switching points	Connector	LED
R928028409	WE-1SP-M12 x 1	Changeover	1	M12 x 1	without
R928028410	WE-2SP-M12 x 1	Normally open (at 75%) / normally closed contact (at 100%)	2		3 pieces
R928028411	WE-2SPSU-M12 x 1				
R928036318	WE-1SP-EN175301-803	Normally closed contact	1	EN 175301-803	without

Mating connectors

for electronic switching element with round plug-in connection M12 x 1

Mating connector suitable for K24 4-pole, M12 x 1 with screw connection, cable gland Pg9.

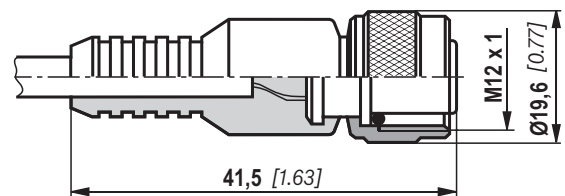
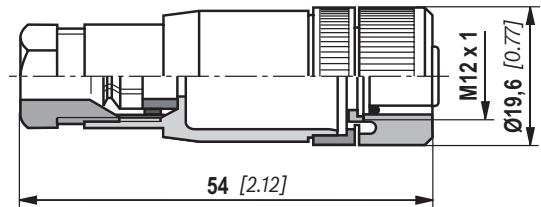
Material no. R900031155

Mating connector suitable for K24-3m 4-pole, M12 x 1 with potted-in PVC cable, 3 m long.

Line cross-section: 4 x 0.34 mm²

Core marking: **1** brown **2** white
 3 blue **4** black

Material no. R900064381



For more round plug-in connections and technical data refer to data sheet 08006.

Order example:

Inline filter with mechanical optical maintenance indicator for $p_{nom.} = 250 \text{ bar [3628 psi]}$ with bypass valve, size 0100, with filter element 10 μm and electronic switching element M12x1 with 1 switching point for hydraulic fluid mineral oil HLP according to DIN 51524.

Filter with mech. optical maintenance indicator: 245LEN0100-H10XLA00-V5,0-M-R4

Material no. R928030538

Switching element: WE-1SP-M12 x 1

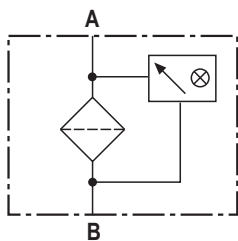
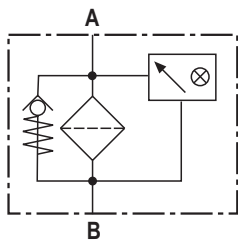
Material no. R928028409

Mating connector: Mating connector suitable for K24 4-pole, M12 x 1 with screw connection, cable gland Pg9.

Material no. R900031155

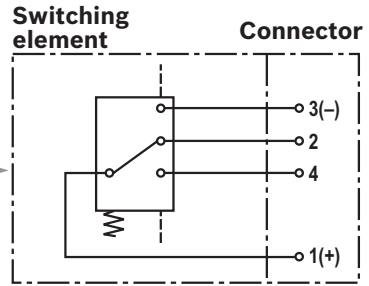
Symbols

Inline filter with bypass and mechanical indicator

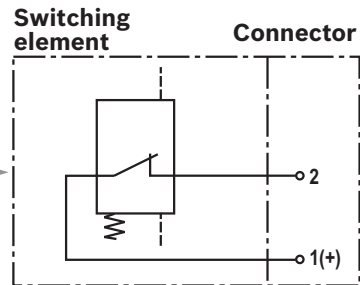


Inline filter without bypass and with mechanical indicator

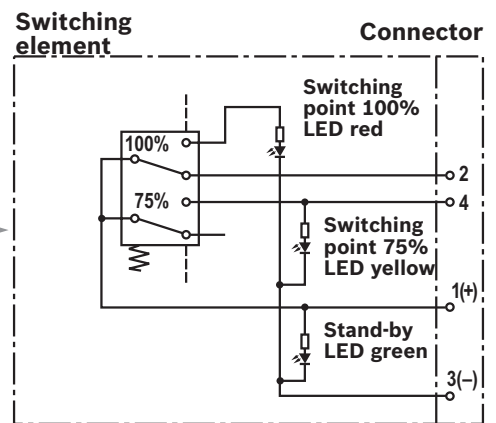
Electronic switching element for maintenance indicator



WE-1SP-M12 x 1

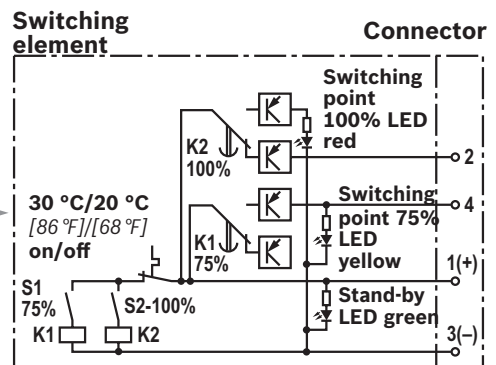


WE-1SP-EN175301-803



WE-2SP-M12 x 1

Circuit diagram drawn in plugged condition (operating state)



WE-2SPSU-M12 x 1

Circuit diagram drawn in plugged condition at temperature > 30 °C [86 °F] (operating condition)

Function, section

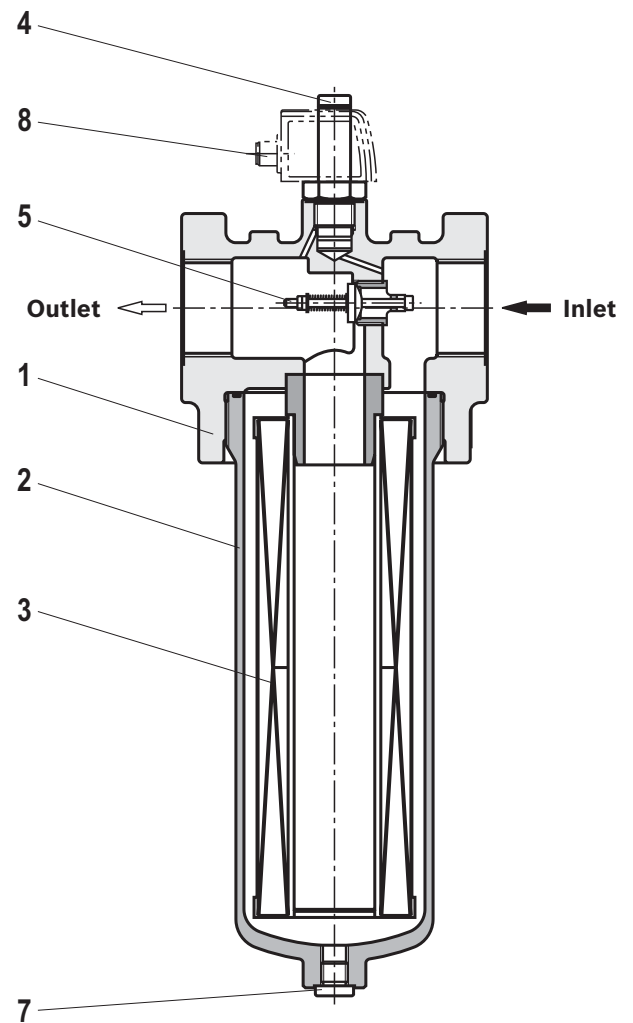
The 245LE(N) inline filter is suitable for inline installation. It basically consists of filter head (1), a screwable filter bowl (2), filter element (3) as well as mechanical optical maintenance indicator (4). In case of filters with low-pressure-differential-stable filter elements (= code letter pressure differential A), there is an assembled bypass valve (5) as standard.

Via the inlet, the fluid reaches the filter element (3) where it is cleaned. The dirt particles filtered out collect in the filter element (3). Via the outlet, the filtered fluid enters the hydraulic circuit.

The filter housing and all connection elements are designed so that pressure peaks - as they may e.g. occur in case of abrupt opening of large control valves due to the accelerated fluid quantity - can be securely absorbed. As of size 0160, the standard equipment comprises a drain screw (7).

By default, the filter is equipped with mechanical optical maintenance indicator (4). The electronic switching element (8) which has to be ordered separately is attached to the mechanical optical maintenance indicator (4) and held by means of a locking ring.

The electronic switching elements with 1 or 2 switching points are connected via a mating connector according to IEC-60947-5-2 or via a cable connection according to EN17301-803.



WARNING!

- ▶ If the maintenance indicator is not observed while the element is exchanged, the bypass valve will open if the pressure differential increases. This means that part of the volume flow enters unfiltered into the clean side of the filter. Effective filtration is therefore no longer guaranteed.

Technical data

(For applications outside these parameters, please consult us!)

General						
Installation position		vertical				
Ambient temperature range		°C [°F]	-10 ... +65 [+14 ... +149]; (short periods down to -30 [-22])			
Storage conditions	- NBR seal	°C [°F]	40 ... +65 [-40 ... +149]; max. relative air humidity 65%			
	- FKM seal	°C [°F]	-20 ... +65 [-4 ... +149]; max. relative air humidity 65%			
Weight	- Filter	Size	0040	0063	0100	0130
		kg [lbs]	3.2 [7.10]	3.8 [8.40]	4.2 [9.30]	6.95 [15.30]
		Size	0150	0160	0250	0400
		kg [lbs]	7.25 [16]	11.5 [25.40]	12.2 [26.90]	13.8 [30.40]
	- Filter bowl	Size	0040	0063	0100	0130
		kg [lbs]	0.57 [1.26]	1.03 [2.27]	1.44 [3.17]	1.93 [4.25]
		Size	0150	0160	0250	0400
		kg [lbs]	2.27 [5.00]	2.49 [5.49]	3.33 [7.34]	4.72 [10.41]
Volume	Size	0040	0063	0100	0130	
		l [US gal]	0.21 [0.06]	0.38 [0.10]	0.53 [0.14]	0.76 [0.20]
	Size	0150	0160	0250	0400	
		l [US gal]	0.96 [0.25]	1.13 [0.30]	1.6 [0.42]	2.4 [0.63]
Material	- Filter head	GGG				
	- Filter bowl	Steel				
	- Bypass valve	Aluminum / steel / POM				
	- Seals	NBR or FKM				
	- Optical maintenance indicator	Brass				
	- Electronic switching element	Plastic PA6				

Hydraulic			
Maximum operating pressure	bar [psi]	250 [3628]	
Hydraulic fluid temperature range	°C [°F]	-10 ... +100 [+14 ... +212]	
Minimum conductivity of the medium	pS/m	300	
Fatigue strength according to ISO 10771	Load cycles	> 10 ⁶ with max. operating pressure	
Type of pressure measurement of the maintenance indicator	Pressure differential		
Assignment: Response pressure of the maintenance indicator / cracking pressure of the bypass valve		Response pressure of the maintenance indicator	Cracking pressure of the bypass valve
	bar [psi]	2.2 ± 0.3 [31.9 ± 4.4]	3.5 ± 0.35 [50.8 ± 5.1]
	bar [psi]	5.0 ± 0.5 [72.5 ± 7.3]	7.0 ± 0.5 [101.5 ± 7.3]
Filtration direction	From the outside to the inside		

Technical data

(For applications outside these parameters, please consult us!)

Electric (electronic switching element)				
Electrical connection	Round plug-in connection M12 x 1, 4-pole			Standard connection EN 175301-803
	Version	WE-1SP- M12 x 1	WE-2SP- M12 x 1	WE-2SPSU- M12 x 1
Contact load, direct voltage	A _{max.}	1		
Voltage range	V _{max.}	150 (AC/DC)	10 ... 30 (DC)	250 (AC)/200 (DC)
Max. switching power with resistive load	W	20		
Switching type	- 75% signal	-	Normally open contact	
	- 100% signal	Changeover	Normally closed contact	
	- 2SPSU			Signal interconnection at 30 °C [86 °F], return switching at 20 °C [68 °F]
Display via LEDs in the electronic switching element 2SP...		Stand-by (LED green); 75% switching point (LED yellow) 100% switching point (LED red)		
Protection class according to EN 60529	IP	67		
Ambient temperature range	°C [°F]	-25 ... +85 [-13 ... +185]		
For direct voltage above 24 V, spark extinguishing is to be provided for protecting the switching contacts.				
Weight	- electronic switching element	kg [lbs]	0.1 [0.22]	

Filter element				
Glass fiber material H.XL		Single-use element on the basis of inorganic fiber		
Particle separation			Filtration ratio according to ISO 16889 up to $\Delta p = 5 \text{ bar [72.5 psi]}$	Achievable oil cleanliness accord- ing to ISO 4406 [SAE-AS 4059]
	H20XL		$\beta_{20(c)} \geq 200$	19/16/12 ... 22/17/14
	H10XL		$\beta_{10(c)} \geq 200$	17/14/10 ... 21/16/13
	H6XL		$\beta_{6(c)} \geq 200$	15/12/10 ... 19/14/11
	H3XL		$\beta_{5(c)} \geq 200$	13/10/8 ... 17/13/10
Admissible pressure differential	- A00	bar [psi]	30 [435]	
	- B00	bar [psi]	330 [4785]	

Compatibility with permitted hydraulic fluids

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oil	HLP	NBR	DIN 51524
Biodegradable	- insoluble in water	HETG	VDMA 24568
		HEES	
	- soluble in water	HEPG	VDMA 24568
Flame-resistant	- water-free	HFDU, HFDR	VDMA 24317
	- containing water	HFAS	DIN 24320
		HFAE	
		HFC	
		NBR	VDMA 24317



Important information on hydraulic fluids!

- For more information and data on the use of other hydraulic fluids, please refer to data sheet 90220 or contact us!
- **Flame-resistant – containing water:** Due to possible chemical reactions with materials or surface coatings of machine and system components, the service life with these hydraulic fluids may be less than expected.

Filter materials made of filter paper (P) may not be used, filter elements with glass fiber material have to be used instead.

- **Biodegradable:** If filter materials made of filter paper are used, the filter life may be shorter than expected due to material incompatibility and swelling.

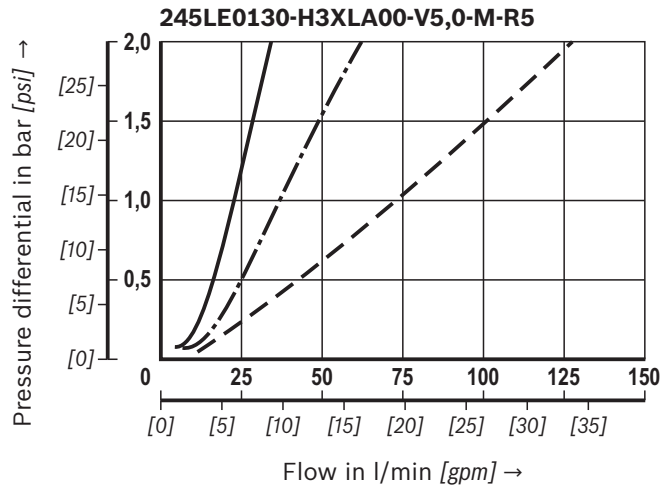
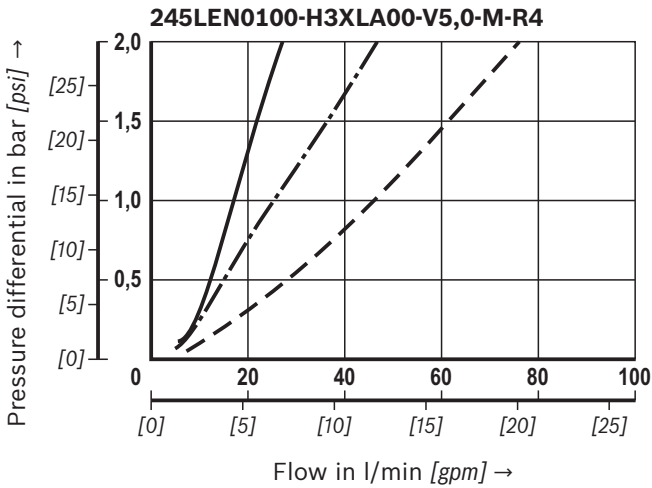
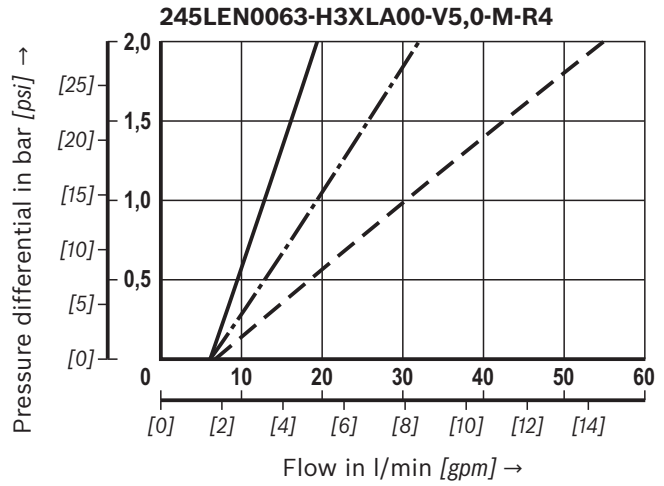
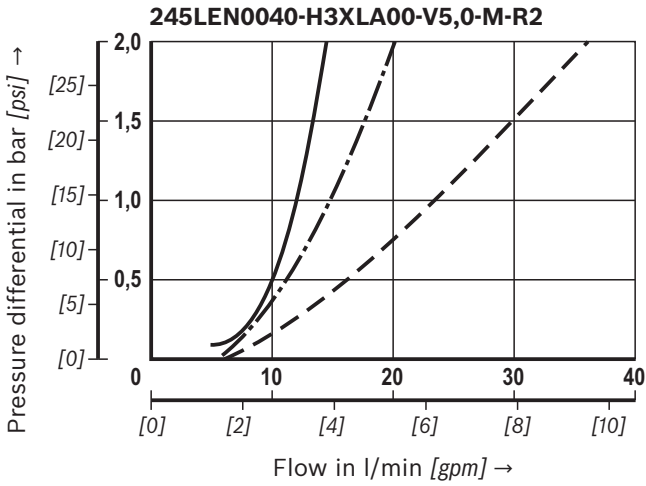
Characteristic curves

(measured with mineral oil HLP46 according to ISO 3968)

Spec. weight: < 0.9 kg/dm³ Δp-Q-characteristic curves for complete filters recommended initial Δp for design = 1.5 bar [21.75 psi]

A proper filter design is made possible by our online “Bosch Rexroth FilterSelect” design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



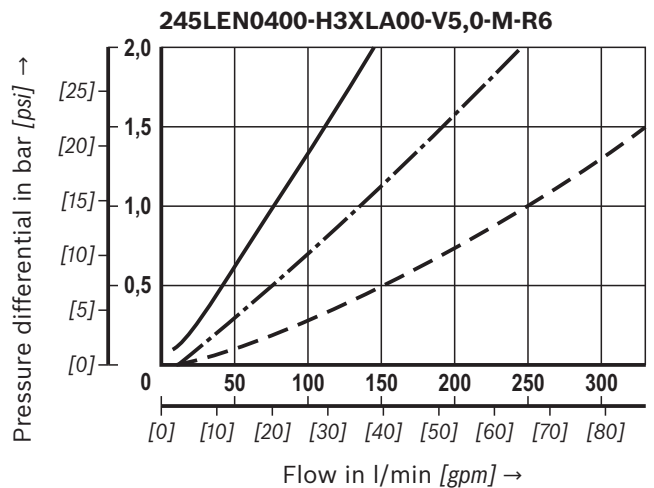
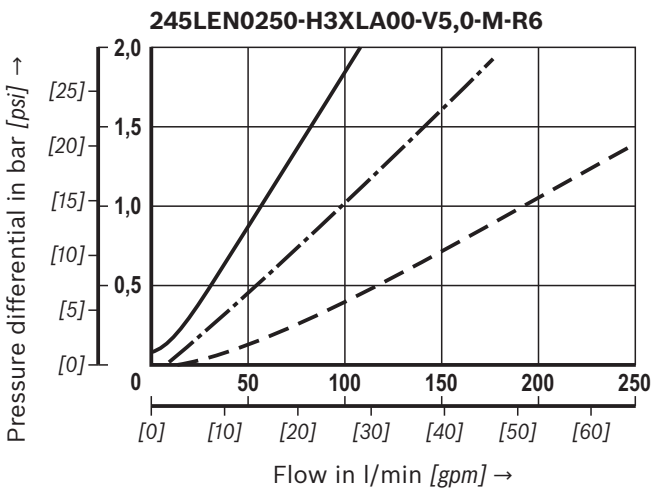
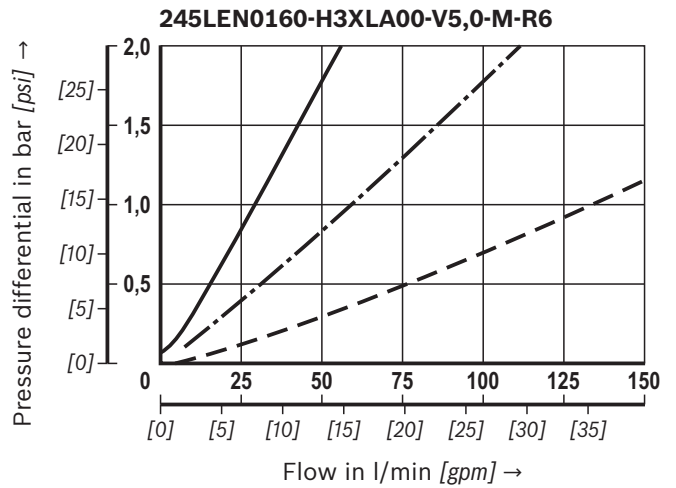
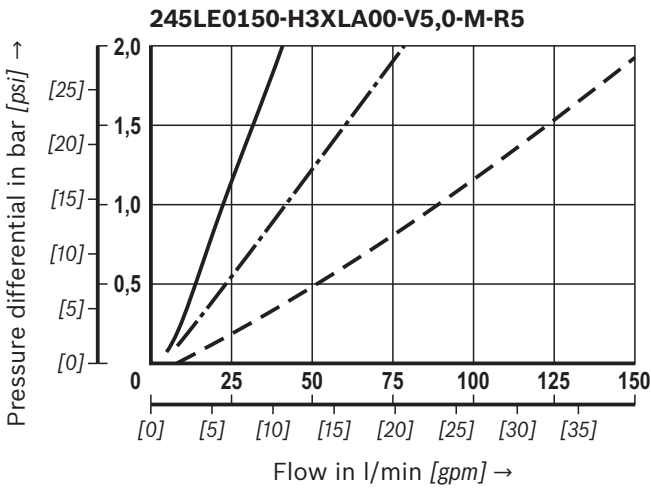
Characteristic curves
(measured with mineral oil HLP46 according to ISO 3968)

H3XL

Spec. weight: < 0.9 kg/dm³ Δp-Q-characteristic curves for complete filters recommended initial Δp for design = 1.5 bar [21.75 psi]

A proper filter design is made possible by our online “Bosch Rexroth FilterSelect” design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



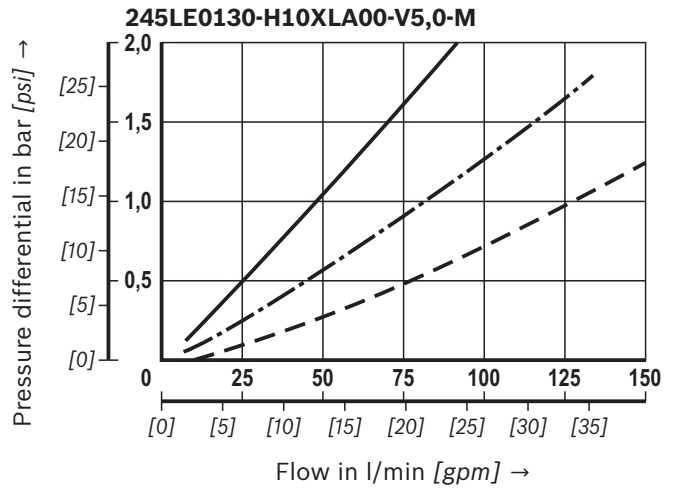
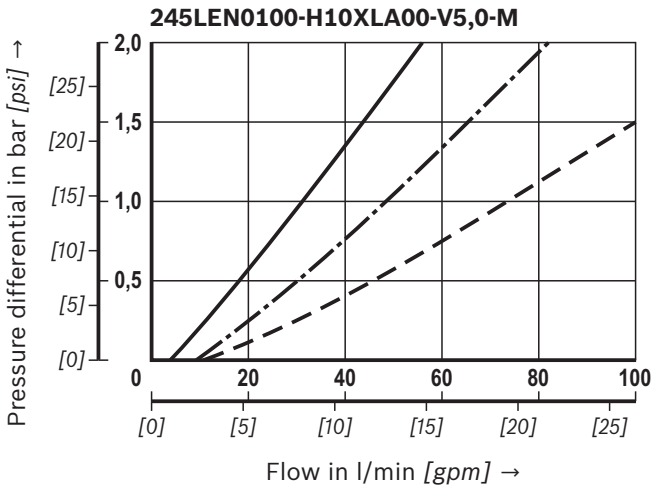
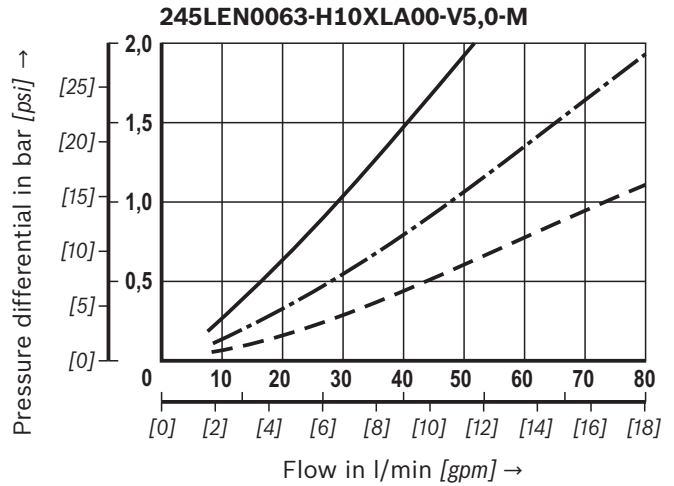
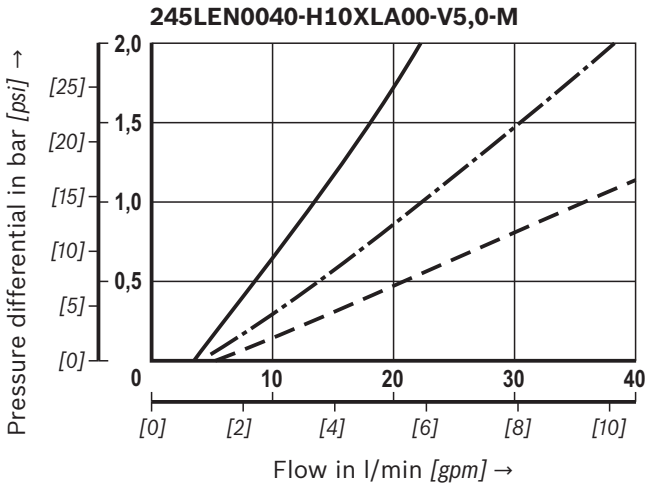
Characteristic curves

(measured with mineral oil HLP46 according to ISO 3968)

Spec. weight: < 0.9 kg/dm³ Δp-Q-characteristic curves for complete filters recommended initial Δp for design = 1.5 bar [21.75 psi]

A proper filter design is made possible by our online “Bosch Rexroth FilterSelect” design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Characteristic curves

H10XL

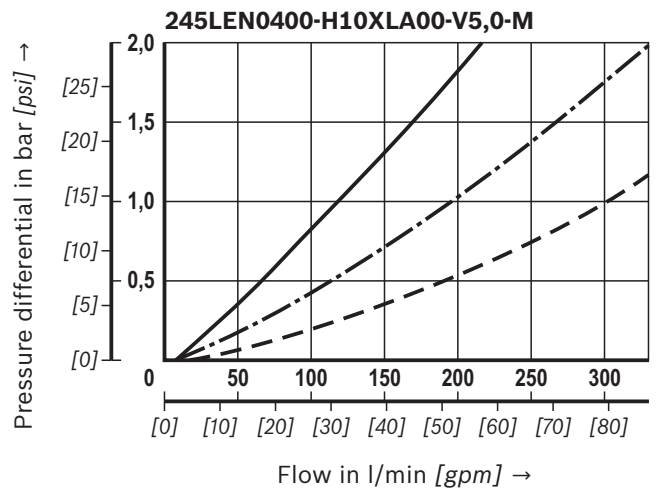
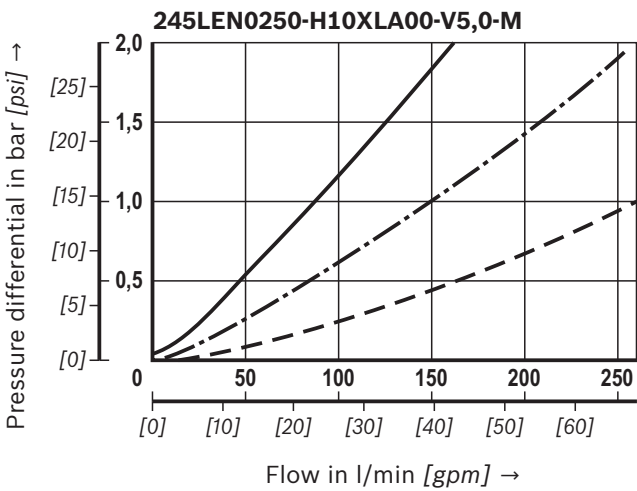
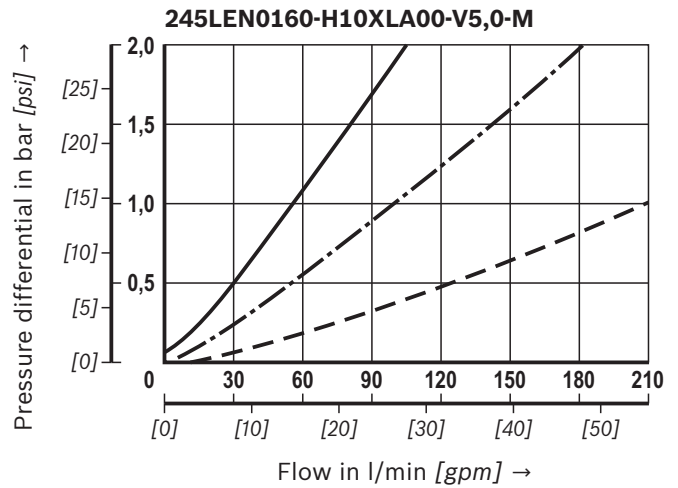
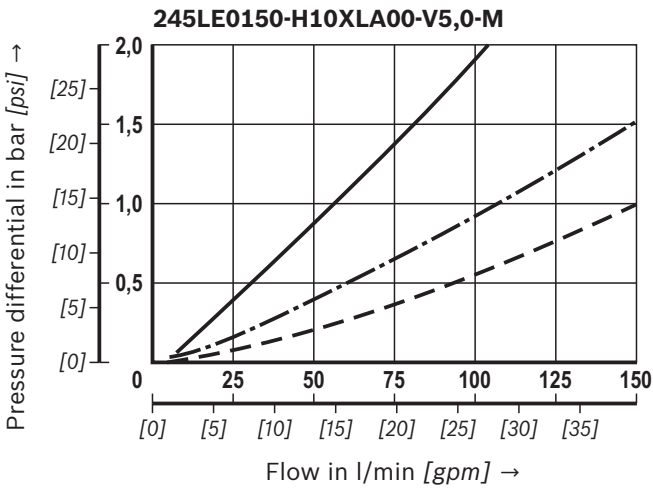
(measured with mineral oil HLP46 according to ISO 3968)

Spec. weight: < 0.9 kg/dm³

Δp -Q-characteristic curves for complete filters recommended initial Δp for design = 1.5 bar [21.75 psi]

A proper filter design is made possible by our online "Bosch Rexroth FilterSelect" design software.

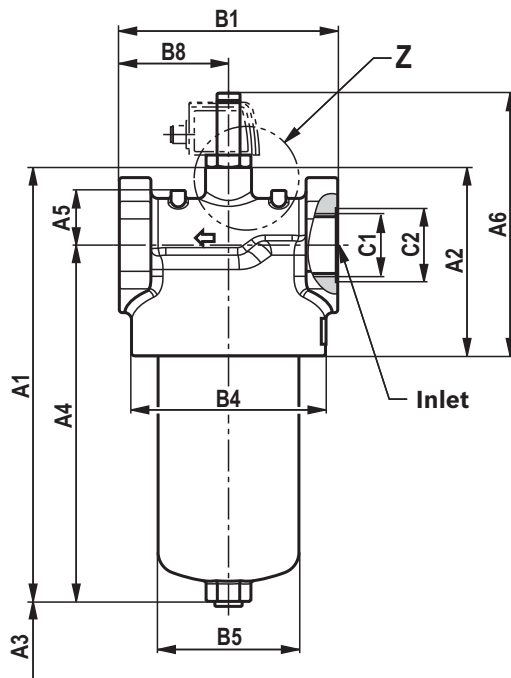
Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



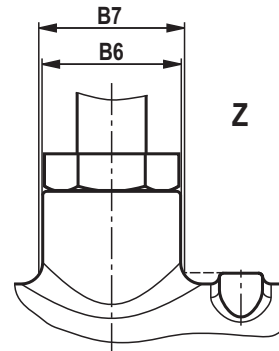
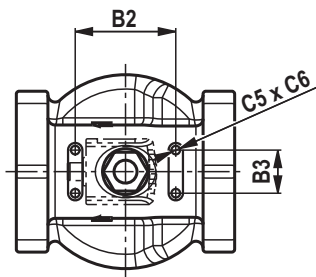
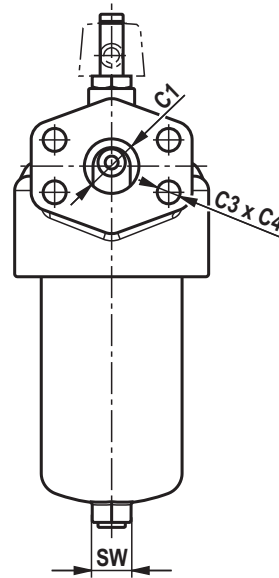
6

Dimensions: 245LE(N) NG0040 ... NG0400
 (Dimensions in mm [inch])

Pipe thread connections
 UNF thread



Connection SAE 1 1/2"
 - 3000 psi



Dimensions: NG0040 ... NG0400
(Dimensions in mm [inch])

Type	A1	A2	A3 ¹⁾	A4	A5	A6
245LEN0040	200 [7.87]	94 [3.70]	120 [4.72]	156 [6.14]	25 [0.98]	146 [5.75]
245LEN0063	264 [10.39]			220 [8.66]		
245LEN0100	354 [13.94]			310 [12.20]		
245LE0130	324 [12.76]	121 [4.76]	140 [5.51]	270 [10.63]	38 [1.50]	173 [6.81]
245LE0150	374 [14.72]			320 [12.60]		
245LEN0160	356 [14.02]	131 [5.16]	120 [4.72]	302 [11.89]		183 [7.20]
245LEN0250	392 [15.43]			338 [13.31]		
245LEN0400	542 [21.34]			488 [19.21]		

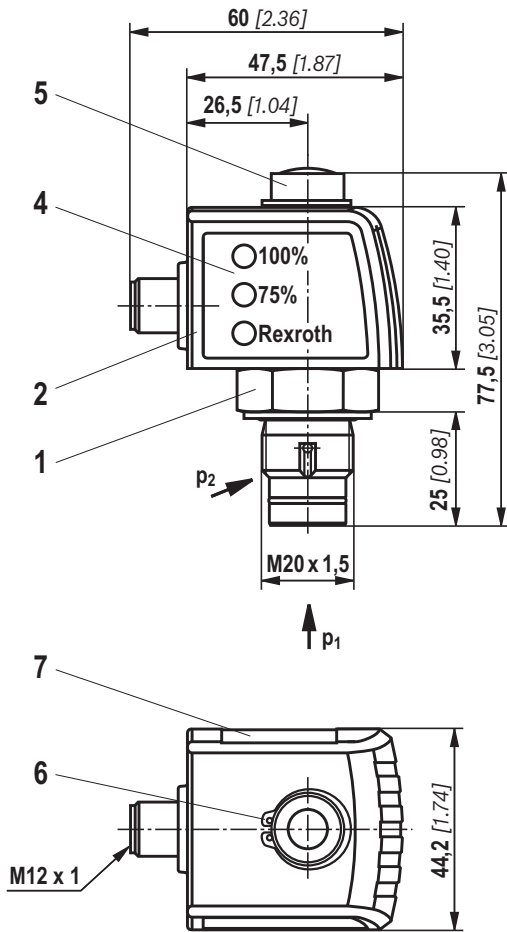
Type	B1 ²⁾	B2	B3	ØB4	ØB5	ØB6	ØB7	B8
245LEN0040	92 [3.62]	60 [2.36]	25 [0.98]	85 [3.35]	55 [2.17]	32 [1.26]	34 [1.34]	46 [1.81]
245LEN0063								
245LEN0100								
245LE0130	122 [4.80]	80 [3.15]	30 [1.18]	116 [4.57]	77 [3.03]		32 [1.26]	61 [2.40]
245LE0150								
245LEN0160	152 [5.98]	70 [2.76]	135 [5.31]	98 [3.86]	76 [2.99]			
245LEN0250								
245LEN0400								

Type	C1 connection					C3	C4	C5	C6	SW
	Standard R...	ØC2	Optional U...	ØC2	Optional S...					
245LEN0040	G1/2	28 [1.10]	SAE 10 7/8-14 UNF-2B	41 [1.61]	-	M16	22 [0.87]	M6	8 [0.31]	19 [0.75]
245LEN0063			SAE 12 1 1/16-12 UN-2B							
245LEN0100	G1	51 [2.01]	SAE 20 1 5/8-12 UN-2B	58 [2.28]						24 [0.94]
245LE0130			G1 1/4	SAE 24 1 7/8-12 UN-2B						
245LE0150	G1 1/2	56 [2.20]								
245LEN0160										
245LEN0250										
245LEN0400										

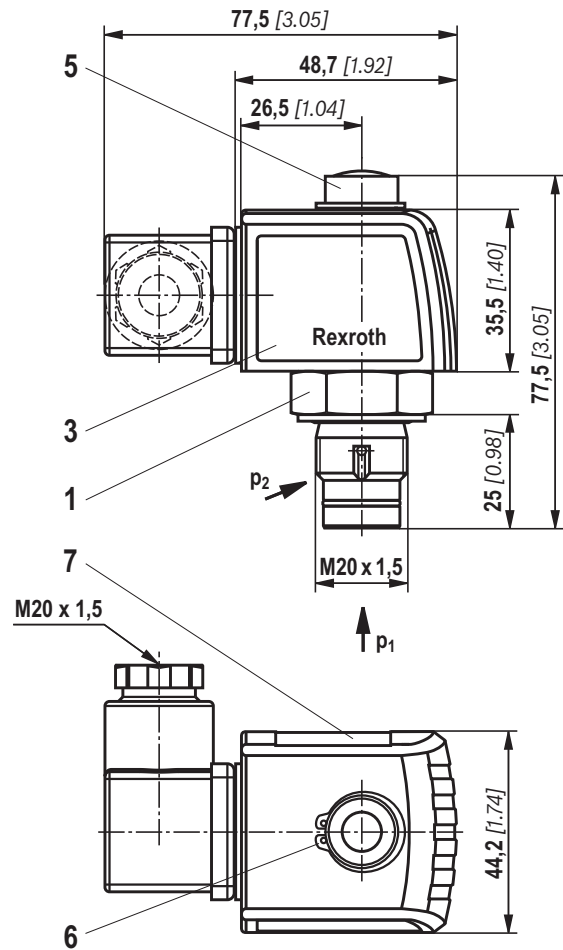
1) Servicing height for filter element exchange
2) Dimension B1 is reduced with SAE flanges by 4 mm [0.16 inch]

Maintenance indicator (dimensions in mm [inch])

Pressure differential indicator with mounted switching element M12 x 1



Pressure differential indicator with mounted switching element EN-175301-803



- 1 Mechanical optical maintenance indicator; max. tightening torque $M_{A \max} = 50 \text{ Nm}$ [36.88 lb-ft]
- 2 Switching element with locking ring for electrical maintenance indicator (rotatable by 360°); round plug-in connection M12 x 1, 4-pole
- 3 Switching element with locking ring for electrical maintenance indicator (rotatable by 360°); rectangular plug-in connection EN175301-803
- 4 Housing with three LEDs: 24 V =
green: Stand-by
yellow: Switching point 75%
red: Switching point 100%
- 5 Visual indicator bistable
- 6 Locking ring DIN 471-16 x 1, **material no. R900003923**
- 7 Name plate

Notices:

Representation contains mechanical optical maintenance indicator (1) and electronic switching element (2) (3).

Ordering code spare parts

Filter element

01	02	03	04	05	06
2.			-	-	0

Filter element

01	Design	2.
----	--------	----

Size

02	LEN...	0040 0063 0100 0160 0250 0400
	LE...	0130 0150

Filter rating in µm

03	Absolute (ISO 16889; β _{x(c)} ≥ 200)	Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
	Nominal	Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100

Pressure differential

04	Max. admissible pressure differential of the filter element 30 bar [435 psi] – Filter with bypass valve	A00
	Max. admissible pressure differential of the filter element 330 bar [4786 psi] – Filter without bypass valve	B00

Bypass valve

05	without bypass valve	0
----	-----------------------------	---

Seal

06	NBR seal	M
	FKM seal	V

Order example:

2,0100 H3XL-A00-0-M

For detailed information on Rexroth filter elements please refer to data sheet 51420.

Preferred program replacement filter element

Replacement filter element 3 micron		Replacement filter element 6 micron		Replacement filter element 10 micron	
R928006645	2,0040 H3XL-A00-0-M	R928006646	2,0040 H6XL-A00-0-M	R928006647	2,0040 H10XL-A00-0-M
R928006699	2,0063 H3XL-A00-0-M	R928006700	2,0063 H6XL-A00-0-M	R928006701	2,0063 H10XL-A00-0-M
R928006753	2,0100 H3XL-A00-0-M	R928006754	2,0100 H6XL-A00-0-M	R928006755	2,0100 H10XL-A00-0-M
R928022274	2,0130 H3XL-A00-0-M	R928022275	2,0130 H6XL-A00-0-M	R928022276	2,0130 H10XL-A00-0-M
R928022283	2,0150 H3XL-A00-0-M	R928022284	2,0150 H6XL-A00-0-M	R928022285	2,0150 H10XL-A00-0-M
R928006807	2,0160 H3XL-A00-0-M	R928006808	2,0160 H6XL-A00-0-M	R928006809	2,0160 H10XL-A00-0-M
R928006861	2,0250 H3XL-A00-0-M	R928006862	2,0250 H6XL-A00-0-M	R928006863	2,0250 H10XL-A00-0-M
R928006915	2,0400 H3XL-A00-0-M	R928006916	2,0400 H6XL-A00-0-M	R928006917	2,0400 H10XL-A00-0-M

Ordering code spare parts

Mechanical optical maintenance indicator

01	02	03	04	05	06
W	O	-	D01	-	-

01	Maintenance indicator	W
----	-----------------------	---

02	Mechanical optical indicator	O
----	------------------------------	---

Version

03	Pressure difference, modular design	D01
----	-------------------------------------	-----

Switching pressure

04	2.2 bar [32 psi]	2,2
	5.0 bar [72.5 psi]	5,0

Seal

05	NBR seal	M
	FKM seal	V

Max. operating pressure

06	Switching pressure 2.2 bar [32 psi], 160 bar [2321 psi]	160
	Switching pressure 5.0 bar [72.5 psi], 450 bar [6527 psi]	450

Mechanical optical maintenance indicator	Material no.
WO-D01-2.2-M-160	R901025312
WO-D01-2.2-V-160	R901066233
WO-D01-5,0-M-450	R901025313
WO-D01-5,0-V-450	R901066235

**Ordering code
spare parts**

Seal kit

01	02	03	04
D	245LE		-

01	Seal kit	D
02	Series	245LE

Size

03	NG0040-0100	N0040-0100
	Size 0130-0150	0130-0150
	NG0160-0400	N0160-0400

Seal

04	NBR seal	M
	FKM seal	V

Material no.	Seal kit
R928028016	D245LEN0040-0100-M
R928028214	D245LE0130-0150-M
R928028017	D245LEN0160-0400-M
R928047988	D245LEN0040-0100-V
R928048951	D245LE0130-0150-V
R928039838	D245LEN0160-0400-V

Assembly, commissioning, maintenance

Installation

- ▶ The max. operating pressure of the system must not exceed the max. admissible operating pressure of the filter (see type plate).
- ▶ During assembly of the filter (see also chapter “Tightening torque”), the flow direction (direction arrows) and the required servicing height of the filter element (see chapter “Dimensions”) are to be considered.
- ▶ Easy filter element exchange is guaranteed in the installation position filter bowl vertically downwards. The maintenance indicator must be arranged so it is easily viewed in operation.
- ▶ Remove the plastic plugs in the filter inlet and outlet.
- ▶ Ensure that the system is assembled without tension stress.
- ▶ The optional electronic maintenance indicator is connected via the electronic switching element with 1 or 2 switching points, which is attached to the mechanical optical maintenance indicator and held by means of the locking ring.

Commissioning

- ▶ Commission the system.

Notice:

There is no bleed function provided at the filter.

Maintenance

- ▶ If at operating temperature, the red indicator pin reaches out of the mechanical optical maintenance indicator and/or if the switching process in the electronic switching element is triggered, the filter element is contaminated and needs to be replaced and cleaned respectively.

More details see data sheet 51450

- ▶ The material number of the corresponding replacement filter element is indicated on the name plate of the complete filter. It must comply with the material number on the filter element.
- ▶ Decommission the system.
- ▶ The operating pressure is to be built up on the system side.

Notice:

There is no bleed function provided at the filter.

- ▶ Via the drain screw (from size 0160 fitted by default), the oil on the dirt side can be drained.
- ▶ Screw off the filter bowl.
- ▶ Remove the filter element from the spigot by rotating it slightly.
- ▶ Clean the filter components, if necessary.
- ▶ Check the seals at the filter bowl for damage and renew them, if necessary.
For suitable seal kits refer to chapter “Spare parts”.
- ▶ Filter elements made of wire mesh can be cleaned. For detailed cleaning instructions refer to data sheet 51420.
- ▶ Install the new or cleaned filter element on the spigot again by slightly rotating it.
- ▶ The filter is to be assembled in reverse order.
- ▶ The torque specifications (Tightening torques chapter) are to be observed.
- ▶ Commission the system.

WARNING!

- ▶ Assemble and disassemble only with depressurized system!
- ▶ Filter is pressurized!
- ▶ Remove the filter bowl only if it is not under pressure!
- ▶ Do not exchange the optical/mechanical maintenance indicator while the filter is under pressure!
- ▶ If the flow direction is not considered during assembly, the filter element will be destroyed. Particle contaminates could enter the system and damage the downstream components.

Notices:

- ▶ All maintenance of the filter should be performed by trained specialists.
- ▶ Proper function and safety are only guaranteed if original Bosch Rexroth filter elements and spare parts are used.
- ▶ Warranty becomes void if the delivered item is changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental condition that do not comply with the installation conditions.

Tightening torques (dimensions in mm [inch])

Mounting

Series 245...	LEN0040	LEN0063	LEN0100	LE0130	LE0150	LEN0160	LEN0250	LEN0400
Screw/tightening torque with $\mu_{total} = 0.14$	M6 / 4.5 Nm \pm 10%							
Quantity	4							
Recommended property class of screw	8.8							
Minimum screw-in depth	6 + 1 mm [0.24 + 0.04 in]							

Filter bowl and maintenance indicator

Series 245...	LEN0040	LEN0063	LEN0100	LE0130	LE0150	LEN0160	LEN0250	LEN0400
Tightening torque filter bowl	50 Nm + 10 Nm							
Tightening torque maintenance indicator	max. 50 Nm							
Tightening torque cubic connector screw switching element EN-175301-803	M3/0.5 Nm							

Directives and standardization

Classification according to the Pressure Equipment Directive

The inline filters for hydraulic applications according to 51421 are pressure holding equipment according to article 1, section 2.1.4 of the Pressure Equipment Directive 97/23/EC (PED). However, based on the exception in article 1, section 3.6 of the PEG, hydraulic filters are

exempt from the PED if they are not classified higher than category I (guideline 1/19).

The fluids from the chapter “Compatibility with approved pressure fluids” were considered for the classification. They do not receive a CE mark.

Use in explosive areas according to directive 94/9/EC (ATEX)

The inline filters according to 51421 are no equipment or components in the sense of directive 94/9/EC and are not provided with a CE mark. It has been proven with the ignition risk analysis that these inline filters do not have own ignition sources acc. to DIN EN 13463-1:2009.

According to DIN EN 60079-11:2012, electronic maintenance indicators with a switching point:

WE-1SP-M12 x 1 **R928028409**

WE-1SP-EN175301-803 **R928036318**

are simple, electronic operating equipment that do not have an own voltage source. This simple, electronic operat-

ing equipment may - according to DIN EN 60079-14:2012 - in intrinsically safe electric circuits (Ex ib) be used in systems without marking and certification.

The inline filters and the electronic maintenance indicators described here can be used for the following potentially explosive areas:

	zone suitability	
Gas	1	2
Dust	21	22

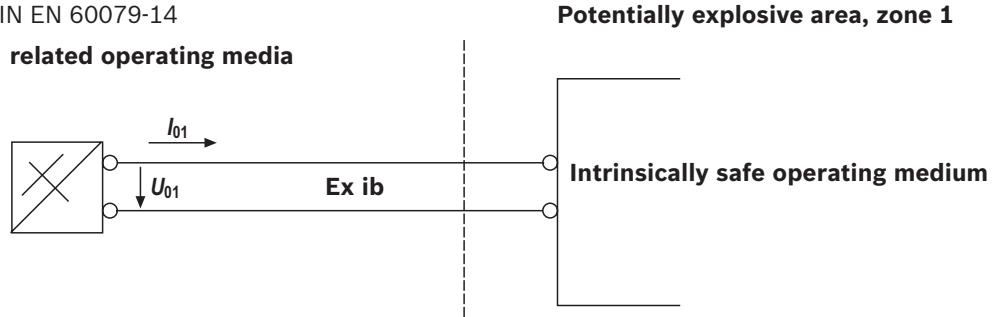
Directives and standardization

Complete filter with mech./opt. Maintenance indicator			
Use /assignment		Gas 2G	Dust 2D
Assignment		Ex II 2G c IIC TX	Ex II 2D c IIC TX
Conductivity of the medium	pS/m	min	300
Dust accumulation		max	–
			0.5 mm

electronic switching element in the intrinsically safe electric circuit			
Use /assignment		Gas 2G	Dust 2D
Assignment		Ex II 2G Ex ib IIB T4 Gb	Ex II 2D Ex ib IIIC T100°C Db
perm. intrinsically safe electric circuits		Ex ib IIC, Ex ic IIC	Ex ib IIIC
Technical data		Values only for intrinsically safe electric circuit	
Switching voltage	Ui	max	150 V AC/DC
Switching current	li	max	1.0 A
Switching power	Pi	max	1.3 W T4 T _{max} 40 °C
		max	1.0 W T4 T _{max} 80 °C
Surface temperature ¹⁾		max	–
			100 °C
inner capacity	Ci		negligible
inner inductivity	Li		negligible
Dust accumulation		max	–
			0.5 mm

¹⁾ The temperature depends on the temperature of the medium in the filter and must not exceed the value specified here.

Possible circuit according to DIN EN 60079-14



⚠ WARNING!

- ▶ Explosion hazard due to high temperature! The temperature depends on the temperature of the medium in the hydraulic circuit and must not exceed the value specified here. Measures are to be taken so that in the explosive area, the max. admissible ignition temperature is not exceeded.
- ▶ When using the inline filters in accordance with 51 421 in potentially explosive areas, appropriate equipo-

tential bonding has to be ensured. The filter is preferably to be grounded via the mounting screws. It has to be noted in this connection that paintings and oxidic protective layers are not electrically conductive.

- ▶ During filter element exchanges, the packaging material is to be removed from the replacement element outside the explosive area

👉 Notices:

- ▶ Maintenance only by trained specialists, instruction by the machine end-user acc. to DIRECTIVE 1999/92/EC appendix II, section 1.1
- ▶ Warranty is only applicable when using genuine Rexroth spare parts

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Inline filter with filter element according to DIN 24550

Type 350LEN0040 to 1000; 350LE0130, 0150

RE 51422

Edition: 2015-03

Replaces: 07.11



350LEN_d

- ▶ Size as per **DIN 24550**: 0040 to 1000
- ▶ Other sizes: 0130, 0150
- ▶ Nominal pressure: 350 bar [5,079 psi]
- ▶ Connection sizes up to G2; SAE 2"; SAE 24
- ▶ Operating temperature: -10 °C to 100 °C [14 °F to 212 °F]

Features

Inline filters are used in hydraulic systems for separating solid materials from fluids and lubricating oils.

They come with the following features:

- ▶ Filter for inline installation
- ▶ Special, highly efficient filter materials
- ▶ Filtration of very fine particles and high dirt holding capacity across a broad pressure differential range
- ▶ High collapse rating of the filter elements
- ▶ Equipped standard with mechanical optical maintenance indicator with memory function
- ▶ Various, optional electronic switching elements, modular design
- ▶ Optional bypass valve integrated in the filter housing
- ▶ High filtration performance due to tangential, cyclonic flow path
- ▶ Additional configurations available for special fluids

Contents

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Filter ordering code

01	02	03	04	05	06	07	08	09	10
350LE			-			-	-	-	-

Series

01	Inline filter, 350 bar [5,079 psi]	350LE
----	------------------------------------	-------

Filter element

02	With filter element as per DIN 24550	N
----	---	---

Size

03	LEN... (Filter element as per DIN 24550)	0040 0063 0100 0160 0250 0400 0630 1000
	LE... (Filter element as per Bosch Rexroth standard)	0130 0150

Filter rating in μm

04	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$)	Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
	Nominal	Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100

Pressure differential

05	Max. admissible filter element pressure differential: 30 bar [435 psi], filter with bypass valve	A
	Max. admissible filter element pressure differential: 330 bar [4,786 psi], filter has no bypass valve	B

Element design

06	Standard adhesive with galvanized steel	00
	Special adhesive with stainless steel	HV ¹⁾

Maintenance indicator

07	Maintenance indicator, mech. visual, switching pressure: 2.2 bar [32 psi] – bypass cracking pressure: 3.5 bar [51 psi]	V2.2
	Maintenance indicator, mech. visual, switching pressure: 5.0 bar [72.5 psi] – bypass cracking pressure: 7 bar [102 psi]	V5.0
	Maintenance indicator, mech. visual, switching pressure 8.0 bar [116 psi] – no bypass valve	V8.0

Seal

08	NBR seal	M
	FKM seal	V
	EPDM seal	E ²⁾

Filter ordering code

01	02	03	04	05	06	07	08	09	10
350LE			-			-	-		-

Connection

09	Installation size		0040	0063-0100	0130-0150	0160-0400	0630-1000		
	Connection								
	G1/2	Pipe thread as per ISO 228	●	X				R2	
	G3/4		X	X				R3	
	G1		X	●	X			R4	
	G1 1/4				●	X		R5	
	G1 1/2				X	●		R6	
	G2							●	R8
	SAE 1 1/2"	SAE flange 6,000 psi				X		S6	
	SAE 2"						X	S8	
	SAE 10"	Pipe thread as per SAE J1926	X					U3	
	SAE 12"			X				U4	
	SAE 20"					X		U5	
	SAE 24"						X	U6	
	● Standard connection X Alternative connection option								

Supplementary information

10	Manufacturer's inspection certificate M as per DIN 55350 T18	Z1
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- 1) Only with FKM or EPDM seal
- 2) Only with maintenance indicator V5.0

Order example:
350LEN0100-H10XLA00-V5.0-M-R4

Other versions are available on request.

Preferred types

350LE(N), flow specifications for 30 mm²/s [143 SUS]

Inline filter, 3 µm filter rating

Type	Flow in l/min [US gpm] whereas $\Delta p = 1.5 \text{ bar } [21.76 \text{ psi}]^{1)}$	Material no. Filter				Replacement element material no.
		
350LEN0040-H3XLA00-V5.0-M-...	32 [8.5]	...R2	R928033024	...U3	R928033216	R928006645
350LEN0063-H3XLA00-V5.0-M-...	48 [12.7]	...R4	R928033025	...U4	R928033217	R928006699
350LEN0100-H3XLA00-V5.0-M-...	64 [16.9]	...R4	R928033026	...U4	R928033218	R928006753
350LE0130-H3XLA00-V5.0-M-...	103 [27.2]	...R5	R928033027	...U5	R928033219	R928022274
350LE0150-H3XLA00-V5.0-M-...	127 [33.6]	...R5	R928033028	...U5	R928033220	R928022283
350LEN0160-H3XLA00-V5.0-M-...	160 [42.3]	...R6	R928033029	...U6	R928033221	R928006807
350LEN0250-H3XLA00-V5.0-M-...	267 [70.5]	...R6	R928033030	...U6	R928033222	R928006861
350LEN0400-H3XLA00-V5.0-M-...	335 [88.5]	...R6	R928033031	...U6	R928033223	R928006915
350LEN0630-H3XLA00-V5.0-M-...	449 [118.6]	...R8	R928034432	...S8	R928034448	R928006969
350LEN1000-H3XLA00-V5.0-M-...	597 [157.7]	...R8	R928034433	...S8	R928034449	R928007023

Inline filter, 6 µm filter rating

Type	Flow in l/min [US gpm] whereas $\Delta p = 1.5 \text{ bar } [21.76 \text{ psi}]^{1)}$	Material no. Filter				Replacement element material no.
		
350LEN0040-H6XLA00-V5.0-M-...	41 [10.8]	...R2	R928033280	...U3	R928033472	R928006646
350LEN0063-H6XLA00-V5.0-M-...	69 [18.2]	...R4	R928033281	...U4	R928033473	R928006700
350LEN0100-H6XLA00-V5.0-M-...	104 [27.5]	...R4	R928033282	...U4	R928033474	R928006754
350LE0130-H6XLA00-V5.0-M-...	125 [33]	...R5	R928033283	...U5	R928033475	R928022275
350LE0150-H6XLA00-V5.0-M-...	135 [35.7]	...R5	R928033284	...U5	R928033476	R928022284
350LEN0160-H6XLA00-V5.0-M-...	265 [70]	...R6	R928033285	...U6	R928033477	R928006808
350LEN0250-H6XLA00-V5.0-M-...	320 [84.5]	...R6	R928033286	...U6	R928033478	R928006862
350LEN0400-H6XLA00-V5.0-M-...	400 [105.7]	...R6	R928025783	...U6	R928033479	R928006916
350LEN0630-H6XLA00-V5.0-M-...	520 [137.4]	...R8	R928034464	...S8	R928034480	R928006970
350LEN1000-H6XLA00-V5.0-M-...	635 [167.8]	...R8	R928034465	...S8	R928034481	R928007024

Inline filter, 10 µm filter rating

Type	Flow in l/min [US gpm] whereas $\Delta p = 1.5 \text{ bar } [21.76 \text{ psi}]^{1)}$	Material no. Filter				Replacement element material no.
		
350LEN0040-H10XLA00-V5.0-M-...	51 [13.5]	...R2	R928033536	...U3	R928033728	R928006647
350LEN0063-H10XLA00-V5.0-M-...	76 [20.1]	...R4	R928033537	...U4	R928033729	R928006701
350LEN0100-H10XLA00-V5.0-M-...	100 [26.4]	...R4	R928033538	...U4	R928033730	R928006755
350LE0130-H10XLA00-V5.0-M-...	191 [50.5]	...R5	R928025653	...U5	R928033731	R928022276
350LE0150-H10XLA00-V5.0-M-...	202 [53.4]	...R5	R928028868	...U5	R928033732	R928022285
350LEN0160-H10XLA00-V5.0-M-...	261 [69]	...R6	R928033541	...U6	R928033733	R928006809
350LEN0250-H10XLA00-V5.0-M-...	330 [87.2]	...R6	R928033542	...U6	R928033734	R928006863
350LEN0400-H10XLA00-V5.0-M-...	409 [108.1]	...R6	R928033543	...U6	R928033735	R928006917
350LEN0630-H10XLA00-V5.0-M-...	590 [155.9]	...R8	R928034496	...S8	R928034512	R928006971
350LEN1000-H10XLA00-V5.0-M-...	650 [171.7]	...R8	R928034497	...S8	R928034513	R928007025

¹⁾ Measured pressure differential across filter and measuring equipment in accordance with ISO 3968. The measured pressure differential at the maintenance indicator is lower.

Accessories ordering code
(dimensions in mm [inch])

Electronic switching element for maintenance indicators

01	02	03	
WE	-	-	

Maintenance indicator

01	Electronic switching element	WE
----	------------------------------	-----------

Type of signal

02	1 switching point	1SP
	2 switching points, 3 LEDs	2SP
	2 switching points, 3 LEDs and signal suppression up to 30 °C [86 °F]	2SPSU

Plug

03	M12x1, 4-pole round plug-in connection	M12x1
	2-pole rectangular plug-in connection, design A as per EN 175301-803	EN 175301-803

Material numbers for electronic switching elements

Material no.	Type	Signal	Switching points	Plug	LEDs
R928028409	WE-1SP-M12x1	Changeover	1	M12x1	0
R928028410	WE-2SP-M12x1	Normally open (at 75%)/ normally closed contact (at 100%)	2		3
R928028411	WE-2SPSU-M12x1				
R928036318	WE-1SP-EN175301-803	Normally closed contact	1	EN 175301-803	0

Mating connectors (max. admissible voltage: 50 V)

For electronic switching element with M12x1 round plug-in connection

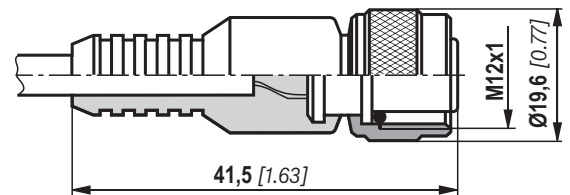
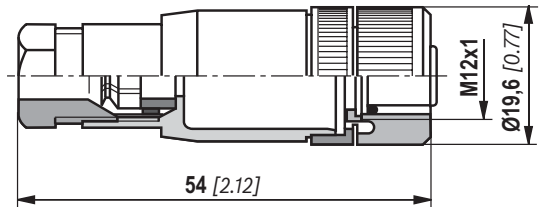
Mating connector fitting M12x1,
4-pole K24 with screw connection, Pg9 cable gland.

Material no. R900031155

Mating connector fitting M12x1,
4-pole K24-3m with potted-in PVC cable, 3 m long.
Line cross-section: 4 x 0.34 mm²

Core marking: **1** brown **2** white
 3 blue **4** black

Material no. R900064381



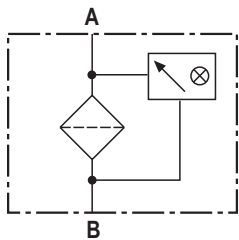
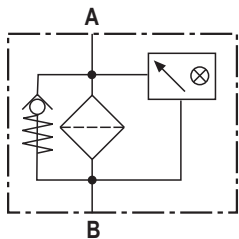
For more round plug-in connections, see data sheet 08006.

Order example:
 Inline filter with mechanical visual maintenance indicator for $p_{nom} = 350 \text{ bar}$ [5,079 psi] with bypass valve, size 0100, with 10 µm filter element and M12x1 electronic switching element with 1 switching point for HLP mineral oil hydraulic fluid as per DIN 51524.

Filter with mech. visual maintenance indicator:	350LEN0100-H10XLA00-V5.0-M-R4	Material no. R928033538
Electronic switching element:	WE-1SP-M12x1	Material no. R928028409
Mating connector:	Mating connector fitting M12x1, 4-pole K24	Material no. R900031155

Symbols

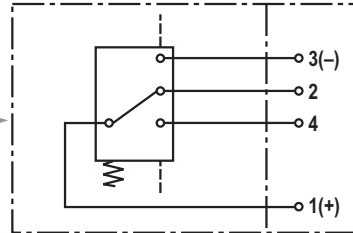
Inline filter
with bypass
and mechanical indicator



Inline filter,
no bypass,
with mechanical indicator

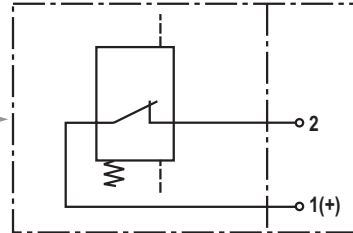
**Electronic switching element
for maintenance indicator**

Switching element Plug



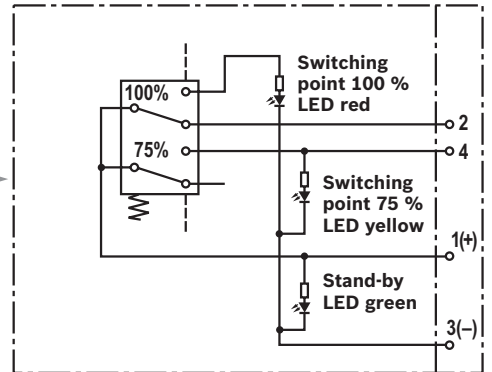
WE-1SP-M12x1

Switching element Plug



WE-1SP-EN175301-803

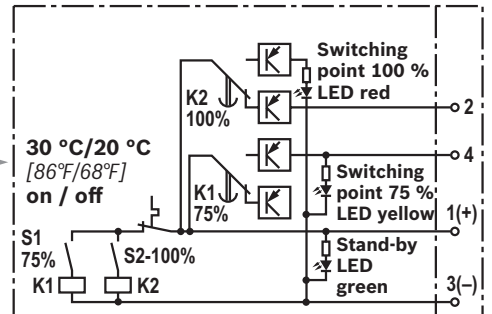
Switching element Plug



WE-2SP-M12x1

Circuit diagram drawn in plugged condition (operating state)

Switching element Plug



WE-2SPSU-M12x1

Circuit diagram drawn in plugged condition at temperature > 30 °C [86 °F] (operating state)

Function, cross-section

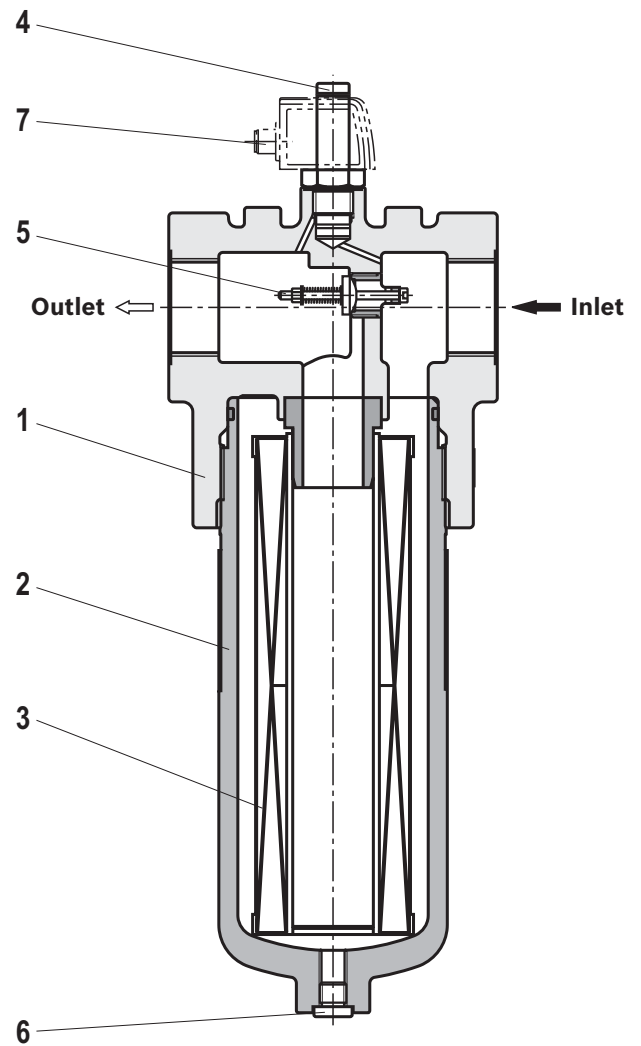
The 350LE(N) inline filter is designed for direct installation into pressure lines.

It consists primarily of a filter head (1), a threaded filter bowl (2), a filter element (3) and a mechanical optical maintenance indicator (4). For filters with low collapse filter elements (= pressure differential code letter A), a bypass valve (5) comes standard.

The fluid passes through the inlet to the filter element, where it is cleaned. Any dirt particles filtered out collect in the filter element. The filtered fluid then enters the hydraulic circuit through the outlet.

The filter housing and all connection elements are designed so that pressure spikes – as they may occur, e.g., due to an accelerated fluid quantity from large control valves opening abruptly – can be safely absorbed. Sizes 0160 and larger come with a drain screw (6) standard. Size 1000 comes with a two-part filter bowl, with the filter bowl fixed to prevent the bowl from spinning in the filter head.

An electronic switching element (7) can be added to the mechanical optical maintenance indicator in order to integrate it into an electric circuit. The electronic switching element must be attached to the mechanical visual maintenance indicator and held with the locking ring supplied. The electronic switching elements are connected with a mating connector or cable connection. The electronic switching element must be ordered separately.



⚠ WARNING

- ▶ If the maintenance indicator is ignored when an element change is required, there is the possibility the filter will go into bypass and contaminated oil will pass to the clean side of the filter outlet. Therefore the filtration effectiveness is no longer guaranteed.

Technical data

(Please consult us for applications outside these parameters)

General							
Installation position		Vertical					
Ambient temperature range		°C [°F]	-10 to +65 [14 to 149] (down to -30 [-22] for brief periods)				
Storage conditions	▶ NBR/EPDM seal	°C [°F]	-40 to 65 [-40 to 149]; max. relative air humidity: 65%				
	▶ FKM seal	°C [°F]	-20 to 65 [-4 to 149]; max. relative air humidity: 65%				
Weight	▶ Filter	Size	0040	0063	0100	0130	0150
		kg [lbs]	4.4 [9.7]	5.0 [11.1]	5.9 [13.0]	10.5 [23.2]	11.2 [24.8]
		Size	0160	0250	0400	0630	1000
		kg [lbs]	17.2 [30.0]	19.5 [43.1]	23.0 [50.8]	45.0 [99.5]	93.0 [205.6]
	▶ Filter bowl	Size	0040	0063	0100	0160	
		kg [lbs]	1.3 [2.9]	1.3 [2.9]	2.1 [4.6]	5.5 [12.1]	
		Size	0250	0400	0630	1000	
		kg [lbs]	8.0 [17.6]	12.2 [26.9]	21.4 [47.2]	Filter pipe ¹⁾ 45.3 [99.8] End cap 2.0 [4.4]	
Flow	Size	0040	0063	0100	0130	0150	
		l [US gal]	0.3 [0.1]	0.4 [0.1]	0.5 [0.1]	0.9 [0.2]	1.1 [0.3]
	Size	0160	0250	0400	0630	1000	
		l [US gal]	1.3 [0.3]	1.9 [0.5]	3.0 [0.8]	4.5 [1.2]	6.5 [1.7]
Material	▶ Filter head	Ductile iron					
	▶ Filter bowl	Steel					
	▶ Bypass valve	Aluminum/steel/POM					
	▶ Seals	NBR or FKM					
	▶ Visual maintenance indicator	Brass					
	▶ Electronic switching element	Nylon 6 plastic					

Hydraulics			
Max. operating pressure	bar [psi]	350 [5,079]	
Hydraulic fluid temperature range	°C [°F]	-10 to 100 [14 to 212] (down to -30 [-22] for brief periods)	
Min. medium conductivity	pS/m	300	
Fatigue strength as per ISO 10771	load cycles	> 10 ⁶ at max. operating pressure	
Maintenance indicator pressure measurement type	Pressure differential		
Assignment: Maintenance indicator response pressure/ bypass valve cracking pressure		Maintenance indicator response pressure	Bypass valve cracking pressure
	bar [psi]	2.2 ± 0.3 [31.9 ± 4.4]	3.5 ± 0.35 [50.8 ± 5.1]
	bar [psi]	5.0 ± 0.5 [72.5 ± 7.3]	7.0 ± 0.5 [101.5 ± 7.3]
	bar [psi]	8.0 ± 0.8 [116 ± 11.6]	No bypass valve
Direction of filtration	From the outside to the inside		

¹⁾ This weight is not relevant to changing the filter element, since only the cap has to be unscrewed.

Technical data

(Please consult us for applications outside these parameters)

Electrical (electronic switching element)				
Electrical connection	M12x1, 4-pole round plug-in connection			EN 175301-803 standard connection
Version	WE-1SP-M12x1	WE-2SP-M12x1	WE-2SPSU-M12x1	WE-1SP-EN175301-803
Contact load, DC voltage	$A_{max.}$	1		
Voltage range	$V_{max.}$	150 (AC/DC)	10 – 30 (DC)	250 (AC) / 200 (DC)
Max. switching power with resistive load	W	20		70
Switching type	▶ 75% signal	–	Normally open contact	–
	▶ 100% signal	Changeover	Normally closed contact	Normally closed contact
	▶ 2SPSU		Signal inter-connection at 30 °C [86 °F], return switching at 20 °C [68 °F]	
LED indicators in 2SP electronic switching elements		Stand-by (LED green) 75% switching point (LED yellow) 100% switching point (LED red)		
IP rating as per EN 60529	IP	67		65
Ambient temperature range	°C [°F]	-25 to 85 [-13 to 185]		
Include spark extinguishing for DC voltage above 24 V to protect the switching contacts.				
Weight Electronic switching element	kg [lbs]	0.1 [0.22]		

Filter element			
H-series XL glass fiber material	Inorganic fiber-based single-use element		
		Filtration ratio as per ISO 16889 up to $\Delta p = 5 \text{ bar [72.5 psi]}$	Best oil cleanliness as per ISO 4406 [SAE-AS 4059]
	H20XL	$\beta_{20(c)} \geq 200$	19/16/12 – 22/17/14
	H10XL	$\beta_{10(c)} \geq 200$	17/14/10 – 21/16/13
	H6XL	$\beta_6(c) \geq 200$	15/12/10 – 19/14/11
	H3XL	$\beta_5(c) \geq 200$	13/10/8 – 17/13/10
Admissible pressure differential	▶ A	bar [psi]	30 [435]
	▶ B	bar [psi]	330 [4,785]

For detailed information on Rexroth filter elements, see data sheet 51420.

Compatibility with permitted hydraulic fluids

Hydraulic fluid	Classification	Suitable sealing materials	Suitable adhesive	Standards	
Mineral oil	HLP	NBR	Standard	DIN 51524	
Biodegradable	▶ Water insoluble	HETG		NBR	VDMA 24568
		HEES		FKM	VDMA 24568
	▶ Water soluble	HEPG		FKM	VDMA 24317
Flame-resistant	▶ Waterless	HFDR, HFDR		FKM	DIN 24320
		HFAS		NBR	VDMA 24317
	▶ Aqueous	HFAE		NBR	
		HFC		NBR	
▶ Skydrol	–	EPDM		Special "H"	–

Important information on hydraulic fluids:

- ▶ For more information and data on the use of other hydraulic fluids, see data sheet 90220 or contact us.
- ▶ **Flame-resistant, aqueous:** Due to possible chemical reactions with materials or machine and system component surface coating, the service life with these hydraulic fluids may be less than expected.

Do not use filter materials made of filter paper P, use filter elements with glass fiber filter material instead.

- ▶ **Biodegradable:** If filter materials made of filter paper are used, the filter life may be shorter than expected due to material incompatibility and swelling.

Characteristic curves

(Measured with HLP46 mineral oil as per ISO 3968)

H3XL

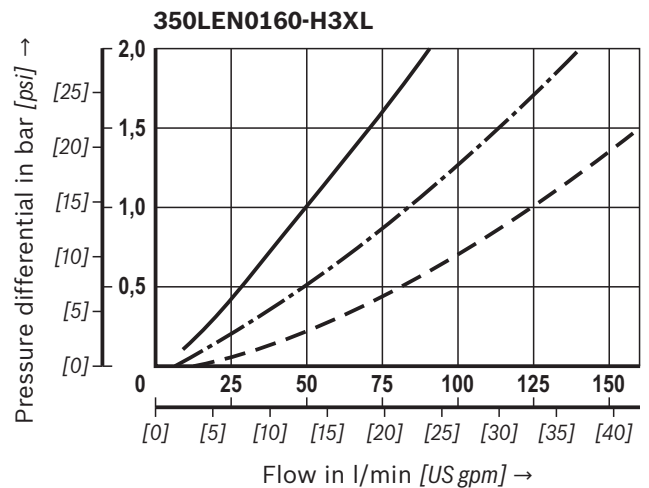
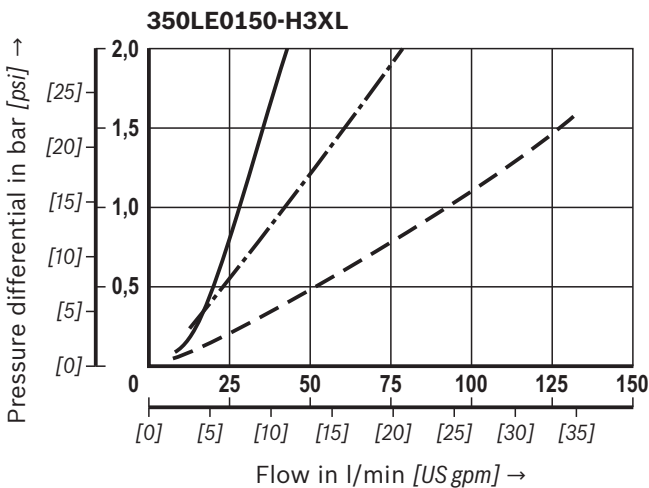
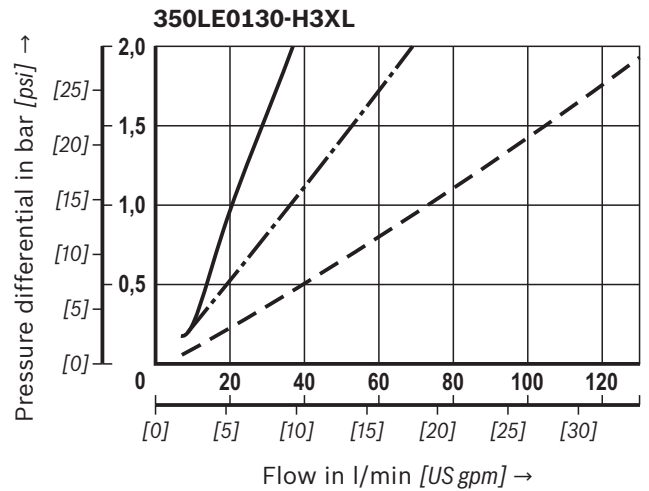
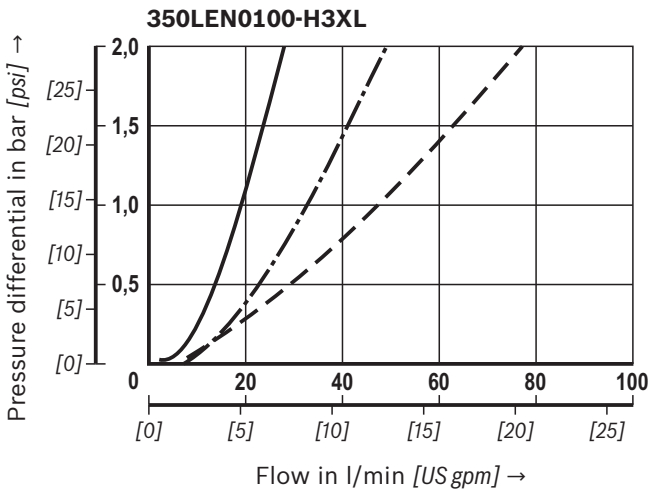
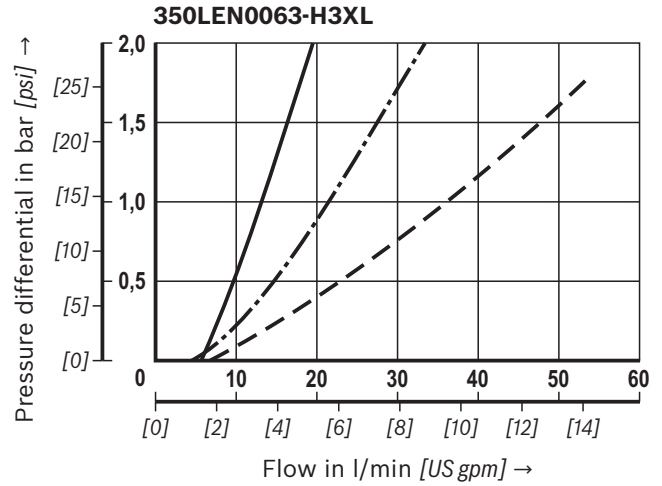
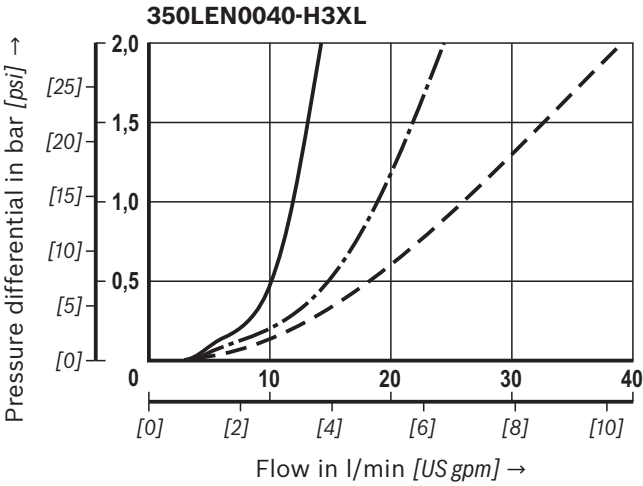
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters

Recommended initial Δp for design = 1.5 bar [21.76 psi]

Use our “Bosch Rexroth FilterSelect” online design software to select the ideal filter.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Characteristic curves

(Measured with HLP46 mineral oil as per ISO 3968)

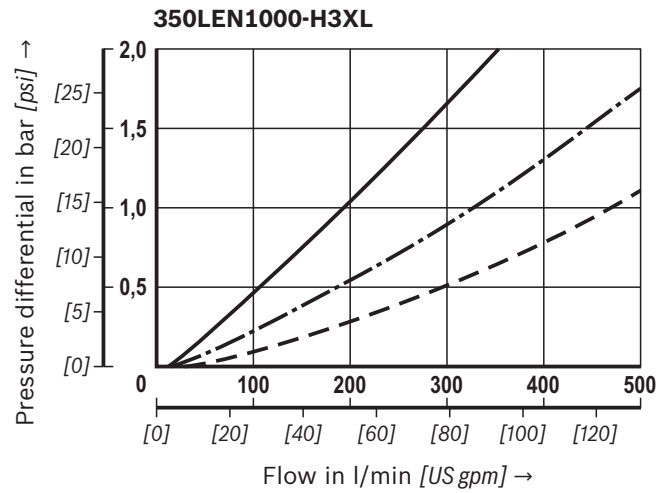
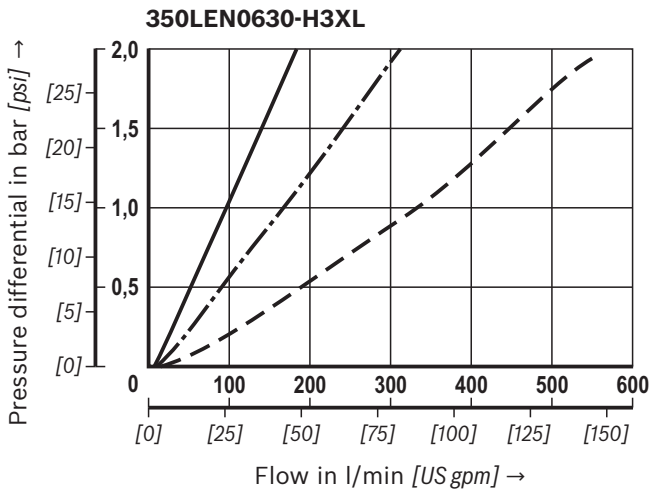
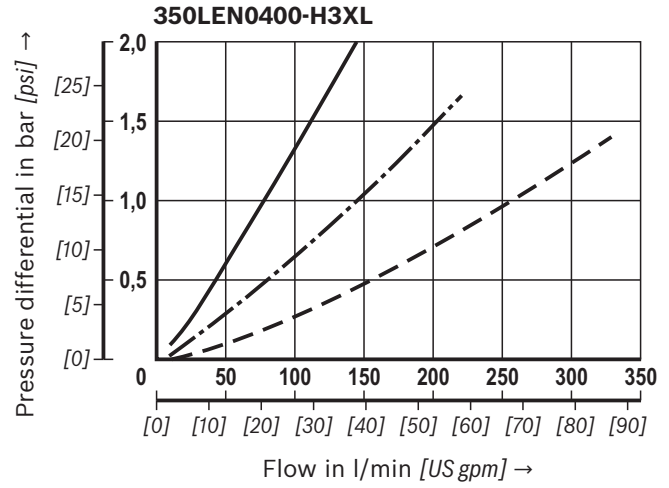
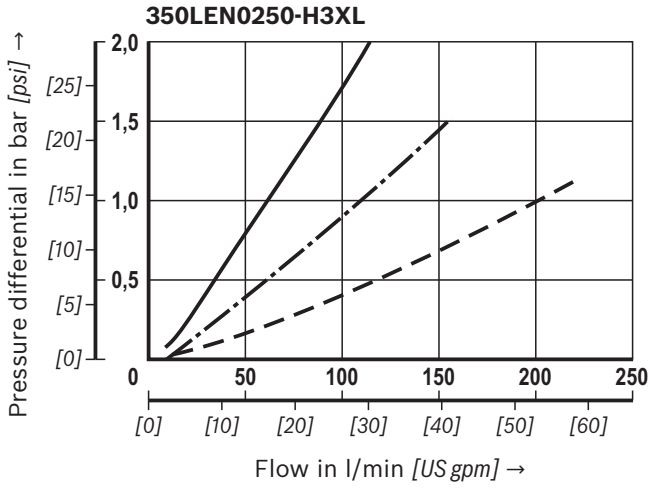
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters

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 - · - 68 mm²/s [315 SUS]
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Characteristic curves

(Measured with HLP46 mineral oil as per ISO 3968)

Spec. weight: < 0.9 kg/dm³

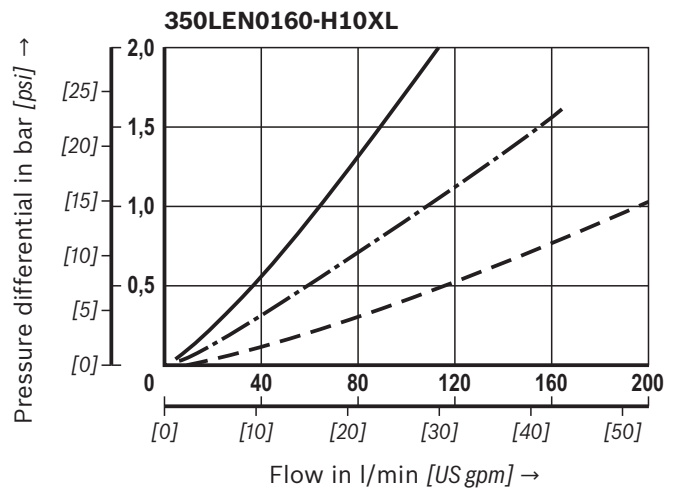
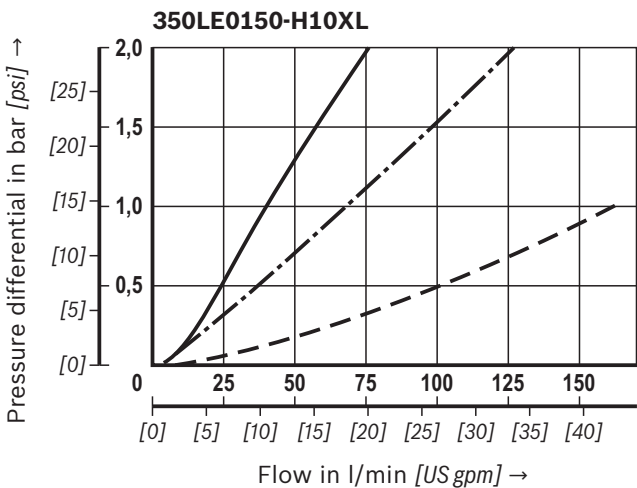
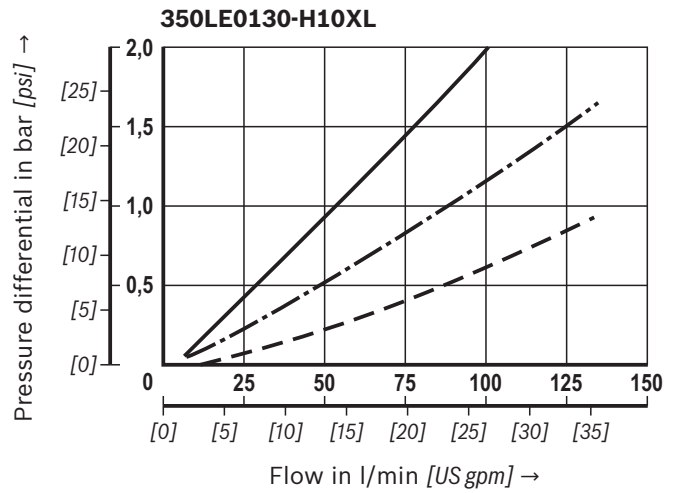
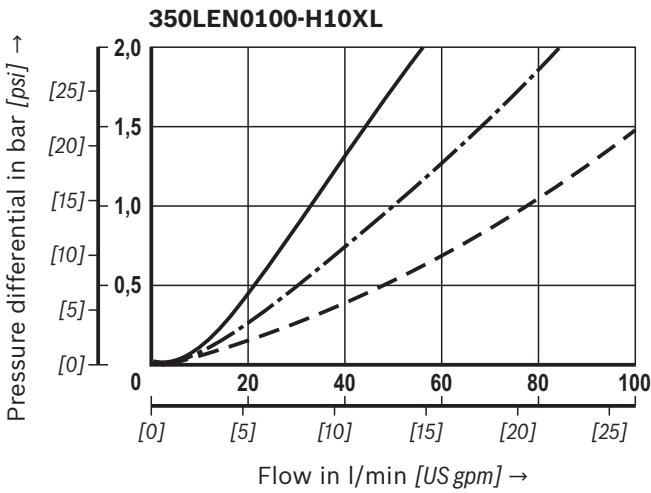
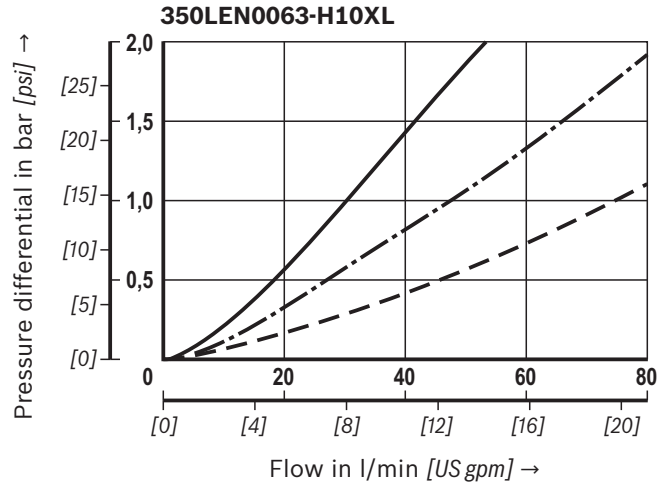
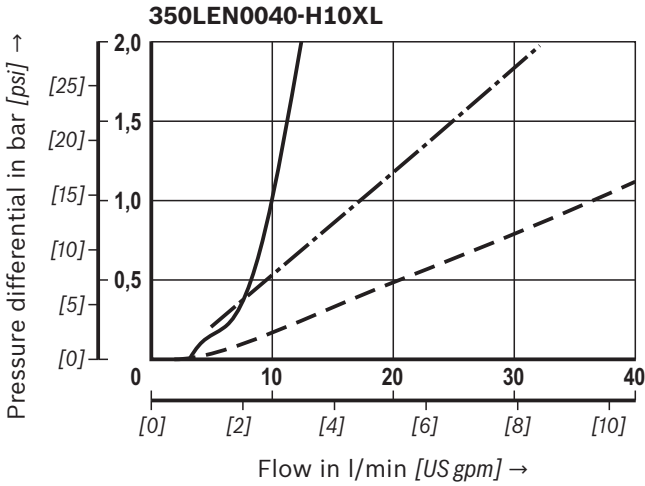
Δp -Q characteristic curves for complete filters

Recommended initial Δp for design = 1.5 bar [21.76 psi]

H10XL

Use our “Bosch Rexroth FilterSelect” online design software to select the ideal filter.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Characteristic curves

(Measured with HLP46 mineral oil as per ISO 3968)

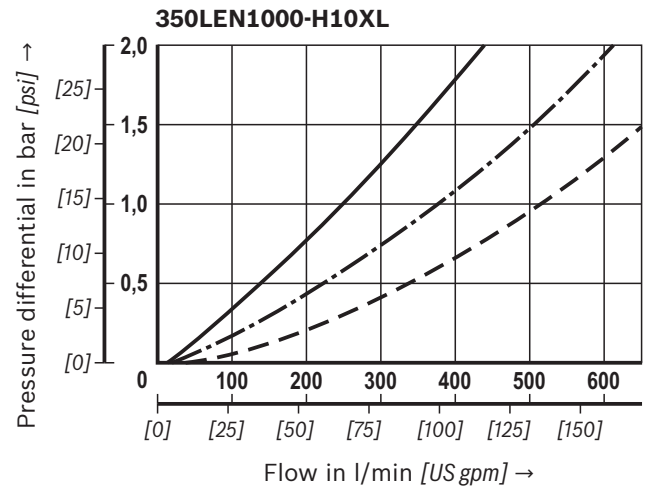
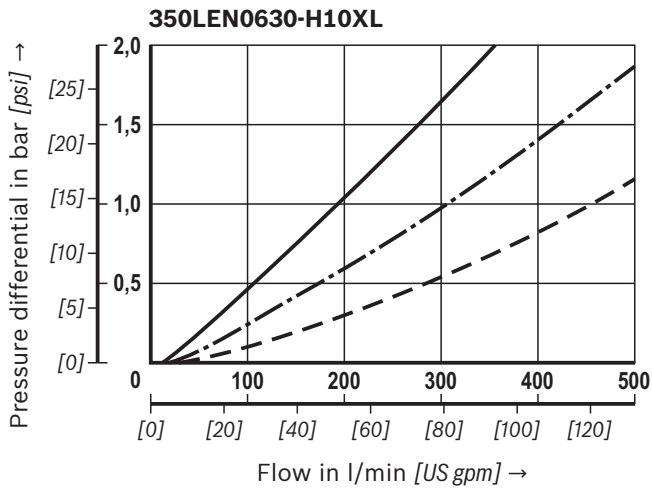
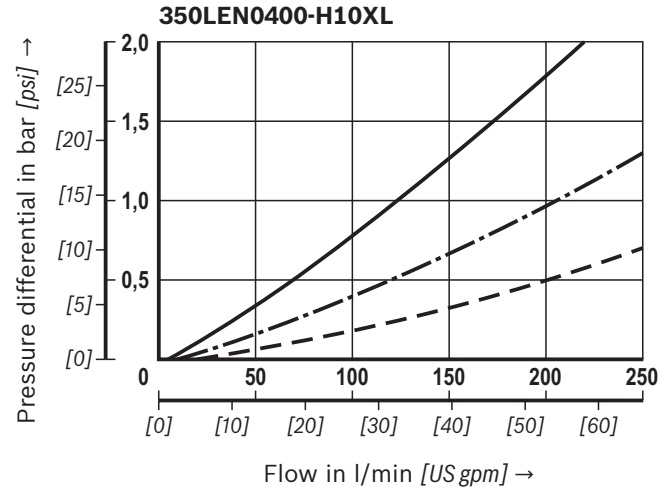
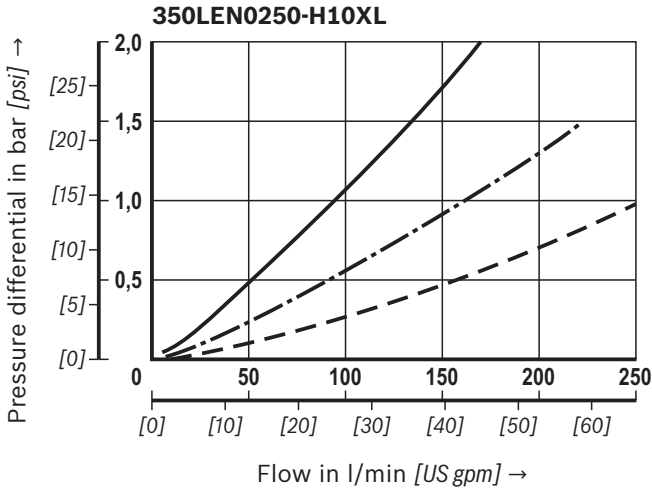
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters

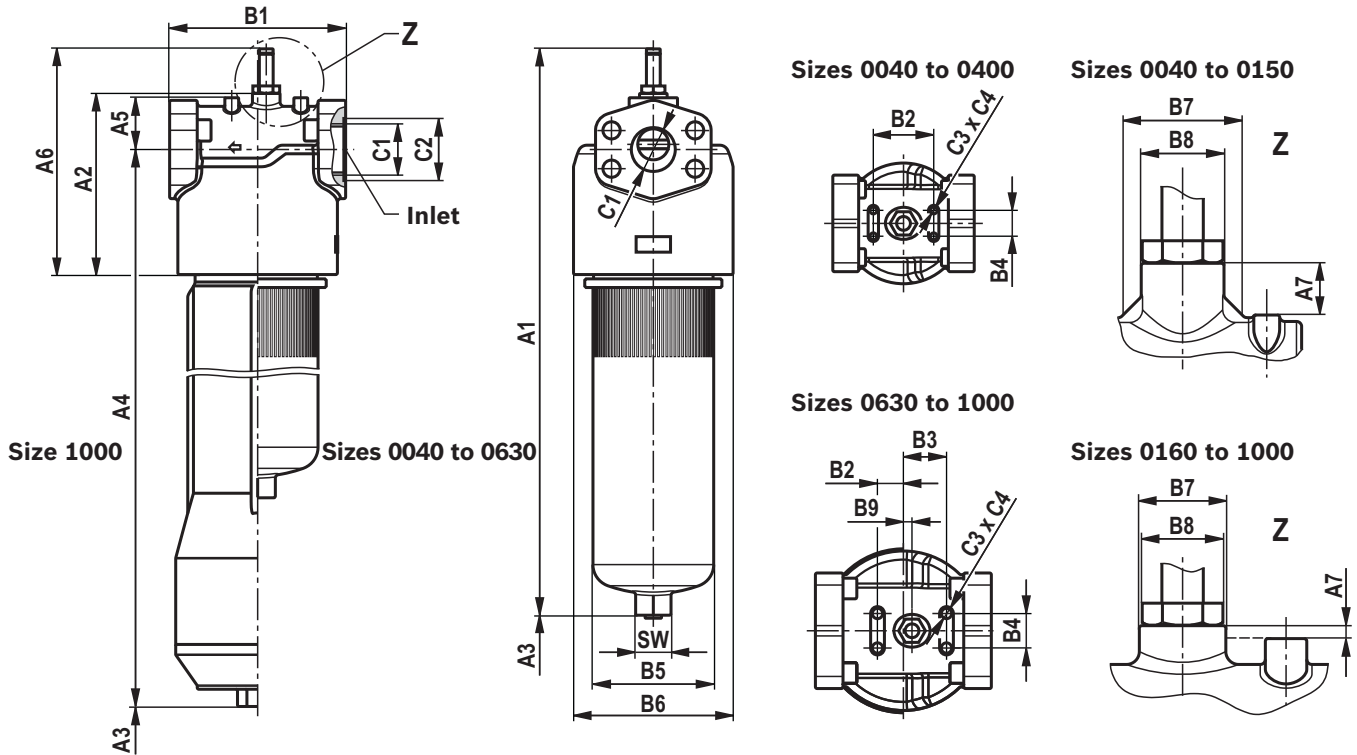
Recommended initial Δp for design = 1.5 bar [21.76 psi]

Use our “Bosch Rexroth FilterSelect” online design software to select the ideal filter.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Dimensions: 350LE(N) sizes 0040 to 1000
(Dimensions in mm [inch])



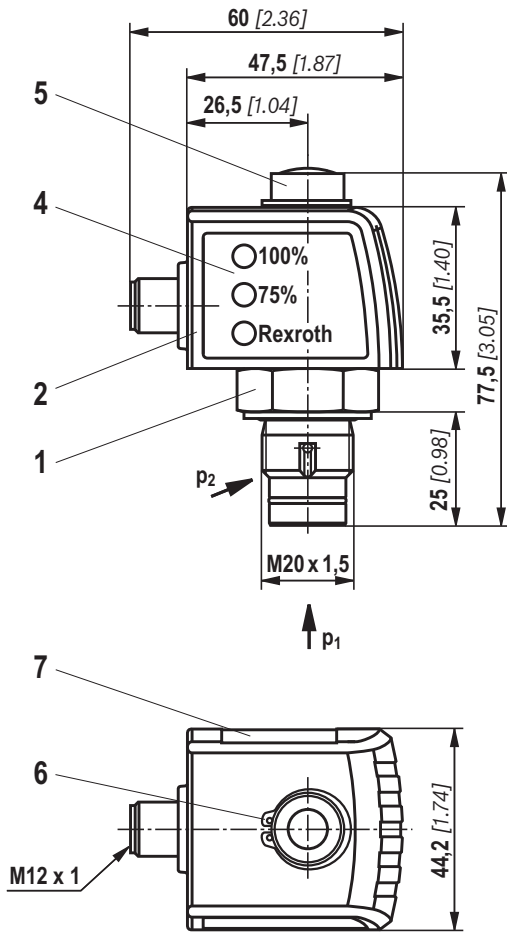
Type 350...	A1	A2	A3 ¹⁾	A4	A5	A6	A7	B1 ²⁾	B2	B3	ØB4
LEN0040	203 [7.99]	115 [4.53]	80 [3.15]	158 [6.22]	25 [0.98]	167 [6.57]	20 [0.79]	92 [3.62]	65 [2.56]	-	30 [1.18]
LEN0063	266 [10.47]			221 [8.70]							
LEN0100	356 [14.02]			311 [12.24]							
LE0130	328 [12.91]	150 [5.91]	140 [5.51]	273 [10.75]	40 [1.57]	202 [7.95]	15 [0.59]	132 [5.20]	80 [3.15]	-	30 [1.18]
LE0150	364 [14.33]			324 [12.76]							
LEN0160	322 [12.68]	170 [6.69]	140 [5.51]	262 [10.31]	50 [1.97]	222 [8.74]	10 [0.39]	164 [6.46]	70 [2.76]	-	30 [1.18]
LEN0250	412 [16.22]			352 [13.86]							
LEN0400	562 [22.13]			502 [19.76]							
LEN0630	605 [23.82]	210 [8.27]	160 [6.30]	540 [21.26]	60 [2.36]	262 [10.31]	5 [0.20]	204 [8.03]	30 [1.18]	50 [1.97]	40 [1.57]
LEN1000	843 [33.19]		650 [25.59]	778 [30.63]							

Type 350...	ØB5	ØB6	ØB7	ØB8	B9	C1 connection				C3	C4	SW
						R... (ISO 228)	ØC2	U... (SAE J1926)	ØC2			
LEN0040	64 [2.52]	85 [3.35]	47 [1.85]	32 [1.26]	-	G1/2	28 [1.10]	SAE 10" 7/8-14 UNF-2B	34 [1.34]	-	M6	8 [0.31]
LEN0063						G1	41 [1.61]	SAE 12" 1 1/16-12 UN-2B				
LEN0100						G1 1/4	51 [2.01]	SAE 20" 1 5/8-12 UN-2B				
LE0130	92 [3.62]	118 [4.65]	32 [1.26]	32 [1.26]	-	G1 1/2	56 [2.20]	SAE 24" 1 7/8-12 UN-2B	65 [2.56]	SAE 1 1/2" 6,000 psi	M8	12 [0.47]
LE0150						G1 1/2	56 [2.20]	SAE 24" 1 7/8-12 UN-2B				
LEN0160	114 [4.49]	140 [5.51]	32 [1.26]	32 [1.26]	10 [0.39]	G2	72 [2.83]	-	-	SAE 2" 6,000 psi	M12	12 [0.47]
LEN0250	140 [5.51]	185 [7.28]										
LEN0400	190 [7.48]	190 [7.48]										

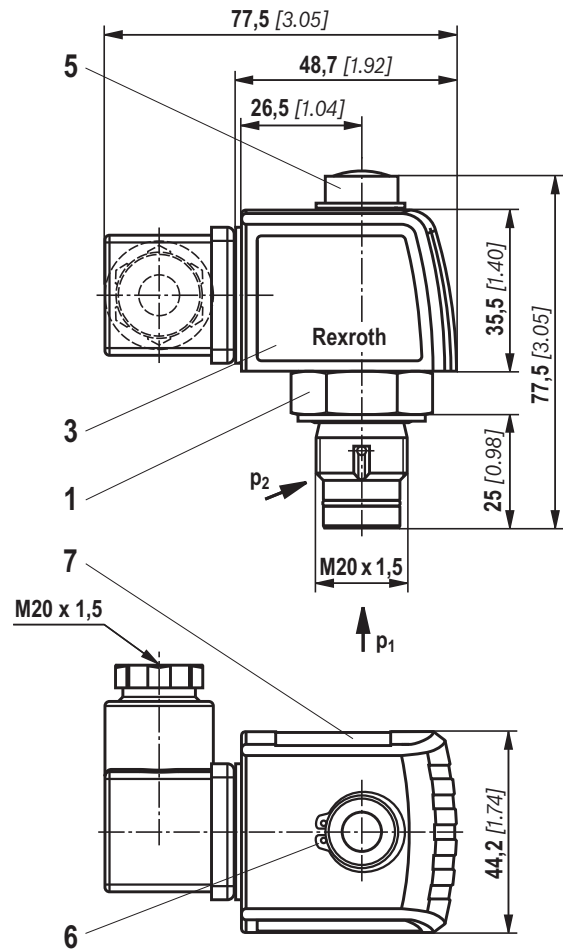
¹⁾ Servicing height for changing filter element ²⁾ Dimension B1 is reduced by 4 mm [0.16 in] for SAE flanges

Maintenance indicator (Dimensions in mm [inch])

Pressure differential indicator with mounted
M12x1 switching element



Pressure differential indicator with mounted
EN 175301-803 switching element



- 1 Mechanical optical maintenance indicator;
max. tightening torque $M_{A \max} = 50 \text{ Nm}$ [36.88 lb-ft]
- 2 Switching element with locking ring for
electrical maintenance indicator (rotatable 360°);
M12x1, 4-pole round plug-in connection
- 3 Switching element with locking ring for electrical
maintenance indicator (rotatable 360°);
EN 175301-803 rectangular plug-in connection
- 4 Housing with three LEDs: 24 V =
green: Stand-by
yellow: Switching point 75%
red: Switching point 100%
- 5 Visual indicator with memory function
- 6 16x1 DIN 471 locking ring,
Material no. R900003923
- 7 Name plate

Important:

Illustration includes a mechanical visual maintenance indicator (1) and electronic switching element (2), (3).

Spare parts ordering codes

Filter element

01	02	03	04	05	06	07
2.			-		-	0

Filter element

01	Design	2.
----	--------	----

Size

02	LEN... (Filter element as per DIN 24550)	0040 0063 0100 0160 0250 0400 0630 1000
	LE... (Filter elements as per Bosch Rexroth standard)	0130 0150

Filter rating in µm

03	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$)	Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
	Nominal	Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100

Pressure differential

04	Max. admissible filter element pressure differential: 30 bar [435 psi], filter with bypass valve	A
	Max. admissible filter element pressure differential: 330 bar [4,786 psi], filter has no bypass valve	B

Element design

05	Standard adhesive with galvanized steel	00
	Special adhesive with stainless steel	HV ¹⁾

Bypass valve

06	Without bypass valve	0
----	-----------------------------	---

Seal

07	NBR seal	M
	FKM seal	V
	EPDM seal	E

¹⁾ Only with FKM or EPDM seal

Order example:

2.0100 H10XL-A00-0-M

Material no. R928006755

For detailed information on Rexroth filter elements, see data sheet 51420.

Spare parts ordering codes

Filter element

Preferred replacement filter element program

3-micron replacement filter element		6-micron replacement filter element		10-micron replacement filter element	
R928006645	2.0040 H3XL-A00-0-M	R928006646	2.0040 H6XL-A00-0-M	R928006647	2.0040 H10XL-A00-0-M
R928006699	2.0063 H3XL-A00-0-M	R928006700	2.0063 H6XL-A00-0-M	R928006701	2.0063 H10XL-A00-0-M
R928006753	2.0100 H3XL-A00-0-M	R928006754	2.0100 H6XL-A00-0-M	R928006755	2.0100 H10XL-A00-0-M
R928006807	2.0160 H3XL-A00-0-M	R928006808	2.0160 H6XL-A00-0-M	R928006809	2.0160 H10XL-A00-0-M
R928006861	2.0250 H3XL-A00-0-M	R928006862	2.0250 H6XL-A00-0-M	R928006863	2.0250 H10XL-A00-0-M
R928006915	2.0400 H3XL-A00-0-M	R928006916	2.0400 H6XL-A00-0-M	R928006917	2.0400 H10XL-A00-0-M
R928006969	2.0630 H3XL-A00-0-M	R928006970	2.0630 H6XL-A00-0-M	R928006971	2.0630 H10XL-A00-0-M
R928007023	2.1000 H3XL-A00-0-M	R928007024	2.1000 H6XL-A00-0-M	R928007025	2.1000 H10XL-A00-0-M

Mechanical visual maintenance indicator

01	02	03	04	05	06
W	O	-	D01	-	-

01	Maintenance indicator	W
----	-----------------------	----------

02	Mechanical visual indicator	O
----	-----------------------------	----------

Version

03	Pressure differential, modular design	D01
----	---------------------------------------	------------

Switching pressure

04	2.2 bar [32 psi]	2.2
	5.0 bar [72.5 psi]	5.0

Seal

05	EPDM seal	E ¹⁾
	NBR seal	M
	FKM seal	V

Max. operating pressure

06	Switching pressure of 2.2 bar [31.9 psi]: 160 bar [2,320 psi]	160
	Switching pressure of 5.0 bar [72.5 psi]: 450 bar [6,527 psi]	450
	Switching pressure of 8.0 bar [116 psi]: 450 bar [6,527 psi]	450

¹⁾ Only with a switching pressure of 5.0 bar

Mechanical visual maintenance indicator

Material no.	Description
R928038785	WO-D01-8.0-M-450
R901025313	WO-D01-5.0-M-450
R901025312	WO-D01-2.2-M-160
R928038784	WO-D01-8.0-V-450
R901066235	WO-D01-5.0-V-450
R901066233	WO-D01-2.2-V-160
R928054248	WO-D01-5.0-E-450

Spare parts ordering codes

Seal kit

01	02	03	04
D	350/445LE		-

01	Seal kit	D
02	Series	350/445LE

Size

03	Sizes 0040-0100	N0040-0100
	Sizes 0130-0150	0130-0150
	Sizes 0160-0400	N0160-0400
	Size 0630	N0630
	Size 1000	N1000

Seal

04	NBR seal	M
	FKM seal	V
	EPDM seal	E

Seal kit

Material no.	Description
R928028527	D350/445LEN0040-0100-M
R928028530	D350LE0130-0150-M
R928028532	D350/445LEN0160-0400-M
R928028536	D350/445LEN0630-M
R928028537	D350/445LEN1000-M
R928028528	D350/445LEN0040-0100-V
R928028531	D350LE0130-0150-V
R928028533	D350/445LEN0160-0400-V
R928028529	D350/445LEN0630-V
R928028534	D350/445LEN1000-V
R961010717	D350/445LEN0040-0100-E
R961010716	D350LE0130-0150-E
R961010715	D350/445LEN0160-0400-E
R961010714	D350/445LEN0630-E
R961010713	D350/445LEN1000-E

Assembly, commissioning, maintenance

Assembly

- ▶ The max. operating pressure of the system cannot exceed the max. admissible operating pressure of the filter (see name plate).
- ▶ When assembling the filter (see also “Tightening torques”), note the flow direction (arrows) and the required servicing height of the filter element (see “Dimensions”).
- ▶ Filter element exchange is made easiest when the filter bowl is oriented downward. Ensure the maintenance indicator is easily visible.
- ▶ Remove the plastic plugs in the filter inlet and outlet.
- ▶ Make sure power is disconnected during assembly.
- ▶ The optional electrical maintenance indicator is connected using the electronic switching element with 1 or 2 switching points, which is placed on the mechanical visual maintenance indicator and held in place by a locking ring.

Commissioning

- ▶ Commission the system.

Important:

The filter has no bleeding mechanism.

Maintenance

- ▶ If the red indicator pin rises out of the mechanical visual maintenance indicator and/or the electronic switching element switches at operating temperature,

the filter element is dirty and has to be replaced/cleaned. For more details, see data sheet 51420.

- ▶ The material number of the correct replacement filter element is on the name plate of the complete filter. Verify that it matches the material number on the filter element.
- ▶ Decommission the system.
- ▶ Release operating pressure on the system side.

Important:

The filter has no bleeding mechanism.

- ▶ Drain the oil on the dirt side using the drain screw (size 0160 and larger).
- ▶ Unscrew the filter bowl (or base if size 1000).
- ▶ Slightly turn the filter element to remove it from the spigot.
- ▶ Clean the filter components as needed.
- ▶ Check the seals on the filter bowl for damage and replace them as needed.
For compatible seal kits, see “Spare parts”.
- ▶ Wire mesh filter elements can be cleaned. For detailed cleaning instructions, see data sheet 51420.
- ▶ Slightly turn the new or cleaned filter element to install it on the spigot.
- ▶ Assembly is reverse of removal.
- ▶ Note the torque specifications (“Tightening torques”).
- ▶ Commission the system.

WARNING

- ▶ Only install or remove when system is not pressurized.
- ▶ Filter is pressurized.
- ▶ Only remove filter bowl when it is not pressurized.
- ▶ Do not replace maintenance indicator when filter is pressurized.
- ▶ Failure to observe flow of direction during assembly will cause filter element to be damaged beyond repair. Particles will enter the system and damage downstream components.

Important:

- ▶ Only trained specialists may work on the filter.
- ▶ The safety and functionality of the filter are only guaranteed with original Bosch Rexroth spare parts.
- ▶ The warranty will be void if the delivery item is

modified or improperly mounted, installed, maintained, repaired or used by the ordering party or a third party, or exposed to environmental conditions exceeding our installation conditions.

Tightening torques

Mounting

Series 350...	LEN0040	LEN0063	LEN0100	LE0130	LE0150	LEN0160	LEN0250	LEN0400	LEN0630	LEN1000
Screw/tightening torque when $\mu_{total} = 0.14$	Nm [lb-ft]		M6/4.5 [3.3] ± 10%			M8/10.5 [7.7] ± 10%		M12/37 [27.3] ± 10%		
Quantity	4									
Recommended screw property class	8.8									
Min. screw-in depth	mm [inch]		6 [0.24] + 1 [0.04]			10 [0.4] + 2 [0.08]				

Filter bowl and maintenance indicator

Series 350...	LEN0040	LEN0063	LEN0100	LE0130	LE0150	LEN0160	LEN0250	LEN0400	LEN0630	LEN1000
Filter bowl	Screw in filter bowl as far as it will go, then unscrew 1/8 to 1/2 turn									
Maintenance indicator	Nm [lb-ft]		Max. 50 [36.9]							
EN 175301-803 switching element cubic connector screw	Nm [lb-ft]		M3/0.5 [3.7]							

Directives and standardization

Classification according to the Pressure Equipment Directive

Inline filters for hydraulic applications as per 51422 are considered pressure holding equipment under Article 1 Section 2.1.4 Pressure Equipment Directive 97/23/EC (PED). However, under Article 1 Section 3.6 PED, hydraulic filters are exempt from the PED if they are not classified

higher than Category I (Guideline 1/19). The fluids from “Compatibility with permitted hydraulic fluids” were considered for the classification. They do not receive a CE mark.

Use in explosive areas as per Directive 94/9/EC (ATEX)

Inline filters as per 51422 are not equipment or components in terms of Directive 94/9/EC and do not receive a CE mark. The ignition risk analysis showed that these inline filters do not have their own ignition sources as per DIN EN 13463-1:2009.

According to DIN EN 60079-11:2012, electronic maintenance indicators with a switching point:

WE-1SP-M12x1 **R928028409**

WE-1SP-EN175301-803 **R928036318**

are considered simple electronic operating equipment that does not have its own voltage source. This simple electronic operating equipment may – according to

DIN EN 60079-14:2012 – be used in intrinsically safe electric circuits (Ex ib) in systems without requiring marking and certification. Inline filters and the electronic maintenance indicators described here can be used in the following explosive areas:

	Zone suitability	
Gas	1	2
Dust	21	22

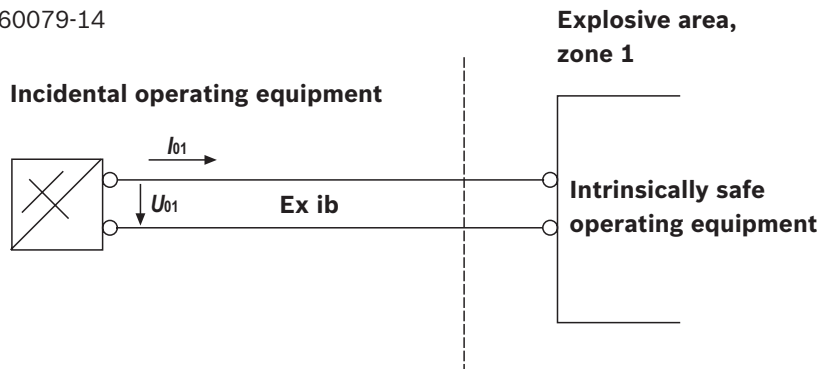
Directives and standardization

Complete filter with mech. visual maintenance indicator			
Use/classification		Gas 2G	Dust 2D
Classification		Ex II 2G c IIC TX	Ex II 2D c IIC TX
Medium conductivity	pS/m min.	300	
Dust accumulation	max.	-	0.5 mm

Electronic switching element in intrinsically safe electric circuit			
Use/classification		Gas 2G	Dust 2D
Classification		Ex II 2G Ex ib IIB T4 Gb	Ex II 2D Ex ib IIIC T100 °C Db
Admissible intrinsically safe electric circuits		Ex ib IIC, Ex ic IIC	Ex ib IIIC
Technical data		Values only for intrinsically safe electric circuit	
Switching voltage	Vi max.	150 V AC/DC	
Switching current	Ii max.	1.0 A	
Switching power	Pi max.	1.3 W T4 T _{max} 40 °C	750 mW T _{max} 40 °C
		1.0 W T4 T _{max} 80 °C	550 mW T _{max} 100 °C
Surface temperature ¹⁾	max.	-	100 °C
Inner capacitance	Ci	Negligible	
Inner inductance	Li	Negligible	
Dust accumulation	max.	-	0.5 mm

¹⁾ Temperature is based on the temperature of the medium in the filter and cannot exceed this value.

Possible circuit as per DIN EN 60079-14



⚠ WARNING

- ▶ Explosion hazard due to high temperature. Temperature is based on temperature of medium in hydraulic circuit and cannot exceed this value. Take steps to make sure max. admissible ignition temperature is not exceeded in explosive area.
- ▶ Make sure potential equalization is sufficient when using 51422 inline filters in explosive areas. Ground-

- ing the filter with mounting screws is recommended. Note that paint and oxide protective coating are not electrically conductive.
- ▶ When replacing filter element, remove packaging material from explosive area around replacement element.

👉 Important:

- ▶ Safety and functionality of the filter are only guaranteed with original Bosch Rexroth spare parts.

- ▶ Maintenance may only be performed by specialists on instruction of the owner in accordance with Directive 1999/92/EC Annex II Section 1.1.

Notes

Notes

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This information only serves to describe the product. It cannot be used to derive statements concerning a certain condition or suitability for a certain application. This information also does not release the user from exercising his/her own judgment and conducting his/her own testing.
Our products are subject to a natural process of wear and aging.

Inline filter with filter element according to DIN 24550

Type 445LEN0040 to 1000

RE 51423

Issue: 2014-08

Replaces: 09.12



HAD7826_d

- ▶ Sizes according to **DIN 24550**: 0040 to 1000
- ▶ Nominal pressure 450 bar [6527 psi]
- ▶ Connection up to 2", SAE 2 1/2", SAE 24
- ▶ Operating temperature: -10 °C ... +100 °C [+14 °F ... +212 °F]

Features

Inline filters are used in hydraulic systems for separating solid materials from fluids and lubricating oils. They are intended for attachment in pipelines.

They distinguish themselves by the following:

- ▶ Filters for inline installation
- ▶ Size 1000 with divided filter bowl
- ▶ Special highly efficient filter materials
- ▶ Filtration of very fine particles and high dirt holding capacity across a broad pressure differential range
- ▶ High collapse resistance of the filter elements
- ▶ By default equipped with mechanical optical maintenance indicator with memory function
- ▶ Available as an option with different electronic switching elements, modular design
- ▶ Optional bypass valve integrated in the filter housing
- ▶ Optional measuring port
- ▶ High filtration performance due to the tangential cyclone-effect flow path

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Ordering codes filter element

01	02	03	04	05	06	07	08	09	09	09
445LE	N		-			-		-		-

Series

01	Inline filter 450 bar [6527 psi]	445LE
----	----------------------------------	-------

Filter element

02	With filter element according to DIN 24550	N
----	---	---

Nominal size

03	LEN... (with filter element according to DIN 24550)	0040 0063 0100 0160 0250 0400 0630 1000
----	--	--

Filter rating in µm

04	Absolute (ISO 16889 ; $\beta_x(c) \geq 200$) Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
	Nominal Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100

Pressure differential

05	Max. admissible pressure differential of the filter element 30 bar [435 psi] (with bypass valve)	A00
	Max. admissible pressure differential of the filter element 330 bar [4786 psi] (without bypass valve)	B00

Maintenance indicator

06	Maintenance indicator, mech./optical, switching pressure 5.0 bar [72.5 psi] – bypass cracking pressure 7 bar [101.53 psi]	V5,0
	Maintenance indicator, mech./optical, switching pressure 8.0 bar [116 psi] – without bypass valve	V8,0

Seal

07	NBR seal	M
	FKM seal	V

Connection

08	Frame size	0040	0063-0100	0160-0400	0630-1000	
		Connection				
	G1/2	●	X			R2
	G3/4	X	X			R3
	G1	X	●			R4
	G1 1/2			●		R6
	G2				●	R8
	SAE 1 1/2"			X		S6
	SAE 2"			X	X	S8
	SAE 2 1/2"				X	S9
	7/8-14 UNF-2B	X				U3
	1 1/16-12 UN-2B [SAE 12]		X			U4
	1 7/8-12 UN-2B			X		U6
		● Standard connection				
		X Alternative connection				

Ordering codes filter element

01	02	03	04	05	06	07	08	09	09	09
445LE	N		-		-	-	-	-	-	-

Supplementary information (for configuration options, see chapter "Version options")

09	Outlet top, outlet opposite, inlet closed (only with size 0160 - 1000) ¹⁾	7
	Filter rotated 180°, filter bowl can be unscrewed to the top (only with size 0160 - 1000)	9
	Bleed function in the filter bowl, drain in the filter head	
	Additional threaded couplings G 1/4, on the side (only with size 0160 - 1000), not possible with 7 or 9	M
	Maintenance indicator on the right (only with size 0160 - 1000), not possible with M	V3
	Maintenance indicator on the left (only with size 0160 - 1000), not possible with M	V9
	Manufacturer's inspection certificate M according to DIN 55350 T18 Z1	Z1

¹⁾ The option can only be configured with SAE flange connection

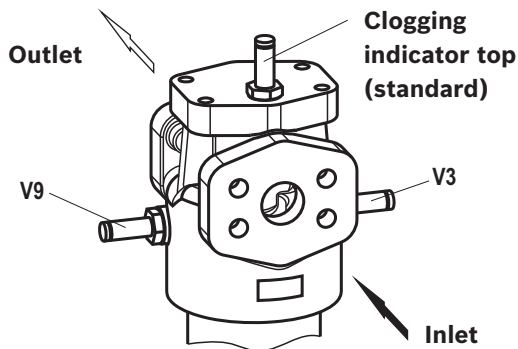
Order example:

445LEN0100-H3XLA00-V5,0-M-R4

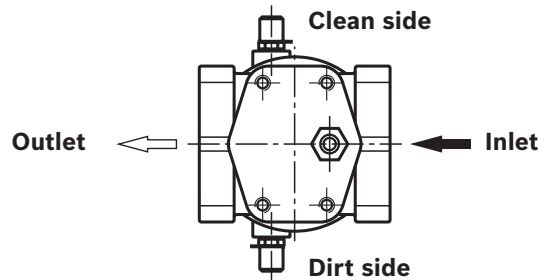
Further versions (filter materials, connections) are available on request.

Version options

Possible positions of the mechanical optical maintenance indicator

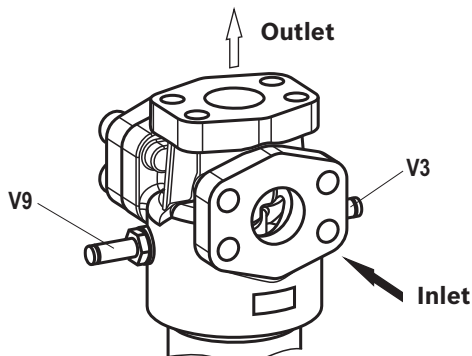


2 additional Minimes connections on the clean and dirt side



Cannot be combined with "7", "9", "V3" and "V9"

Outlet top – order option "7"
Outlet opposite inlet closed

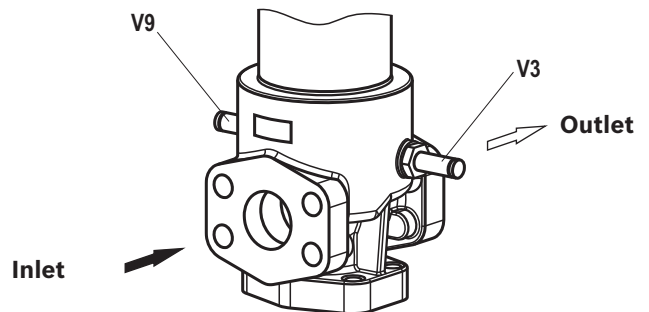


Cannot be combined with "M"!

Always specify the position of the clogging indicator ("V3" or "V9")

In this version, the filter has no mounting possibility. The pipe mounting elements must be positioned close to the filter so that the filter weight can be held.

Filter rotated 180° – order option "9"
Filter bowl can be unscrewed from the top



Cannot be combined with "M"!

Always specify the position of the clogging indicator ("V3" or "V9")

Preferred types

445LEN preferred types, NBR seal, flow specification for 30 mm²/s [142 SUS]

Inline filter with bypass, filter rating 3 µm

Type	Flow in l/min [gpm] at $\Delta p = 1.5 \text{ bar } [21.8 \text{ psi}]$ ¹⁾	Material no. Filter				Material no. replacement element
		..R2	R928043216	..U3	R928043456	
445LEN0040-H3XLA00-V5,0-M-..	26 [6.87]	..R2	R928043216	..U3	R928043456	R928006645
445LEN0063-H3XLA00-V5,0-M-..	36 [9.51]	..R4	R928043217	..U4	R928043457	R928006699
445LEN0100-H3XLA00-V5,0-M-..	46 [12.15]	..R4	R928043218	..U4	R928043458	R928006753
445LEN0160-H3XLA00-V5,0-M-..	126 [33.29]	..R6	R928043221	..U6	R928043461	R928006807
445LEN0250-H3XLA00-V5,0-M-..	212 [56.01]	..R6	R928043222	..U6	R928043462	R928006861
445LEN0400-H3XLA00-V5,0-M-..	258 [68.16]	..R6	R928043223	..U6	R928043463	R928006915
445LEN0630-H3XLA00-V5,0-M-..	325 [85.86]	..R8	R928043224	..S8	R928043304	R928006969
445LEN1000-H3XLA00-V5,0-M-..	486 [128.40]	..R8	R928043225	..S8	R928043305	R928007023

Inline filter with bypass, filter rating 6 µm

Type	Flow in l/min [gpm] at $\Delta p = 1.5 \text{ bar } [21.8 \text{ psi}]$ ¹⁾	Material no. Filter				Material no. replacement element
		..R2	R928043520	..U3	R928043760	
445LEN0040-H6XLA00-V5,0-M-..	33 [8.72]	..R2	R928043520	..U3	R928043760	R928006646
445LEN0063-H6XLA00-V5,0-M-..	55 [14.53]	..R4	R928043521	..U4	R928043761	R928006700
445LEN0100-H6XLA00-V5,0-M-..	69 [18.23]	..R4	R928043522	..U4	R928043762	R928006754
445LEN0160-H6XLA00-V5,0-M-..	175 [46.23]	..R6	R928043525	..U6	R928043765	R928006808
445LEN0250-H6XLA00-V5,0-M-..	253 [66.84]	..R6	R928043526	..U6	R928043766	R928006862
445LEN0400-H6XLA00-V5,0-M-..	298 [78.73]	..R6	R928043527	..U6	R928043767	R928006916
445LEN0630-H6XLA00-V5,0-M-..	406 [107.26]	..R8	R928043528	..S8	R928043608	R928006970
445LEN1000-H6XLA00-V5,0-M-..	505 [133.42]	..R8	R928043529	..S8	R928043609	R928007024

Inline filter with bypass, filter rating 10 µm

Type	Flow in l/min [gpm] at $\Delta p = 1.5 \text{ bar } [21.8 \text{ psi}]$ ¹⁾	Material no. Filter				Material no. replacement element
		..R3	R928043904	..U3	R928044064	
445LEN0040-H10XLA00-V5,0-M-..	37 [9.77]	..R3	R928043904	..U3	R928044064	R928006647
445LEN0063-H10XLA00-V5,0-M-..	70 [18.49]	..R4	R928043825	..U4	R928044065	R928006701
445LEN0100-H10XLA00-V5,0-M-..	78 [20.60]	..R4	R928043826	..U4	R928044066	R928006755
445LEN0160-H10XLA00-V5,0-M-..	211 [55.75]	..R6	R928043829	..U6	R928044069	R928006809
445LEN0250-H10XLA00-V5,0-M-..	280 [73.98]	..R6	R928043830	..U6	R928044070	R928006863
445LEN0400-H10XLA00-V5,0-M-..	325 [85.86]	..R6	R928043831	..U6	R928044071	R928006917
445LEN0630-H10XLA00-V5,0-M-..	460 [121.53]	..R8	R928043832	..S8	R928043912	R928006971
445LEN1000-H10XLA00-V5,0-M-..	515 [136.06]	..R8	R928043833	..S8	R928043913	R928007025

¹⁾ An appropriate differential pressure via the filter and measuring device according to ISO 3968.
The differential pressure measured on the maintenance indicator is lower.

Ordering code accessories
(dimensions in mm [inch])

Electronic switching element for maintenance indicators

01	02	03
WE	-	-

Maintenance indicator

01	Electronic switching element	WE
----	------------------------------	----

Type of signal

02	1 switching point	1SP
	2 switching points, 3 LED	2SP
	2 switching points, 3 LED and signal suppression up to 30 °C [86 °F]	2SPSU

Connector

03	Round plug-in connection M12 x 1, 4-pole	M12 x 1
	Rectangular plug-in connection, 2-pole, design A according to EN-175301-803	EN175301-803

Material numbers of the electronic switching elements

Material no.	Type	Signal	Switching points	Connector	LED
R928028409	WE-1SP-M12 x 1	Changeover	1	M12 x 1	without
R928028410	WE-2SP-M12 x 1	Normally open (at 75%) / normally closed contact (at 100%)	2		3 pieces
R928028411	WE-2SPSU-M12 x 1				
R928036318	WE-1SP-EN175301-803	Normally closed contact	1	EN 175301-803	without

Mating connectors

for electronic switching element with round plug-in connection M12 x 1

Mating connector suitable for K24 4-pole, M12 x 1 with screw connection, cable gland Pg9.

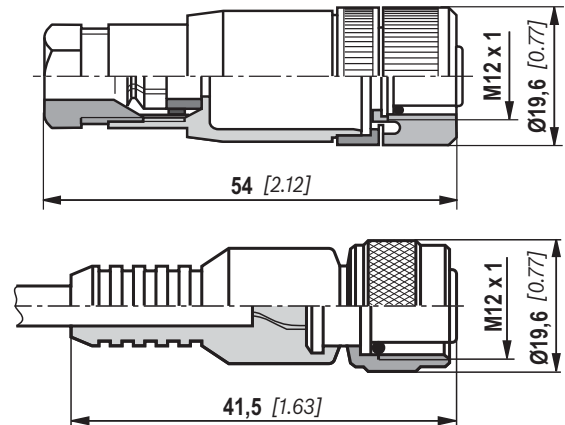
Material no. R900031155

Mating connector suitable for K24-3m 4-pole, M12 x 1 with potted-in PVC cable, 3 m long.

Line cross-section: 4 x 0.34 mm²

Core marking: **1** brown **2** white
 3 blue **4** black

Material no. R900064381



For more round plug-in connections and technical data refer to data sheet 08006.

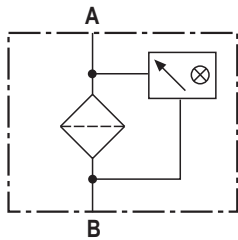
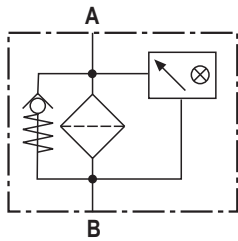
Order example:

Inline filter with mechanical optical maintenance indicator for $p_{Nominal} = 450 [6527 \text{ psi}]$ with bypass valve, Size 0160, with filter element 10 µm and electronic switching element M12 x 1 with 1 switching point.

Filter with mech. optical maintenance indicator:	445LEN0160-H10XLA00-V5,0-M-R6	Material no. R928043829
Switching element:	WE-1SP-M12 x 1	Material no. R928028409
Mating connector:	Mating connector suitable for K24 4-pole, M12 x 1 with screw connection, Cable gland Pg9.	Material no. R900031155

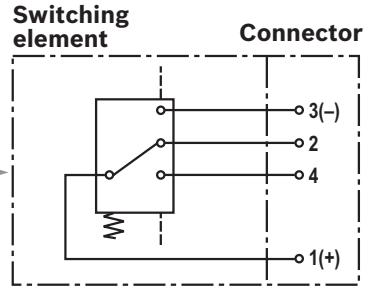
Symbols

Inline filter with bypass and mechanical indicator

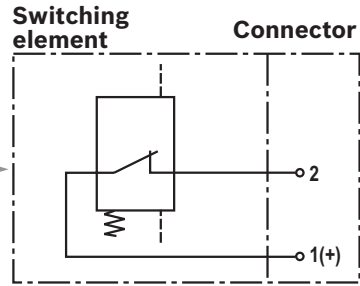


Inline filter without bypass and with mechanical indicator

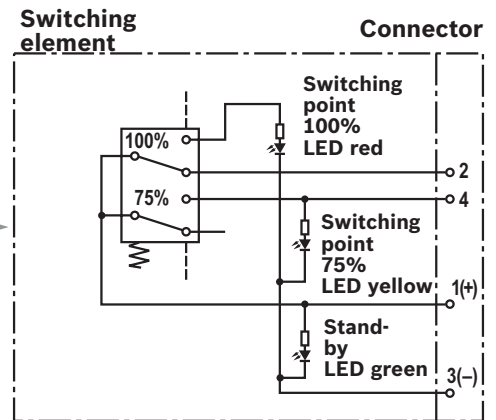
electronic switching element
for maintenance indicator



WE-1SP-M12 x 1

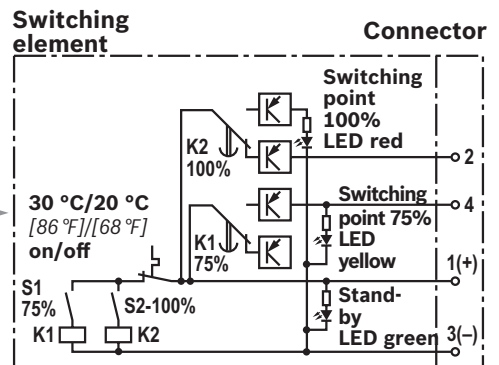


WE-1SP-EN175301-803



WE-2SP-M12 x 1

Circuit diagram drawn in plugged condition (operating state)



WE-2SPSU-M12 x 1

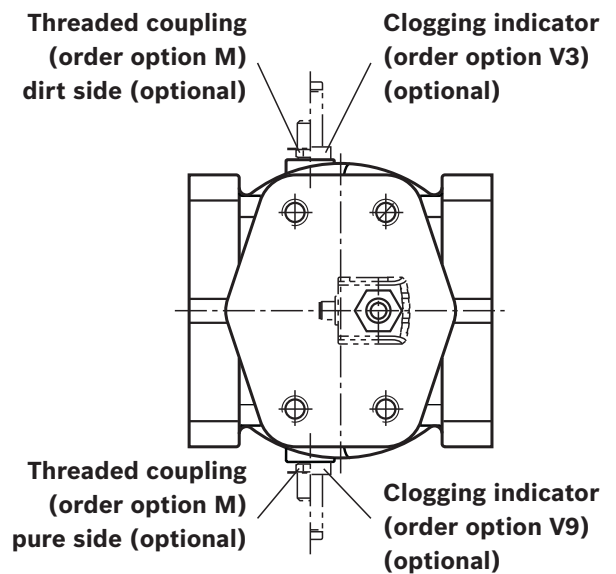
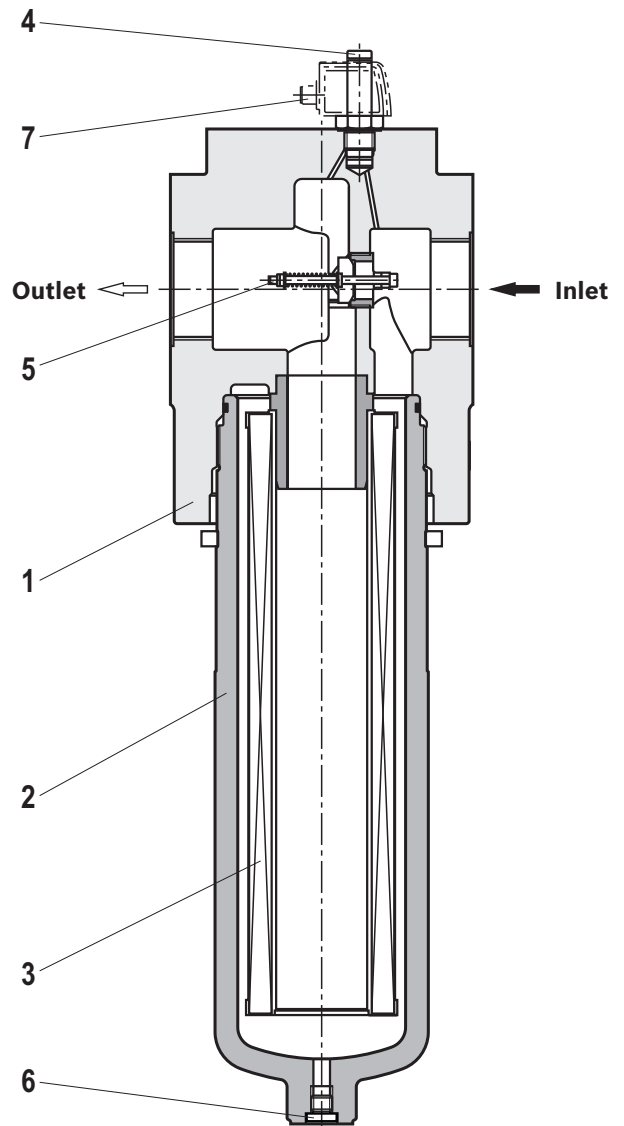
Circuit diagram drawn in plugged condition at temperature > 30 °C [86 °F] (operating state)

Function, section

The inline filter 445LEN is suitable for installation in pressure lines. It basically consists of filter head (1), a screwable filter bowl (2) (size 1000 filter pipe with filter cover), filter element (3) as well as a mechanical optical maintenance indicator (4). In case of filters with low-pressure-differential-stable filter elements (= code letter pressure differential A), there is also an assembled bypass valve (5). Via the inlet, the hydraulic fluid reaches the filter element (3) where it is cleaned. The dirt particles filtered out settle in the filter element (3). Via the outlet, the filtered hydraulic fluid enters the hydraulic circuit. The filter housing and all connection elements are designed so that pressure peaks - as they may e.g. occur in case of abrupt opening of large control valves due to the accelerated fluid quantity - can be securely absorbed. As of size 0160, the standard equipment comprises a drain screw (6). With the size 1000, the filter bowl has a two-part design. The filter pipe is secured against twisting in the filter head. By default, the filter is equipped with mechanical optical maintenance indicator (4). The electronic switching element (7) which has to be ordered separately is attached to the mechanical optical maintenance indicator (4) and held by means of a locking ring. The electronic switching elements with 1 or 2 switching points are connected via a mating connector according to IEC-60947-5-2 or via a cable connection according to EN17301-803.

Variants

- ▶ **Order option supplementary information -7**
The standard outlet is closed with a SAE blind flange. The outlet is mounted upwards, which means that the direction of flow is angled upwards by 90°.
- ▶ **Order option supplementary information -9**
The bleeding is on the hexagon of the filter bowl. The drain function is located on the side of the filter head opposite the clogging indicator.



Type	Maintenance indicator	Assembly position	
		Bleeding	Draining
445LEN...			
0160-1000...9-V3	V3	On the filter bowl, top, G1/4	Opposite maintenance indicator
0160-1000...9-V9	V9		

Notice:
Configuration options see version options on page 3

Technical data

(For applications outside these parameters, please consult us!)

General						
Installation position		vertical				
Ambient temperature range		°C [°F]	-10 ... +65 [+14 ... +149]; (briefly to -30 [-22])			
Storage conditions	- NBR seal	°C [°F]	-40 ... +65[-40 ... +149]; max. relative air humidity 65 %			
	- FKM seal	°C [°F]	-20 ... +65[-4 ... +149]; max. relative air humidity 65 %			
Weight	- Filters	NS	0040	0063	0100	0160
		kg [lbs]	4.4 [9.7]	5 [11.1]	5.9 [13.1]	24 [53.2]
		NS	0250	0400	0630	1000
		kg [lbs]	26 [57.7]	30 [66.5]	60 [133.1]	104 [230.7]
	- Filter bowl	NS	0040	0063	0100	0160
		kg [lbs]	1.33 [2.93]	1.33 [2.93]	2.1 [4.63]	5.52 [12.17]
		NS	0250	0400	0630	1000
		kg [lbs]	8.02 [17.68]	12.21 [26.91]	21.36 [47.08]	45.34 [99.93]
Volume	NS	0040	0063	0100	0160	
	l [US gal]	0.25 [0.06]	0.35 [0.09]	0.52 [0.13]	1.4 [0.36]	
	NS	0250	0400	0630	1000	
	l [US gal]	1.95 [0.51]	3.1 [0.81]	5.0 [1.32]	6.5 [1.71]	
Material	- Filter head	GGG				
	- Filter bowl	Steel				
	- Optical maintenance indicator	Brass				
	- Electronic switching element	Plastic PA6				
	- Bypass valve	Steel/POM				
	- Seals	NBR or FKM				

Hydraulic			
Maximum operating pressure	bar [psi]	450 [6527]	
Hydraulic fluid temperature range	°C [°F]	-10 ... +100 [+14 ... +212]	
Minimum conductivity of the medium	pS/m	300	
Fatigue strength according to ISO 10771	Load cycles	> 10 ⁶ with max. operating pressure	
Type of pressure measurement of the maintenance indicator	Pressure differential		
Assignment: Response pressure of the maintenance indicator / cracking pressure of the bypass valve		Response pressure of the maintenance indicator	Cracking pressure of the bypass valve
	bar [psi]	5.0 ± 0.5 [72.5 ± 7.3]	7,0 ± 0,5 [101.5 ± 7.3]
		8.0 ± 0.8 [116 ± 11.6]	without bypass valve
Filtration direction	From the outside to the inside		

Technical data

(For applications outside these parameters, please consult us!)

Electric (electronic switching element)				
Electrical connection	Round plug-in connection M12 x 1, 4-pole			Standard connection EN 175301-803
Version	WE-1SP-M12 x 1	WE-2SP-M12 x 1	WE-2SPSU-M12 x 1	WE-1SP-EN175301-803
Contact load, direct voltage	A _{max.}	1		
Voltage range	V _{max.}	150 (AC/DC)	10 ... 30 (DC)	250 (AC)/200 (DC)
Max. switching power with resistive load	W	20		
Switching type	- 75% signal	-	Normally open contact	-
	- 100% signal	Changeover	Normally closed contact	Normally closed contact
	- 2SPSU		Signal interconnection at 30 °C [86 °F], return switching at 20 °C [68 °F]	
Display via LEDs in the electronic switching element 2SP...		Stand-by (LED green); 75% switching point (LED yellow) 100% switching point (LED red)		
Protection class according to EN 60529	IP	67		
Ambient temperature range	°C [°F]	-25 ... +85 [-13 ... +185]		
For direct voltage above 24 V, spark extinguishing is to be provided for protecting the switching contacts.				
Weight	- electronic switching element	kg [lbs]	0,1 [0.22]	

Filter element				
Glass fiber material H.XL		Single-use element on the basis of inorganic fiber		
		Filtration ratio according to ISO 16889 up to Δp = 5 bar [72.5 psi]	Achievable oil cleanliness according to ISO 4406 [SAE-AS 4059]	
Particle separation	H20XL	β _{20(c)} ≥ 200	19/16/12 ... 22/17/14	
	H10XL	β _{10(c)} ≥ 200	17/14/10 ... 21/16/13	
	H6XL	β _{6(c)} ≥ 200	15/12/10 ... 19/14/11	
	H3XL	β _{5(c)} ≥ 200	13/10/8 ... 17/13/10	
Admissible pressure differential	- A00	bar [psi]	30 [435]	
	- B00	bar [psi]	330 [4785]	

Compatibility with permitted hydraulic fluids

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oil	HLP	NBR	DIN 51524
Biodegradable	- insoluble in water	HETG	VDMA 24568
		HEES	
Flame-resistant	- soluble in water	HEPG	VDMA 24568
	- water-free	HFDU, HFDR	VDMA 24317
- containing water	HFAS	NBR	DIN 24320
	HFAE	NBR	
	HFC	NBR	



Important information on hydraulic fluids:

- For more information and data on the use of other hydraulic fluids, please refer to data sheet 90220 or contact us!
- **Flame-resistant - containing water:** due to possible chemical reactions with materials or surface coatings of machine and system components, the service life with these hydraulic fluids may be less than expected.

Filter materials made of filter paper P may not be used, filter elements with glass fiber material have to be used instead.

- **Biodegradable:** If filter materials made of filter paper are used, the filter life may be shorter than expected due to material incompatibility and swelling.

Characteristic curves

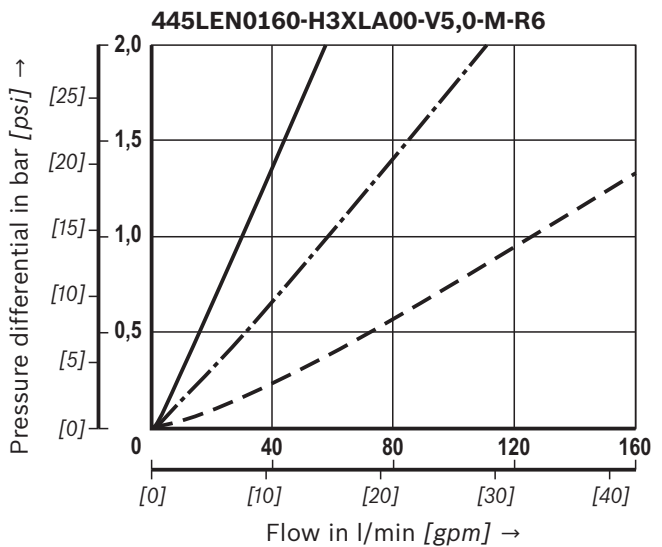
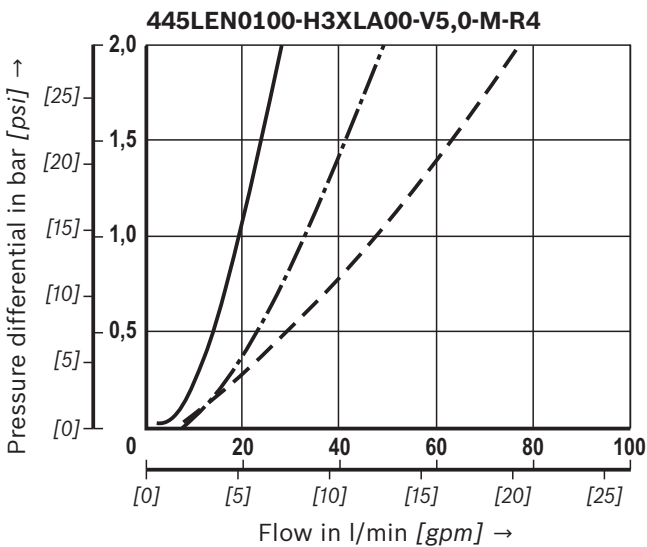
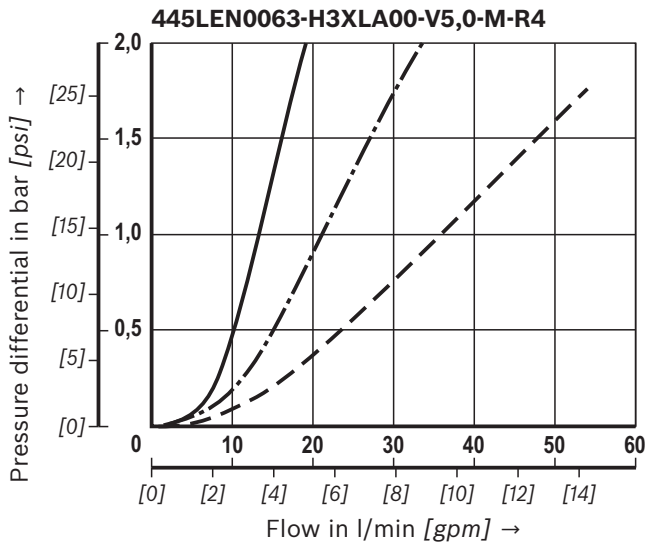
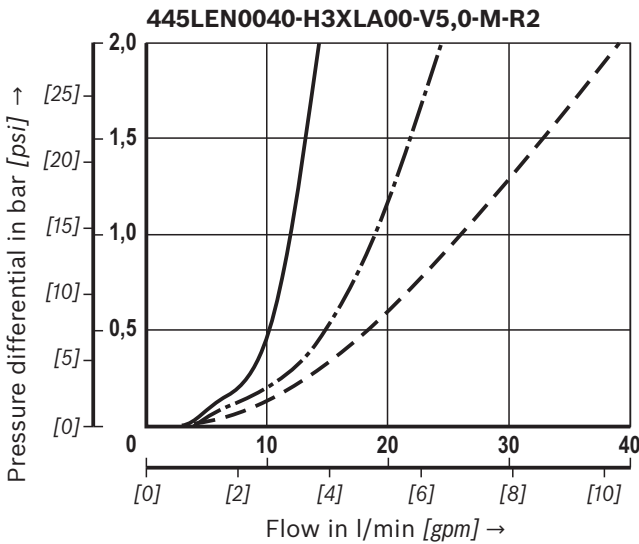
(measured with mineral oil HLP46 according to ISO 3968)

Spec. weight: < 0.9 kg/dm³

Δp -Q-characteristic curves for complete filters recommended initial Δp for version = 1.5 bar [21.8 psi]

Selection of the perfect filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 — 140 mm²/s [649 SUS]
 - · - 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Characteristic curves

(measured with mineral oil HLP46 according to ISO 3968)

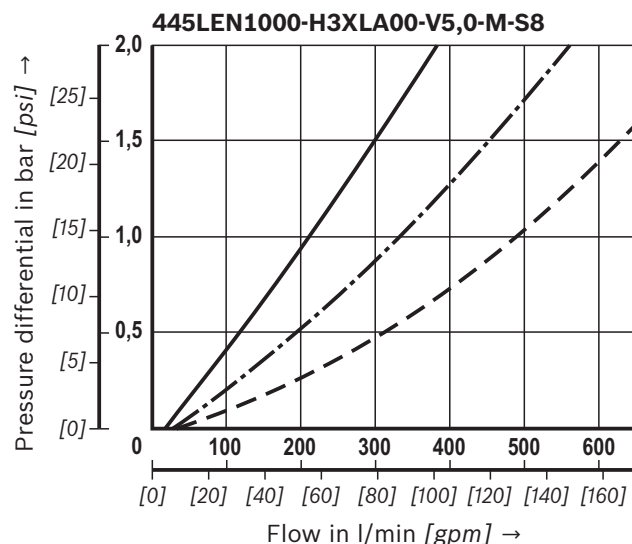
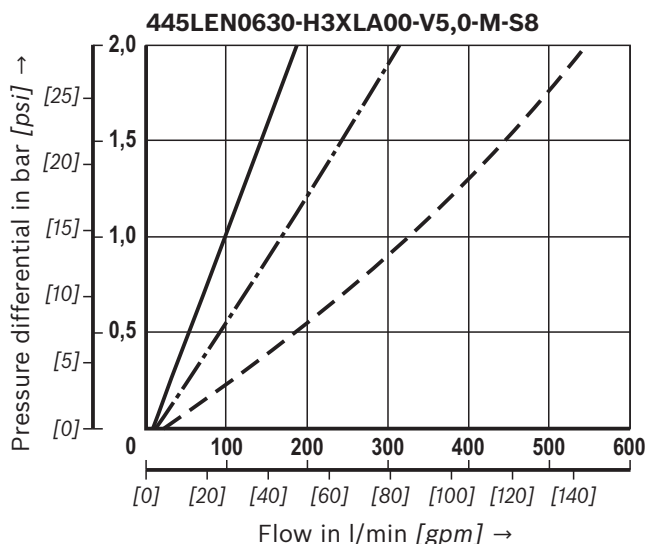
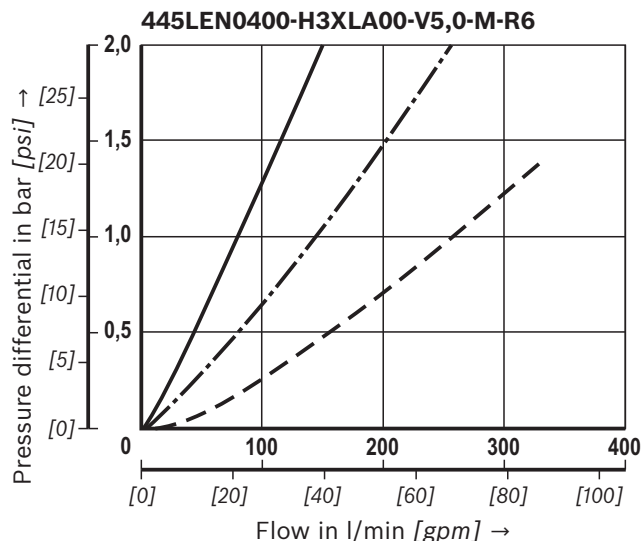
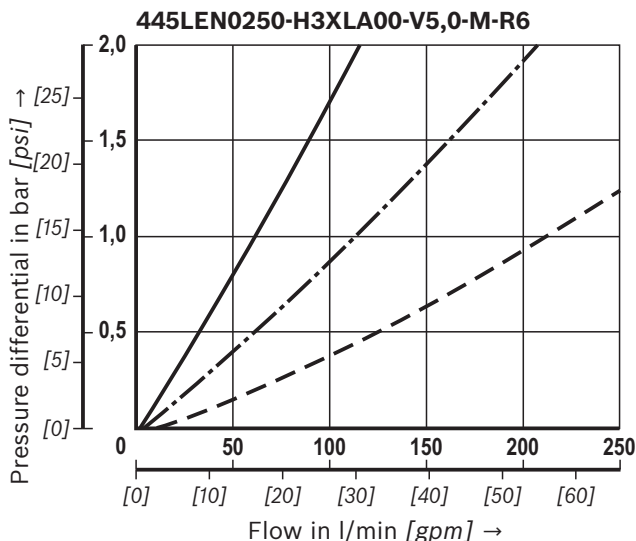
H3XL

Spec. weight: < 0.9 kg/dm³

Δp -Q-characteristic curves for complete filters recommended initial Δp for version = 1.5 bar [21.8 psi]

Selection of the perfect filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Characteristic curves

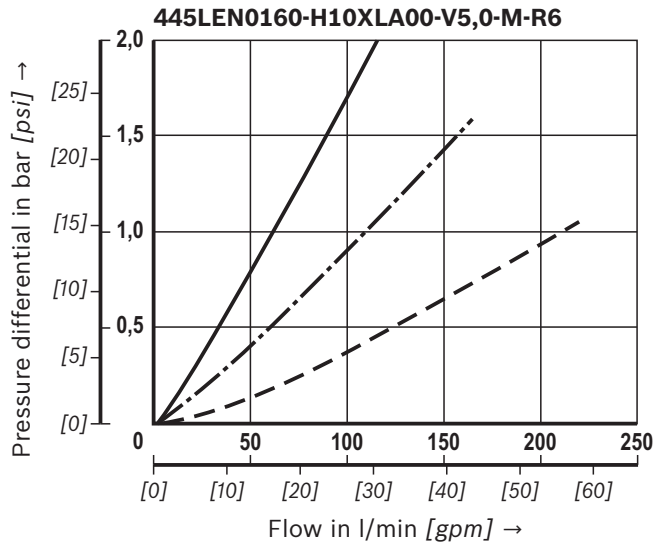
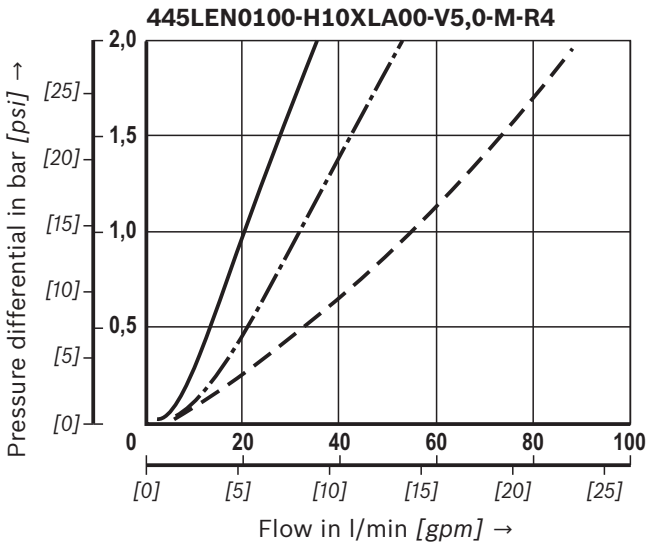
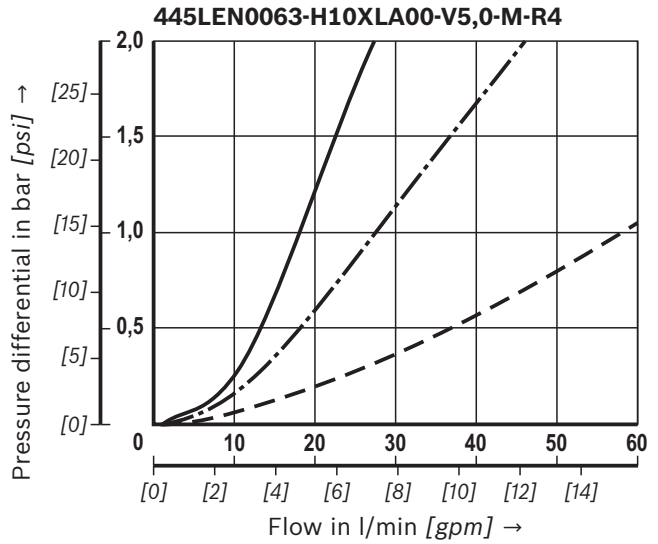
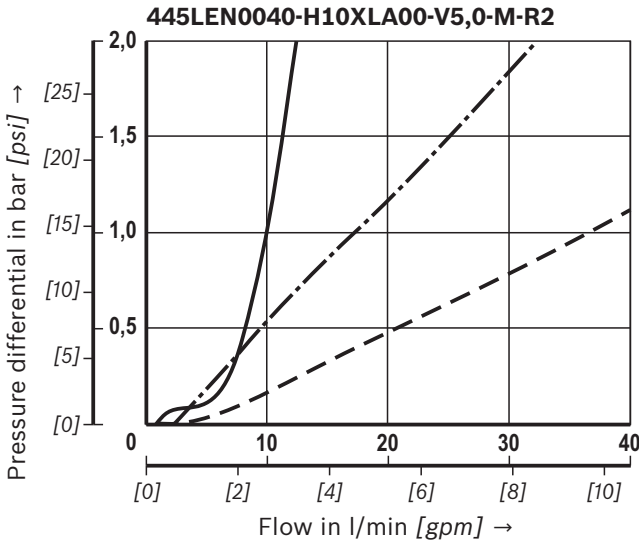
(measured with mineral oil HLP46 according to ISO 3968)

Spec. weight: < 0.9 kg/dm³

Δp -Q-characteristic curves for complete filters recommended initial Δp for version = 1.5 bar [21.8 psi]

Selection of the perfect filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Characteristic curves

(measured with mineral oil HLP46 according to ISO 3968)

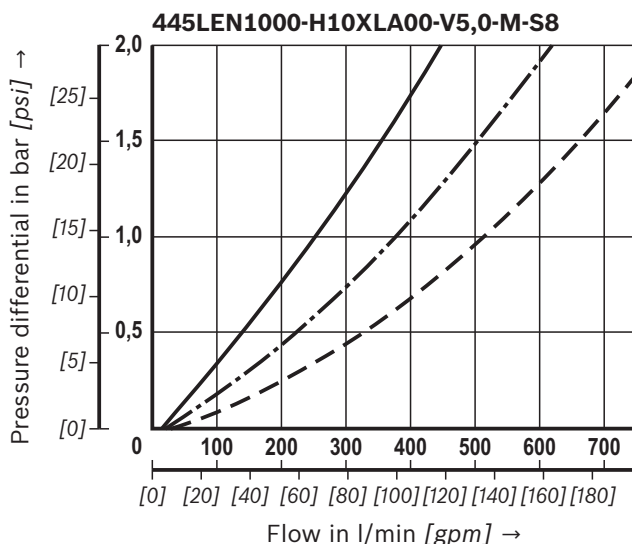
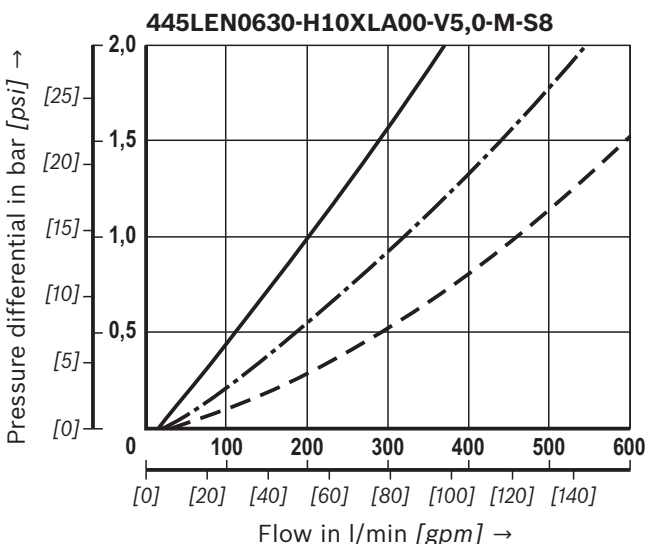
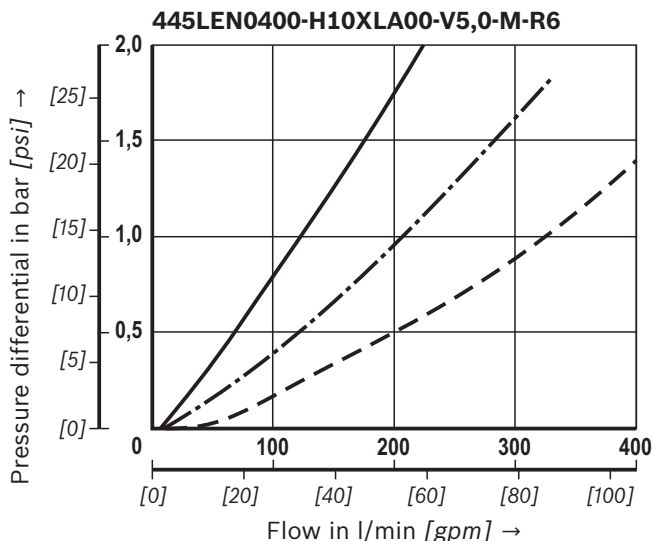
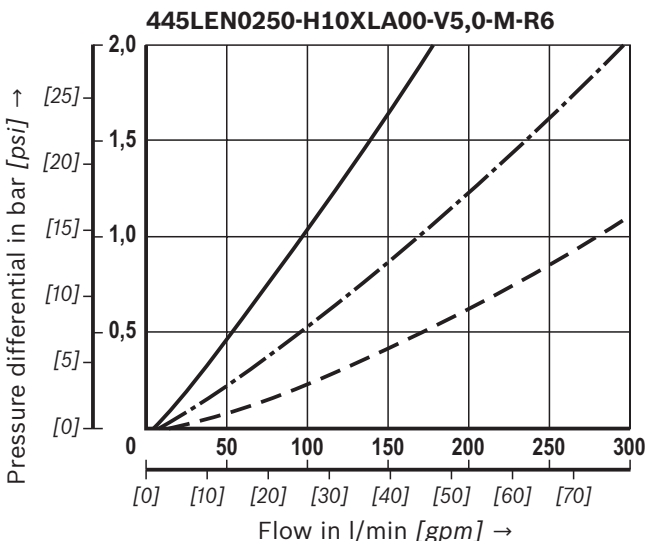
H10XL

Spec. weight: < 0.9 kg/dm³

Δp -Q-characteristic curves for complete filters recommended initial Δp for version = 1.5 bar [21.8 psi]

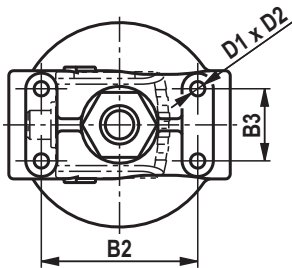
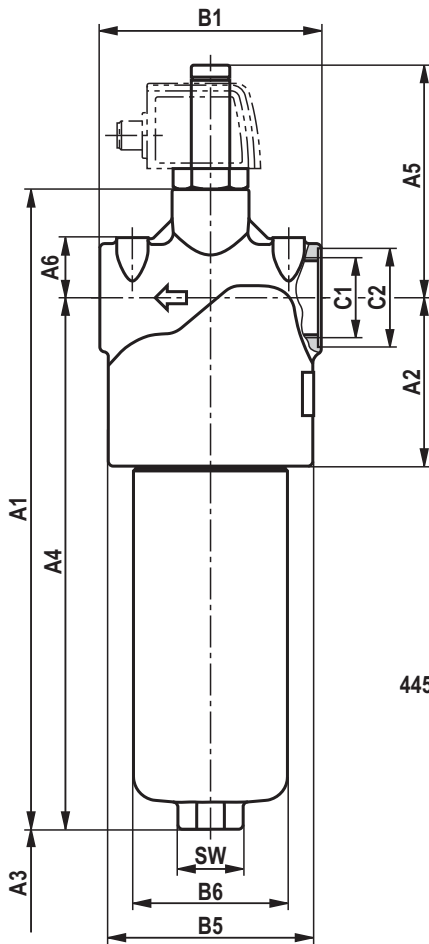
Selection of the perfect filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]

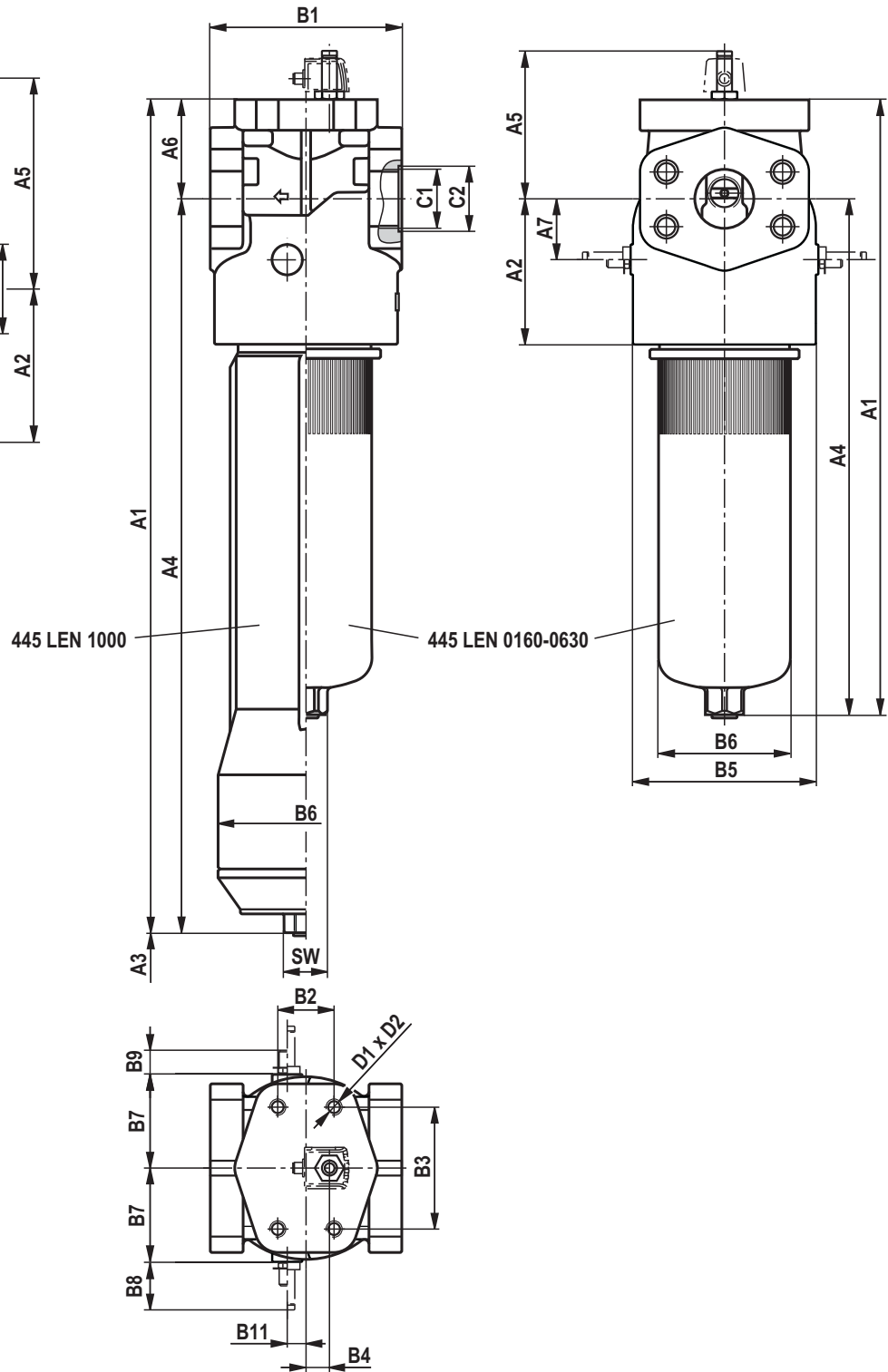


Dimensions: Size 0040 ... NG1000
(dimensions in mm [inch])

445LEN0040 ... 0100



445LEN0160 ... 1000



Dimensions: Size 0040 ... NG1000
(dimensions in mm [inch])

445LEN...	A1	A2	A3 ¹⁾	A4	A5	A6	A7
0040	203 [7.99]	70 [2.76]	80 [3.15]	158 [6.22]	96.7 [3.81]	25 [0.98]	-
0063	266 [10.47]			221 [8.70]			
0100	356 [14.02]			311 [12.24]			
0160	344 [13.54]	110 [4.33]	120 [4.72]	262 [10.31]	133.7 [5.26]	82 [3.23]	46 [1.81]
0250	434 [17.09]			352 [13.86]			
0400	584 [22.99]			502 [19.76]			
0630	656 [25.83]	155 [6.10]	160 [6.30]	550 [21.65]	157.7 [6.21]	106 [4.17]	65 [2.56]
1000	893.5 [35.18]		630 [24.80]	787.5 [31.00]			

445LEN...	B1	B2	B3	B4	ØB5	ØB6	B7	B8	B9	B10	B11
0040	92 [3.62]	65 [2.56]	30 [1.18]	-	85 [3.35]	64 [2.52]	-	-	-	-	-
0063											
0100											
0160	164 [6.46]	55 [2.17]	105 [4.13]	30 [1.18]	150 [5.91]	114 [4.49]	80 [3.15]	51.7 [2.04]	29.3 [1.15]	128 [5.04]	20 [0.79]
0250											
0400											
0630										169 [6.65]	
1000	200 [7.87]	60 [2.36]	130 [5.12]	25 [0.98]	195 [7.68]	140 [5.51] 188 [7.40]	100 [3.94]				

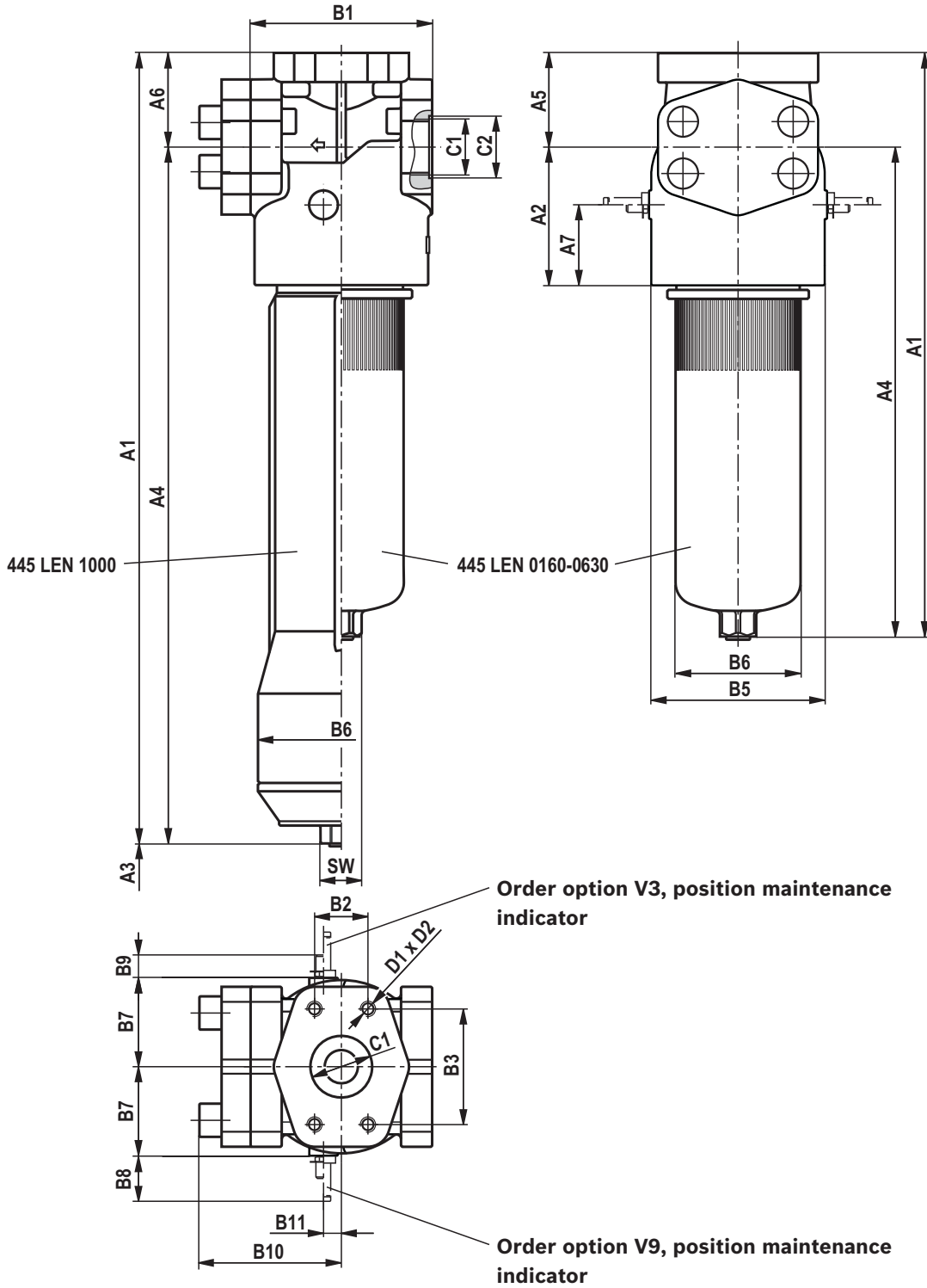
445LEN...	C1 connection						D1	D2	SW
	Standard R...	ØC2	Optional U...	ØC2	Optional S...	ØC2			
0040	G1/2	28 [1.10]	7/18-14 UNF-2B	34 [1.34]	-		M6	8 [0.31]	24 [0.94]
0063	G1	41 [1.61]	1 1/16 UN-2B	41 [1.61]					
0100									
0160	G1 1/2	56 [2.20]	1 7/8-12 UN-2B	65 [2.56]	SAE 1 1/2"	38 [1.50]	M12	28 [1.10]	32 [1.26]
0250					SAE 2"	51 [2.01]			
0400									
0630	G2	72 [2.83]	-	-	-	-	M16	33 [1.30]	41 [1.61]
1000									

¹⁾ Servicing height for filter element exchange.

Dimensions: Size 0160 ... Size 1000 version 7
 (dimensions in mm [inch])

445LEN0160 ... 1000 version 7

Outlet top, outlet opposite inlet closed



Dimensions: Size 0160 ... Size 1000 version 7
 (dimensions in mm [inch])

445LEN...	A1	A2	A3	A4	A5	A6	A7
0160...7	344 [13.54]	110 [4.33]	120 [4.72]	262 [10.31]	82 [3.23]	82 [3.23]	46 [1.81]
0250...7	434 [17.09]			352 [13.86]			
0400...7	584 [22.99]			502 [19.76]			
0630...7	656 [25.83]	155 [6.10]	160 [6.30]	550 [21.65]	106 [4.17]	106 [4.17]	65 [2.56]
1000...7	893.5 [35.18]		630 [24.80]	787.5 [31.00]			

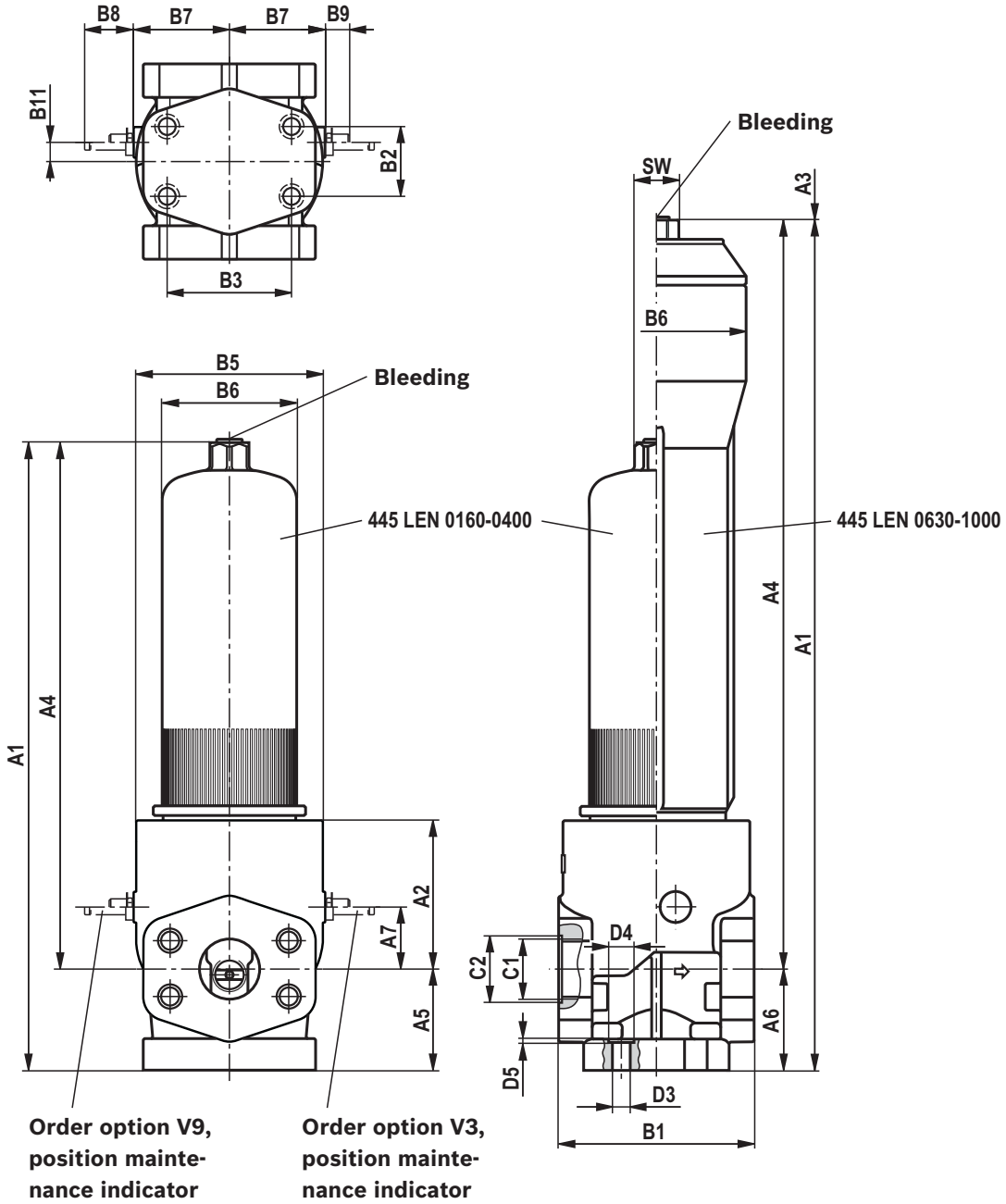
445LEN...	B1	B2	B3	B4	ØB5	ØB6	B7	B8	B9	B10	B11
0160...7	164 [6.46]	55 [2.17]	105 [4.13]	30 [1.18]	150 [5.91]	114 [4.49]	80 [3.15]	51.7 [2.04]	29.3 [1.15]	128 [5.04]	20 [0.79]
0250...7										169 [6.65]	
0400...7											
0630...7	200 [7.87]	60 [2.36]	130 [5.12]	25 [0.98]	195 [7.68]	140 [5.51]	100 [3.94]				
1000...7						188 [7.40]					

445LEN...	C1 connection						D1	D2	SW
	Standard R...	ØC2	Optional U...	ØC2	Optional S...	ØC2			
0160...7	G1 1/2	56 [2.20]	1 7/8-12 UN-2B	65 [2.56]	-		M12	28 [1.10]	32 [1.26]
0250...7									
0400...7									
0630...7	-	-	-	-	SAE 2"	51 [2.01]	M16	33 [1.30]	41 [1.61]
1000...7					SAE 2 1/2"	63 [2.48]			

Dimensions: Size 0160 ... Size 1000 version 9
(dimensions in mm [inch])

445LEN0160 ... 1000 version 9

Filter rotated 180°, filter bowl can be unscrewed to the top



Type	Maintenance indicator	Assembly position	
		Bleeding	Draining
445LEN0160-1000...9-V3	V3	On the filter bowl, top, G1/4	Opposite maintenance indicator
445LEN0160-1000...9-V9	V9		

Dimensions: Size 0160 ... Size 1000 version 9
 (dimensions in mm [inch])

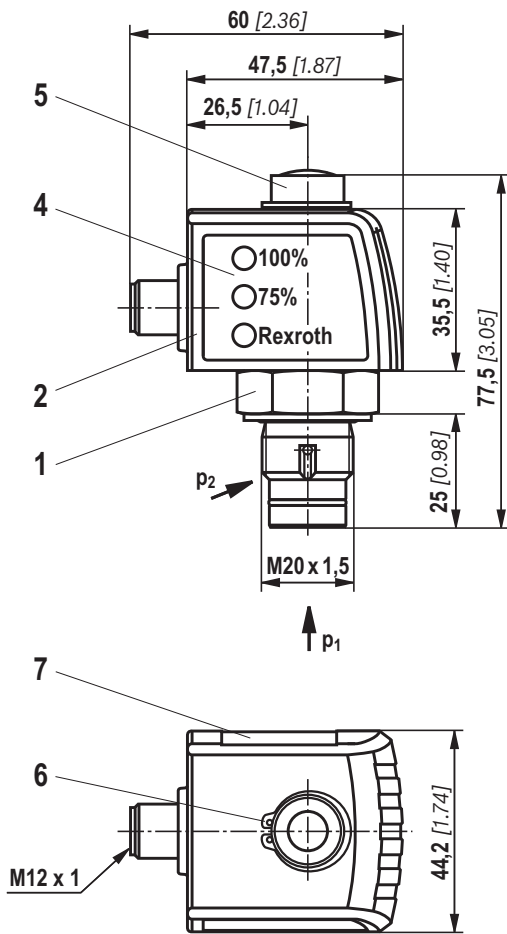
445LEN...	A1	A2	A3	A4	A5	A6	A7
0160...9	344 [13.54]	110 [4.33]	160 [6.30]	262 [10.31]	82 [3.23]	82 [3.23]	46 [1.81]
0250...9	434 [17.09]		250 [9.84]	352 [13.86]			
0400...9	584 [22.99]		400 [15.75]	502 [19.76]			
0630...9	656 [25.83]	155 [6.10]	160 [6.30]	550 [21.65]	106 [4.17]	106 [4.17]	65 2.56]
1000...9	893.5 [35.18]		630 [24.80]	787.5 [31.00]			

445LEN...	B1	B2	B3	B4	ØB5	ØB6	B7	B8	B9	B10	B11
0160...9	164 [6.46]	55 [2.17]	105 [4.13]	30 [1.18]	150 [5.91]	114 [4.49]	80 [3.15]	51.7 [2.04]	29.3 [1.15]	128 [5.04]	20 [0.79]
0250...9										169 [6.65]	
0400...9											
0630...9	200 [7.87]	60 [2.36]	130 [5.12]	25 [0.98]	195 [7.68]	140 [5.51]	100 [3.94]				
1000...9					188 [7.40]						

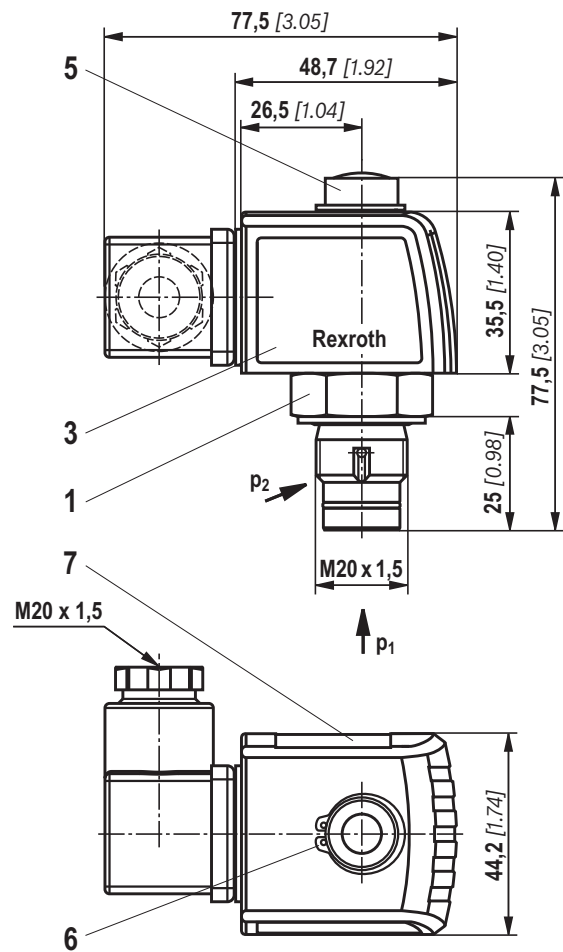
445LEN...	C1 connection						ØD3	ØD4	D5	SW
	Standard R...	ØC2	Optional U...	ØC2	Optional S...	ØC2				
0160...9	G1 1/2	56 [2.20]	1 7/8-12 UN-2B	65 [2.56]	-		14 [0.55]	20 [0.79]	1 [0.04]	32 [1.26]
0250...9										
0400...9										
0630...9	-	-	-	-	SAE 2"	51 [2.01]	18 [0.71]	26 [1.02]		41 [1.61]
1000...9					SAE 2 1/2"	63 [2.48]				

Maintenance indicator (dimensions in mm [inch])

Pressure differential indicator with mounted switching element M12 x 1



Pressure differential indicator with mounted switching element EN-175301-803



- 1 Mechanical optical maintenance indicator; max. tightening torque $M_{A \max} = 50 \text{ Nm}$ [36.88 lb-ft]
- 2 Switching element with locking ring for electrical maintenance indicator (rotatable by 360°); round plug-in connection M12 x 1, 4-pole
- 3 Switching element with locking ring for electrical maintenance indicator (rotatable by 360°); rectangular plug-in connection EN175301-803
- 4 Housing with three LEDs: 24V =
green: Stand-by
yellow: Switching point 75%
red: Switching point 100%
- 5 Visual indicator bistable
- 6 Locking ring DIN 471-16 x 1, material no. R900003923
- 7 Name plate

Notices:

Representation contains mechanical optical maintenance indicator (1) and electronic switching element (2) (3).

**Ordering code
spare parts**

Filter element

01	02	03	04	05	06
2.			-	-	0

Filter element

01	Design	2.
----	--------	----

Nominal size

02	LEN... (with filter element according to DIN 24550)	0040 0063 0100 0160 0250 0400 0630 1000
----	--	--

Filter rating in µm

03	Absolute (ISO 16889 ; Glass fiber material, not cleanable β_x(c) ≥ 200)	H3XL H6XL H10XL H20XL
	Nominal Stainless steel wire mesh, cleanable	G10 G25 G40 G60 G100

Pressure differential

04	Max. admissible pressure differential of the filter element 30 bar [435 psi] – filter with bypass valve	A00
	Max. admissible pressure differential of the filter element 330 bar [4786 psi] – filter without bypass valve	B00

Bypass valve

05	without bypass valve	0
----	-----------------------------	---

Seal

06	NBR seal	M
	FKM seal	V

Order example:

2.0100 H3XL-A00-0-M

For detailed information on Rexroth filter elements please refer to data sheet 51420.

Preferred program replacement filter element

Replacement filter element 3 micron		Replacement filter element 6 micron		Replacement filter element 10 micron	
R928006645	2.0040 H3XL-A00-0-M	R928006646	2.0040 H6XL-A00-0-M	R928006647	2.0040 H10XL-A00-0-M
R928006699	2.0063 H3XL-A00-0-M	R928006700	2.0063 H6XL-A00-0-M	R928006701	2.0063 H10XL-A00-0-M
R928006753	2.0100 H3XL-A00-0-M	R928006754	2.0100 H6XL-A00-0-M	R928006755	2.0100 H10XL-A00-0-M
R928006807	2.0160 H3XL-A00-0-M	R928006808	2.0160 H6XL-A00-0-M	R928006809	2.0160 H10XL-A00-0-M
R928006861	2.0250 H3XL-A00-0-M	R928006862	2.0250 H6XL-A00-0-M	R928006863	2.0250 H10XL-A00-0-M
R928006915	2.0400 H3XL-A00-0-M	R928006916	2.0400 H6XL-A00-0-M	R928006917	2.0400 H10XL-A00-0-M
R928006969	2.0630 H3XL-A00-0-M	R928006970	2.0630 H6XL-A00-0-M	R928006971	2.0630 H10XL-A00-0-M
R928007023	2.1000 H3XL-A00-0-M	R928007024	2.1000 H6XL-A00-0-M	R928007025	2.1000 H10XL-A00-0-M

Ordering code spare parts

Mechanical optical maintenance indicator

01	02	03	04	05	06
W	O	-	D01	-	-
					450

01	Maintenance indicator	W
----	-----------------------	----------

02	Mechanical optical indicator	O
----	------------------------------	----------

Version

03	Pressure differential, modular design	D01
----	---------------------------------------	------------

Switching pressure

04	5.0 bar [72.5 psi]	5,0
	8.0 bar [116 psi]	8,0

Seal

05	NBR seal	M
	FKM seal	V

Max. operating pressure

06	Switching pressure 5.0 bar [72.5 psi], 450 bar [6527 psi]	450
	Switching pressure 8.0 bar [116.0 psi], 450 bar [6527 psi]	450

Mechanical optical maintenance indicator	Material no.
WO-D01-5.0-M-450	R901025313
WO-D01-5.0-V-450	R901066235
WO-D01-8.0-M-450	R928038785
WO-D01-8.0-V-450	R928038784

Ordering code spare parts

Seal kit

01	02	03	04
D	350/445LEN		-

01	Seal kit	D
02	Series 445LEN	350/445LEN

Nominal size

03	Size 0040-0100	0040-0100
	Size 0160-0400	0160-0400
	Size 0630	0630
	Size 1000	1000

Seal

04	NBR seal	M
	FKM seal	V

Seal kit	Material no.
D350/445LEN0040-0100-M	R928028527
D350/445LEN0040-0100-V	R928028528
D350/445LEN0160-0400-M	R928028532
D350/445LEN0160-0400-V	R928028533
D350/445LEN0630-M	R928028536
D350/445LEN0630-V	R928028529
D350/445LEN1000-M	R928028537
D350/445LEN1000-V	R928028534

Assembly, commissioning, maintenance

Installation

- ▶ The max. operating pressure of the system must not exceed the max. admissible operating pressure of the filter (see type plate).
- ▶ During assembly of the filter (see also chapter “Tightening torque”) the flow direction (direction arrows) and the required servicing height of the filter element (see chapter “Dimensions”) must be taken into account.
- ▶ Easy filter element exchange is guaranteed in the installation position filter bowl vertically downwards. For filters with order option - supplementary information 9 - the installation position of the filter bowl is vertically upwards. The maintenance indicator must be arranged in a well visible way.
- ▶ Remove the plastic plugs in the filter inlet and outlet.
- ▶ Ensure that the system is assembled without tension stress.
- ▶ The optional electronic maintenance indicator is connected via the electronic switching element with 1 or 2 switching points, which is attached to the mechanical optical maintenance indicator and held by means of the locking ring.

Commissioning

Commission the system.

Notice:

There is no bleeding provided at the filter. However, some sizes or variants have optional threaded couplings which may also be used for bleeding.

Maintenance

- ▶ If at operating temperature, the red indicator pin reaches out of the mechanical optical maintenance indicator and/or if the switching process in the electronic switching element is triggered, the filter element is contaminated and needs to be replaced and cleaned respectively. More details see data sheet 51450
- ▶ The material number of the corresponding replacement filter element is indicated on the name plate of the complete filter. It must comply with the material number on the filter element.
- ▶ Decommission the system.
- ▶ The operating pressure is to be built up on the system side.

Notice:


There is no bleeding provided at the filter. However, some sizes or variants have optional threaded couplings which may also be used for bleeding.


- ▶ Via the drain screw (from size 0160 fitted by default), the oil on the dirt side can be drained.
- ▶ Unscrew filter bowl (or base with size 1000).
- ▶ Remove the filter element from the spigot by rotating it slightly.
- ▶ Clean the filter components, if necessary.
- ▶ Check the seals at the filter bowl for damage and renew them, if necessary.
For suitable seal kits refer to chapter “Spare parts”.
- ▶ Filter elements made of wire mesh can be cleaned. For detailed cleaning instructions refer to data sheet 51420.
- ▶ Install the new or cleaned filter element on the spigot again by slightly rotating it.
- ▶ The filter is to be assembled in reverse order. **Please note:**
Screw in the filter bowl to the stop, unscrew the filter bowl again by 1/8 to 1/2 rotation so that the filter bowl does not get stuck due to the pressure pulsation and can be loosened easily during maintenance work.
- ▶ The torque specifications (“Tightening torques” chapter) are to be observed.
- ▶ Commission the system and bleed the filter for order option - supplementary information 9

WARNING!

- ▶ Only with order option - supplementary information 9 - upwards installation position of the filter bowl is permitted. This variant guarantees safe bleeding.

Assembly, commissioning, maintenance

 WARNING!	
<ul style="list-style-type: none"> ▶ Assembly and disassembly only with depressurized system! ▶ Filter is under pressure! ▶ Remove the filter bowl only if it is not under pressure! ▶ Do not exchange the mechanical-optical maintenance 	<p style="margin-left: 20px;">indicator while the filter is under pressure!</p> <ul style="list-style-type: none"> ▶ If the flow direction is not considered during assembly, the filter element will be destroyed. Particles get in system and damage the following components.

<p> Notices:</p> <ul style="list-style-type: none"> ▶ All works at the filter only be trained specialists. ▶ Functioning and safety are only guaranteed if original Bosch Rexroth filter elements and spare parts are used. 	<ul style="list-style-type: none"> ▶ Warranty becomes void if the delivered item is changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental condition that do not comply with the installation conditions.
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Tightening torques (dimensions in mm [inch])

Mounting

Series 445LEN...	0040	0063	0100	0160	0250	0400	0160	0250
Screw/tightening torque with $\mu_{total} = 0.14$	M6 / 10.4 Nm \pm 10 %			M12 / 37 Nm \pm 10 %			M16 / 90 Nm \pm 10 %	
Quantity	4							
Recommended property class of screw	8.8							
Minimum screw-in depth	6 mm + 2 mm [0.24 + 0.08]			18 mm + 4 mm [0.7 + 0.16]			24 mm + 4 mm [0.94 + 0.16]	

Filter bowl and maintenance indicator

Series 445LEN...	0040	0063	0100	0160	0250	0400	0160	0250
Tightening torque filter bowl	Screw in the filter bowl to the stop, unscrew the filter bowl again by 1/8 to 1/2 rotation							
Tightening torque maintenance indicator	Max. 50 Nm							
Tightening torque cubic connector screw switching element EN-175301-803	M3/0.5 Nm							

Directives and standardization

Classification according to the Pressure Equipment Directive

The inline filters for hydraulic applications according to 51423 are pressure holding equipment according to article 1, section 2.1.4 of the Pressure Equipment Directive 97/23/EC (PED). However, on the basis of the exception in article 1, section 3.6 of the PEG, hydraulic filters

are exempt from the PED if they are not classified higher than category I (guideline 1/19). The fluids from the chapter “Compatibility with approved pressure fluids” were considered for the classification. They do not receive a CE mark.

Use in potentially explosive areas according to directive 94/9/EC (ATEX)

The inline filters according to 51423 are no equipment or components in the sense of directive 94/9/EC and are not provided with a CE mark. It has been proven with the ignition risk analysis that these inline filters do not have own ignition sources acc. to DIN EN 13463-1:2009.

have an own voltage source. This simple, electronic operating equipment may - according to DIN EN 60079-14:2012 - in intrinsically safe electric circuits (Ex ib) be used in systems without marking and certification. The inline filters and the electronic maintenance indicators described here can be used for the following explosive areas

According to DIN EN 60079-11:2012, electronic maintenance indicators with a switching point:
 WE-1SP-M12 x 1 R928028409
 WE-1SP-EN175301-803 R928036318
 are simple, electronic operating equipment that do not

	zone suitability	
Gas	1	2
Dust	21	22

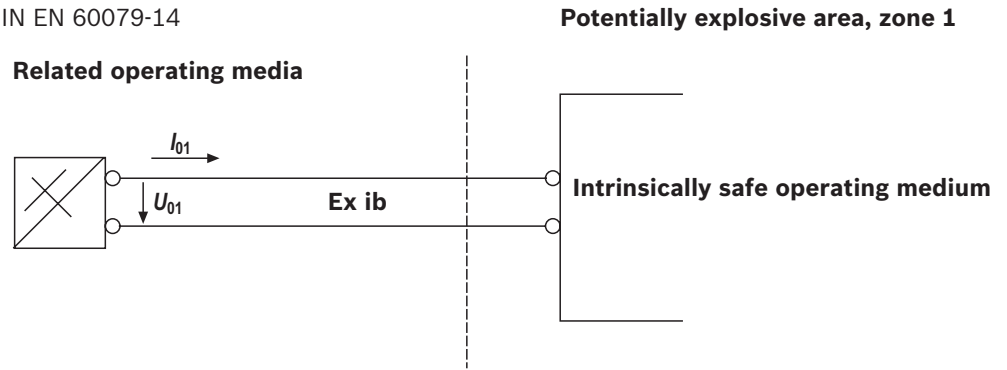
Complete filter with mech./opt. Maintenance indicator			
Use /assignment		Gas 2G	Dust 2D
Assignment		Ex II 2G c IIC TX	Ex II 2D c IIC TX
Conductivity of the medium	pS/m min	300	
Dust accumulation	max	-	0.5 mm

Electronic switching element in the intrinsically safe electric circuit			
Use /assignment		Gas 2G	Dust 2D
Assignment		Ex II 2G Ex ib IIB T4 Gb	Ex II 2D Ex ib IIIC T100°C Db
perm. intrinsically safe electric circuits		Ex ib IIC, Ex ic IIC	Ex ib IIIC
Technical data		Values only for intrinsically safe electric circuit	
Switching voltage	Ui max	150 V AC/DC	
Switching current	Ii max	1.0 A	
Switching power	Pi max	1.3 W T4 T _{max} 40 °C	750 mW T _{max} 40 °C
		1.0 W T4 T _{max} 80 °C	550 mW T _{max} 100 °C
Surface temperature ¹⁾	max	-	100 °C
inner capacity	Ci	negligible	
inner inductivity	Li	negligible	
Dust accumulation	max	-	0.5 mm

¹⁾ The temperature depends on the temperature of the medium in the filter and must not exceed the value specified here.

Directives and standardization

Possible circuit according to DIN EN 60079-14



⚠ WARNING!

- ▶ Explosion hazard due to high temperature!
The temperature depends on the temperature of the medium in the hydraulic circuit and must not exceed the value specified here. Measures are to be taken so that in the potentially explosive area, the max. admissible ignition temperature is not exceeded.
- ▶ When using the inline filters in accordance with 51423 in potentially explosive areas, appropriate equipotential bonding has to be ensured. The filter is preferably to be earthed via the mounting screws. It has to be noted in this connection that paintings and oxidic protective layers are not electrically conductive.
- ▶ During filter element exchanges, the packaging material is to be removed from the replacement element outside the potentially explosive area

👉 Notices:

- ▶ Maintenance only by specialists, instruction by the machine end-user acc. to DIRECTIVE 1999/92/EC appendix II, section 1.1
- ▶ Functional and safety warranty only applicable when using genuine Rexroth spare parts

Notes

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Block mounting filter, for vertical flange-mounting

RE 51417/12.10
Replaces: 07.10

1/18

Type 450PBFN0040 to 1000; 450PBF0130, 0150

Size according to **DIN 24550**: 0040 to 1000
 Additional sizes: 0130, 0150
 Nominal pressure 450 bar [6530 psi]
 Connection up to DN 40
 Operating temperature -10 °C to 100 °C [14 °F to 212 °F]



Filter_75_d

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Features

- Special highly efficient filter media
- Adsorption of very fine particles across a broad pressure differential range
- High dirt holding capacity thanks to large specific filter area
- Good chemical resistance of the filter elements
- High collapse resistance of the filter elements (e.g. in case of cold start)
- Filter ratings of $3\text{ }\mu\text{m}$ to $100\text{ }\mu\text{m}$
- By default equipped with mechanical optical maintenance indicator with memory function
- Flow-optimized design due to 3D computer-supported design

Ordering code

of the filter

450 PBF — 00—V5,0—

Pressure 450 bar [6530 psi]	= 450
Block mounting filter, For vertical flange-mounting	= PBF
Filter element According to DIN 24550	= N
Size PBFN...	= 0040 0063 0100 0160 0250 0400 0630 1000
PBF...	= 0130 0150
Filter rating in µm nominal Stainless steel wire mesh, cleanable G10, G25, G40, G100	= G...
absolute (ISO 16889) Micro glass, not cleanable H3XL, H6XL, H10XL, H20XL	= H...XL
Pressure differential Max. admissible pressure differential of the filter element 30 bar [435 psi], with bypass valve 7 bar [102 psi]	= A
330 bar [4786 psi], without bypass valve	= B
Element design Standard adhesive T = 100 °C [212 °F]	= 0...
Standard material	= ...0

Complementary details	
without =	No complementary details
-A1 =	Connection nominal width 32 (size 0630 – 1000)
Seal	
M =	NBR seal
V =	FKM seal
Maintenance indicator	
V5,0 =	Maintenance indicator, optical specify switching pressure 5.0 bar [72.5 psi]

Order example:
450PBFN0063-H3XLB00-V5,0-M
Material no.: R928023332

Further versions (filter materials, connections,...) are available at request.

of the filter element

2. — 0 —

Filter element Design	= 2.
Size PSFN...	= 0040 0063 0100 0160 0250 0400 0630 1000
PSF...	= 0130 0150
Filter rating in µm nominal Stainless steel wire mesh, cleanable G10, G25, G40, G100	= G...
absolute (ISO 16889) Micro glass, not cleanable H3XL, H6XL, H10XL, H20XL	= H...XL
Pressure differential Max. admissible pressure differential of the filter element 30 bar [435 psi], with bypass valve 7 bar [102 psi]	= A
330 bar [4786 psi], without bypass valve	= B

Seal	
M =	NBR seal
V =	FKM seal
Bypass valve	
0 =	at filter element always 0
Element design	
0... =	Standard adhesive T = 100 °C [212 °F]
...0 =	Standard material

Order example:
2.0063 H3XL-B00-0-M
Material no.: R928006708

Standard types

NBR seal, without bypass, flow specifications for $v = 30 \text{ mm}^2/\text{s}$

Block mounting filter 450PFB(N), filter rating **3 μm**

Type	Flow in l/min [gpm] with $\Delta p = 1.5 \text{ bar}$ [21.8 psi] ¹⁾	Material no. Filter	Material no. Replacement element
450PBFN0040-H3XLB00-V5,0-M	28 [7.4 gpm]	R928023331	R928006654
450PBFN0063-H3XLB00-V5,0-M	37 [9.8 gpm]	R928023332	R928006708
450PBFN0100-H3XLB00-V5,0-M	42 [11.1 gpm]	R928023333	R928006762
450PBF0130-H3XLB00-V5,0-M	80 [21.1 gpm]	R928023334	R928022310
450PBF0150-H3XLB00-V5,0-M	94 [24.8 gpm]	R928023335	R928022319
450PBFN0160-H3XLB00-V5,0-M	160 [42.3 gpm]	R928023336	R928006816
450PBFN0250-H3XLB00-V5,0-M	225 [59.4 gpm]	R928023337	R928006870
450PBFN0400-H3XLB00-V5,0-M	260 [68.7 gpm]	R928023338	R928006924
450PBFN0630-H3XLB00-V5,0-M	350 [92.5 gpm]	R928023339	R928006978
450PBFN1000-H3XLB00-V5,0-M	380 [100.4 gpm]	R928023340	R928007032

Block mounting filter 450PFB(N), filter rating **6 μm**

Type	Flow in l/min [gpm] with $\Delta p = 1.5 \text{ bar}$ [21.8 psi] ¹⁾	Material no. Filter	Material no. Replacement element
450PBFN0040-H6XLB00-V5,0-M	38 [10.0 gpm]	R928023411	R928006655
450PBFN0063-H6XLB00-V5,0-M	43 [11.4 gpm]	R928023412	R928006709
450PBFN0100-H6XLB00-V5,0-M	48 [12.7 gpm]	R928023413	R928006763
450PBF0130-H6XLB00-V5,0-M	100 [26.4 gpm]	R928023414	R928022311
450PBF0150-H6XLB00-V5,0-M	115 [30.4 gpm]	R928023415	R928022320
450PBFN0160-H6XLB00-V5,0-M	210 [55.5 gpm]	R928023416	R928006817
450PBFN0250-H6XLB00-V5,0-M	250 [66.0 gpm]	R928023417	R928006871
450PBFN0400-H6XLB00-V5,0-M	270 [71.3 gpm]	R928023418	R928006925
450PBFN0630-H6XLB00-V5,0-M	380 [100.4 gpm]	R928023419	R928006979
450PBFN1000-H6XLB00-V5,0-M	420 [111.0 gpm]	R928023420	R928007033

Block mounting filter 450PFB(N), filter rating **10 μm**

Type	Flow in l/min [gpm] with $\Delta p = 1.5 \text{ bar}$ [21.8 psi] ¹⁾	Material no. Filter	Material no. Replacement element
450PBFN0040-H10XLB00-V5,0-M	43 [11.4 gpm]	R928023491	R928006656
450PBFN0063-H10XLB00-V5,0-M	48 [12.7 gpm]	R928023492	R928006710
450PBFN0100-H10XLB00-V5,0-M	52 [13.7 gpm]	R928023493	R928006764
450PBF0130-H10XLB00-V5,0-M	110 [29.1 gpm]	R928023494	R928022312
450PBF0150-H10XLB00-V5,0-M	125 [33.0 gpm]	R928023495	R928022321
450PBFN0160-H10XLB00-V5,0-M	240 [63.4 gpm]	R928023496	R928006818
450PBFN0250-H10XLB00-V5,0-M	260 [68.7 gpm]	R928023497	R928006872
450PBFN0400-H10XLB00-V5,0-M	280 [74.0 gpm]	R928023498	R928006926
450PBFN0630-H10XLB00-V5,0-M	400 [105.7 gpm]	R928023499	R928006980
450PBFN1000-H10XLB00-V5,0-M	450 [118.9 gpm]	R928023500	R928007034

¹⁾ Measured pressure differential across filter and measuring equipment according to ISO 3968. The measured pressure differential at the maintenance indicator is lower.

Ordering code: Electronic switching element for maintenance indicator

ABZ	F	V	-	-1X	/	-DIN
-----	---	---	---	-----	---	------

Rexroth plant construction accessories

Filter

Maintenance indicator

Electronic switching element with 1 switching point (changeover)
round plug-in connection M12x1**= E1SP-M12X1**Electronic switching element with 2 switching points (normally open/
normally closed), 75 %, 100 %, round plug-in
connection M12x1, 3 LED**= E2SP-M12X1**Electronic switching element with 2 switching points (normally open/
normally closed), 75 %, 100 %, signal suppression until 30 °C
round plug-in connection M12x1, 3 LED**= E2SPSU-M12X1****-DIN =**

Mark for DIN version

1X =**Component series**Component series 10 to 19
(10 to 19; identical installation
and connection dimensions)

Electronic switching element	Material no.
ABZFV-E1SP-M12X1-1X/-DIN	R901025339
ABZFV-E2SP-M12X1-1X/-DIN	R901025340
ABZFV-E2SPSU-M12X1-1X/-DIN	R901025341

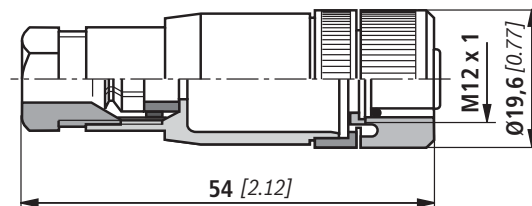
Order example: Block mounting filter with mechanical optical maintenance indicator for $p_{nom.} = 450 \text{ bar}$ [6527 psi] without bypass valve, size 0063, with filter element $10 \mu\text{m}$ and electronic switching element M12x1 with 1 switching point for hydraulic fluid mineral oil HLP according to DIN 51524.

Filter: 450PBFN0063-H10XLB00-V5,0-M**Material number: R928023492****Maintenance indicator:** ABZFV-E1SP-M12X1-1X/-DIN**Material number: R901025339****Mating connectors according to IEC 60947-5-2** (dimensions in mm [inch])

For electronic switching element with round plug-in connection M12 x 1

**Mating connector for K24 4-pin, M12 x 1
with screw connection, cable gland Pg9.**

Material no. R900031155



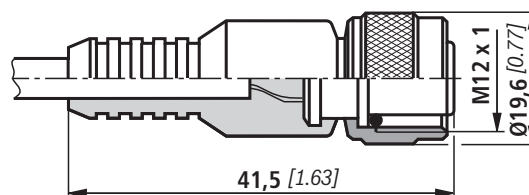
**Mating connector for K24-3m 4-pin, M12 x 1
with potted-in PVC cable, 3 m long.**

Line diameter: 4 x 0.34 mm²

Core marking:

1	Brown
2	White
3	Blue
4	Black

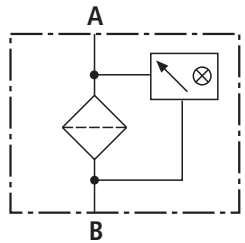
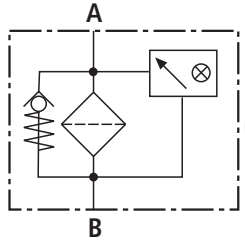
Material no. R900064381



For more round plug-in connections, see data sheet 08006.

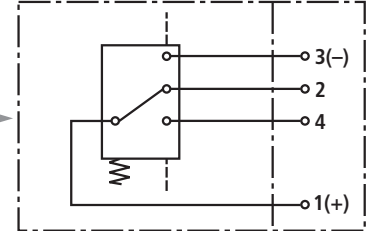
Symbols

Block mounting filter



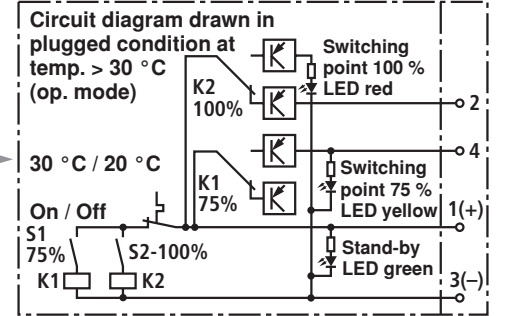
Electronic switching element for maintenance indicator

Switching element Plug-in connector



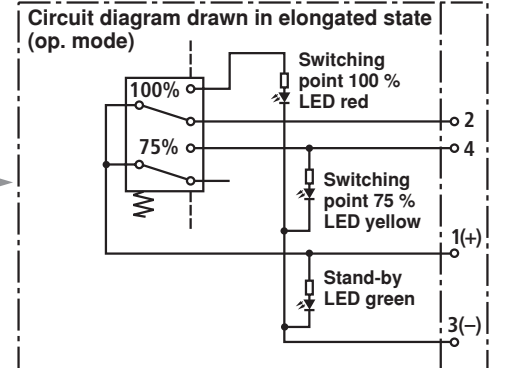
ABZFV-E1SP-M12X1-1X/-DIN

Switching element Plug-in connector



ABZFV-E2SPSU-M12X1-1X/-DIN

Switching element Plug-in connector



ABZFV-E2SP-M12X1-1X/-DIN

Function, section

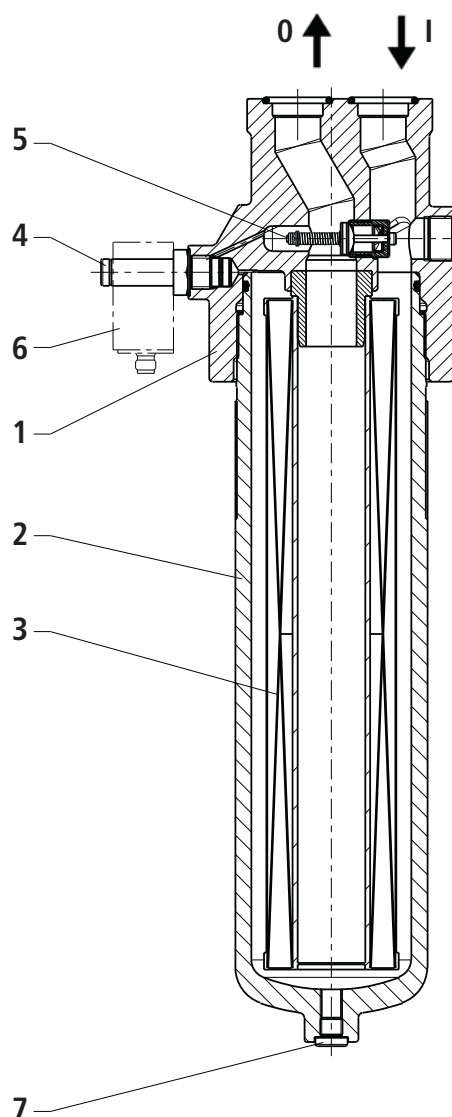
Block mounting filters are suitable for direct attachment in pump blocks and manifolds. They are installed upstream control units or controllers to be protected.

They basically consist of filter head (1), a screwable filter bowl (2), filter element (3) as well as mechanical optical maintenance indicator (4). In case of filters with low-pressure-differential-stable filter elements (= code letter pressure differential A), there is also an assembled bypass valve (5).

Via port I, the hydraulic fluid reaches the filter element (3) where it is cleaned. The dirt particles filtered out settle in the filter bowl (2) and in the filter element (3). Via port 0, the filtered hydraulic fluid enters the hydraulic circuit.

The filter housing and all connection elements are designed so that pressure peaks - as they may e.g. occur in case of the abrupt opening of large control valves due to the accelerated fluid weight - can be securely absorbed. As of size 0160, the standard equipment comprises an oil drain plug (7). With size 1000, the filter bowl has a two-part design.

Basically, the filter is equipped with mechanical optical maintenance indicator (4). The electronic maintenance indicator is connected via the electronic switching element with 1 or 2 switching points (6), which has to be ordered separately. The electronic switching element is attached to the mechanical optical maintenance indicator and held by means of a locking ring.



Technical data (For applications outside these parameters, please consult us!)**general**

Installation position		Vertical				
Ambient temperature range		°C [°F] -30 to +100 [-22 to +212]				
Weight	Size	0040	0063	0100	0130	0150
	kg [lbs]	5 [11]	5.5 [12.1]	6.4 [14.1]	11.9 [26.2]	12.9 [28.4]
Weight	Size	0160	0250	0400	0630	1000
	kg [lbs]	15.9 [35.1]	16.5 [36.3]	19.9 [43.8]	37.5 [82.5]	48 [106]
Material	Filter head	GGG				
	Filter bowl	Steel				
	Optical maintenance indicator	Brass				
	Electronic switching element	Plastic PA6				

hydraulic

Maximum operating pressure	bar [psi]	450 [6530]
Hydraulic fluid temperature range	°C [°F]	-10 to +100 [+14 to +212] (shortly -30 [-22])
Fatigue strength according to ISO 10771	Load cycles	> 10 ⁶ with max. operating pressure
Cracking pressure of the bypass valve	bar [psi]	7 ± 0.5 [100 ± 7]
Type of pressure measurement of the maintenance indicator		Differential pressure
Response pressure of the maintenance indicator	bar [psi]	5 ± 0.5 [72 ± 7]

electrical (electronic switching element)

Electrical connection		Round plug-in connection M12 x 1, 4-pin
Contact load, direct voltage		A max. 1
Voltage range	E1SP-M12x1 V DC/AC	max. 150
	E2SP V DC	10 to 30
Max. switching power with resistive load		20 VA; 20 W; (70 VA)
Switching type	E1SP-M12x1	Changeover
	E2SP-M12x1	Normally open contact at 75 % of the response pressure, normally closed contact at 100 % of the response pressure
	E2SPSU-M12x1	Normally open contact at 75 % of the response pressure, normally closed contact at 100 % of the response pressure Signal interconnection at 30 °C [86 °F], return switching at 20 °C [68 °F]
Display via LEDs in the electronic switching element E2SP...		Stand-by (LED green); 75 % switching point (LED yellow); 100 % switching point (LED red)
Protection class according to EN 60529		IP 65

For direct voltage above 24 V, a spark extinguishing is to be planned to protect the switching contacts.

Weight	Electronic switching element: – with round plug-in connection M12 x 1	kg [lbs]	0.1 [0.22]
--------	--	----------	------------

Technical data (For applications outside these parameters, please consult us!)**Filter element**

Glass fiber paper H..XL			Single-use element on the basis of inorganic fiber
			Filtration ratio according to ISO 16889 up to $\Delta p = 5 \text{ bar [72.5 psi]}$
			Achievable oil cleanliness according to ISO 4406 [SAE-AS 4059]
	H20XL		$\beta_{20}(c) \geq 200$
	H10XL		$\beta_{10}(c) \geq 200$
	H6XL		$\beta_6(c) \geq 200$
	H3XL		$\beta_5(c) \geq 200$
Admissible pressure differential	A	bar [psi]	30 [435]
	B	bar [psi]	330 [4786]

Seal material for hydraulic fluids

Mineral oil			Ordering code
Mineral oil	HLP	according to DIN 51524	M
Flame-resistant hydraulic fluids			Ordering code
Emulsions	HFA-E	according to DIN 24320	M
Synthetic water solutions	HFA-S	according to DIN 24320	M
Water solutions	HFC	according to VDMA 24317	M
Phosphoric acid esters	HFD-R	according to VDMA 24317	V
Organic esters	HFD-U	according to VDMA 24317	V
Fast biodegradable hydraulic fluids			Ordering code
Triglycerides (rape seed oil)	HETG	according to VDMA 24568	M
Synthetic esters	HEES	according to VDMA 24568	V
Polyglycols	HEPG	according to VDMA 24568	V

Characteristic curves (measured with HLP46, according to ISO 3968)

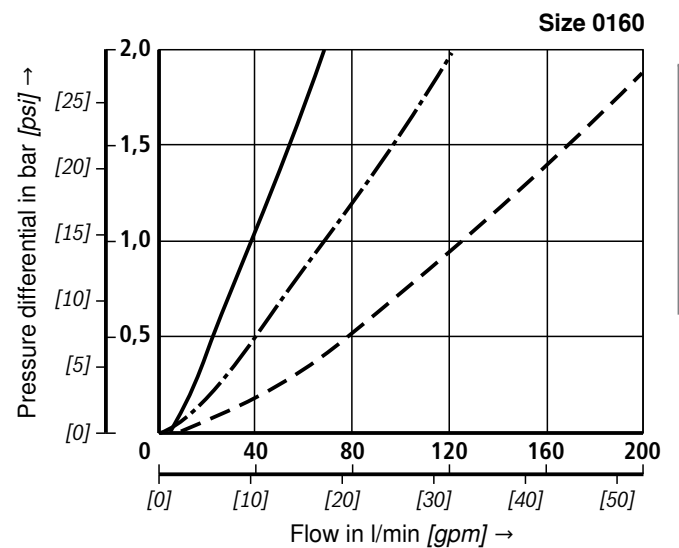
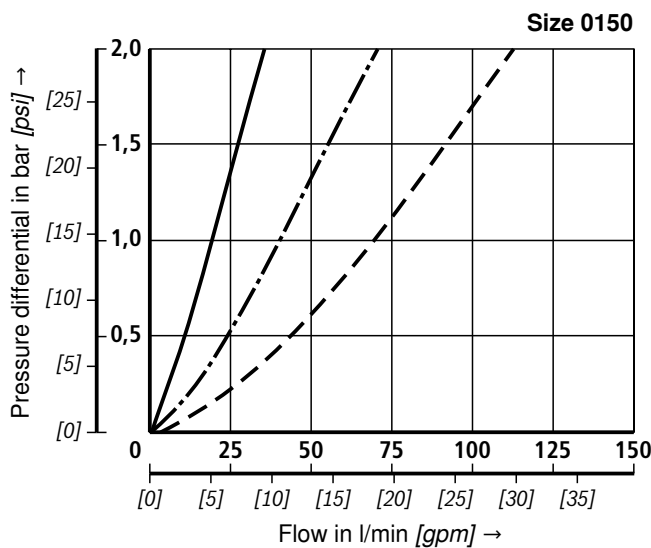
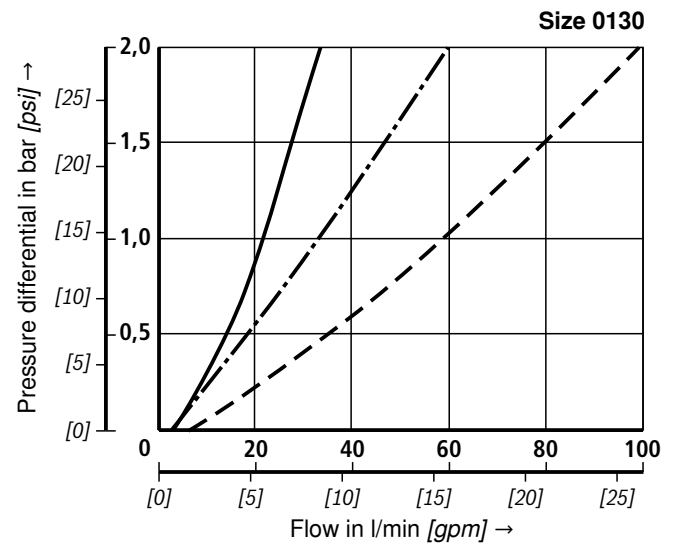
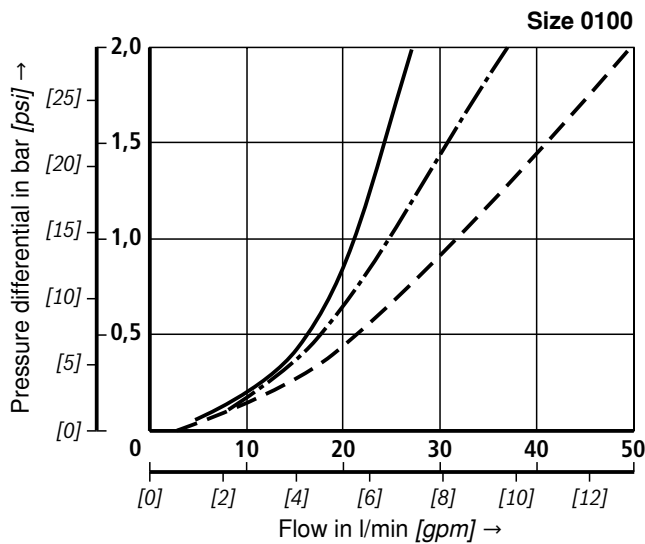
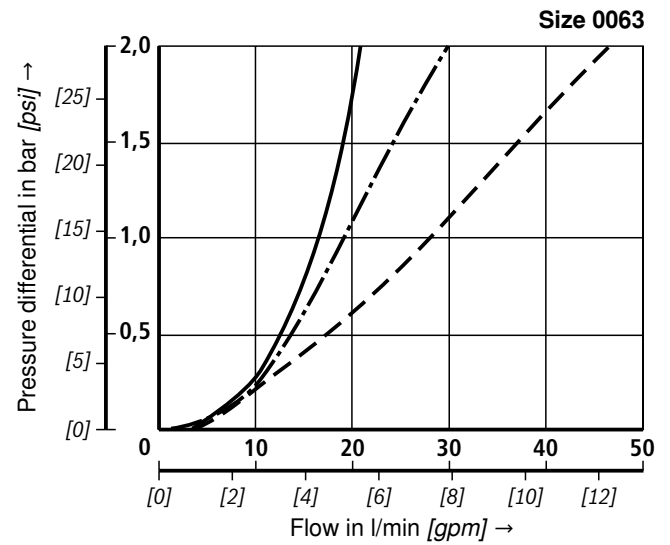
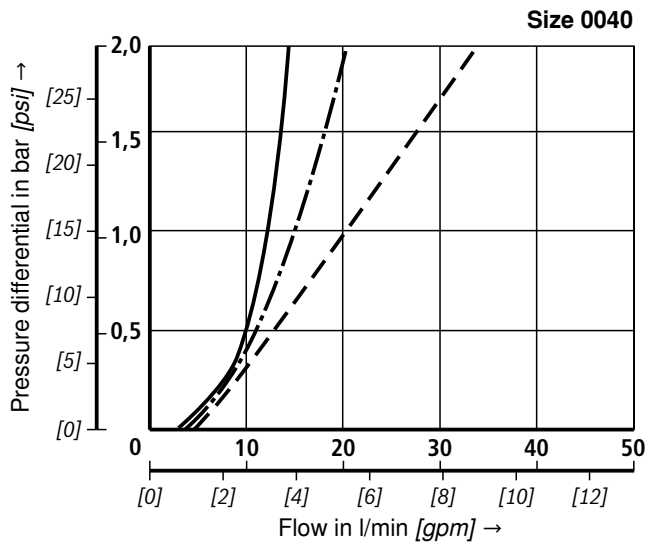
H3XL...

Specific weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters
recommended initial Δp for design = 1.5 bar

A proper filter design is enabled by our computer program
"BRFilterSelect".

Oil viscosity:
 — 140 mm²/s [649 SUS]
 - · - 68 mm²/s [315 SUS]
 - - - 30 mm²/s [142 SUS]



Characteristic curves (measured with HLP46, according to ISO 3968)

H3XL...

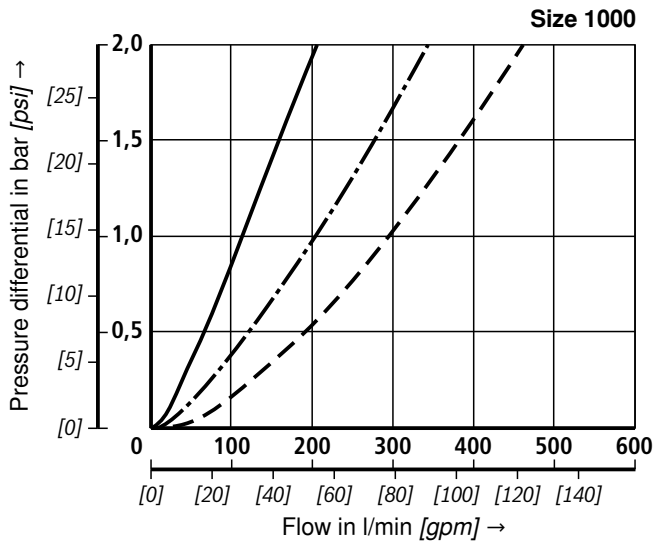
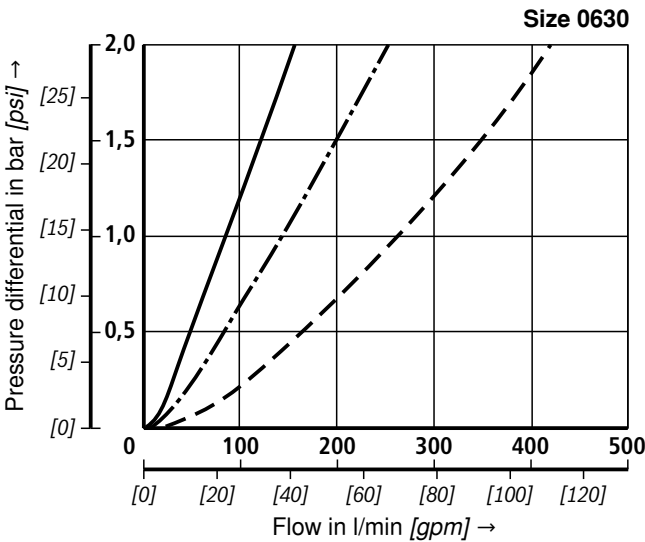
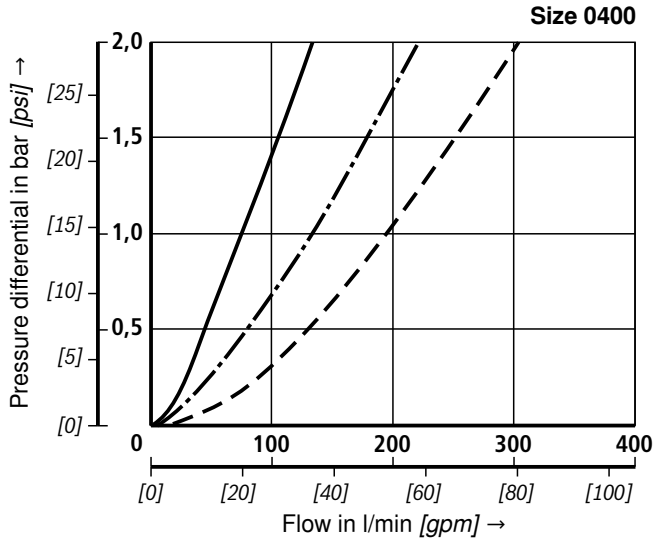
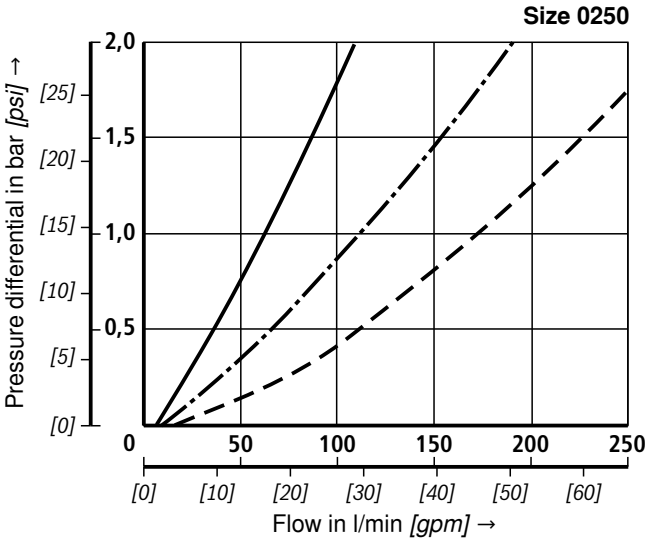
Specific weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters
recommended initial Δp for design = 1.5 bar

A proper filter design is enabled by our computer program
"BRFilterSelect".

- 140 mm²/s [649 SUS]
- · - 68 mm²/s [315 SUS]
- - - 30 mm²/s [142 SUS]

Oil viscosity:



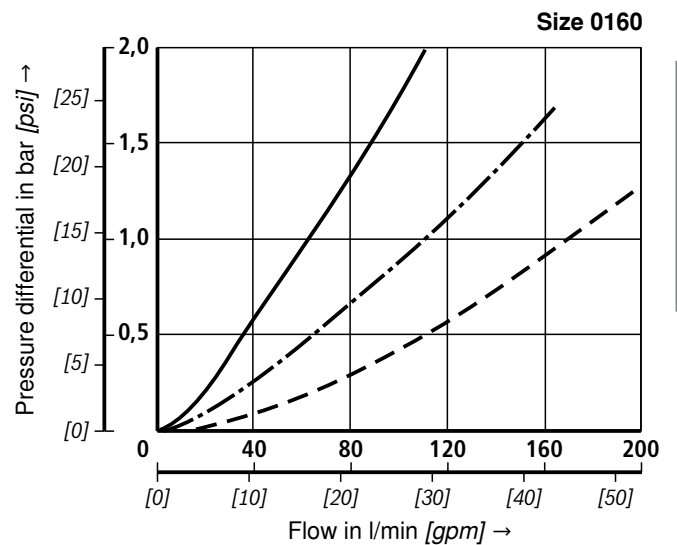
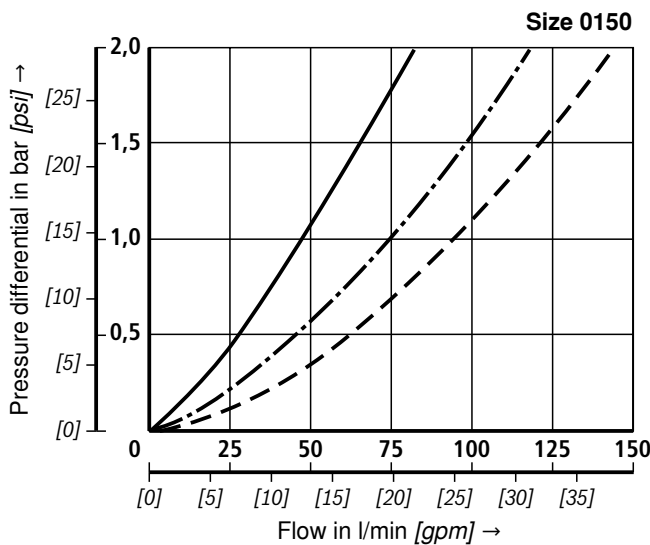
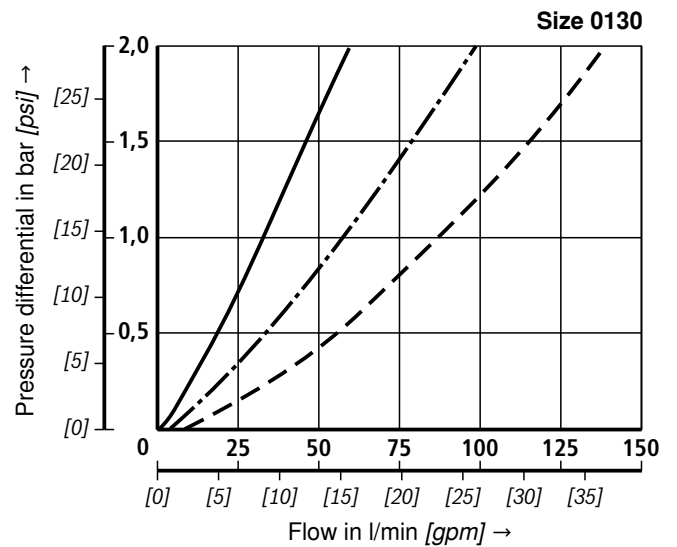
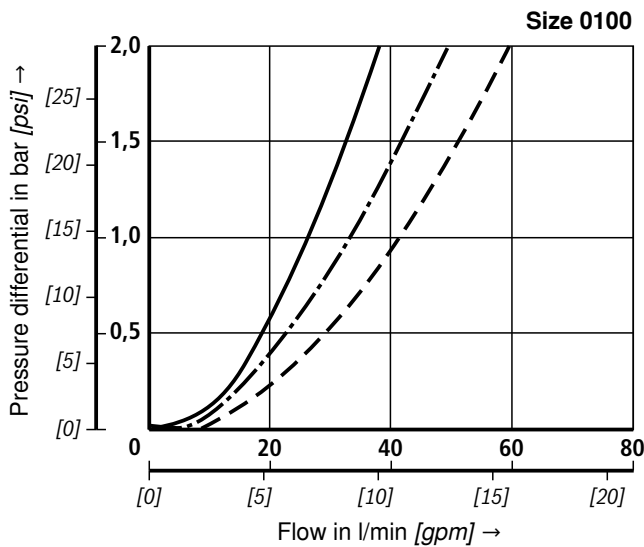
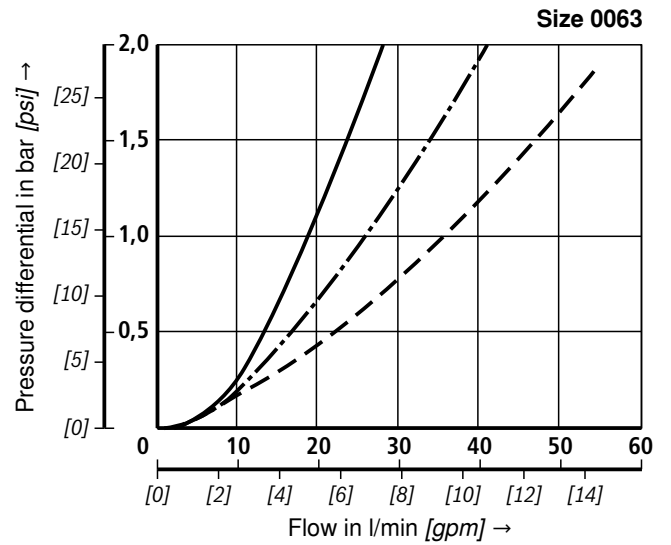
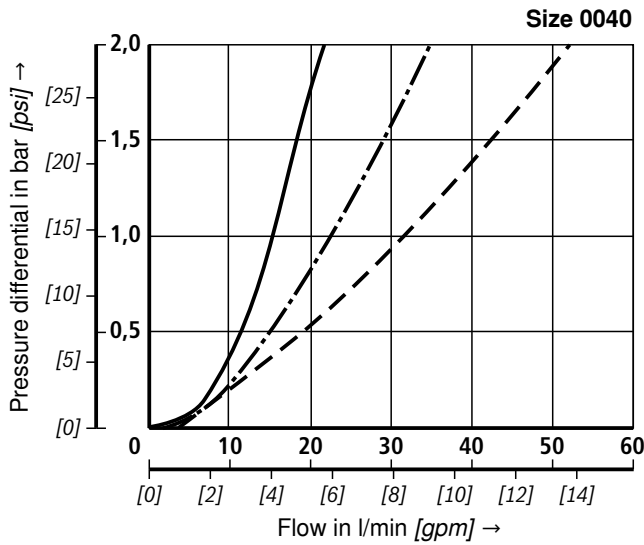
Characteristic curves (measured with HLP46, according to ISO 3968)

H10XL...

Specific weight: < 0.9 kg/dm³
 Δp -Q characteristic curves for complete filters
 recommended initial Δp for design = 1.5 bar

A proper filter design is enabled by our computer program
 "BRFilterSelect".

Oil viscosity:
 — 140 mm²/s [649 SUS]
 - · - 68 mm²/s [315 SUS]
 - - - 30 mm²/s [142 SUS]



Characteristic curves (measured with HLP46, according to ISO 3968)

H10XL...

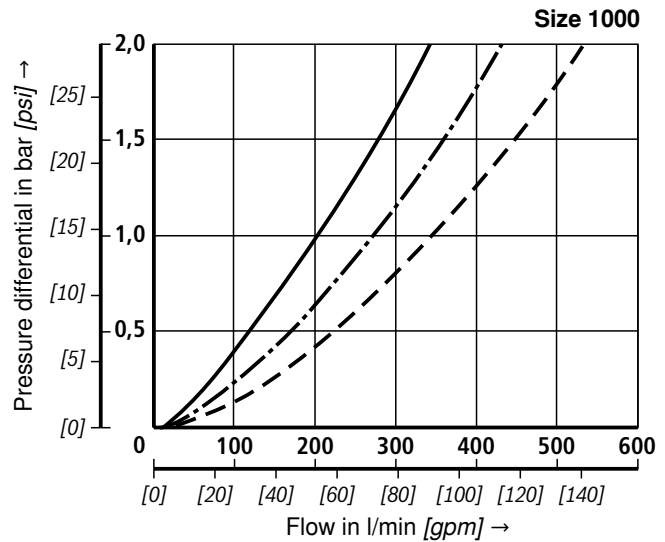
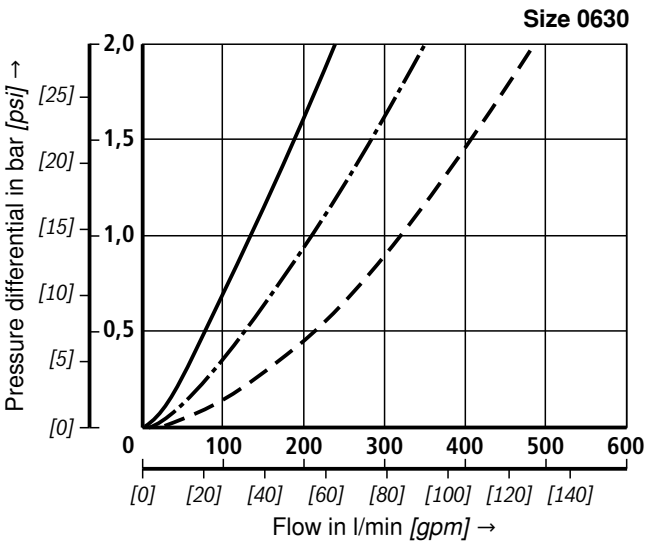
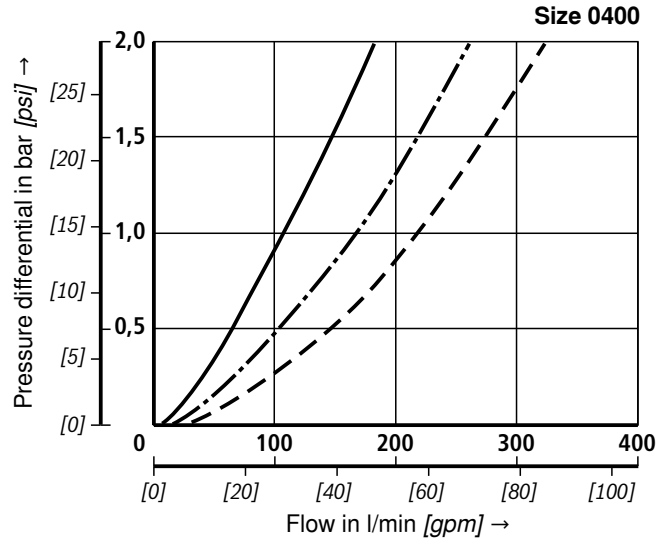
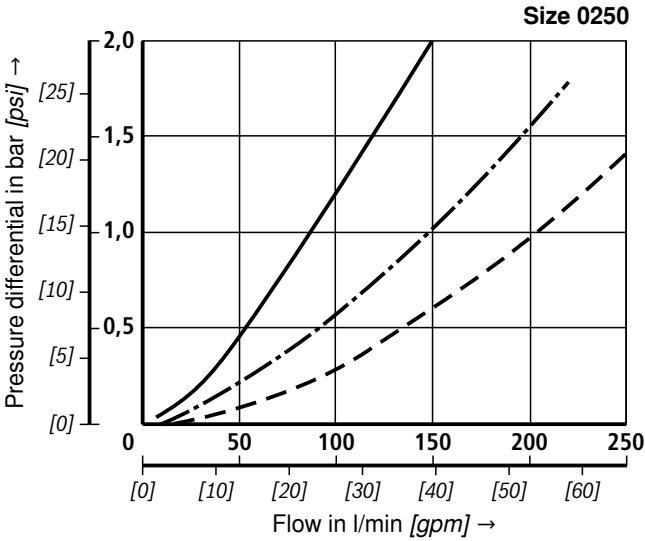
Specific weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters
recommended initial Δp for design = 1.5 bar

A proper filter design is enabled by our computer program
"BRFilterSelect".

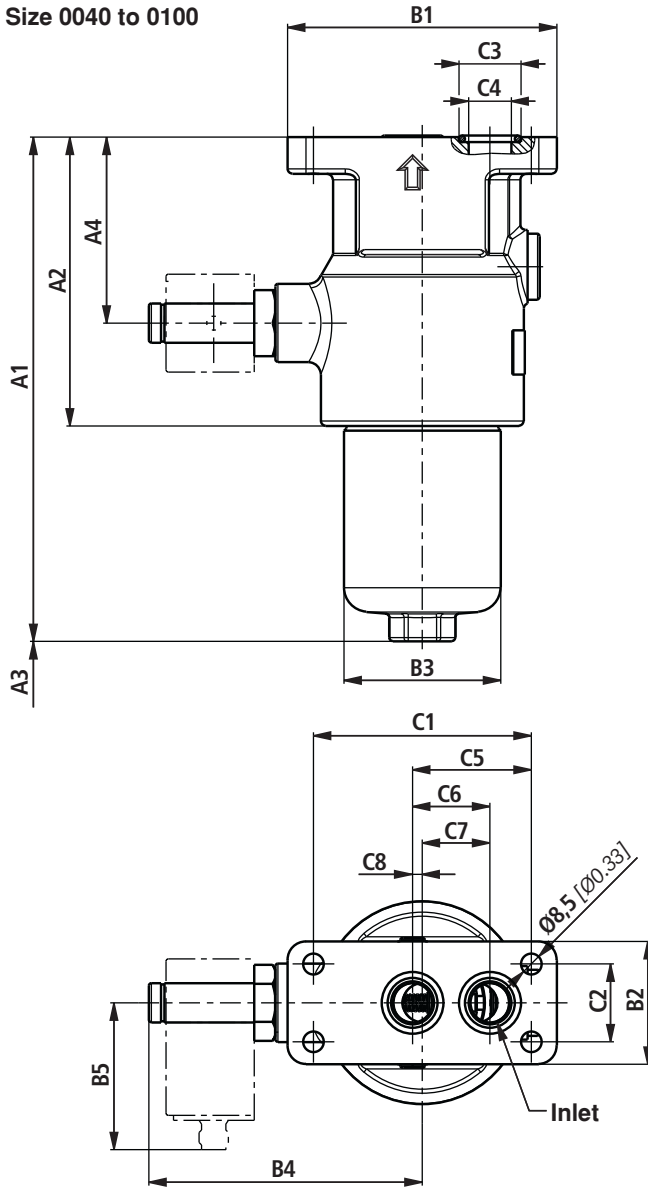
- 140 mm²/s [649 SUS]
- · - 68 mm²/s [315 SUS]
- - - 30 mm²/s [142 SUS]

Oil viscosity:

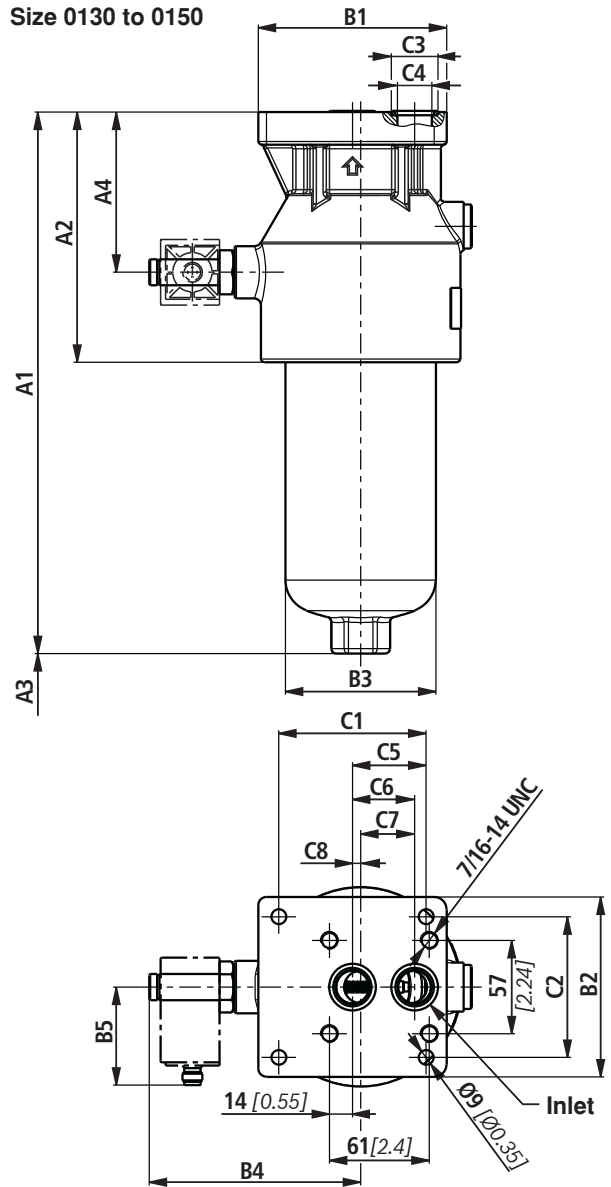


Unit dimensions size 0040 to size 0150 (dimensions in mm [inch])

Size 0040 to 0100



Size 0130 to 0150



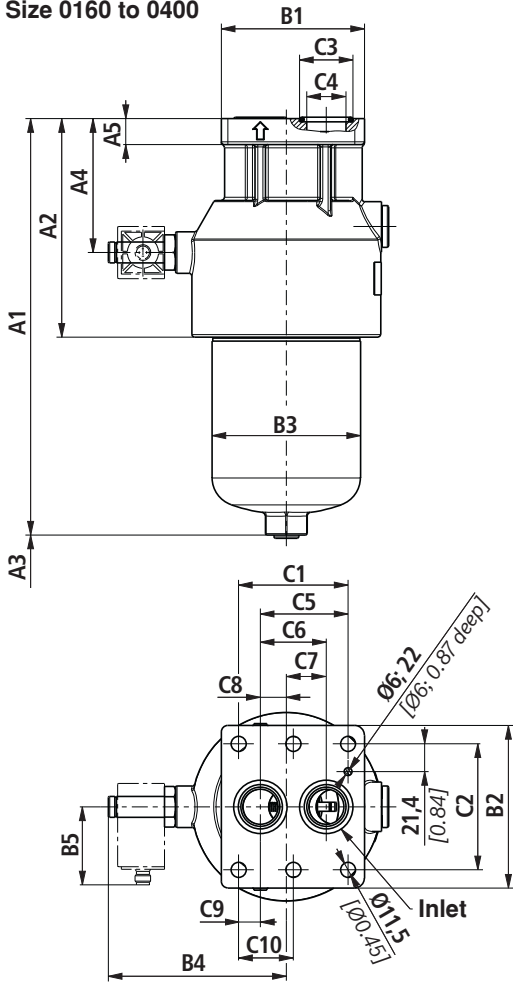
Type 450 PBF(N)...	Content in l [US gal]	A1	A2	A3 ¹⁾	A4	B1	B2	B3 Ø	B4
0040	0.25 [0.06]	206 [8.11]	118 [4.65]	100 [3.94]	76 [2.99]	110 [4.33]	50 [1.97]	64 [2.52]	112 [4.41]
0063	0.36 [0.09]	270 [10.6]							
0100	0.55 [0.14]	360 [14.2]							
0130	0.95 [0.25]	331 [13.0]	153 [6.03]	120 [4.72]	98 [3.86]	115 [4.53]	110 [4.33]	92 [3.62]	129 [5.08]
0150	1.15 [0.30]	382 [15.0]							

Type 450 PBF(N)...	B5	C1	C2	C3 Ø	C4 Ø	C5	C6	C7	C8
0040	60 [2.36]	89 [3.50]	31.8 [1.25]	25.3 [0.99]	17.5 [0.69]	48.5 [1.91]	31.6 [1.24]	27.6 [1.09]	4 [0.16]
0063									
0100									
0130		90 [3.54]	86 [3.39]	28.6 [1.13]	21 [0.83]	45 [1.77]	38 [1.50]	33 [1.30]	5 [0.20]
0150									

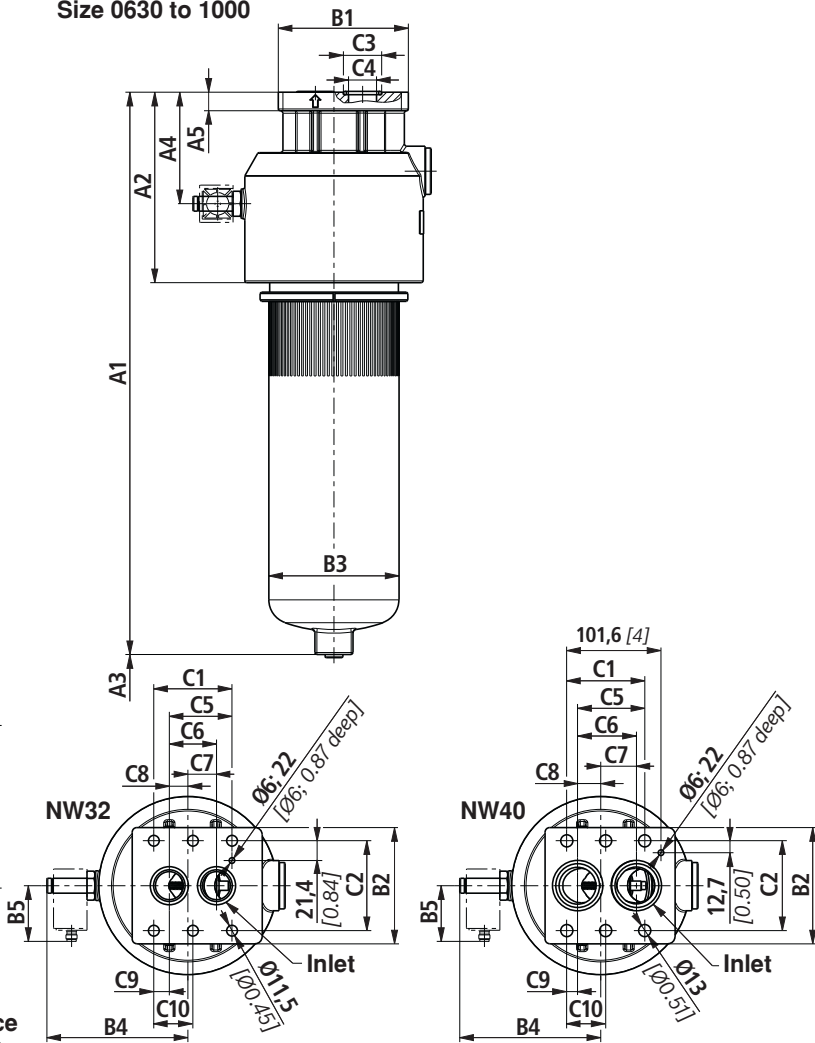
¹⁾ Servicing height for filter replacement

Unit dimensions size 0160 to size 1000 (dimensions in mm [inch])

Size 0160 to 0400



Size 0630 to 1000



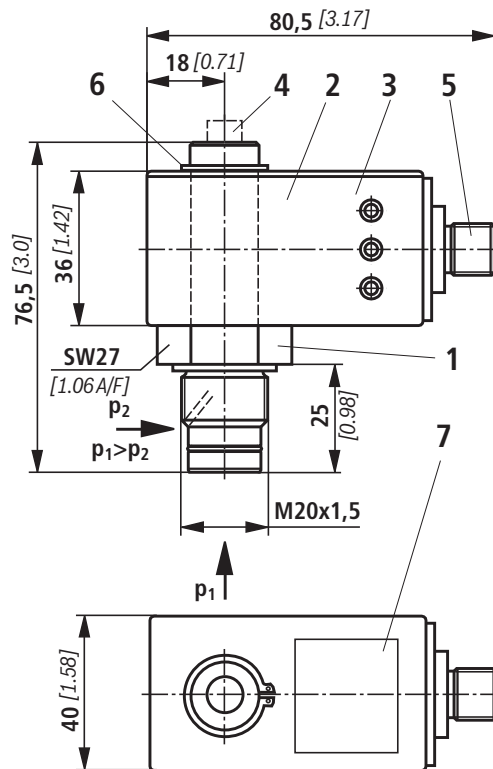
Filter housing for filter elements in accordance with DIN 24550 and according to BR standard

Type 450 PBF(N)...	Content in l [US gal]	A1	A2	A3 ¹⁾	A4	A5	B1	B2	B3	B4	B5
0160	1.6 [0.42]	320 [12.6]	168 [6.61]	120 [4.72]	103 [4.06]	22 [0.87]	110 [4.33]	125 [4.92]	114 [4.49]	137 [5.39]	60 [2.36]
0250	2.2 [0.58]	410 [16.1]									
0400	3.5 [0.92]	560 [22.05]									
0630	5.0 [1.32]	605 [23.82]	205 [8.07]	160 [6.30]	120 [4.72]	140 [5.51]	125 [4.92]	140 [5.51]	152 [5.98]	60 [2.36]	
1000	6.5 [1.72]	843 [33.20]		650 [25.6]				190 [7.48]			
A1 0630	5.0 [1.32]	605 [23.82]		160 [6.30]				140 [5.51]			
A1 1000	6.5 [1.72]	843 [33.20]		650 [25.6]				190 [7.48]			

Type 450 PBF(N)...	C1	C2	C3 Ø	C4 Ø	C5	C6	C7	C8	C9	C10
0160	84.1 [3.31]	96.8 [3.81]	41 [1.61]	30 [1.18]	67.4 [2.65]	50.7 [1.99]	30.7 [1.21]	20 [0.79]	16.7 [0.66]	42.05 [1.66]
0250			54.3 [2.14]	40 [1.57]	72.4 [2.85]	63.5 [2.50]	38.5 [1.52]	25 [0.98]	11.7 [0.46]	
0400										
0630										
1000	41 [1.61]	30 [1.18]	67.4 [2.65]	50.7 [1.99]	30.7 [1.21]	20 [0.79]	16.7 [0.66]			
A1 0630										
A1 1000										

¹⁾ Servicing height for filter replacement

Maintenance indicator (dimensions in mm)



- 1 Mechanical optical maintenance indicator; max. tightening torque $M_{A \max} = 50 \text{ Nm}$ [36.88 lb-ft]
- 2 Switching element with locking ring for electrical maintenance indicator (can be rotated by 360°); Plug-in connection M12x1 or according to DIN EN 175201-804
- 3 Housing with three LEDs: 24 V =
Green: Stand-by
Yellow: Switching point 75 %
Red: Switching point 100 %
- 4 Optical indicator bistable
- 5 Round connector M12x1, 4-pin
- 6 Locking ring
- 7 Name plate

Notes:

Presentation contains mechanical optical maintenance indicator (1) and electronic switching element (2).

Round plug-in connection M12x1 (5)

For connection e.g. to ABZFV-E1SP-M12x1-1X/-DIN (see page 17).

Switching elements with increased switching power at request.

Spare parts

Mechanical optical maintenance indicator

ABZ | F | V - HV5 - 1X / - DIN

Rexroth plant construction accessories

Filter

Maintenance indicator

Mechanical optical maintenance indicator for high-pressure filters switching point 5 bar [72 psi]

= HV5

DIN = Mark for DIN and SAE version

M =

V =

Seal material

NBR seal

FKM seal

Component series

Component series 10 to 19 (10 to 19; identical installation and connection dimensions)

1X =

Mechanical optical maintenance indicator	Material no.
ABZ FV-HV5-1X/M-DIN	R901025313

Seal kit

D | 450PBF

Seal kit

Type 450PBF

Size

Size 0040-0100

= N0040-0100

Size 0130-0150

= 0130-0150

Size 0160-0400

= N0160-0400

Size 0630

= N0630

Size 1000

= N1000

Size 0630, port A1

= N0630-A1

Size 1000, port A1

= N1000-A1

M =

V =

Seal

NBR seal

FKM seal

Seal kit	Material no.
SEAL KIT D450PBFN0040-0100-M	R961005214
SEAL KIT D450PBF0130-0150-M	R961005212
SEAL KIT D450PBFN0160-0400-M	R961005216
SEAL KIT D450PBFN0630-M	R961005218
SEAL KIT D450PBFN1000-M	R961005220

Installation, commissioning and maintenance

Installation of the filter

Verify operating pressure with name plate information. Remove blanking plugs from filter inlet and outlet, mount filter at the manifold without tension stress considering flow direction (direction arrows) and servicing height of the filter element. The filter must preferably be installed with the filter bowl (2) downward. The maintenance indicator must be arranged in a well visible way.

Connection of the electrical maintenance indicator

Basically, the filter is equipped with mechanical optical maintenance indicator (4). The electronic maintenance indicator is connected via the switching element (6) with 1 or 2 switching points, which is attached to the mechanical optical maintenance indicator and held by means of the locking ring.

When must the filter element be exchanged or cleaned respectively?

Upon start-up in cold condition, the red pushbutton of the optical maintenance indicator (4) may jump out and an electrical signal is output via the switching element (6). Only push the red pushbutton in again after the operating temperature has been reached. If it jumps out again immediately or if the electrical signal has not gone out at operating temperature, the filter element must be exchanged or cleaned respectively after the end of the shift.

Element exchange

- Switch off the system and discharge the filter on the pressure side.
- Screw off the filter bowl (2) or the floor (size 1000) by anticlockwise rotation. Clean the filter housing in a suitable medium.
- Remove the filter element (3) from the centering spigot in the filter head by turning it slightly
- Check the seal ring and the support ring in the filter bowl for position and damage. If necessary, these parts are to be renewed.
- Replace filter elements H...XL, clean the filter element with material G...
- The efficiency of the cleaning process depends on the characteristics of contamination and the final pressure drop prior to servicing / cleaning the filter element. If the pressure differential after the filter element exchange exceeds 50 % of the value before the filter element exchange, the G... element also needs to be replaced.
- Check whether the type designation or material number on the replacement element corresponds to the type designation/material number on the name plate of the filter.
- Install replaced or cleaned filter element on the spigot again by slightly turning it.
- Now screw in the filter bowl or floor to stop. Then turn out the filter bowl by 1/8 to 1/2 turn so that the filter bowl is not stuck due to the pressure pulsation and can be easily loosened in case of maintenance works.

Quality and standardization

The block mounting filters for hydraulic applications according to 51417 are pressure holding equipment according to article 1, section 2.1.4 of the pressure equipment directive 97/23/EC (PED). However, on the basis of the exception in article 1, section 3.6 of the PED, hydraulic filters are exempt from the PED if they are not classified higher than category I (guideline 1/19). They do not receive a CE mark.

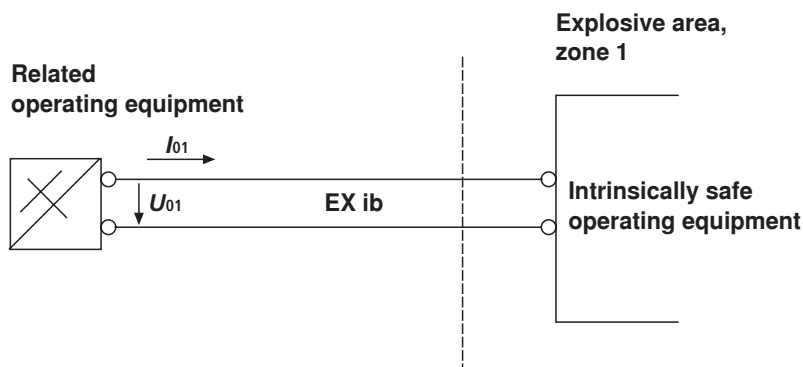
Use in explosive areas according to directive 94/9/EC (ATEX)

The block mounting filters according to 51417 are no equipment or components in the sense of directive 94/9/EC and are not provided with a CE mark.

When using the block mounting filters according to 51417 in explosive areas, potential equalization has to be ensured.

According to DIN EN 50020, the electrical maintenance indicators are simple, electrical operating equipment not having own voltage sources. This simple, electrical operating equipment may - according to DIN EN 60079-14 - in intrinsically safe electrical circuits (EEx ib) be used in systems for device group II, category 2G (zone 1) and category 3G (zone 2) without marking and certification. The operating equipment is assigned to explosion group II B and temperature class T5.

Possible circuit according to DIN EN 60079-14



With electrical maintenance indicators with two switching points, switching units with two intrinsically safe input circles must be used.

Block mounting filter, for lateral flange-mounting

RE 51418/12.10
Replaces: 01.10

1/18

Type 245PSFN0040 to 0400; 245PSF0130, 0150

Size according to **DIN 24550**: 0040 to 0400
 Additional sizes: 0130, 0150
 Nominal pressure 250 bar [3626 psi]
 Connection up to DN 40
 Operating temperature -10 °C to 100 °C [14 °F to 212 °F]



Filter_82_d

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Ordering code:	
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Features

- Special highly efficient filter media
- Adsorption of very fine particles across a broad pressure differential range
- High dirt holding capacity thanks to large specific filter area
- Good chemical resistance of the filter elements
- High collapse resistance of the filter elements (e.g. in case of cold start)
- Filter ratings of 3 µm to 100 µm
- By default equipped with mechanical optical maintenance indicator with memory function
- Flow-optimized design due to 3D computer-supported design

Ordering code

Of the filter

245 PSF — 00—V5,0—

Pressure

250 bar [3626 psi] = 245

Block mounting filter,
for lateral flange-mounting

= PSF

Filter element

according to DIN 24550

= N

Size

PSFN...

= 0040 0063 0100
0160 0250 0400

PSF...

= 0130 0150

Filter rating in μm

nominal

Stainless steel wire mesh, cleanable

G10, G25, G40, G100

= G...

absolute (ISO 16889)

Micro glass, not cleanable

H3XL, H6XL, H10XL, H20XL

= H...XL

Pressure differential

Max. admissible pressure differential of the filter element

30 bar [435 psi], with bypass valve 7 bar [102 psi]

= A

330 bar [4786 psi], without bypass valve

= B

Element design

Standard adhesive T = 100 °C [212 °F]

= 0...

Standard material

= ...0

Complementary details

without =

No additional details

– M =

size 0040 – 0150

1 Minimes connection

(on the dirt side)

size 0160 – 0400

2 Minimes connections

Seal

M =

NBR seal

V =

FKM seal

Maintenance indicator

V5,0 =

Maintenance indicator, optical specify
switching pressure 5.0 bar [72.5 psi]

Order example:

245PSFN0063-H10XLB00-V5,0-M

Material no.: R928024393

Further versions (filter materials, ...) available at request

Of the filter element

2. — — —

Filter element

Design

= 2.

Size

PSFN...

= 0040 0063 0100
0160 0250 0400

PSF...

= 0130 0150

Filter rating in μm

nominal

Stainless steel wire mesh, cleanable

G10, G25, G40, G100

= G...

Absolute (ISO 16889)

Micro glass, not cleanable

H3XL, H6XL, H10XL, H20XL

= H...XL

Pressure differential

Max. admissible pressure differential of the filter element

30 bar [435 psi]

= A

330 bar [4786 psi]

= B

Seal

M =

NBR seal

V =

FKM seal

Bypass valve

0 =

at filter element always 0

Element design

0... =

Standard adhesive T = 100 °C [212 °F]

...0 =

Standard material

Order example:

2.0063 H3XL-B00-0-M0

Material no.: R928006708

Standard types

NBR seal, without bypass, flow specifications for $v = 30 \text{ mm}^2/\text{s}$

Block mounting filter 245 PSF(N), filter rating **3 μm**

Type	Flow in l/min [gpm] with $\Delta p = 1.5 \text{ bar}$ [21.8 psi] ¹⁾	Material no. Filter	Material no. Replacement element
245PSFN0040-H3XLB00-V5,0-M	28	R928024264	R928006654
245PSFN0063-H3XLB00-V5,0-M	50	R928024265	R928006708
245PSFN0100-H3XLB00-V5,0-M	68	R928024266	R928006762
245PSF0130-H3XLB00-V5,0-M	104	R928024267	R928022310
245PSF0150-H3XLB00-V5,0-M	130	R928024268	R928022319
245PSFN0160-H3XLB00-V5,0-M	150	R928024269	R928006816
245PSFN0250-H3XLB00-V5,0-M	250	R928024270	R928006870
245PSFN0400-H3XLB00-V5,0-M	305	R928024271	R928006924

Block mounting filter 245 PSF(N), filter rating **6 μm**

Type	Flow in l/min [gpm] with $\Delta p = 1.5 \text{ bar}$ [21.8 psi] ¹⁾	Material no. Filter	Material no. Replacement element
245PSFN0040-H6XLB00-V5,0-M	35	R928024328	R928006655
245PSFN0063-H6XLB00-V5,0-M	55	R928024329	R928006709
245PSFN0100-H6XLB00-V5,0-M	72	R928024330	R928006763
245PSF0130-H6XLB00-V5,0-M	135	R928024331	R928022311
245PSF0150-H6XLB00-V5,0-M	175	R928024332	R928022320
245PSFN0160-H6XLB00-V5,0-M	200	R928024333	R928006817
245PSFN0250-H6XLB00-V5,0-M	280	R928024334	R928006871
245PSFN0400-H6XLB00-V5,0-M	325	R928024335	R928006925

Block mounting filter 245 PSF(N), filter rating **10 μm**

Type	Flow in l/min [gpm] with $\Delta p = 1.5 \text{ bar}$ [21.8 psi] ¹⁾	Material no. Filter	Material no. Replacement element
245PSFN0040-H10XLB00-V5,0-M	50	R928024392	R928006656
245PSFN0063-H10XLB00-V5,0-M	70	R928024393	R928006710
245PSFN0100-H10XLB00-V5,0-M	75	R928024394	R928006764
245PSF0130-H10XLB00-V5,0-M	180	R928024395	R928022312
245PSF0150-H10XLB00-V5,0-M	220	R928024396	R928022321
245PSFN0160-H10XLB00-V5,0-M	260	R928024397	R928006818
245PSFN0250-H10XLB00-V5,0-M	310	R928024398	R928006872
245PSFN0400-H10XLB00-V5,0-M	350	R928024399	R928006926

¹⁾ Measured pressure differential across filter and measuring equipment according to ISO 3968. The measured pressure differential at the maintenance indicator is lower.

Codification: Electronic switching element for maintenance indicator

ABZ	F	V	-	-1X	/	-DIN
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Rexroth plant construction accessories

Filter

Maintenance indicator

Electronic switching element with 1 switching point (changeover)
round plug-in connection M12x1**= E1SP-M12X1**Electronic switching element with 2 switching points (normally open/
normally closed), 75 %, 100 %, round plug-in connection M12x1,
3 LED**= E2SP-M12X1**Electronic switching element with 2 switching points (normally open/
normally closed), 75 %, 100 %, signal suppression until 30 °C
round plug-in connection M12x1, 3 LED**= E2SPSU-M12X1****-DIN =**

Mark for DIN model

Component seriesComponent series 10 to 19
(10 to 19; identical installation
and connection dimensions)**1X =**

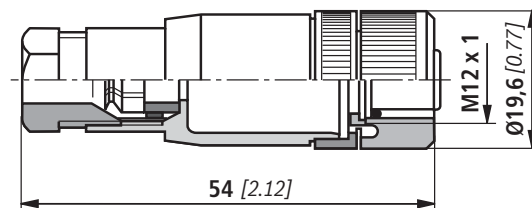
Electronic switching element	Material no.
ABZFV-E1SP-M12X1-1X/-DIN	R901025339
ABZFV-E2SP-M12X1-1X/-DIN	R901025340
ABZFV-E2SPSU-M12X1-1X/-DIN	R901025341

Order example: Block mounting filter with mechanical optical maintenance indicator for $p_{nom.} = 250 \text{ bar}$ [3626 psi] without by-pass valve, size 0063, with filter element 10 μm and electronic switching element M12x1 with 1 switching point for hydraulic fluid mineral oil HLP according to DIN 51524.

Filter: 245PSFN0063-H10XLB00-V5,0-M**Material number:** R928024393**Maintenance indicator:** ABZFV-E1SP-M12X1-1X/-DIN**Material number:** R901025339**Mating connectors according to IEC 60947-5-2 (dimensions in mm [inch])**

For electronic switching element with round plug-in connection M12 x 1

**Mating connector for K24 4-pin, M12 x 1
with screw connection, cable gland Pg9.**

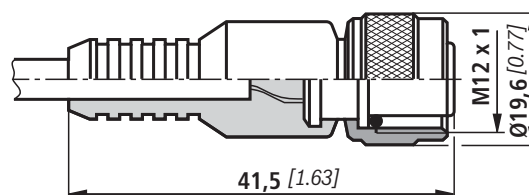
Material no. R900031155

**Mating connector for K24-3m 4-pin, M12 x 1
with potted-in PVC cable, 3 m long.**

Line cross-section: 4 x 0.34 mm²

Core marking:

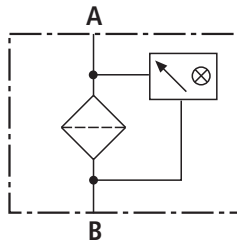
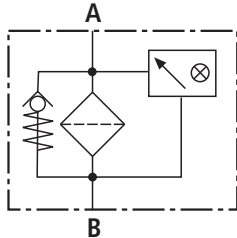
1	Brown
2	White
3	Blue
4	Black

Material no. R900064381

For more round plug-in connections, see data sheet 08006.

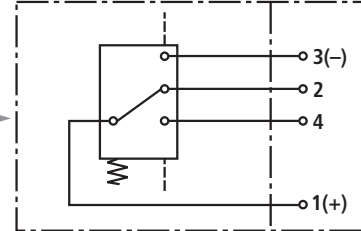
Symbols

Block mounting filter



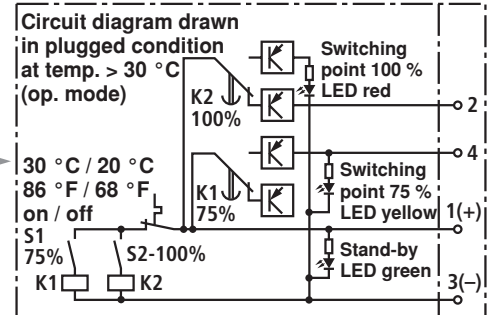
**Electronic switching element
for maintenance indicator**

Switching element Plug-in connector



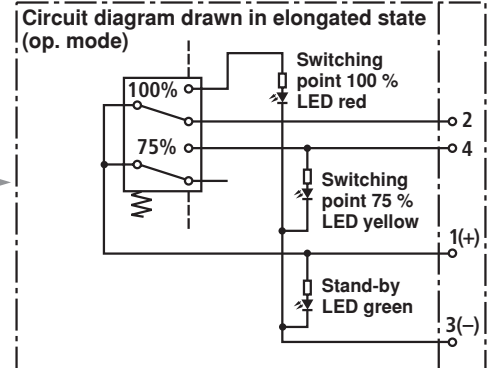
ABZFV-E1SP-M12X1-1X/-DIN

Switching element Plug-in connector



ABZFV-E2SPSU-M12X1-1X/-DIN

Switching element Plug-in connector



ABZFV-E2SP-M12X1-1X/-DIN

Function, section

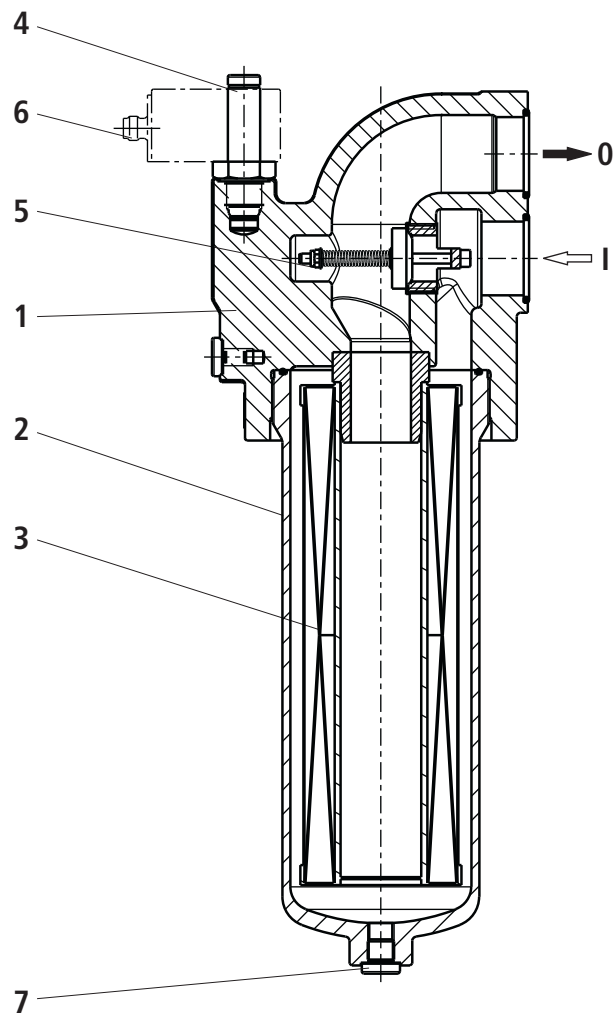
Block mounting filters are suitable for direct attachment to pump and control blocks. They are installed upstream open-loop or closed-loop control units to be protected.

They basically consist of filter head (1), a screwable filter bowl (2), filter element (3) as well as mechanical optical maintenance indicator (4). In case of filters with low-pressure-differential-stable filter elements (= code letter pressure differential A), there is also an assembled bypass valve (5).

Via port I, the hydraulic fluid reaches the filter element (3) where it is cleaned. The dirt particles filtered out settle in the filter bowl (2) and in the filter element (3). Via port O, the filtered hydraulic fluid enters the pump or control block and thus the hydraulic circuit.

The filter housing and all connection elements are designed so that pressure peaks – as they may e.g. occur in case of the abrupt opening of large control valves due to the accelerated fluid weight – can be securely absorbed. As of size 0160, the standard equipment comprises an oil drain plug (7).

Basically, the filter is equipped with mechanical optical maintenance indicator (4). The electronic maintenance indicator is connected via the electronic switching element with 1 or 2 switching points (6), which has to be ordered separately. The electronic switching element is attached to the mechanical optical maintenance indicator and held by means of a locking ring.



Technical data (For applications outside these parameters, please consult us!)**general**

Installation position	Lateral				
Ambient temperature range	°C [°F]	-30 to +100 [-22 to +212]			
Weight ¹⁾	Size	0040	0063	0100	0130
	kg [lbs]	4.6 [10.14]	5.0 [11.02]	5.8 [12.78]	8.8 [19.40]
Weight ¹⁾	Size	0150	0160	0250	0400
	kg [lbs]	9.2 [20.28]	13.5 [29.76]	14.3 [31.52]	16.0 [35.26]
Material	Filter head	GGG			
	Filter bowl	Steel			
	Optical maintenance indicator	Brass			
	Electronic switching element	Plastic PA6			

hydraulic

Maximum operating pressure	bar [psi]	250 [3626]
Hydraulic fluid temperature range	°C [°F]	-10 to +100 [+14 to +212]
Fatigue strength according to ISO 10771	Load cycles	> 10 ⁶ with Max. operating pressure
Cracking pressure of the bypass valve	bar [psi]	7 ± 0.5 [100 ± 7]
Type of pressure measurement of the maintenance indicator	Pressure differential	
Response pressure of the maintenance indicator	bar [psi]	5 ± 0.5 [72 ± 7]

electrical (electronic switching element)

Electrical connection	Round plug-in connection M12 x 1, 4-pin	
Contact load, direct voltage	A	Max. 1
Voltage range	E1SP-M12x1 V DC/AC	Max. 150
	E2SP V DC	10 to 30
Max. switching power with resistive load	20 VA; 20 W; (70 VA)	
Switching type	E1SP-M12x1	Changeover
	E2SP-M12x1	Normally open contact at 75 % of the response pressure, Normally closed contact at 100 % of the response pressure
	E2SPSU-M12x1	Normally open contact at 75 % of the response pressure, Normally closed contact at 100 % of the response pressure Signal interconnection at 30 °C [86 °F], Return switching at 20 °C [68 °F]
Display via LEDs in the electronic switching element E2SP...	Stand-by (LED green); 75 % switching point (LED yellow) 100 % switching point (LED red)	
Protection class according to EN 60529	IP 65	
For direct voltage above 24 V, spark extinguishing is to be provided for protecting the switching contacts.		
Weight Electronic switching element: – with round plug-in connection M12 x 1	kg [lbs]	0.1 [0.22]

¹⁾ Weight including standard filter element and maintenance indicator

Technical Data (For applications outside these parameters, please consult us!)**Filter element**

Glass fiber paper H..XL		Single-use element on the basis of inorganic fiber	
		Filtration ratio according to ISO 16889 up to $\Delta p = 5 \text{ bar [72.5 psi]}$	Achievable oil cleanliness according to ISO 4406 [SAE-AS 4059]
	H20XL	$\beta_{20}(c) \geq 200$	19/16/12 – 22/17/14
	H10XL	$\beta_{10}(c) \geq 200$	17/14/10 – 21/16/13
	H6XL	$\beta_6(c) \geq 200$	15/12/10 – 19/14/11
	H3XL	$\beta_5(c) \geq 200$	13/10/8 – 17/13/10
Admissible pressure differential	A	bar [psi]	30 [435]
	B	bar [psi]	330 [4786]

Seal material for hydraulic fluids

Mineral oil			Ordering code
Mineral oil	HLP	according to DIN 51524	M
Flame-resistant hydraulic fluids			Ordering code
Emulsions	HFA-E	according to DIN 24320	M
Synthetic water solutions	HFA-S	according to DIN 24320	M
Water solutions	HFC	according to VDMA 24317	M
Phosphoric acid esters	HFD-R	according to VDMA 24317	V
Organic esters	HFD-U	according to VDMA 24317	V
Fast biodegradable hydraulic fluid			Ordering code
Triglycerides (rape seed oil)	HETG	according to VDMA 24568	M
Synthetic esters	HEES	according to VDMA 24568	V
Polyglycols	HEPG	according to VDMA 24568	V

Characteristic curves (measured with HLP46, according to ISO 3968)

H3XL...

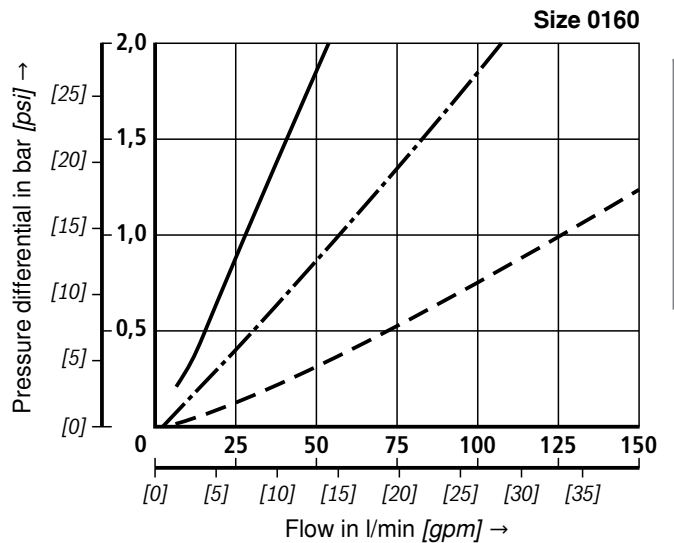
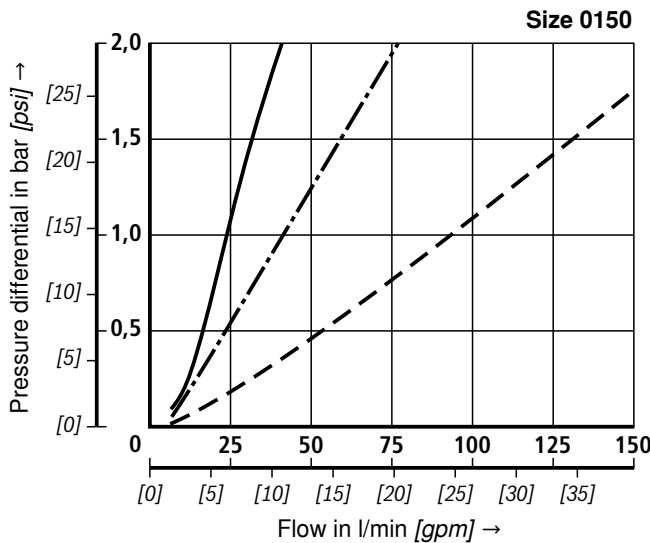
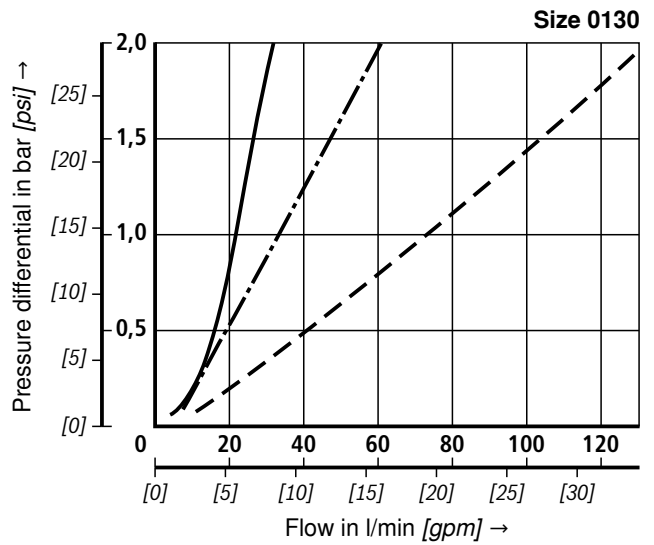
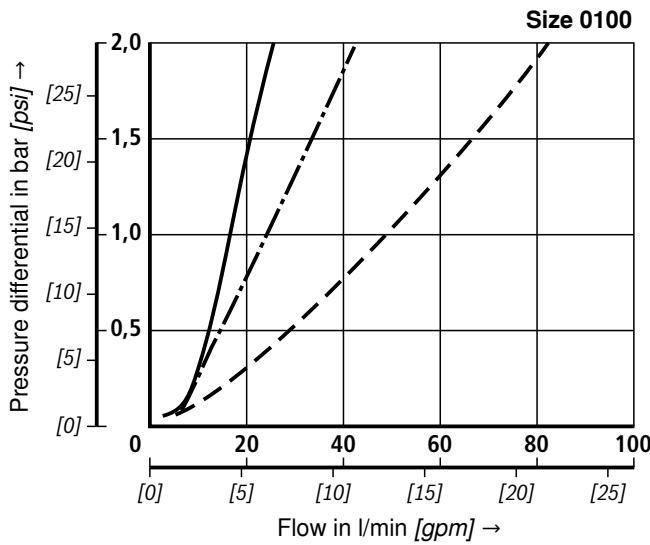
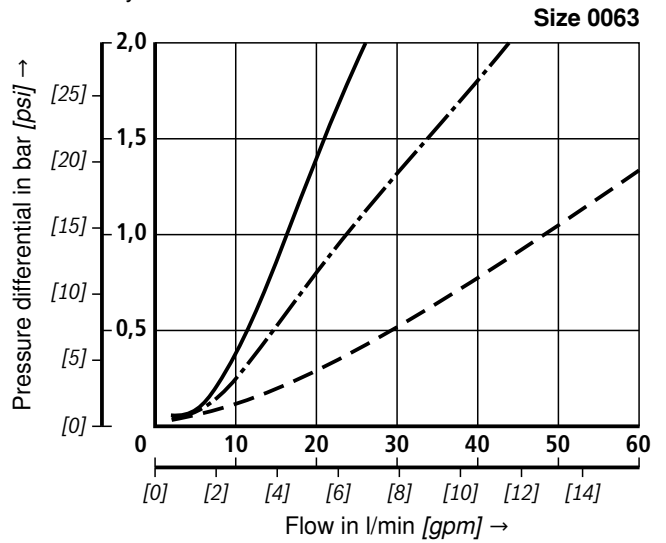
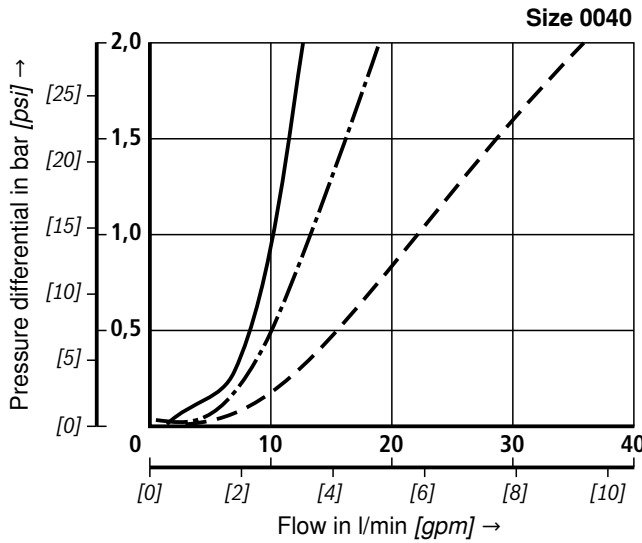
Specific weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters recommended
initial Δp for design = 1.5 bar

A proper filter design is enabled by our computer program
"BRFilterSelect".

- 140 mm²/s [649 SUS]
- · - 68 mm²/s [315 SUS]
- - - 30 mm²/s [142 SUS]

Oil viscosity:



Characteristic curves (measured with HLP46, according to ISO 3968)

H3XL...

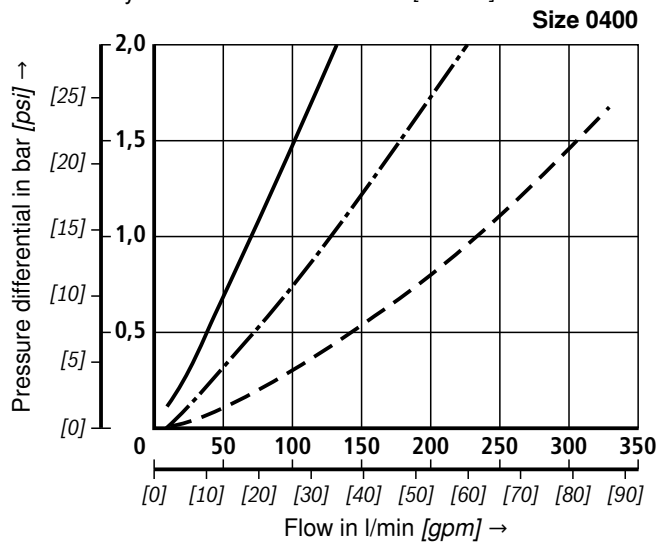
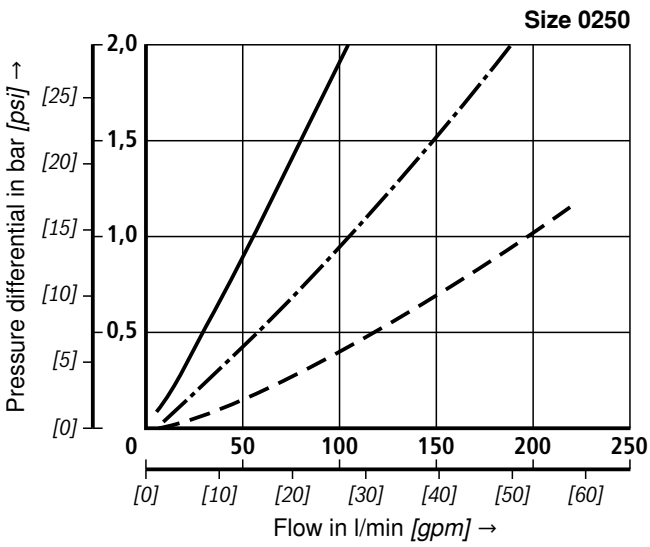
Specific weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters recommended
initial Δp for design = 1.5 bar

A proper filter design is enabled by our computer program
"BRFilterSelect".

- 140 mm²/s [649 SUS]
- · - 68 mm²/s [315 SUS]
- - - 30 mm²/s [142 SUS]

Oil viscosity:



Characteristic curves (measured with HLP46, according to ISO 3968)

H10XL...

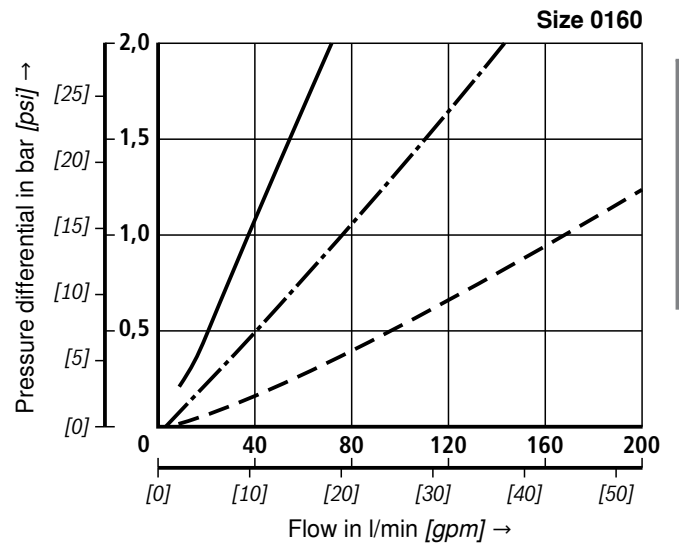
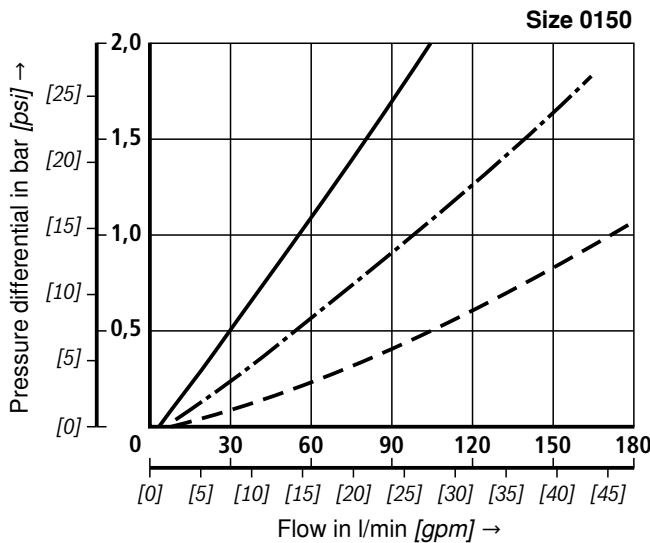
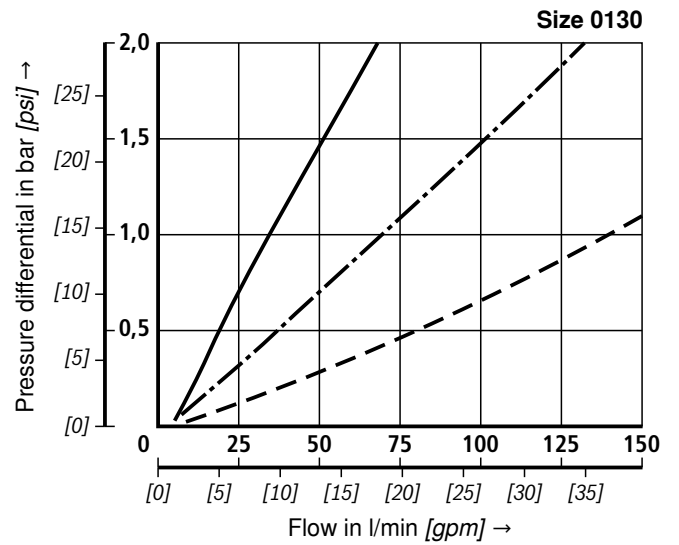
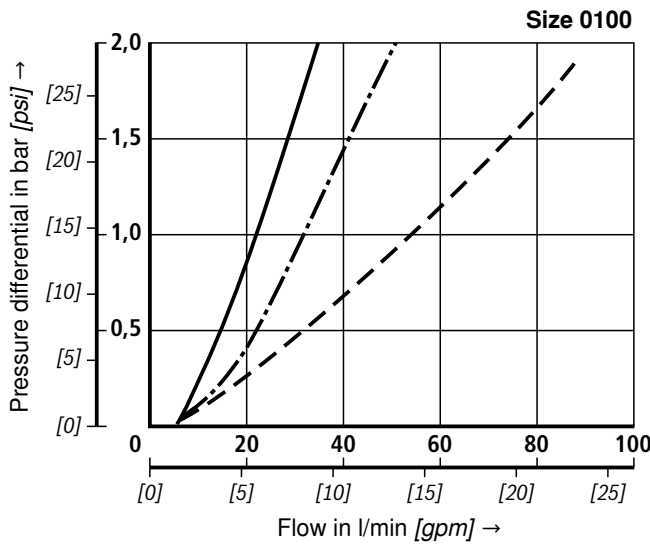
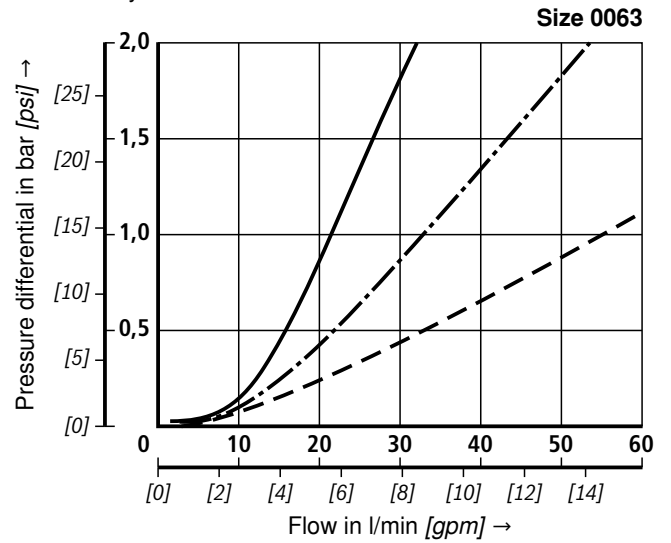
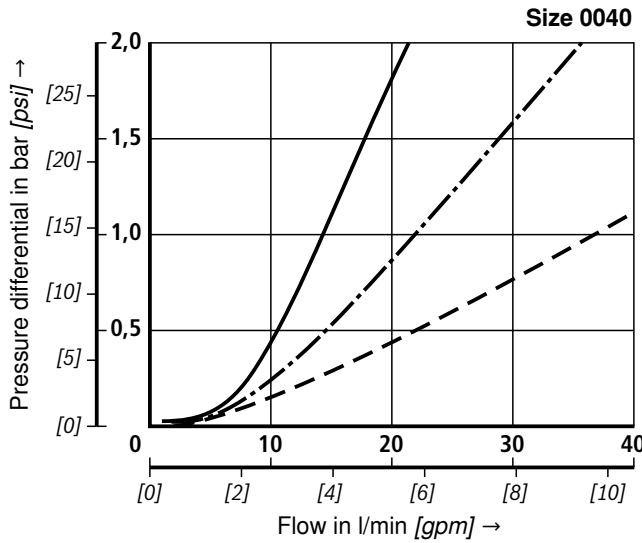
Specific weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters recommended
initial Δp for design = 1.5 bar

A proper filter design is enabled by our computer program
"BRFilterSelect".

- 140 mm²/s [649 SUS]
- · - 68 mm²/s [315 SUS]
- - - 30 mm²/s [142 SUS]

Oil viscosity:



Characteristic curves (measured with HLP46, according to ISO 3968)

H10XL...

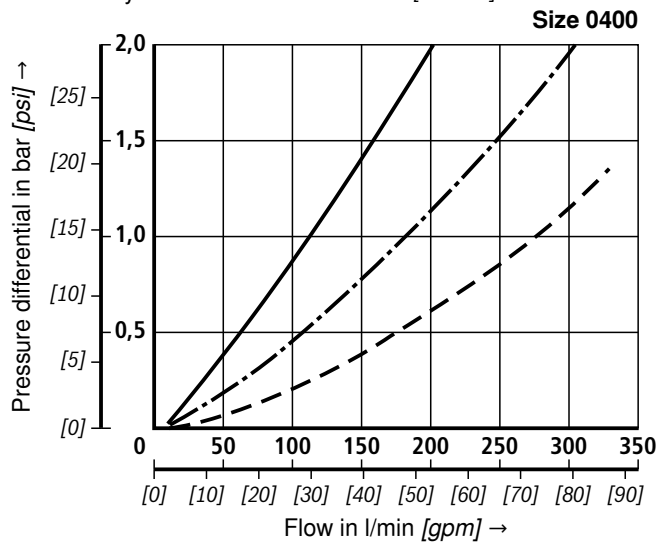
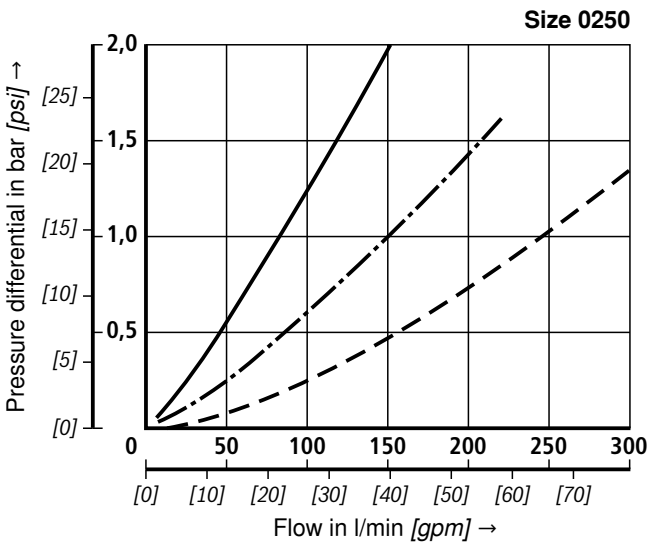
Specific weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters recommended
initial Δp for design = 1.5 bar

A proper filter design is enabled by our computer program
"BRFilterSelect".

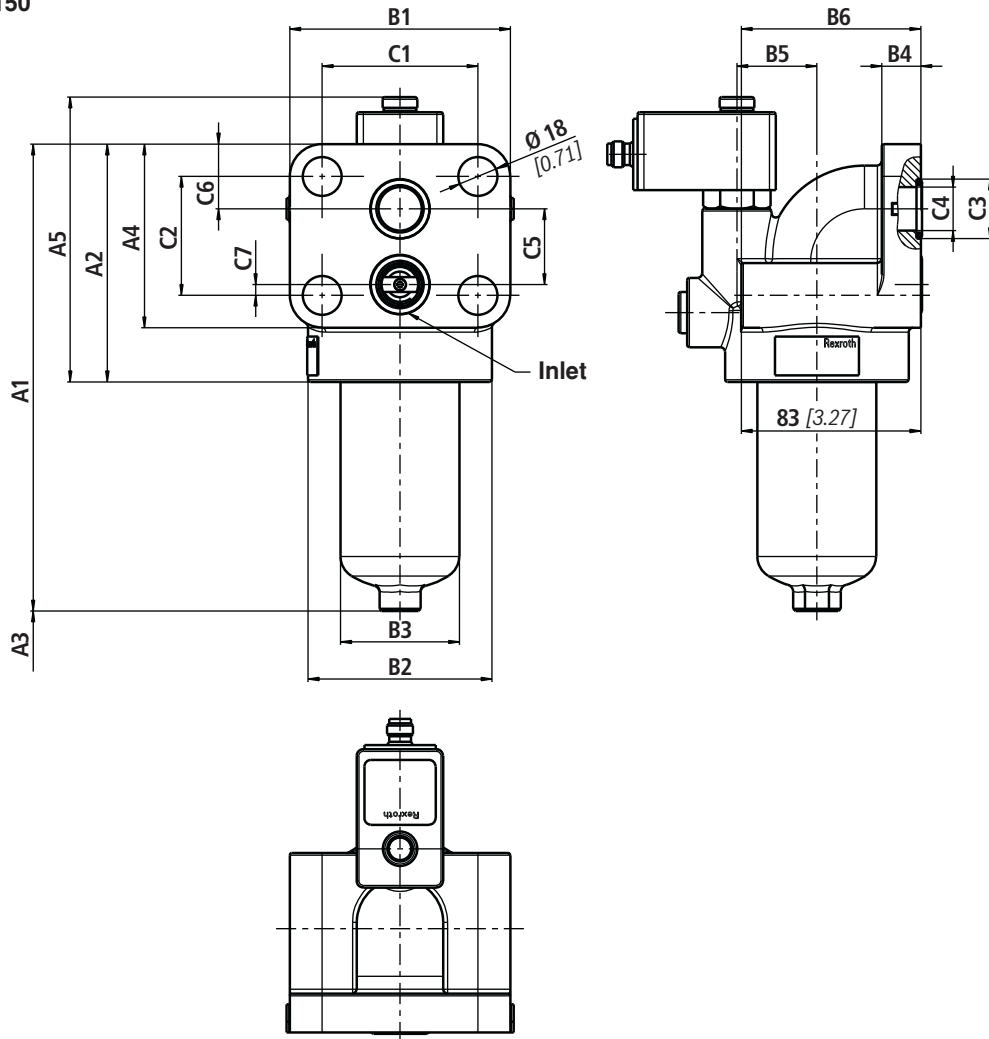
- 140 mm²/s [649 SUS]
- · - 68 mm²/s [315 SUS]
- - - 30 mm²/s [142 SUS]

Oil viscosity:



Unit dimensions size 0040 to size 0150 (dimensions in mm [inch])

Size 0040 to 0150



Filter housing for filter elements in accordance with DIN 24550 and according to BRFS standard

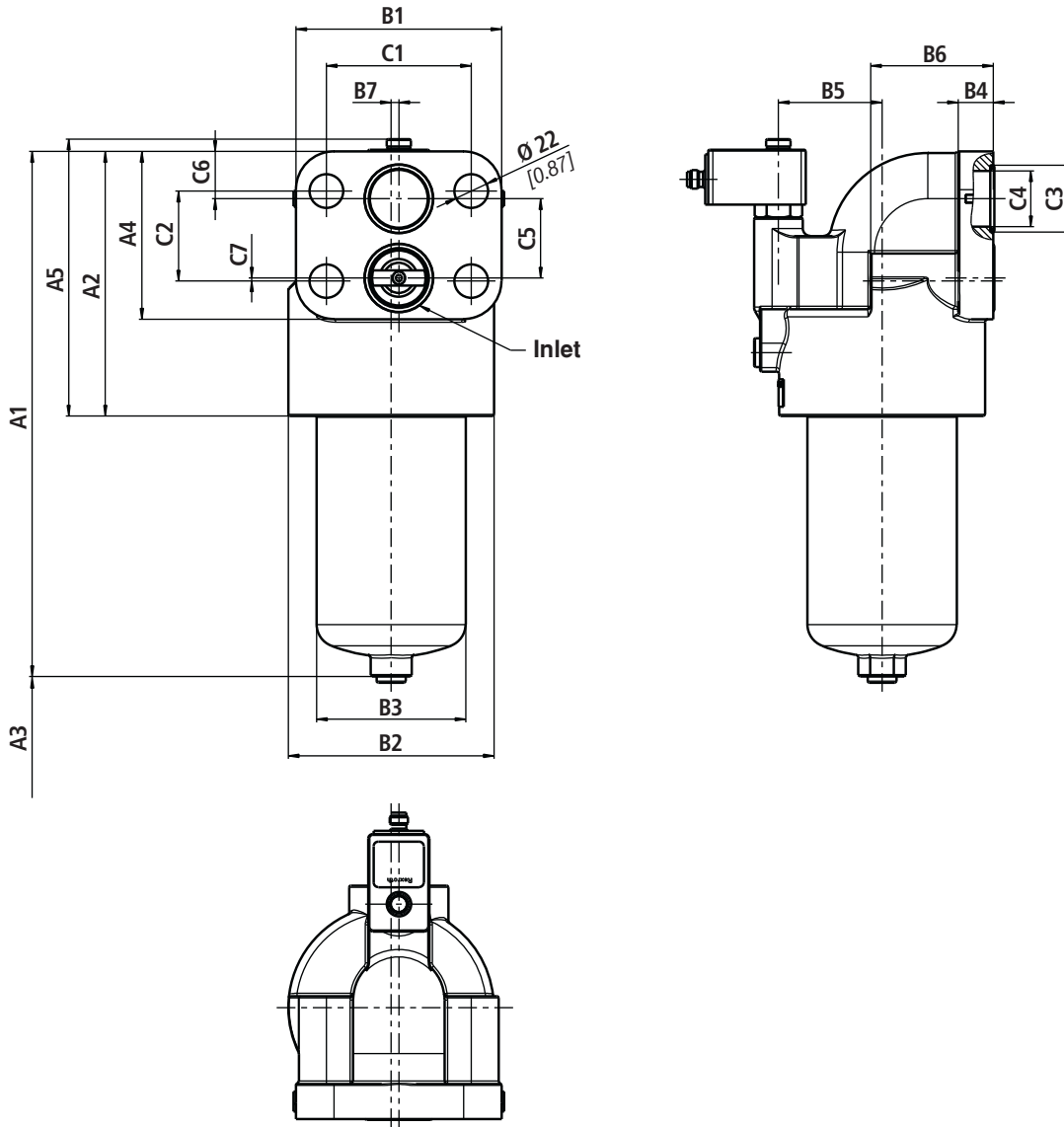
Type 245 PSF(N)...	Content in l [US gal]	A1	A2	A3 ¹⁾	A4	A5	B1	B2	B3
0040	0.25 [0.07]	216 [8.50]	110 [4.33]	100 [3.94]	85 [3.35]	132 [5.20]	102 [4.02]	Ø85 [3.35]	Ø55 [2.17]
0063	0.4 [0.11]	280 [11.02]							
0100	0.6 [0.16]	370 [14.57]							
0130	0.8 [0.21]	349 [13.74]	146 [5.75]	120 [4.72]	110 [4.33]	147 [5.79]	135 [5.31]	Ø116 [4.57]	Ø77 [3.03]
0150	0.98 [0.26]	399 [15.71]							

Type 245 PSF(N)...	B4	B5	B6	C1	C2	C3	C4	C5	C6	C7
0040	18 [0.71]	37 [1.46]	83 [3.27]	72 [2.83]	55 [2.17]	Ø27.5 [1.08]	Ø20 [0.79]	35 [1.38]	30 [1.18]	5 [0.20]
0063										
0100										
0130	20 [0.79]	52.5 [2.07]	75 [2.95]	95 [3.74]	59 [2.32]	Ø40 [1.57]	Ø32 [1.26]	52 [2.05]	31 [1.22]	2 [0.08]
0150										

¹⁾ Servicing height for filter element replacement

Unit dimensions size 0160 to size 0400 (dimensions in mm [inch])

Size 0160 to 0400



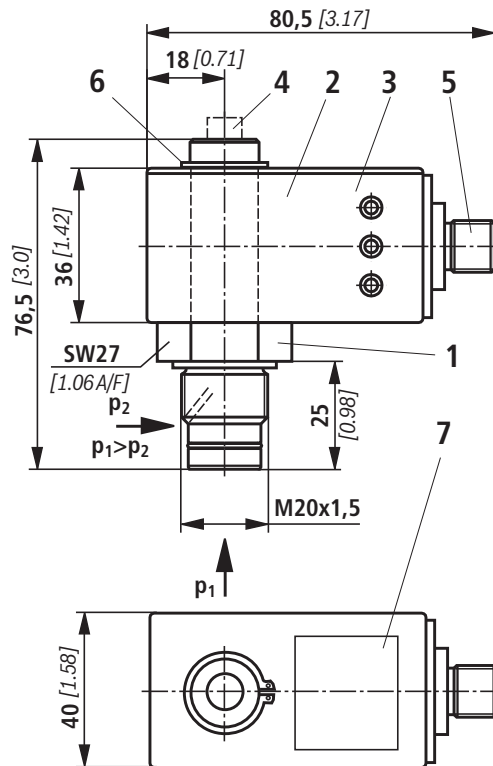
Filter housing for filter elements in accordance with DIN 24550 and according to BRFS standard

Type 245 PSF(N)...	Content in l [US gal]	A1	A2	A3 ¹⁾	A4	A5	B1	B2	B3
0160	1.5 [0.40]	345 [13.58]							
0250	2.1 [0.55]	433 [17.05]	174 [6.85]	120 [4.72]	110 [4.33]	182 [7.17]	135 [5.31]	Ø135 [5.31]	Ø98 [3.86]
0400	3.2 [0.85]	583 [22.95]							

Type 245 PSF(N)...	B4	B5	B6	B7	C1	C2	C3	C4	C5	C6	C7
0160											
0250	23 [0.91]	68 [2.68]	80.5 [3.17]	5 [0.20]	95 [3.74]	59 [2.32]	Ø45 [1.77]	Ø38 [1.5]	52 [2.05]	31 [1.22]	2 [0.08]
0400											

¹⁾ Servicing height for filter element replacement

Maintenance indicator (dimensions in mm [inch])



- 1 Mechanical optical maintenance indicator; Max. tightening torque $M_{A \max} = 50 \text{ Nm}$ [36.88 lb-ft]
- 2 Switching element with locking ring for electrical maintenance indicator (can be rotated by 360°); plug-in connection M12x1 or according to DIN EN 175201-804
- 3 Housing with three LEDs: 24 V =
Green: Stand-by
Yellow: Switching point 75 %
Red: Switching point 100 %
- 4 Optical indicator bistable
- 5 Round connector M12x1, 4-pin
- 6 Locking ring
- 7 Nameplate

Notes:

Presentation contains mechanical optical maintenance indicator (1) and electronic switching element (2).

Round plug-in connection M12x1 (5)

For connection e.g. to ABZFV-E1SP-M12x1-1X/-DIN (see page 17).

Switching elements with increased switching power at request.

Spare parts

Mechanical optical maintenance indicator

ABZ F V-HV5-1X/ -DIN

Rexroth plant construction accessories

Filter

Maintenance indicator

Mechanical optical maintenance indicator for high-pressure filters switching point 5 bar [72 psi]

= HV5

DIN = Mark for DIN model

M =

V =

Seal material

NBR seal

FKM seal

Component series

Component series 10 to 19 (10 to 19; identical installation and connection dimensions)

1X =

Mechanical optical maintenance indicator	Material no.
ABZFV-HV5-1X/M-DIN	R901025313

Seal kit

D 245PSF

Seal kit

Type 245PSF

Size

Size 0040-0100

= N0040-0100

Size 0130-0150

= 0130-0150

Size 0160-0400

= N0160-0400

M =

V =

Seal

NBR seal

FKM seal

Seal kit	Material no.
D245PSFN0040-0100-M	R928028217
D245PSF0130-0150-M	R928028216
D245PSFN0160-0400-M	R928028215

Installation, commissioning and maintenance

Installation of the filter

Verify operating pressure with name plate information. Remove dust protection plugs from filter inlet and outlet, mount filter at the control block without tension stress considering flow direction (direction arrows) and servicing height of the filter element. The filter must preferably be installed with the filter bowl (2) downward. The maintenance indicator must be arranged in a well visible way.

Connection of the electrical maintenance indicator

Basically, the filter is equipped with mechanical optical maintenance indicator (4). The electronic maintenance indicator is connected via the switching element (6) with 1 or 2 switching points, which is attached to the mechanical optical maintenance indicator and held by means of the locking ring.

When must the filter element be exchanged or cleaned respectively?

Upon start-up in cold condition, the red pushbutton of the optical maintenance indicator (4) may jump out and an electrical signal is output via the switching element (6). Only push the red pushbutton in again after the operating temperature has been reached. If it jumps out again immediately or if the electrical signal has not gone out at operating temperature, the filter element must be exchanged or cleaned respectively after the end of the shift.

Element exchange

- Switch off the system and discharge the filter on the pressure side.
- Screw off the filter bowl (2) by anticlockwise rotation. Clean the filter housing in a suitable medium.
- Remove the filter element (3) from the centering spigot in the filter head by turning it slightly
- Check the seal ring and the support ring in the filter bowl for position and damage. If necessary, these parts are to be renewed.
- Replace filter elements H...XL, clean the filter element G...
- The efficiency of the cleaning process depends on the characteristics of contamination and the amount of the pressure differential before the filter element exchange. If the differential pressure after the filter element exchange exceeds 50 % of the value before the filter element exchange, the G... element also needs to be replaced.
- Check whether the type designation or material number on the replacement element corresponds to the type designation/material number on the nameplate of the filter.
- Install replaced or cleaned filter element on the spigot again by slightly turning it.
- Now screw in the filter bowl or floor to stop. Then turn out the filter bowl by 1/8 to 1/2 turn so that the filter bowl is not stuck due to the pressure pulsation and can be easily loosened in case of maintenance works.

Quality and standardization

The pressure filters for hydraulic applications according to 51418 are pressure holding equipment according to article 1, section 2.1.4 of the pressure equipment directive 97/23/EC (PED). However, on the basis of the exception in article 1, section 3.6 of the PED hydraulic filters are exempt from the PED, if there are not classified higher than category I (guide-line 1/19). They do not receive a CE mark.

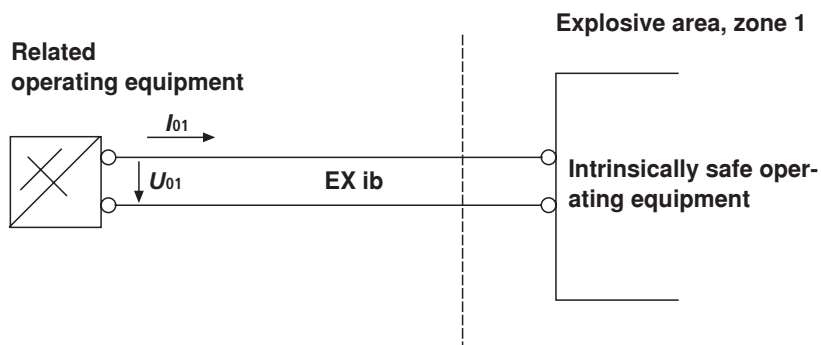
Use in explosive areas according to directive 94/9/EC (ATEX)

The pressure filters according to 51418 are no equipment or components in the sense of directive 94/9/EC and are not provided with a CE mark.

When using the pressure filters according to 51418 in explosive areas, potential equalization has to be ensured.

According to DIN EN 50020, the electrical maintenance indicators are simple, electrical operating equipment not having own voltage sources. This simple, electrical operating equipment may - according to DIN EN 60079-14 - in intrinsically safe electrical circuits (EEx ib) be used in systems for device group II, category 2G (zone 1) and category 3G (zone 2) without marking and certification. The operating equipment is assigned to explosion group II B and temperature class T5.

Possible circuit according to DIN EN 60079-14



With electrical maintenance indicators with two switching points, switching units with two intrinsically safe input circles must be used.

Block mounting filter, for lateral flange-mounting

RE 51419/02.10

1/18

Type 350PSFN0040 to 1000; 350PSF0130, 0150

Size according to **DIN 24550**: 0040 to 1000
 Additional sizes: 0130, 0150
 Nominal pressure 350 bar [5079 psi]
 Port up to Ø 38
 Operating temperature -10 °C to 100 °C [14 °F to 212 °F]



350PSFN_d

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Function, section	6
Technical data	7, 8
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Unit dimensions	13, 14
Maintenance indicator	15
Spare parts	16
Installation, commissioning, maintenance	17
Quality and standardization	18

Features

- Special highly efficient filter media
- Adsorption of very fine particles across a broad pressure differential range
- High dirt holding capacity thanks to large specific filter area
- Good chemical resistance of the filter elements
- High collapse resistance of the filter elements (e.g. in case of cold start)
- Filter ratings of 3 µm to 100 µm
- By default equipped with mechanical optical maintenance indicator with memory function
- Flow-optimized design due to 3D computer-supported design

Ordering code

of the filter

350 PSF — 00—V5,0—

Pressure

350 bar [5079 psi] = 350

Block mounting filter

For lateral flange-mounting = PSF

Filter element

According to DIN 24550 = N

Size

PSFN... = 0040 0063 0100 0160
0250 0400 0630 1000
PSF... = 0130 0150

Filter rating in µm

nominal

Stainless steel wire mesh, cleanable
G10, G25, G40, G100 = G...

absolute (ISO 16889)

Micro glass, not cleanable
H3XL, H6XL, H10XL, H20XL = H...XL

Pressure differential

Max. admissible pressure differential of the filter element
30 bar [435 psi], with bypass valve 7 bar [102 psi] = A
330 bar [4786 psi], without bypass valve = B

Element design

Standard adhesive T = 100 °C [212 °F] = 0...
Standard material = ...0

Complementary details

No code = No complementary details
- M = 2 Minimes connections (Size 0130 - 1000)

Seal

M = NBR seal
V = FKM seal

Maintenance indicator

V5,0 = Maintenance indicator, optical
specify switching pressure 5.0 bar [72.5 psi]

Order example:

350PSFN0063-H10XLB00-V5,0-M

Material no.: R928026491

Further versions (filter materials, connections, ...) are available at request.

of the filter element

2. — 0 —

Filter element

Design = 2.

Size

PSFN... = 0040 0063 0100 0160
0250 0400 0630 1000
PSF... = 0130 0150

Filter rating in µm

nominal

Stainless steel wire mesh, cleanable
G10, G25, G40, G100 = G...

absolute (ISO 16889)

Micro glass, not cleanable
H3XL, H6XL, H10XL, H20XL = H...XL

Pressure differential

Max. admissible pressure differential of the filter element
30 bar [435 psi], with bypass valve 7 bar [102 psi] = A
330 bar [4786 psi], without bypass valve = B

Seal

M = NBR seal
V = FKM seal

Bypass valve

0 = at filter element always 0

Element design

0... = Standard adhesive T = 100 °C [212 °F]
...0 = Standard material

Order example:

2.0063 H10XL-B00-0-M

Material no.: R928006710

Standard types

NBR seal, without bypass, flow specifications for 30 mm²/s

Block mounting filter 350PSF(N), filter rating 3 µm

Type	Flow in l/min [gpm] with $\Delta p = 1.5 \text{ bar}$ [21.8 psi] ¹⁾	Material no. Filter	Material no. Replacement element
350PSFN0040-H3XLB00-V5,0-M	32 [8.5 gpm]	R928026330	R928006654
350PSFN0063-H3XLB00-V5,0-M	47 [12.4 gpm]	R928026331	R928006708
350PSFN0100-H3XLB00-V5,0-M	61 [16.1 gpm]	R928026332	R928006762
350PSF0130-H3XLB00-V5,0-M	108 [28.5 gpm]	R928026333	R928022310
350PSF0150-H3XLB00-V5,0-M	137 [36.2 gpm]	R928026334	R928022319
350PSFN0160-H3XLB00-V5,0-M	185 [48.9 gpm]	R928026335	R928006816
350PSFN0250-H3XLB00-V5,0-M	272 [71.9 gpm]	R928026336	R928006870
350PSFN0400-H3XLB00-V5,0-M	341 [90.1 gpm]	R928026337	R928006924
350PSFN0630-H3XLB00-V5,0-M	390 [103.0 gpm]	R928026338	R928006978
350PSFN1000-H3XLB00-V5,0-M	470 [124.2 gpm]	R928026339	R928007032

Block mounting filter 350PSF(N), filter rating 6 µm

Type	Flow in l/min [gpm] with $\Delta p = 1.5 \text{ bar}$ [21.8 psi] ¹⁾	Material no. Filter	Material no. Replacement element
350PSFN0040-H6XLB00-V5,0-M	44 [11.6 gpm]	R928026410	R928006655
350PSFN0063-H6XLB00-V5,0-M	59 [15.6 gpm]	R928026411	R928006709
350PSFN0100-H6XLB00-V5,0-M	68 [18.0 gpm]	R928026412	R928006763
350PSF0130-H6XLB00-V5,0-M	158 [41.7 gpm]	R928026413	R928022311
350PSF0150-H6XLB00-V5,0-M	196 [51.8 gpm]	R928026414	R928022320
350PSFN0160-H6XLB00-V5,0-M	233 [61.6 gpm]	R928026415	R928006817
350PSFN0250-H6XLB00-V5,0-M	318 [84.0 gpm]	R928026416	R928006871
350PSFN0400-H6XLB00-V5,0-M	369 [97.5 gpm]	R928026417	R928006925
350PSFN0630-H6XLB00-V5,0-M	428 [113.1 gpm]	R928026418	R928006979
350PSFN1000-H6XLB00-V5,0-M	482 [127.3 gpm]	R928026419	R928007033

Block mounting filter 350PSF(N), filter rating 10 µm

Type	Flow in l/min [gpm] with $\Delta p = 1.5 \text{ bar}$ [21.8 psi] ¹⁾	Material no. Filter	Material no. Replacement element
350PSFN0040-H10XLB00-V5,0-M	52 [13.7 gpm]	R928026490	R928006656
350PSFN0063-H10XLB00-V5,0-M	67 [17.7 gpm]	R928026491	R928006710
350PSFN0100-H10XLB00-V5,0-M	72 [19.0 gpm]	R928026492	R928006764
350PSF0130-H10XLB00-V5,0-M	189 [49.9 gpm]	R928026493	R928022312
350PSF0150-H10XLB00-V5,0-M	241 [63.7 gpm]	R928026494	R928022321
350PSFN0160-H10XLB00-V5,0-M	265 [70.0 gpm]	R928026495	R928006818
350PSFN0250-H10XLB00-V5,0-M	349 [92.2 gpm]	R928026496	R928006872
350PSFN0400-H10XLB00-V5,0-M	380 [100.4 gpm]	R928026497	R928006926
350PSFN0630-H10XLB00-V5,0-M	460 [121.5 gpm]	R928026498	R928006980
350PSFN1000-H10XLB00-V5,0-M	490 [129.4 gpm]	R928026499	R928007034

¹⁾ Measured pressure differential across filter and measuring equipment according to ISO 3968. The measured pressure differential at the maintenance indicator is lower.

Ordering code: Electronic switching element for maintenance indicator

ABZ | **F** | **V** | **-** | **-1X** | **-DIN**

Rexroth plant construction accessories

Filter

Maintenance indicator

Electronic switching element with 1 switching point (changeover)
round plug-in connection M12x1

= E1SP-M12X1

Electronic switching element with 2 switching points (normally
open/normally closed), 75 %, 100 %, round plug-in connection
M12x1, 3 LED

= E2SP-M12X1

Electronic switching element with 2 switching points (normally open/
normally closed), 75 %, 100 %, signal suppression until 30 °C
round plug-in connection M12x1, 3 LED

= E2SPSU-M12X1

-DIN =

Mark for DIN version

Component series

Component series 10 to 19
(10 to 19; identical installation
and connection dimensions)

1X =

Electronic switching element	Material no.
ABZFV-E1SP-M12X1-1X/-DIN	R901025339
ABZFV-E2SP-M12X1-1X/-DIN	R901025340
ABZFV-E2SPSU-M12X1-1X/-DIN	R901025341

Order example: Block mounting filter with mechanical optical maintenance indicator for $p_{nom.} = 350 \text{ bar}$ [5079 psi] without by-pass valve, size 0063, with filter element 10 μm and electronic switching element M12x1 with 1 switching point for hydraulic fluid mineral oil HLP according to DIN 51524.

Filter: 350PSFN0063-H10XLB00-V5,0-M

Material no.: R928026491

Maintenance indicator: ABZFV-E1SP-M12X1-1X/-DIN

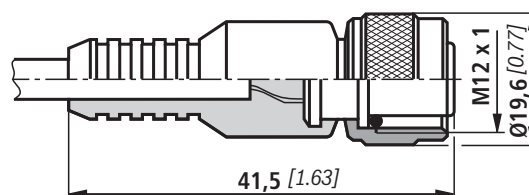
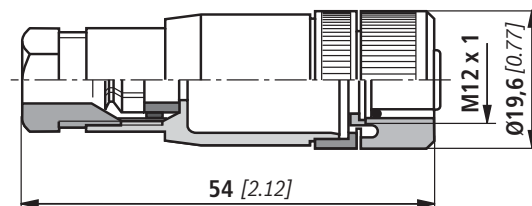
Material no.: R901025339

Mating connectors according to IEC 60947-5-2 (dimensions in mm [inch])

for electronic switching element with round plug-in connection M12 x 1

**Mating connector for K24 4-pin, M12 x 1
with screw connection, cable gland Pg9.**

Material no. R900031155



**Mating connector for K24-3m 4-pin, M12 x 1
with potted-in PVC cable, 3 m long.**

Line cross-section: 4 x 0.34 mm²

Core marking:

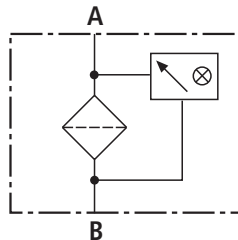
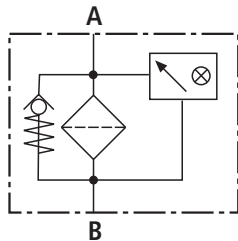
1	Brown
2	White
3	Blue
4	Black

Material no. R900064381

For more round plug-in connections, see data sheet RE 08006.

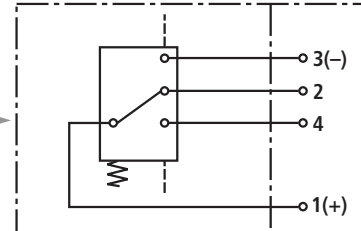
Symbols

Block mounting filter



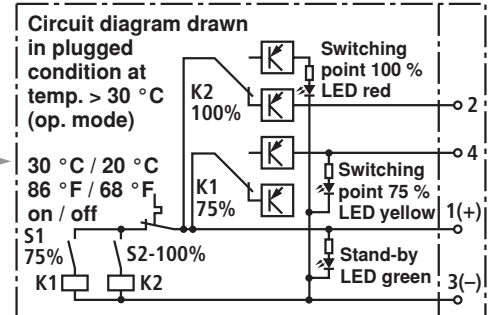
Electronic switching element for maintenance indicator

Switching element Plug-in connector



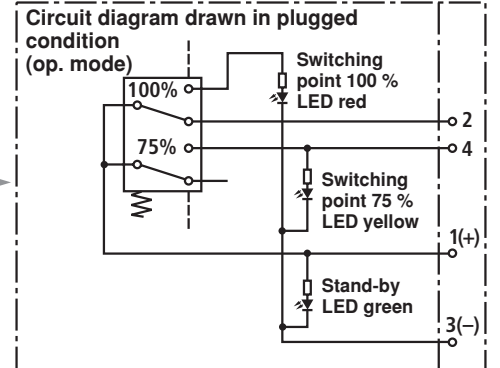
ABZFV-E1SP-M12X1-1X/-DIN

Switching element Plug-in connector



ABZFV-E2SPSU-M12X1-1X/-DIN

Switching element Plug-in connector



ABZFV-E2SP-M12X1-1X/-DIN

Function, section

Block mounting filters are suitable for direct attachment to pump and control blocks. They are installed upstream open-loop or closed-loop control units to be protected.

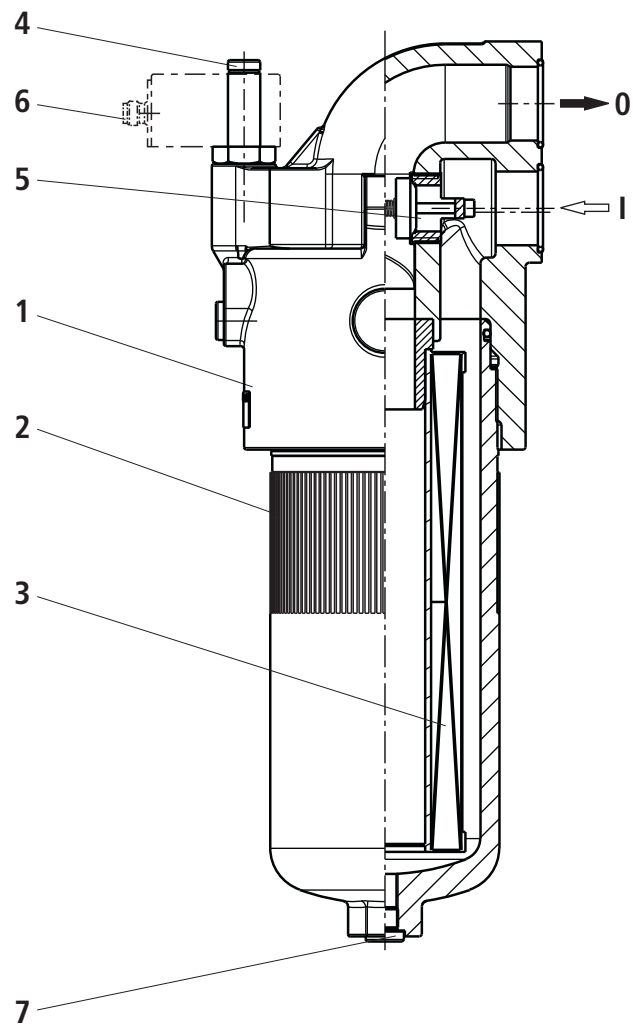
They basically consist of filter head (1), a screwable filter bowl (2), filter element (3) as well as mechanical optical maintenance indicator (4). In case of filters with low-pressure-differential-stable filter elements (= code letter pressure differential A), there is also an assembled bypass valve (5).

Via port I, the hydraulic fluid reaches the filter element (3) where it is cleaned. The dirt particles filtered out settle in the filter bowl (2) and in the filter element (3). Via port O, the filtered hydraulic fluid enters the hydraulic circuit.

The filter housing and all connection elements are designed so that pressure peaks - as they may e.g. occur in case of the abrupt opening of large control valves due to the accelerated fluid weight - can be securely absorbed. As of size 0160, the standard equipment comprises an oil drain plug (7). With size 1000, the filter bowl has a two-part design.

Basically, the filter is equipped with mechanical optical maintenance indicator (4). The electronic maintenance indicator is connected via the electronic switching element with 1 or 2 switching points (6), which has to be ordered separately. The electronic switching element is attached to the mechanical optical maintenance indicator and held by means of a locking ring.

As of size 0130, 2 minimess connections can be ordered via supplementary information in the type key.



Technical Data (For applications outside these parameters, please consult us!)**general**

Installation position		Lateral				
Ambient temperature range		°C [°F] -30 to +100 [-22 to +212]				
Weight	Size	0040	0063	0100	0130	0150
	kg [lbs]	5.5 [12.1]	6.2 [13.6]	7.0 [15.4]	13.0 [28.6]	13.9 [30.6]
Weight	Size	0160	0250	0400	0630	1000
	kg [lbs]	18.5 [40.7]	20.5 [45.1]	24.5 [53.9]	41.2 [90.6]	87.0 [191.4]
Material	Filter head	GGG				
	Filter bowl	Steel				
	Optical maintenance indicator	Brass				
	Electronic switching element	Plastic PA6				

hydraulic

Maximum operating pressure	bar [psi]	350 [5079]
Hydraulic fluid temperature range	°C [°F]	-10 to +100 [+14 to +212] (shortly -30 [-22])
Fatigue strength according to ISO 10771	Load cycles	> 10 ⁶ with max. operating pressure
Cracking pressure of the bypass valve	bar [psi]	7 ± 0.5 [100 ± 7]
Type of pressure measurement of the maintenance indicator		Pressure differential
Response pressure of the maintenance indicator	bar [psi]	5 ± 0.5 [72 ± 7]

electrical (electronic switching element)

Electrical connection		Round plug-in connection M12 x 1, 4-pin
Contact load, direct voltage		A max. 1
Voltage range	E1SP-M12x1 V DC/AC	max. 150
	E2SP V DC	10 to 30
Max. switching power with resistive load		20 VA; 20 W; (70 VA)
Switching type	E1SP-M12x1	Changeover
	E2SP-M12x1	Normally open contact at 75 % of the response pressure Normally closed contact at 100 % of the response pressure
	E2SPSU-M12x1	Normally open contact at 75 % of the response pressure Normally closed contact at 100 % of the response pressure Signal interconnection at 30 °C [86 °F], Return switching at 20 °C [68 °F]
Display via LEDs in the electronic switching element E2SP...		Stand-by (LED green); 75 % switching point (LED yellow); 100 % switching point (LED red)
Protection class according to EN 60529		IP 65
For direct voltage above 24 V, spark extinguishing is to be provided for protecting the switching contacts.		
Weight	Electronic switching element: - with round plug-in connection M12 x 1	kg [lbs] 0.1 [0.22]

Technical Data (For applications outside these parameters, please consult us!)**Filter element**

Glass fiber paper H..XL			Single-use element on the basis of inorganic fiber
			Filtration ratio according to ISO 16889 up to $\Delta p = 5 \text{ bar [72.5 psi]}$
			Achievable oil cleanliness according to ISO 4406 [SAE-AS 4059]
	H20XL		$\beta_{20}(c) \geq 200$
	H10XL		$\beta_{10}(c) \geq 200$
	H6XL		$\beta_6(c) \geq 200$
	H3XL		$\beta_5(c) \geq 200$
Admissible pressure differential	A	bar [psi]	30 [435]
	B	bar [psi]	330 [4786]

Seal material for hydraulic fluids

Mineral oil			Ordering code
Mineral oil	HLP	according to DIN 51524	M
Flame-resistant hydraulic fluids			Ordering code
Emulsions	HFA-E	according to DIN 24320	M
Synthetic water solutions	HFA-S	according to DIN 24320	M
Water solutions	HFC	according to VDMA 24317	M
Phosphoric acid esters	HFD-R	according to VDMA 24317	V
Organic esters	HFD-U	according to VDMA 24317	V
Fast biodegradable hydraulic fluids			Ordering code
Triglycerides (rape seed oil)	HETG	according to VDMA 24568	M
Synthetic esters	HEES	according to VDMA 24568	V
Polyglycols	HEPG	according to VDMA 24568	V

Characteristic curves (measured with HLP46, according to ISO 3968)

H3XL...

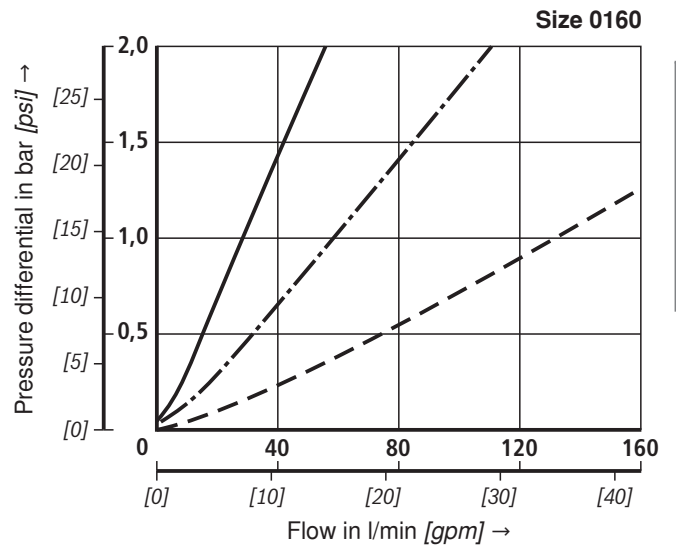
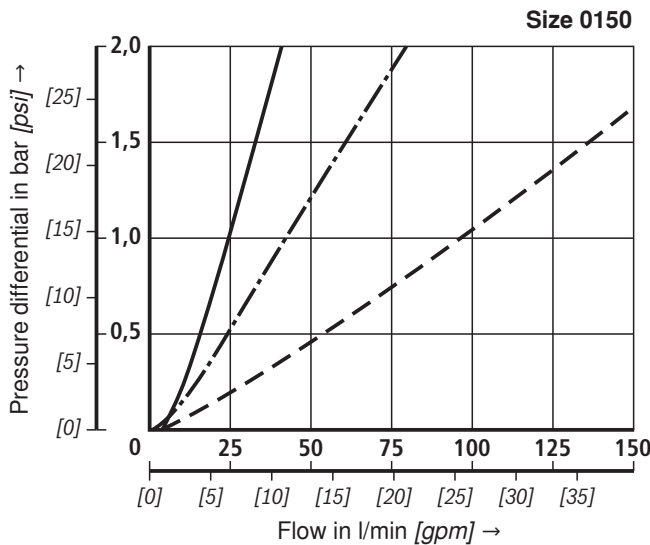
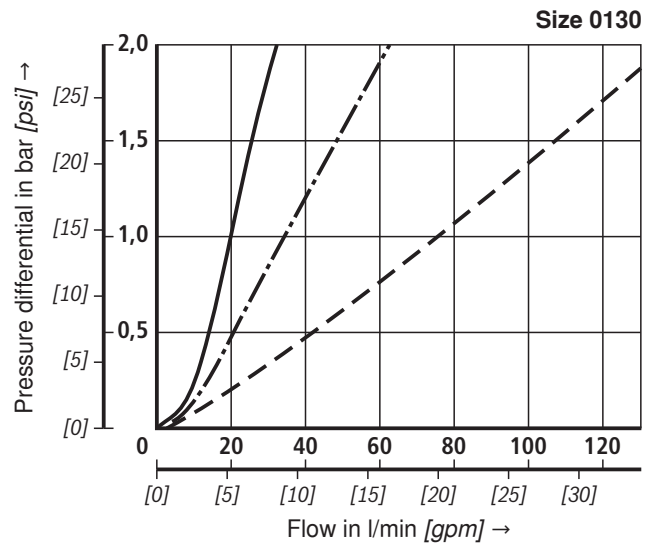
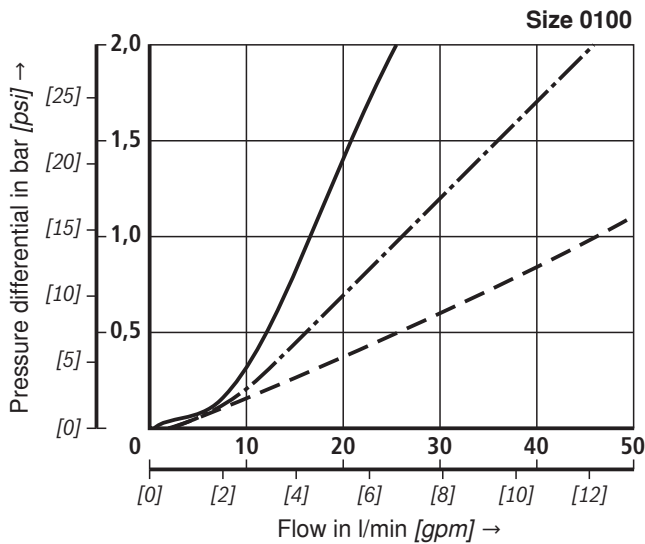
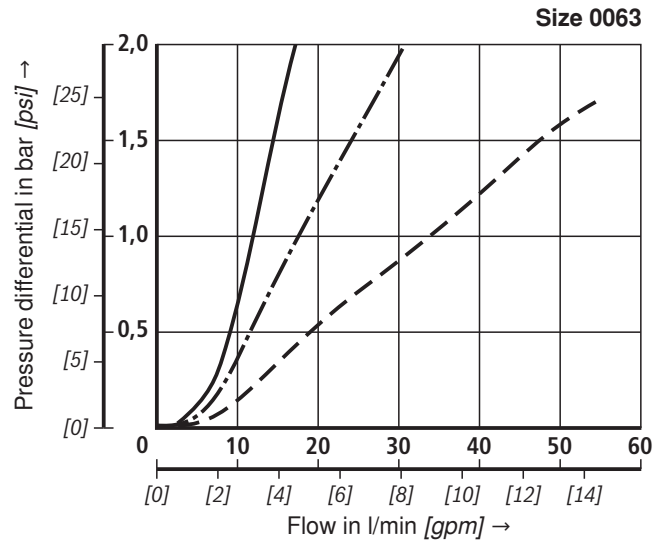
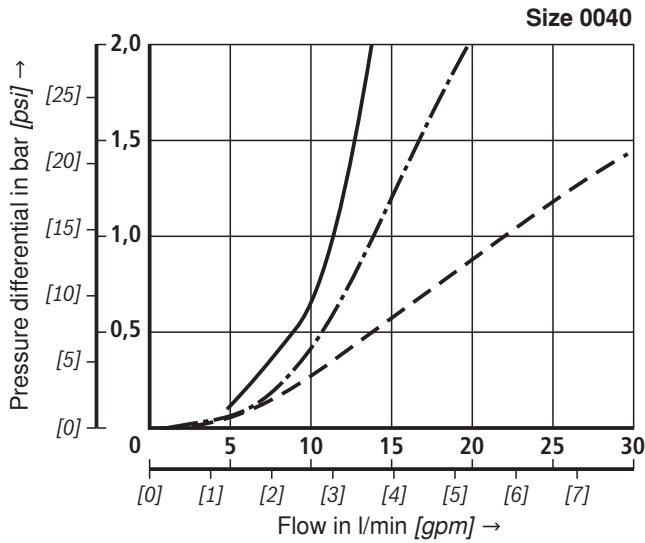
Specific weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters recommended
initial Δp for design = 1.5 bar

A proper filter design is enabled by our computer program
"BRFilterSelect".

- 140 mm²/s [649 SUS]
- · - 68 mm²/s [315 SUS]
- - - 30 mm²/s [139 SUS]

Oil viscosity:



Characteristic curves (measured with HLP46, according to ISO 3968)

H3XL...

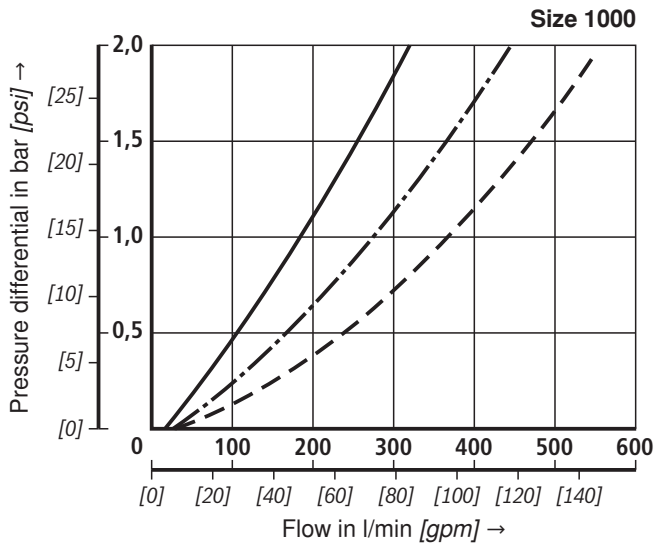
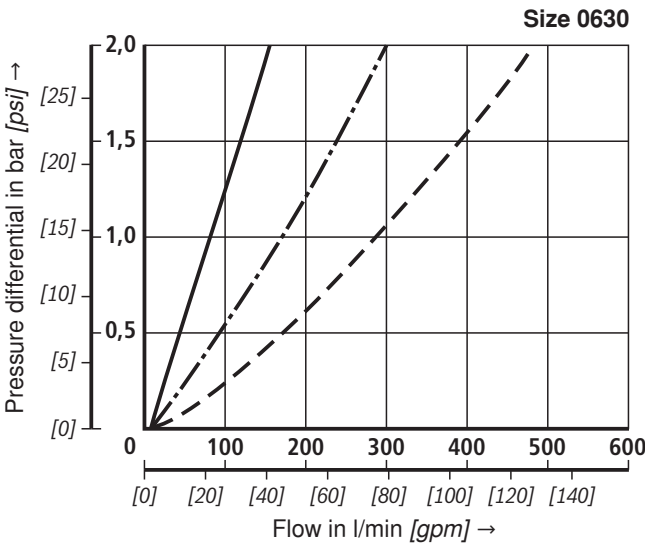
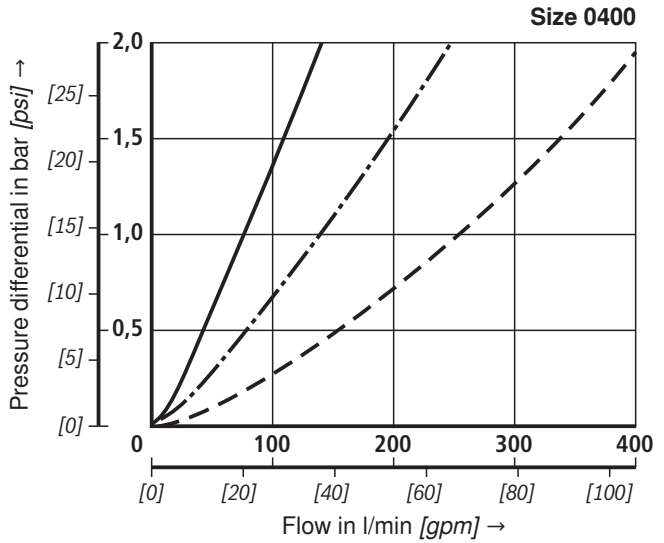
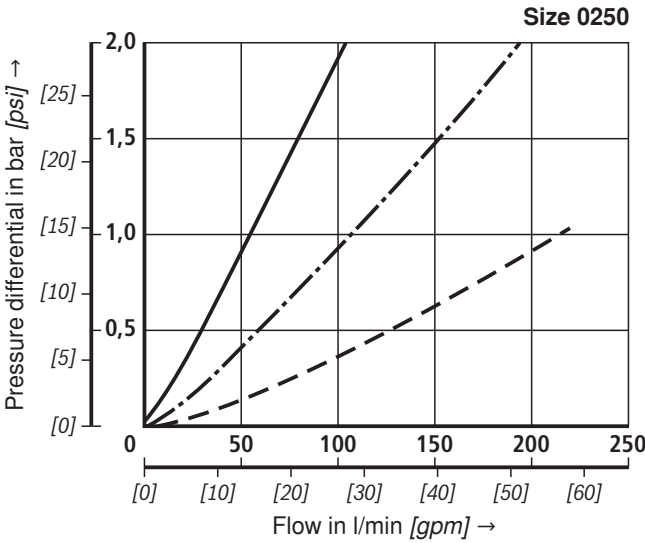
Specific weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters recommended
initial Δp for design = 1.5 bar

A proper filter design is enabled by our computer program
"BRFilterSelect".

- 140 mm²/s [649SUS]
- · - 68 mm²/s [315SUS]
- - - 30 mm²/s [139SUS]

Oil viscosity:



Characteristic curves (measured with HLP46, according to ISO 3968)

H10XL...

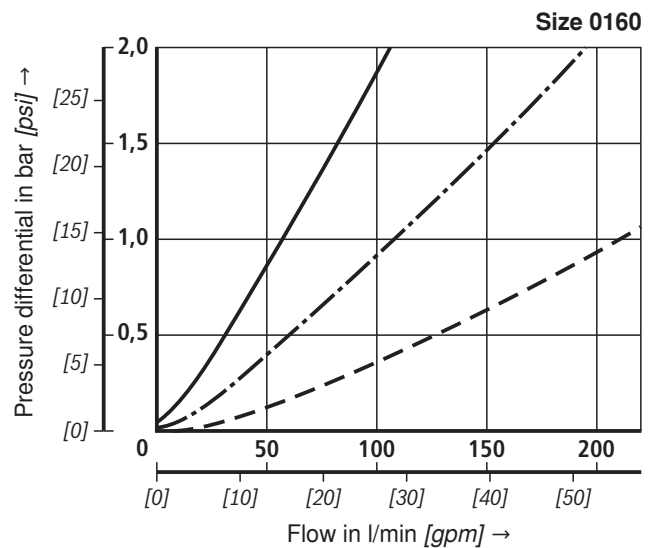
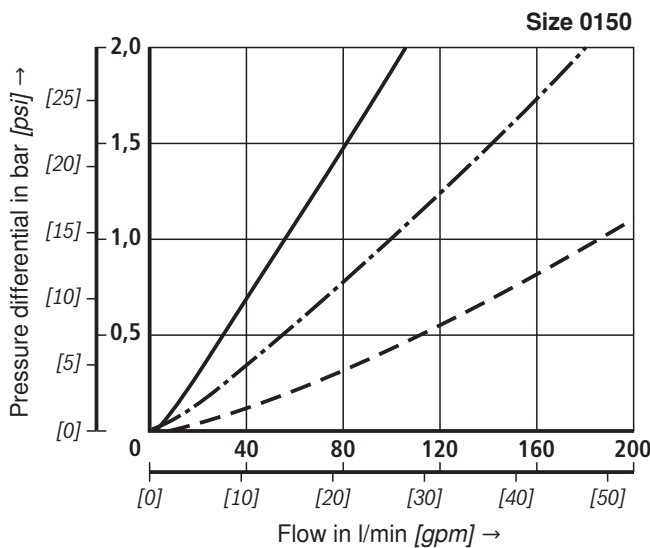
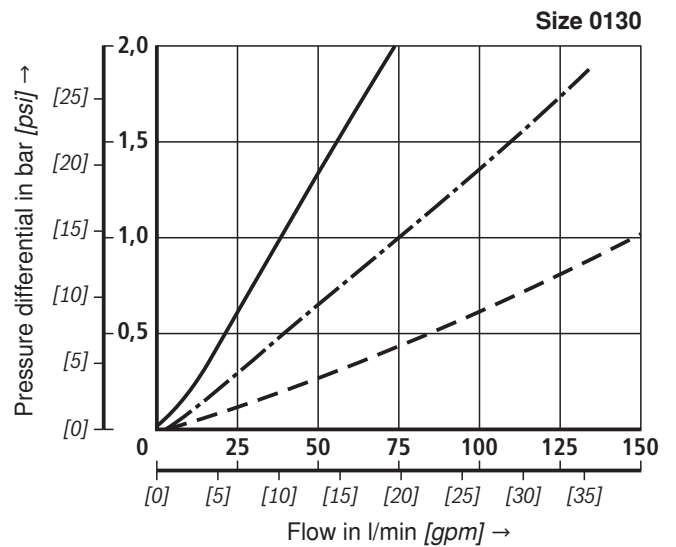
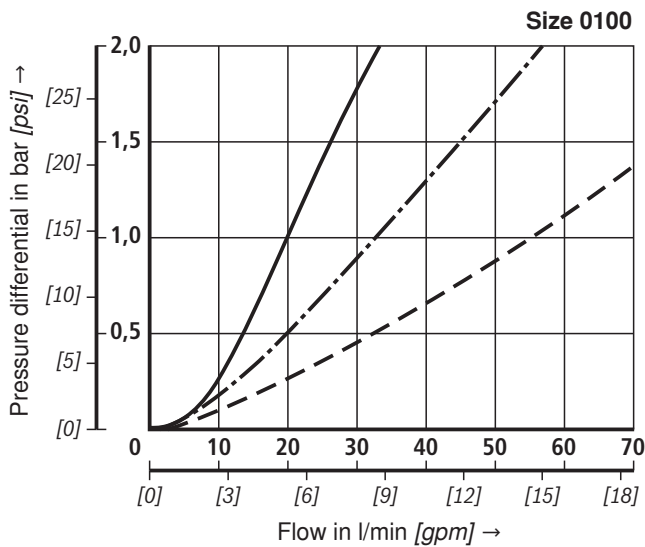
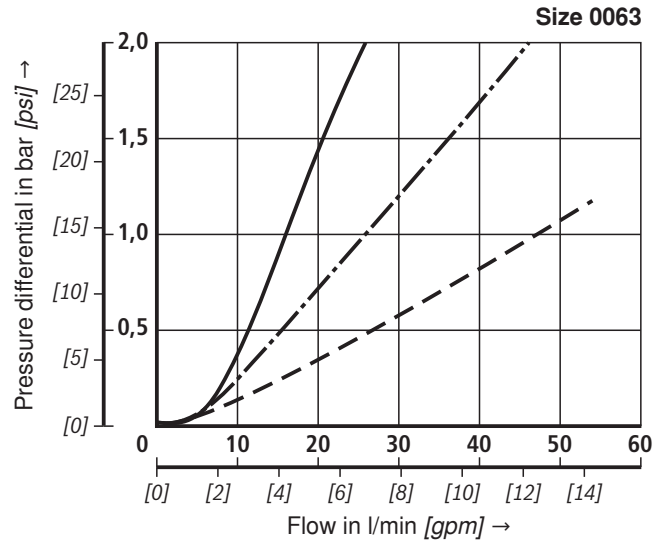
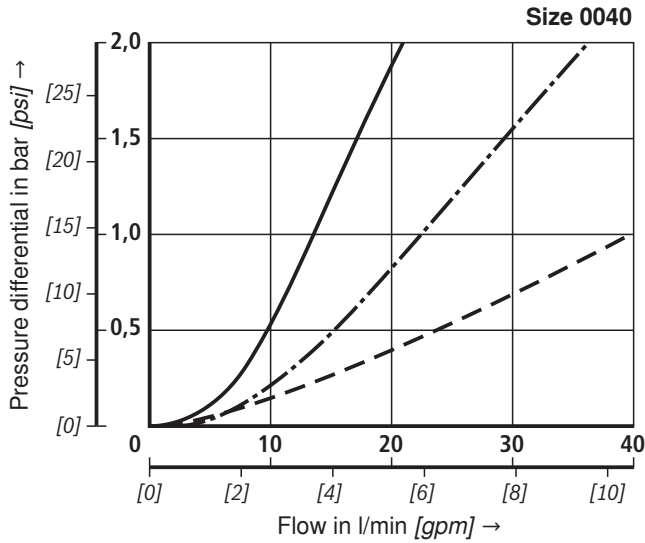
Specific weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters recommended
initial Δp for design = 1.5 bar

A proper filter design is enabled by our computer program
"BRFilterSelect".

- 140 mm²/s [649 SUS]
- · - 68 mm²/s [315 SUS]
- - - 30 mm²/s [139 SUS]

Oil viscosity:



Characteristic curves (measured with HLP46, according to ISO 3968)

H10XL...

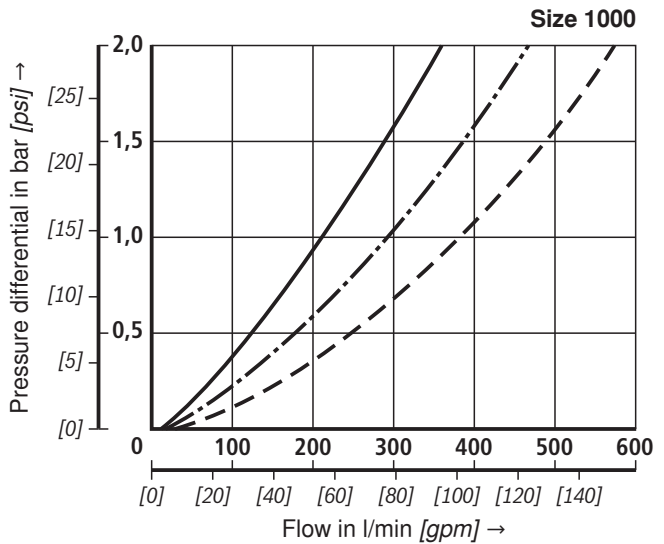
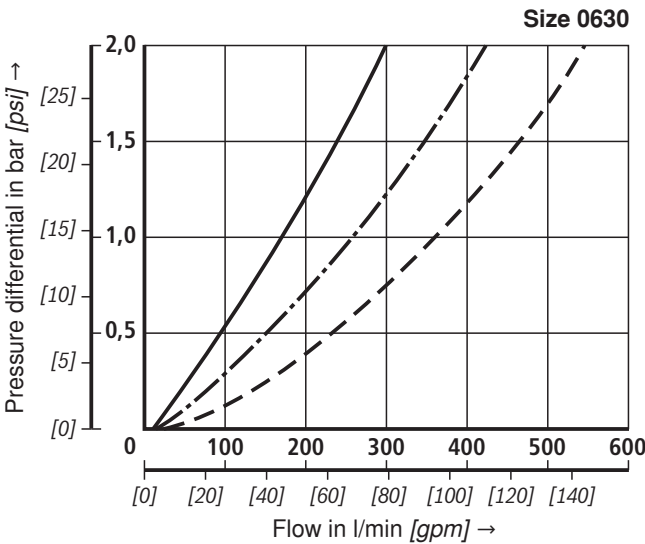
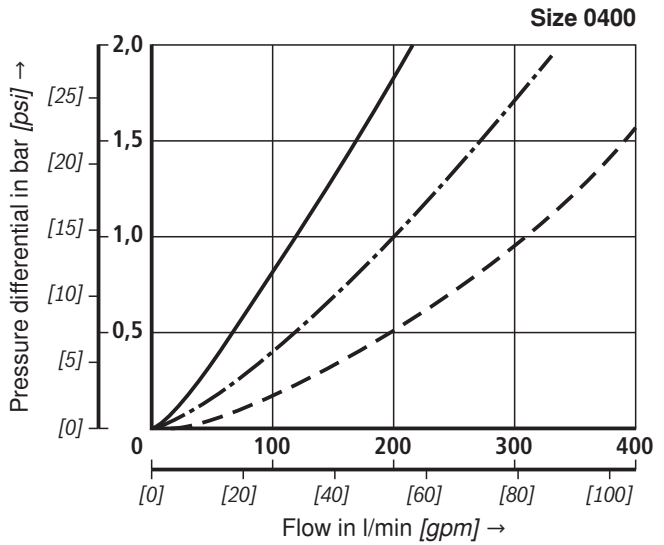
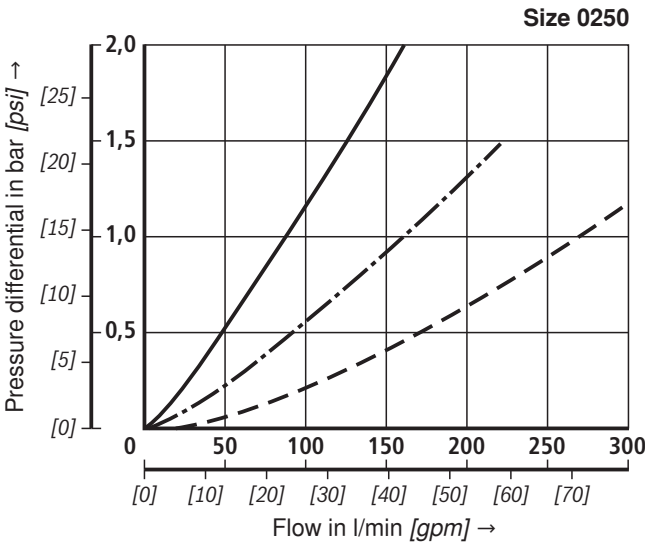
Specific weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters recommended initial Δp for design = 1.5 bar

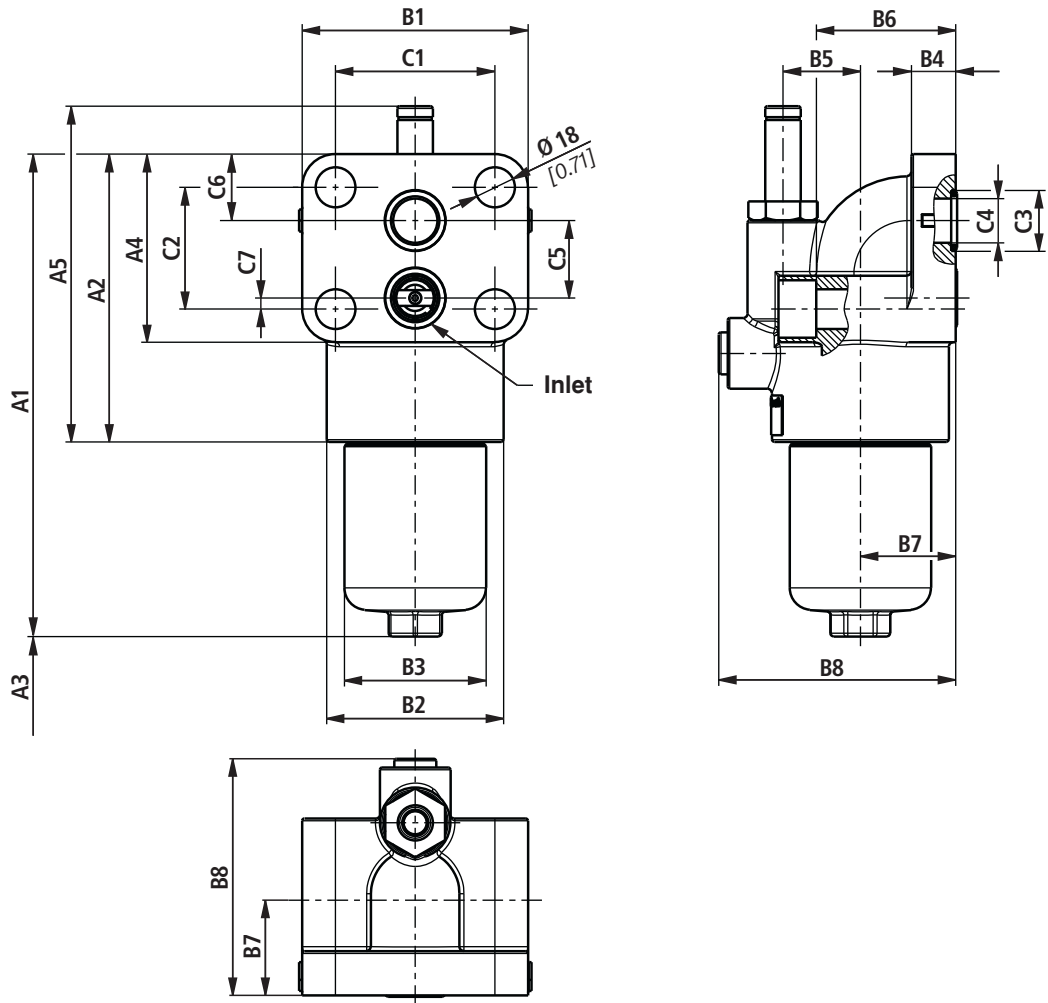
A proper filter design is enabled by our computer program "BRFilterSelect".

- 140 mm²/s [649SUS]
- · - 68 mm²/s [315SUS]
- - - 30 mm²/s [139SUS]

Oil viscosity:



Unit dimensions size 0040 to size 0100 (dimensions in mm [inch])



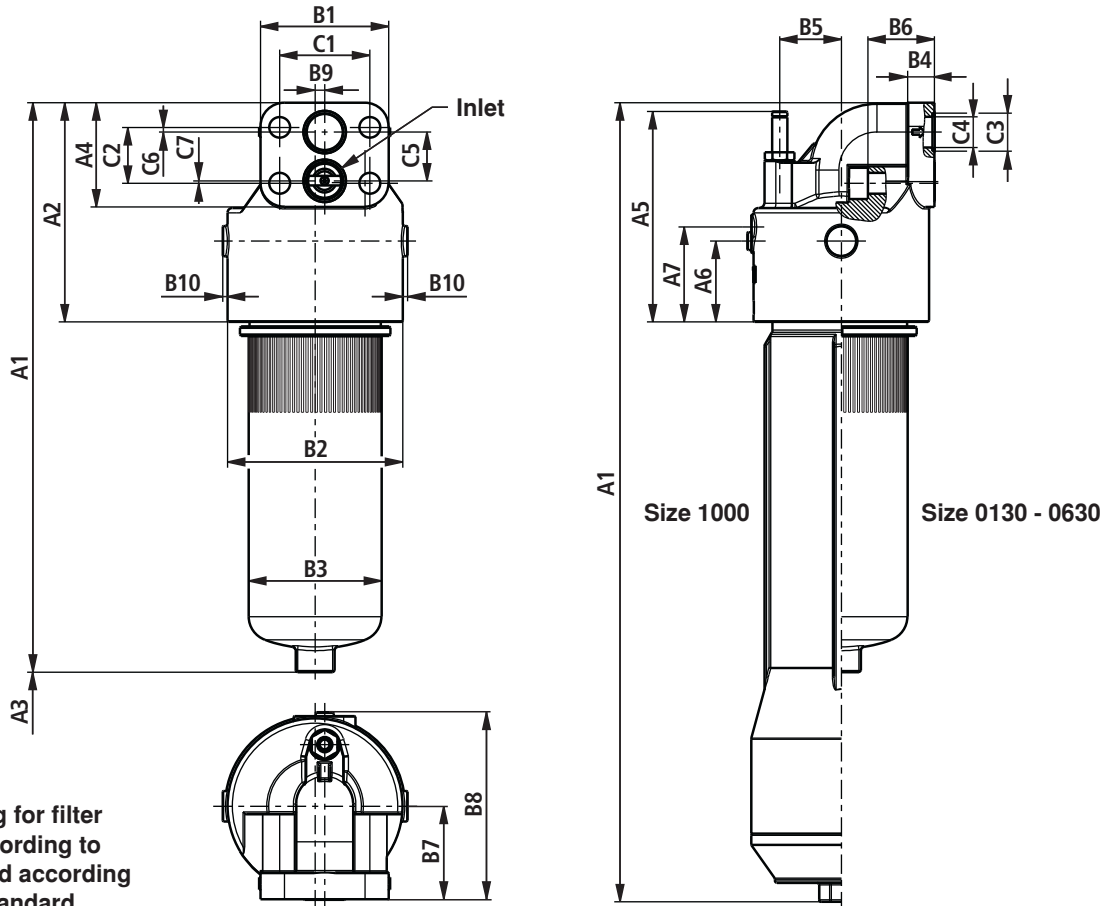
Filter housing for filter elements in accordance with DIN 24550

Type 350PSF(N)	Content in l [US gal]	A1	A2	A3 ¹⁾	A4	A5	B1	B2 Ø	B3 Ø	B4
0040	0.3 [0.08]	218 [8.58]								
0063	0.45 [0.12]	281 [11.06]	130 [5.12]	120 [4.72]	85 [3.35]	152 [5.98]	102 [4.02]	80 [3.15]	64 [2.52]	20 [0.79]
0100	0.65 [0.17]	371 [14.61]								

Type 350PSF(N)	B5	B6	B7	B8	C1	C2	C3 Ø	C4 Ø	C5	C6	C7
0040											
0063	35 [1.38]	63 [2.48]	43 [1.69]	107 [4.21]	72 [2.83]	55 [2.17]	27.5 [1.08]	20 [0.79]	35 [1.38]	30 [1.18]	5 [0.20]
0100											

¹⁾ Servicing height for filter element replacement

Unit dimensions size 0130 to size 1000 (dimensions in mm [inch])



Filter housing for filter elements according to DIN 24550 and according to Rexroth standard

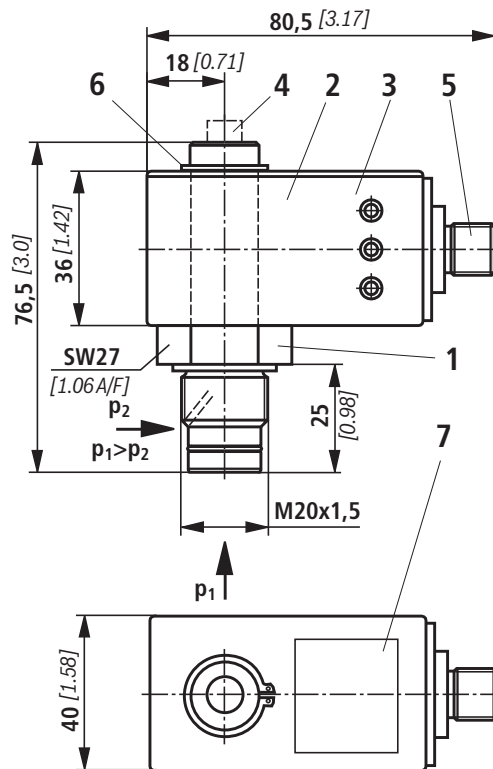
Type 350PSF(N)	Content in l [US gal]	A1	A2	A3 ¹⁾	A4	A5	A6	A7	B1	B2 Ø	B3 Ø	B4	B5					
0130	0.9 [0.24]	366 [14.41]	188 [7.40]	120 [4.72]	110 [4.33]	194 [7.64]	64 [2.52]	80 [3.15]	135 [5.31]	140 [5.51]	114 [4.49]	28 [1.10]	70 [2.76]					
0150	1.1 [0.29]	417 [16.42]												172 [6.77]	55 [2.17]	-	118 [4.65]	92 [3.62]
0160	1.65 [0.44]	355 [13.98]	203 [7.99]											222 [8.74]	85 [3.35]	100 [3.94]	185 [7.28]	140 [5.51]
0250	2.1 [0.55]	445 [17.52]																
0400	3.2 [0.85]	595 [23.43]																
0630	4.4 [1.16]	626 [24.65]	231 [9.09]	160 [6.30]														
1000	6.3 [1.66]	864 [34.02]		555 [21.85]														

Type 350PSF(N)	B6	B7	B8	B9	B10	C1	C2	C3 Ø	C4 Ø	C5	C6	C7
0130	55 [2.17]	60 [2.36]	134 [5.28]	-	16 [0.63]			40 [1.57]	32 [1.26]			
0150												
0160												
0250	68 [2.68]	78 [3.07]	162 [6.38]	5 [0.20]	15 [0.59]	95 [3.74]	59 [2.32]	45 [1.77]	38 [1.50]	52 [2.05]	31 [1.22]	2 [0.08]
0400												
0630	70 [2.76]	98 [3.86]	197 [7.76]	10 [0.39]	5 [0.20]							
1000												

¹⁾ Servicing height for filter element replacement

²⁾ With size 1000, the filter bowl has a two-part design.

Maintenance indicator (dimensions in mm [inch])



- 1 Mechanical optical maintenance indicator;
max. tightening torque $M_{A \max} = 50 \text{ Nm [36.88 lb-ft]}$
- 2 Switching element with locking ring for electrical maintenance indicator (can be rotated by 360°); plug-in connection M12x1 or according to DIN EN 175201-804
- 3 Housing with three LEDs: 24 V =
Green: Stand-by
Yellow: Switching point 75 %
Red: Switching point 100 %
- 4 Optical indicator bistable
- 5 Round connector M12x1, 4-pin
- 6 Locking ring
- 7 Nameplate

Notes:

Presentation contains mechanical optical maintenance indicator (1) and electronic switching element (2).

Round plug-in connection M12x1 (6)

For connection e.g. to ABZFV-E1SP-M12x1-1X/-DIN (see page 17).

Switching elements with increased switching power at request.

Spare parts

Mechanical optical maintenance indicator

ABZ F V HV5-1X / -DIN

Rexroth plant construction accessories

Filter

Maintenance indicator

Mechanical optical maintenance indicator for high-pressure filters switching point 5 bar [72 psi]

= HV5

DIN = Mark for DIN version

M =

V =

Seal material

NBR seal

FKM seal

Component series

Component series 10 to 19 (10 to 19; identical installation and connection dimensions)

1X =

Mechanical optical maintenance indicator	Material no.
ABZ FV-HV5-1X/M-DIN	R901025313

Seal kit

D 350PSF

Seal kit

Type 350PSF

Size

Size 0040-0100

= N0040-0100

Size 0130-0150

= 0130-0150

Size 0160-0400

= N0160-0400

Size 0630

= N0630

Size 1000

= N1000

M =

V =

Seal

NBR seal

FKM seal

Seal kit	Material no.
D350PSFN0040-0100-M	R928028535
D350PSF0130-0150-M	R928028541
D350PSFN0160-0400-M	R928028543
D350PSFN0630-M	R928028546
D350PSFN1000-M	R928028547

Installation, commissioning and maintenance

Installation of the filter

Verify operating pressure with nameplate information. Remove plug screws in the filter inlet and outlet, mount filter at the control block without tension stress considering flow direction (direction arrows) and servicing height of the filter element. The filter must preferably be installed with the filter bowl (2) downward. The maintenance indicator must be arranged in a well visible way.

Connection of the electrical maintenance indicator

Basically, the filter is equipped with mechanical optical maintenance indicator (4). The electronic maintenance indicator is connected via the switching element (6) with 1 or 2 switching points, which is attached to the mechanical optical maintenance indicator and held by means of the locking ring.

When must the filter element be exchanged or cleaned respectively?

Upon start-up in cold condition, the red pushbutton of the optical maintenance indicator (4) may jump out and an electrical signal is output via the switching element (6). Only push the red pushbutton in again after the operating temperature has been reached. If it jumps out again immediately or if the electrical signal has not gone out at operating temperature, the filter element must be exchanged or cleaned respectively after the end of the shift.

Element exchange

- Switch off the system and discharge the filter on the pressure side.
- Screw off the filter bowl (2) or the floor (size 1000) by anti-clockwise rotation. Clean the filter housing in a suitable medium.
- Remove the filter element (3) from the centering spigot in the filter head by turning it slightly
- Check the seal ring and the support ring in the filter bowl for position and damage. If necessary, these parts are to be renewed.
- Replace filter elements H...XL and P..., clean the filter element with material G
- The efficiency of the cleaning process depends on the characteristics of contamination and the amount of the pressure differential before the filter element exchange. If the differential pressure after the filter element exchange exceeds 50 % of the value before the filter element exchange, the G... element also needs to be replaced.
- Check whether the type designation or material number on the replacement element corresponds to the type designation/material number on the nameplate of the filter.
- Install replaced or cleaned filter element on the spigot again by slightly turning it.
- Now screw in the filter bowl or floor to stop. Then turn out the filter bowl by 1/8 to 1/2 turn so that the filter bowl is not stuck due to the pressure pulsation and can be easily loosened in case of maintenance works.

Quality and standardization

The block mounting filters for hydraulic applications according to RE 51419 are pressure holding equipment according to article 1, section 2.1.4 of the pressure equipment directive 97/23/EC (PED).

However, on the basis of the exception in article 1, section 3.6 of the PEG, hydraulic filters are exempt from the PED if they are not classified higher than category I (guideline 1/19). They do not receive a CE mark.

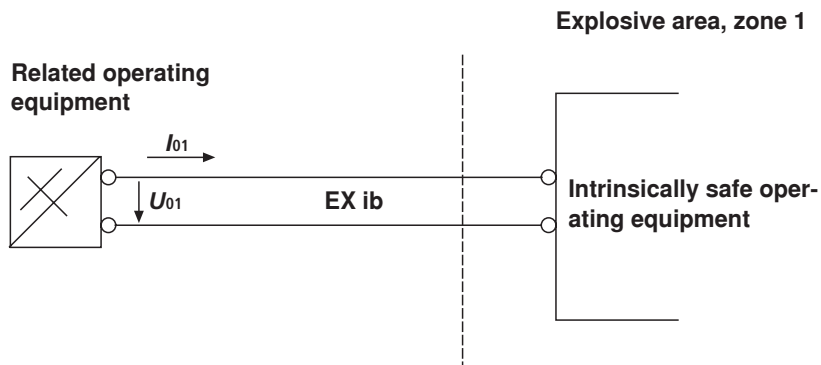
Use in explosive areas according to directive 94/9/EC (ATEX)

The block mounting filters according to RE 51419 are no equipment or components in the sense of directive 94/9/EC and are not provided with a CE mark.

When using the block mounting filters according to RE 51419 in explosive areas, potential equalization has to be ensured.

According to DIN EN 50020, the electrical maintenance indicators are simple, electrical operating equipment not having own voltage sources. This simple, electrical operating equipment may - according to DIN EN 60079-14 in intrinsically safe electrical circuits (EEx ib) be used in systems for device group II, category 2G (zone 1) and category 3G (zone 2) without marking and certification. The operating equipment is assigned to explosion group II B and temperature class T5.

Possible circuit according to DIN EN 60079-14



With electrical maintenance indicators with two switching points, switching units with two intrinsically safe input circles must be used.

Side mounted, flanged manifold filter with filter element according to DIN 24550

Type 450FEN0040 to 1000

RE 51467

Edition: 2014-09



- ▶ Sizes according to **DIN 24550**: 0040 to 1000
- ▶ Component series 2X
- ▶ Nominal pressure 450 bar [6526 psi]
- ▶ Connection up to DN50
- ▶ Operating temperature -10 °C ... +100 °C [14 °F ... 212 °F]

Features

Side mounted, flanged manifold filters are used in hydraulic systems for separating solid materials from fluids and lubricating oils. They are intended for side mounting on manifold blocks.

They distinguish themselves by the following:

- ▶ Filter for manifold mounting, outlet below inlet
- ▶ High filtration performance due to the tangential cyclone-effect flow path
- ▶ Special highly efficient filter materials
- ▶ Filtration of very fine particles and high dirt holding capacity across a broad pressure differential range
- ▶ High collapse resistance of the filter elements
- ▶ By default equipped with mechanical optical maintenance indicator with memory function
- ▶ Various, optional electronic switching elements, modular design
- ▶ Measurement port drilled and closed by default

Contents

Features	1
Ordering code filter	2
Ports	2
Preferred types	3
Ordering code accessories	4
Symbols	5
Function, section	6
Technical data	7, 8
Compatibility with permitted hydraulic fluids	8
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Dimensions	14, 15
Maintenance indicator	16
Ordering code spare parts	17 ... 19
Assembly, commissioning, maintenance	20
Tightening torques	21
Directives and standardization	21, 22

Ordering code filter

01	02	03	04	05	06	07	08	09	09
450FE	N	-	2X	/	B00	-	-	-	-

Series

01	Block mounting filter 450 bar [6526 psi]	450FE
----	--	-------

Filter element

02	with filter element according to DIN 24550	N
----	---	---

Size

03	FEN... (Filter element according to DIN 24550)	0040 0063 0100 0160 0250 0400 0630 1000
----	---	--

04	Component series 20 ... 29 (20 ... 29: unchanged installation and connection dimensions)	2X
----	---	----

Filter rating in μm

05	Absolute (ISO 16889; $\beta_x(c) \geq 200$)	Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
	Nominal	Stainless steel wire mesh, cleanable	G10 G25 G100

Pressure differential

06	Max. admissible pressure differential of the filter element 330 bar [4786 psi], filter without bypass valve	B00
----	--	-----

Maintenance indicator

07	Maintenance indicator, mech./optical, switching pressure 2.2 bar [32 psi]	V2.2
	Maintenance indicator, mech./optical, switching pressure 5.0 bar [72.5 psi]	V5.0
	Maintenance indicator, mech./optical, switching pressure 8.0 bar [116 psi]	V8.0

Seal

08	NBR seal	M
	FKM seal	V

Supplementary information

09	additional threaded couplings, G 1/4, at the inlet and outlet	M
	Manufacturer's inspection certificate M according to DIN 55350 T18	Z1

Order example:

450FEN0040-2X/H10XLB00-V5,0-M

Further versions are available on request.

Material no. R928054175

Ports

Port	Frame size		
	0040-0100	0160-0400	0630-1000
DN18	●		
DN32		●	
DN50			●

● = Standard port

Preferred types

NBR seal, without bypass, flow specifications for 30 mm²/s [143 SUS]

Inline filter 450FEN, filter rating 3 µm

Type	Flow in l/min [US gpm] with $v = 30 \text{ mm}^2/\text{s}$ [143 SUS] and $\Delta p = 1.5 \text{ bar}$ [21.75 psi] ¹⁾	Material no. Filters	Material no. replacement filter element
450FEN0040-2X/H3XLB00-V5,0-M	31 [8.2]	R928054159	R928006654
450FEN0063-2X/H3XLB00-V5,0-M	45 [11.9]	R928054160	R928006708
450FEN0100-2X/H3XLB00-V5,0-M	57 [15.1]	R928054161	R928006762
450FEN0160-2X/H3XLB00-V5,0-M	182 [48.1]	R928054162	R928006816
450FEN0250-2X/H3XLB00-V5,0-M	250 [66.0]	R928054163	R928006870
450FEN0400-2X/H3XLB00-V5,0-M	305 [80.6]	R928054164	R928006924
450FEN0630-2X/H3XLB00-V5,0-M	382 [100.9]	R928054165	R928006978
450FEN1000-2X/H3XLB00-V5,0-M	462 [122.0]	R928054166	R928007032

Inline filter 450FEN, filter rating 6 µm

Type	Flow in l/min [US gpm] with $v = 30 \text{ mm}^2/\text{s}$ [143 SUS] and $\Delta p = 1.5 \text{ bar}$ [21.75 psi] ¹⁾	Material no. Filters	Material no. replacement filter element
450FEN0040-2X/H6XLB00-V5,0-M	38 [10.0]	R928054167	R928006655
450FEN0063-2X/H6XLB00-V5,0-M	55 [14.5]	R928054168	R928006709
450FEN0100-2X/H6XLB00-V5,0-M	60 [15.9]	R928054169	R928006763
450FEN0160-2X/H6XLB00-V5,0-M	215 [56.8]	R928054170	R928006817
450FEN0250-2X/H6XLB00-V5,0-M	270 [71.3]	R928054171	R928006871
450FEN0400-2X/H6XLB00-V5,0-M	337 [89.0]	R928054172	R928006925
450FEN0630-2X/H6XLB00-V5,0-M	430 [113.6]	R928054173	R928006979
450FEN1000-2X/H6XLB00-V5,0-M	501 [132.4]	R928054174	R928007033

Inline filter 450FEN, filter rating 10 µm

Type	Flow in l/min [US gpm] with $v = 30 \text{ mm}^2/\text{s}$ [143 SUS] and $\Delta p = 1.5 \text{ bar}$ [21.75 psi] ¹⁾	Material no. Filters	Material no. replacement filter element
450FEN0040-2X/H10XLB00-V5,0-M	51 [13.5]	R928054175	R928006656
450FEN0063-2X/H10XLB00-V5,0-M	62 [16.4]	R928054176	R928006710
450FEN0100-2X/H10XLB00-V5,0-M	68 [18.0]	R928054177	R928006764
450FEN0160-2X/H10XLB00-V5,0-M	246 [65.0]	R928054072	R928006818
450FEN0250-2X/H10XLB00-V5,0-M	300 [79.3]	R928054073	R928006872
450FEN0400-2X/H10XLB00-V5,0-M	346 [91.4]	R928054074	R928006926
450FEN0630-2X/H10XLB00-V5,0-M	465 [122.8]	R928053894	R928006980
450FEN1000-2X/H10XLB00-V5,0-M	518 [136.8]	R928053895	R928007034

¹⁾ An appropriate differential pressure via the filter and measuring device according to ISO 3968. The differential pressure measured on the maintenance indicator is lower.

Ordering code accessories
(dimensions in mm [inch])

Electronic switching element for maintenance indicators

01	02	03	
WE	-	-	

Maintenance indicator

01	electronic switching element	WE
----	------------------------------	-----------

Type of signal

02	1 switching point	1SP
	2 switching points, 3 LED	2SP
	2 switching points, 3 LED and signal suppression up to 30 °C [86 °F]	2SPSU

Connector

03	Round plug-in connection M12x1, 4-pole	M12x1
	Rectangular plug-in connection, 2-pole, design A according to EN-175301-803	EN175301-803

Material numbers of the electronic switching elements

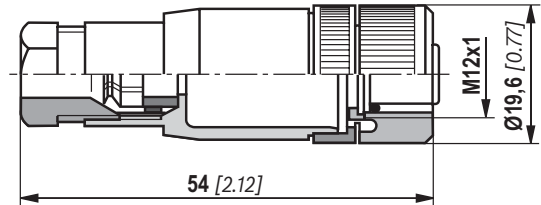
Material no.	Type	Signal	Switching points	Connector	LED
R928028409	WE-1SP-M12x1	Changeover	1	M12x1	without
R928028410	WE-2SP-M12x1	Normally open (at 75%) / normally closed contact (at 100%)	2		3 pieces
R928028411	WE-2SPSU-M12x1				
R928036318	WE-1SP-EN175301-803	Normally closed contact	1	EN 175301-803	without

Mating connectors according to IEC 60947-5-2

for electronic switching element with round plug-in connection M12x1

Mating connector suitable for K24 4-pole, M12x1 with screw connection, cable gland Pg9.

Material no. R900031155

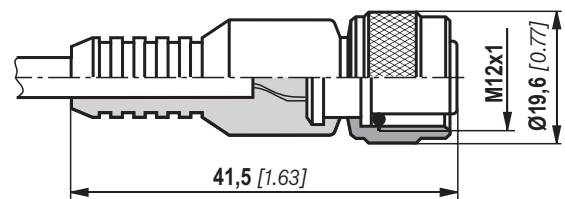


Mating connector suitable for K24-3m 4-pole, M12x1 with potted-in PVC cable, 3 m long.

Line cross-section: 4 x 0.34 mm²

Core marking: **1** brown **2** white
3 blue **4** black

Material no. R900064381

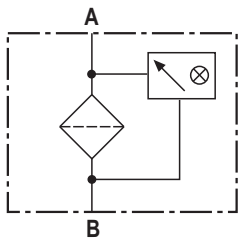


For more round plug-in connections refer to data sheet 08006.

Order example:
Block mounting filter with mechanical optical maintenance indicator for $p_{nominal} = 450 \text{ bar}$ [6526 psi] size 0160, with filter element 10 µm and electronic switching element M12x1 with one switching point.

Filter with mech. optical maintenance indicator:	450FEN0160-2X/H10XLB00-V5,0-M	Material no. R928054072
Electronic switching element:	WE-1SP-M12x1	Material no. R928028409
Mating connector:	Mating connector suitable for K24 4-pole, M12x1	Material no. R900031155

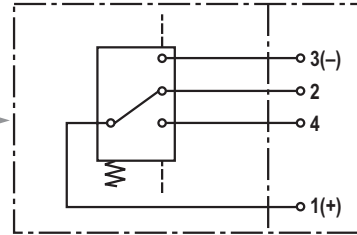
Symbols



Block mounting filter with mechanical indicator

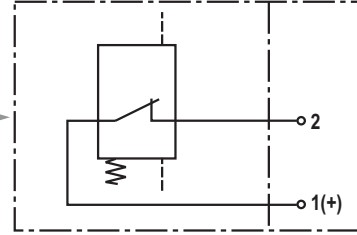
Electronic switching element for maintenance indicator

Switching element Connector



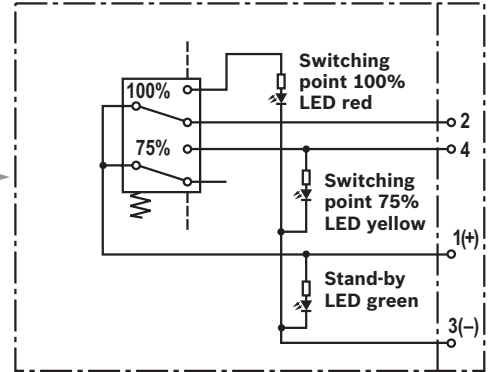
WE-1SP-M12x1

Switching element Connector



WE-1SP-EN175301-803

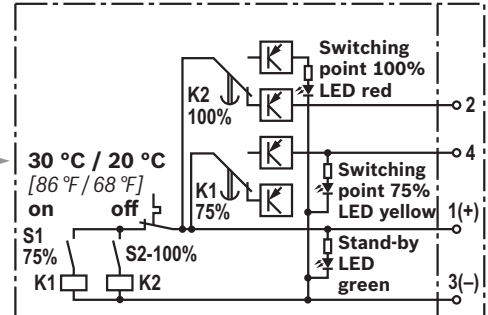
Switching element Connector



WE-2SP-M12x1

Circuit diagram drawn in plugged condition (operating state)

Switching element Connector



WE-2SPSU-M12x1

Circuit diagram drawn in plugged condition at temperature > 30 °C [86 °F] (operating condition)

Function, section

The block mounting filter 450FEN is suitable for direct mounting on manifold blocks.

The filter basically consists of filter head (1), a threaded filter bowl (2), filter element (3) as well as a mechanical optical maintenance indicator (4).

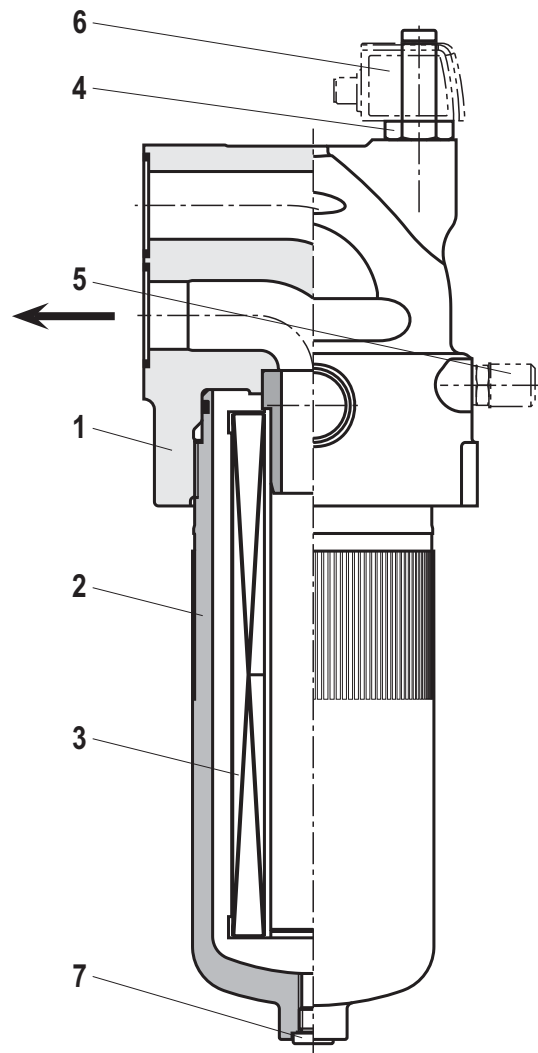
Via the inlet, the hydraulic fluid reaches the filter element (3) where it is cleaned. The dirt particles filtered out collect in the filter element (3). Via the outlet, the filtered hydraulic fluid enters the hydraulic circuit.

The filter housing and all associated elements are designed so that pressure peaks – as they may occur in case of abrupt opening of large control valves due to the accelerated fluid quantity – can be securely absorbed. For sizes 0160 and larger, the standard equipment comprises a drain screw (7). A two-piece filter bowl is standard for size 1000.

By default, measuring ports are drilled at the inlet and outlet and closed with VSTI plug screws. A pressure differential measurement or venting of the filter is possible via the optional threaded coupling – order supplementary option “M”.

By default, the filter is equipped with mechanical optical maintenance indicator (4). The electronic switching element (6) which has to be ordered separately is attached to the mechanical optical maintenance indicator (4) and held by means of a locking ring.

The electronic switching elements with 1 or 2 switching points are connected via a mating connector according to IEC-60947-5-2 or via a cable connection according to EN17301-803.



Type 450FEN0160

Technical data

(For applications outside these parameters, please consult us!)

General					
Installation position		vertical			
Ambient temperature range		°C [°F]	-10 ... +65 [14 ... +149] (shortly up to -30 [-22])		
Storage conditions	- NBR seal	°C [°F]	-40 ... +65 [-40 ... +149]; max. relative air humidity 65%		
	- FKM seal	°C [°F]	-20 ... +65 [-4 ... +149]; max. relative air humidity 65%		
Mass filter	NS	0040	0063	0100	160
	kg [lbs]	5,7 [12.56]	6,4 [14.11]	7,25 [15.98]	18,5 [40.77]
	NS	0250	0400	0630	1000
	kg [lbs]	20,5 [45.18]	24,5 [54.00]	56 [123.42]	92 [202.77]
Volume	NS	0040	0063	0100	0160
	l [US gal]	0,32 [0.08]	0,47 [0.12]	0,68 [0.18]	1,68 [0.44]
	NS	0250	0400	0630	1000
	l [US gal]	2,25 [0.59]	3,25 [0.86]	4,9 [1.29]	6,9 [1.82]
Mass filter bowl	NS	0040	0063	0100	160
	kg [lbs]	1,33 [2.93]	1,33 [2.93]	2,1 [4.63]	5,52 [12.17]
	NS	0250	0400	0630	1000
	kg [lbs]	8,02 [17.68]	12,21 [26.91]	21,36 [47.08]	45,34 [99.93]
Material	- Filter head	Ductile Iron			
	- Filter bowl	Steel			
	- Seals	NBR or FKM			
	- Visual maintenance indicator	Brass			
	- Electronic switching element	Plastic PA6			
Surface requirement tank hydraulic block	- Roughness depth $R_{z \max.}$	µm	4		
	- Levelness $t_{E \max.}$	mm	0,05		

Hydraulic					
Maximum operating pressure		bar [psi]	450 [6526]		
Hydraulic fluid temperature range		°C [°F]	-10 ... +100 [+14 ... +212]		
Minimum conductivity of the medium		pS/m	300		
Fatigue strength according to ISO 10771		Load cycles	> 10 ⁶ with max. operating pressure		
Type of pressure measurement of the maintenance indicator		Pressure differential			
Assignment: Response pressure of the maintenance indicator/cracking pressure of the bypass valve		Response pressure of the maintenance indicator		Cracking pressure of the bypass valve	
		bar [psi]		Bypass valve not possible	
		2,2 ± 0,3 [31.9 ± 4.4]			
		5,0 ± 0,5 [72.5 ± 7.3]			
		8,0 ± 0,8 [116 ± 11.6]			
Filtration direction		From the outside to the inside			

Technical data

(For applications outside these parameters, please consult us!)

Electric (electronic switching element)				
Electrical connection	Round plug-in connection M12x1, 4-pole			Standard connection EN 175301-803
	Version	WE-1SP- M12x1	WE-2SP- M12x1	WE-2SPSU- M12x1
Contact load, direct voltage	$A_{max.}$	1		
Voltage range	$V_{max.}$	150 (AC/DC)	10-30 (DC)	250 (AC)/200 (DC)
max. switching power with resistive load	W	20		70
Switching type	- 75% signal	-	Normally open contact	
	- 100% signal	Changeover	Normally closed contact	
	- 2SPSU			Signal interconnection at 30 °C [86 °F], return switching at 20 °C [68 °F]
Display via LEDs in the electronic switching element 2SP...			Stand-by (LED green); 75% switching point (LED yellow) 100% switching point (LED red)	
Protection class according to EN 60529		IP 67		IP 65
Ambient temperature range	°C [°F]	-25 ... +85 [-13 ... +185]		
For direct voltage above 24 V, spark extinguishing is to be provided for protecting the switching contacts.				
Weight - electronic switching element:		0,1 [0.22]		

Filter element				
Glass fiber material H...XL		Single-use element on the basis of inorganic fiber		
		Filtration ratio according to ISO 16889 up to $\Delta p = 5 \text{ bar [72.5 psi]}$	Achievable oil cleanliness according to ISO 4406 [SAE-AS 4059]	
	H20XL	$\beta_{20(c)} \geq 200$	19/16/12 - 22/17/14	
	H10XL	$\beta_{10(c)} \geq 200$	17/14/10 - 21/16/13	
	H6XL	$\beta_6(c) \geq 200$	15/12/10 - 19/14/11	
	H3XL	$\beta_5(c) \geq 200$	13/10/8 - 17/13/10	
Pressure difference	- B00	bar [psi]	330 [4785]	

Compatibility with permitted hydraulic fluids

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oil	HLP	NBR	DIN 51524
Bio-degradable	- insoluble in water	HETG	VDMA 24568
		HEES	
Flame-resistant	- soluble in water	HEPG	VDMA 24568
	- water-free	HFDU, HFDR	VDMA 24317
- containing water	HFAS	NBR	DIN 24320
	HFAE	NBR	
	HFC	NBR	
			VDMA 24317

Important information on hydraulic fluids!

- ▶ For more information and data on the use of other hydraulic fluids, please refer to data sheet 90220 or contact us!
- ▶ **Flame-resistant - containing water:** Due to possible chemical reactions with materials or surface coatings of machine and system components, the service life with these hydraulic fluids may be less than expected.

Filter materials made of filter paper P may not be used, filter elements with glass fiber material have to be used instead.

- ▶ **Bio-degradable:** If filter materials made of filter paper are used, the filter life may be shorter than expected due to material incompatibility and swelling.

Characteristic curves H3XL

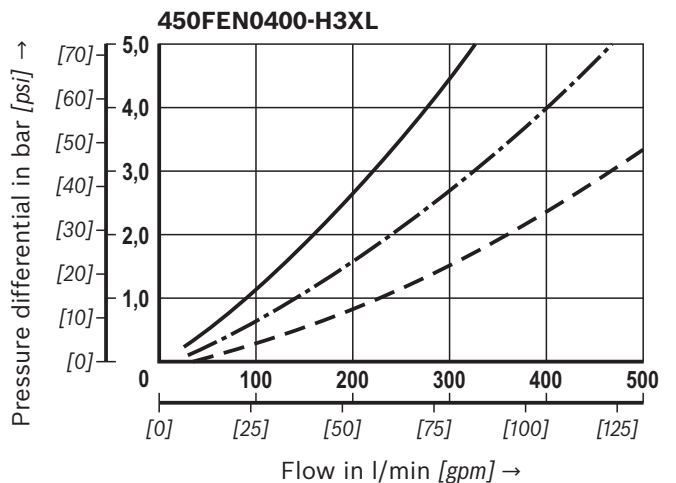
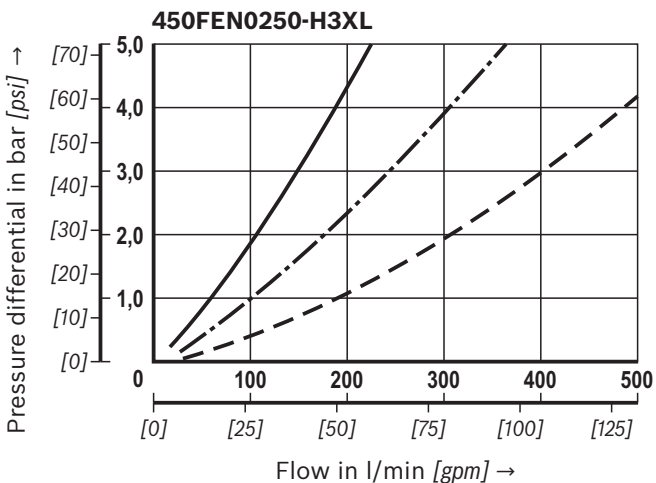
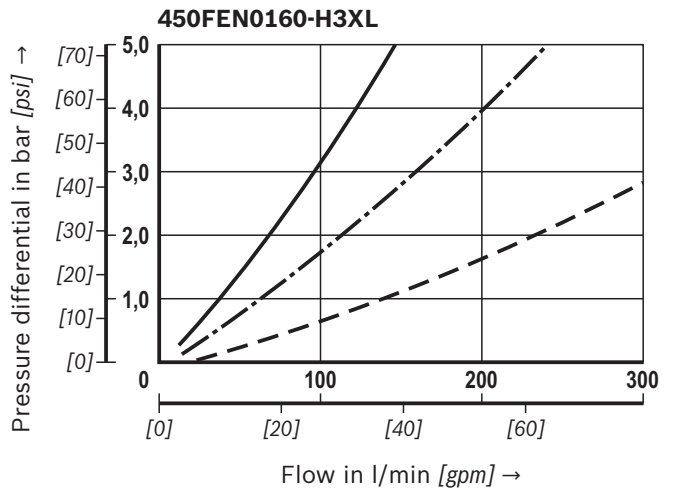
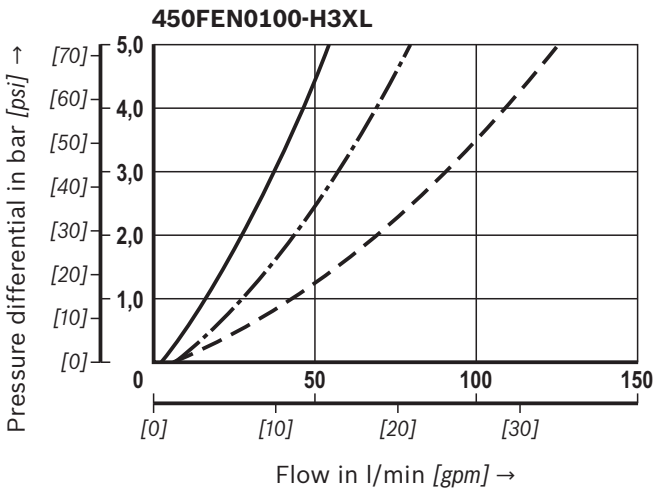
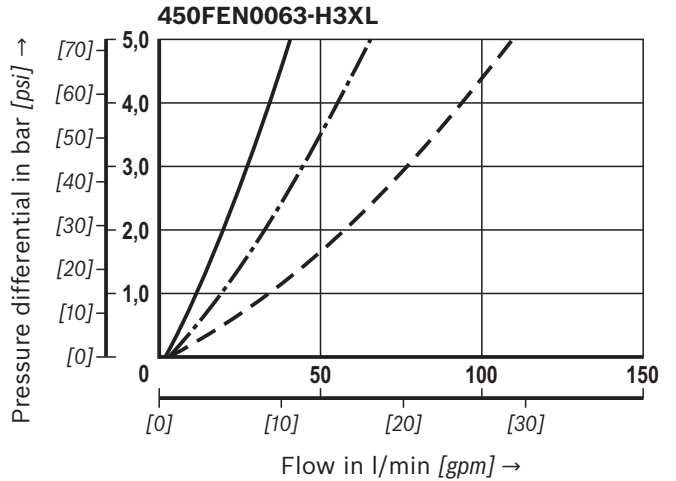
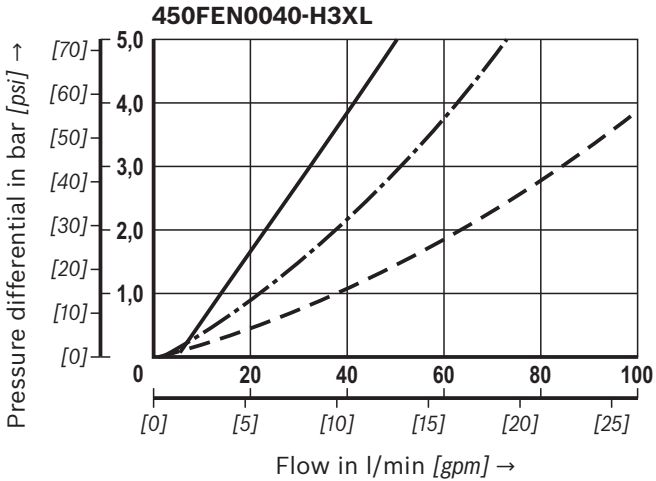
(measured with mineral oil HLP46 according to DIN 51524)

Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters recommended initial Δp for version = 1.5 bar [21.75 psi]

Selection of the correct filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Characteristic curves H3XL, H6XL

(measured with mineral oil HLP46 according to DIN 51524)

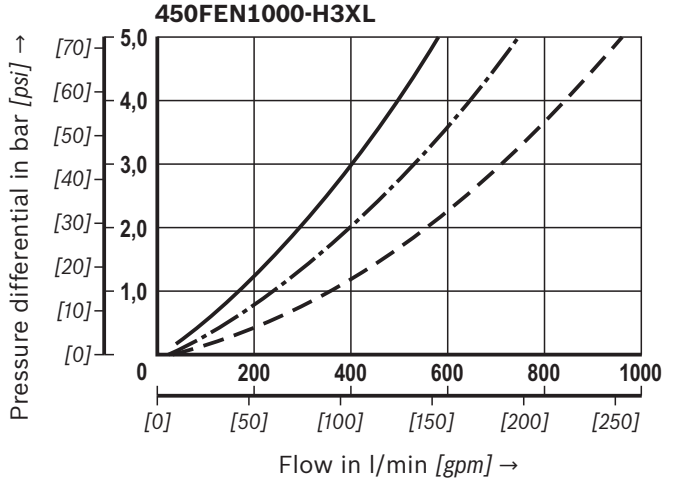
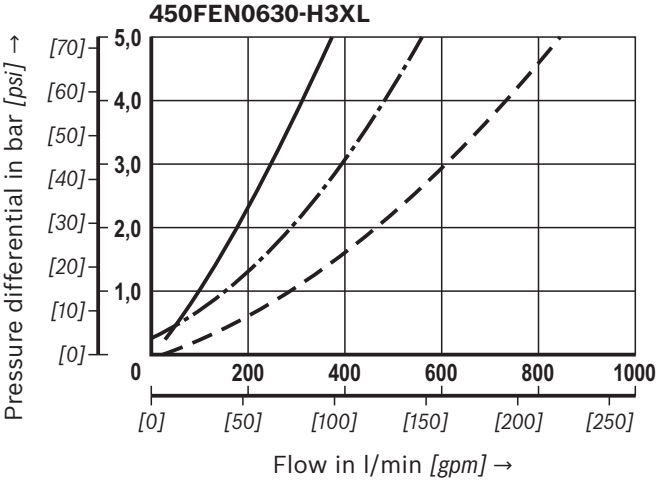
Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters recommended initial Δp for version = 1.5 bar [21.75 psi]

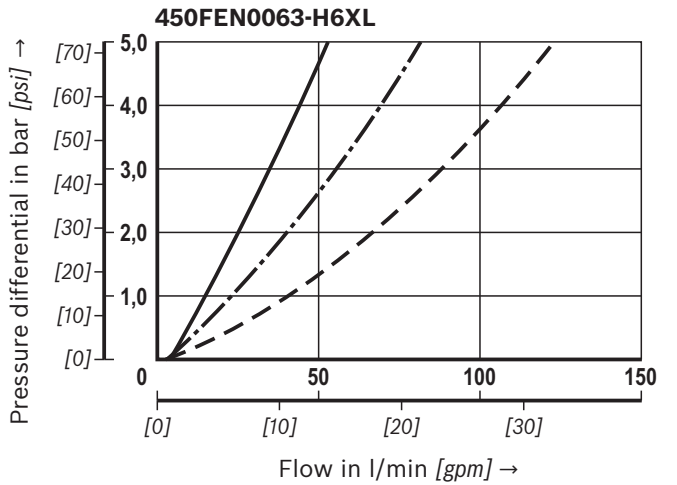
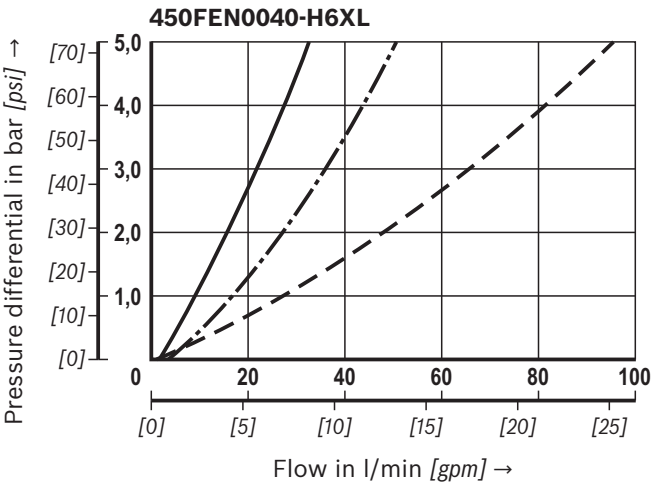
Selection of the correct filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]

H3XL



H6XL



Characteristic curves H6XL

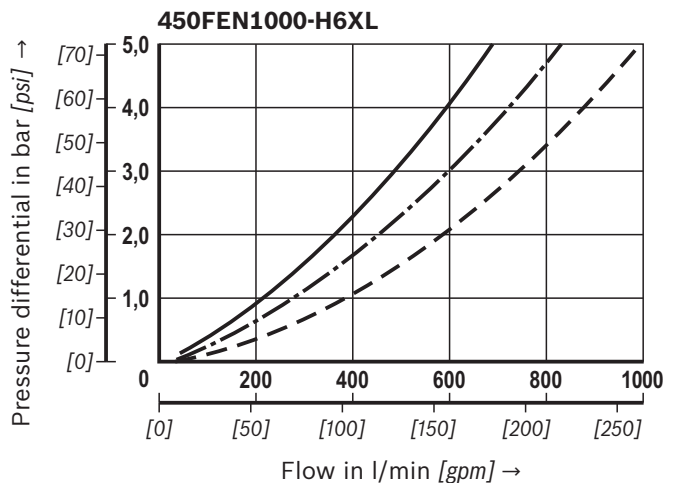
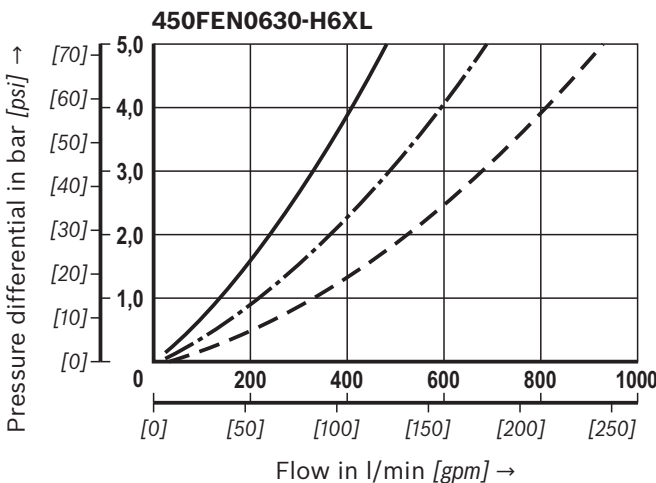
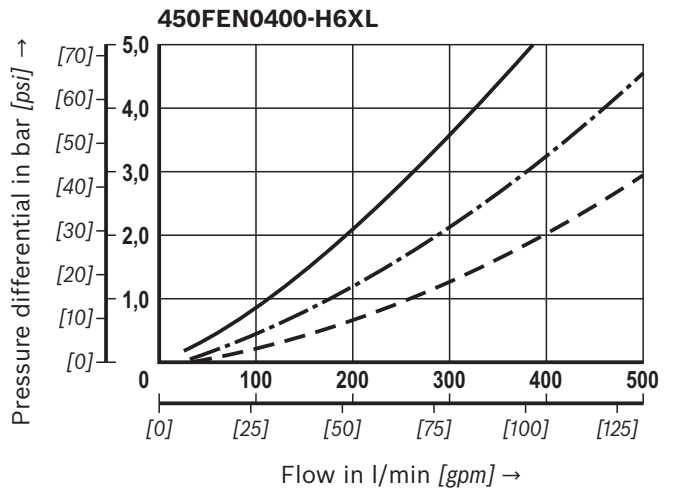
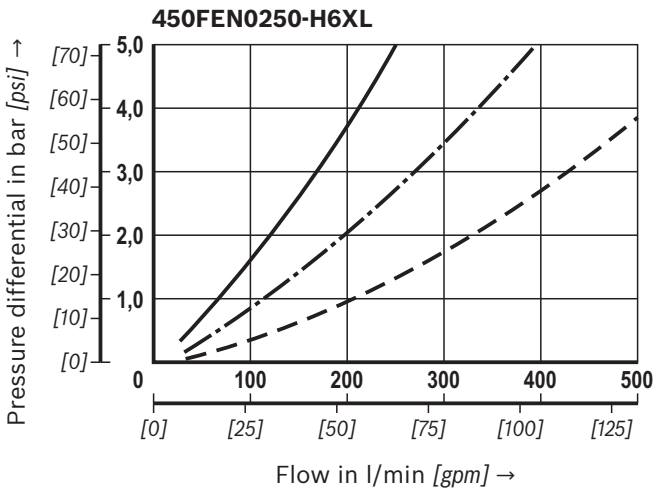
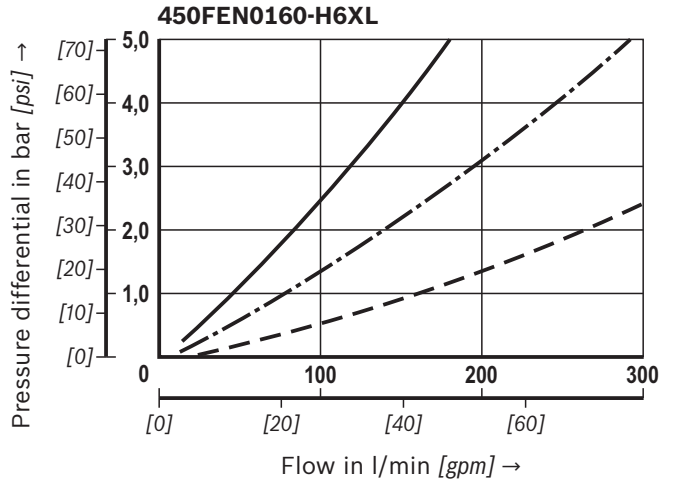
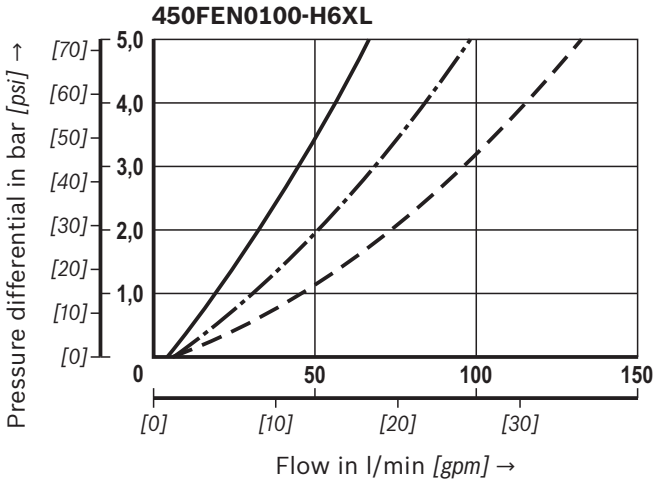
(measured with mineral oil HLP46 according to DIN 51524)

Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters recommended initial Δp for version = 1.5 bar [21.75 psi]

Selection of the correct filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Characteristic curves H10XL

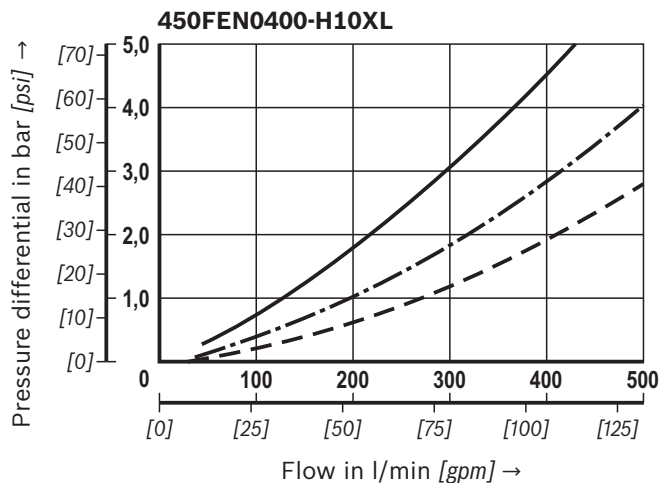
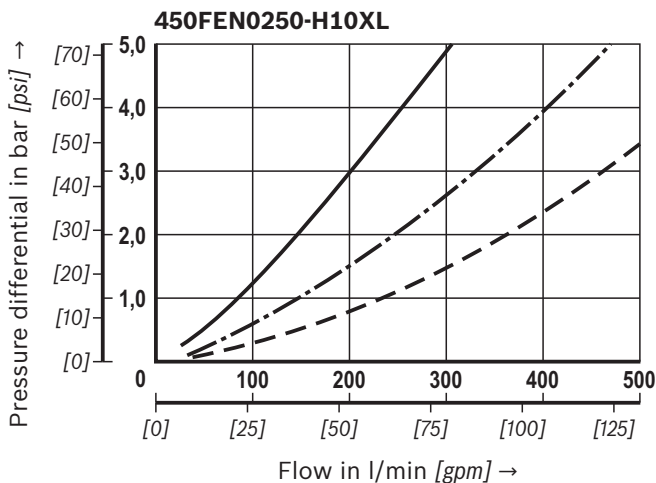
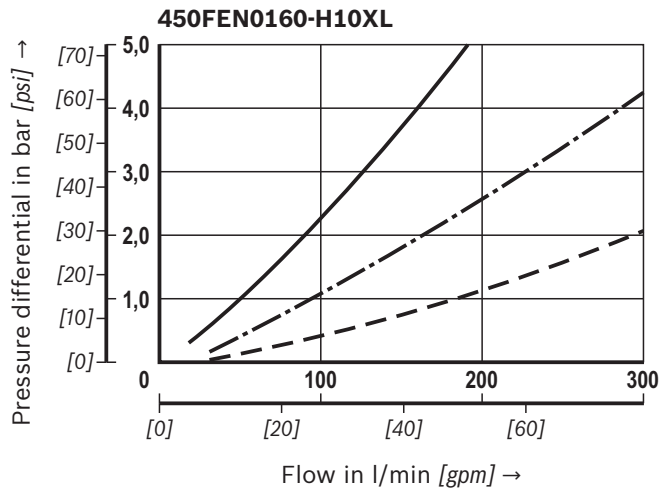
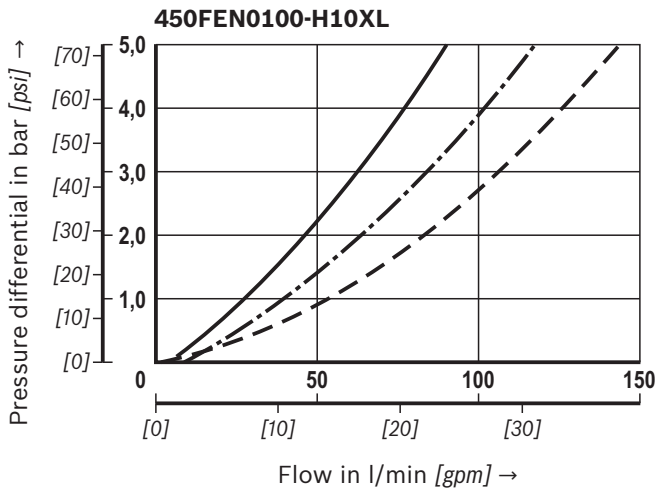
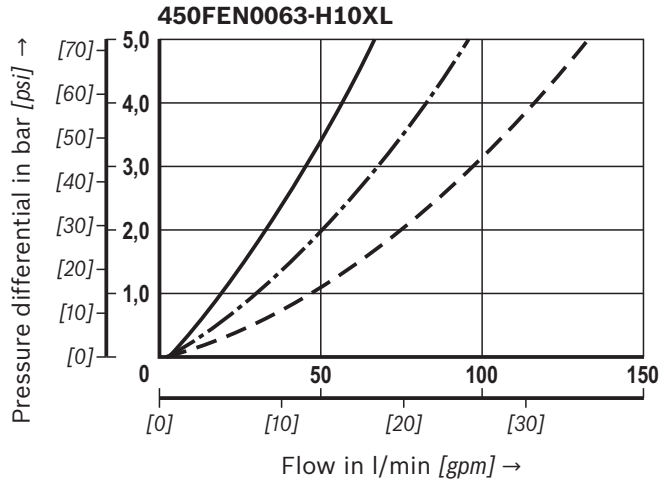
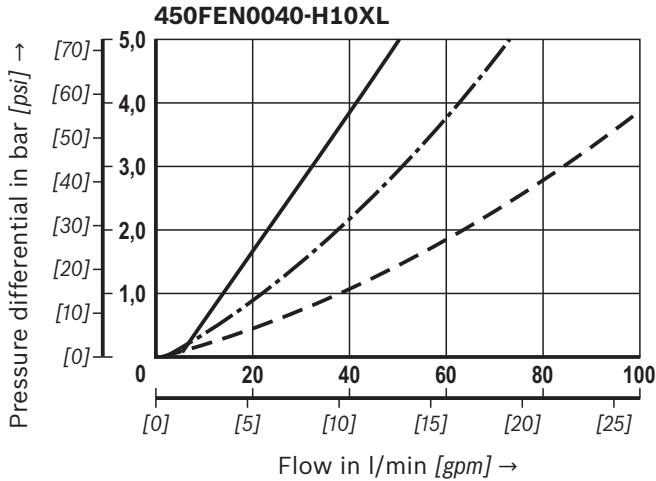
(measured with mineral oil HLP46 according to DIN 51524)

Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters recommended initial Δp for version = 1.5 bar [21.75 psi]

Selection of the correct filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Characteristic curves H10XL

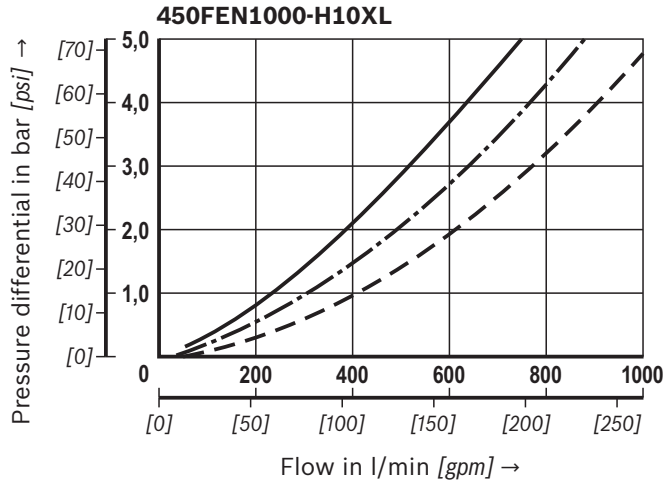
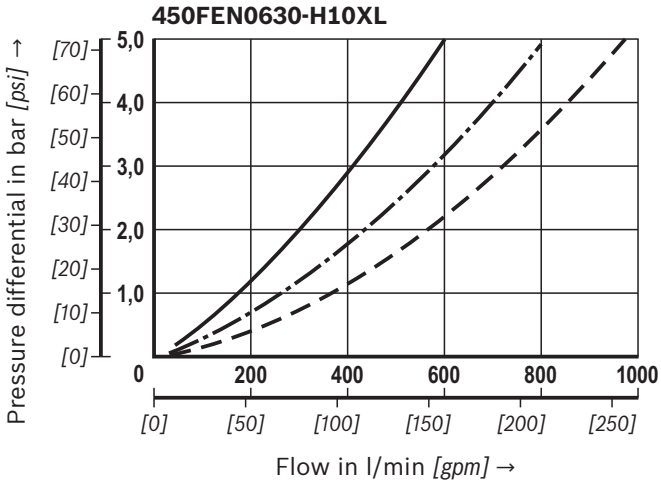
(measured with mineral oil HLP46 according to DIN 51524)

Spec. weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filters recommended initial Δp for version = 1.5 bar [21.75 psi]

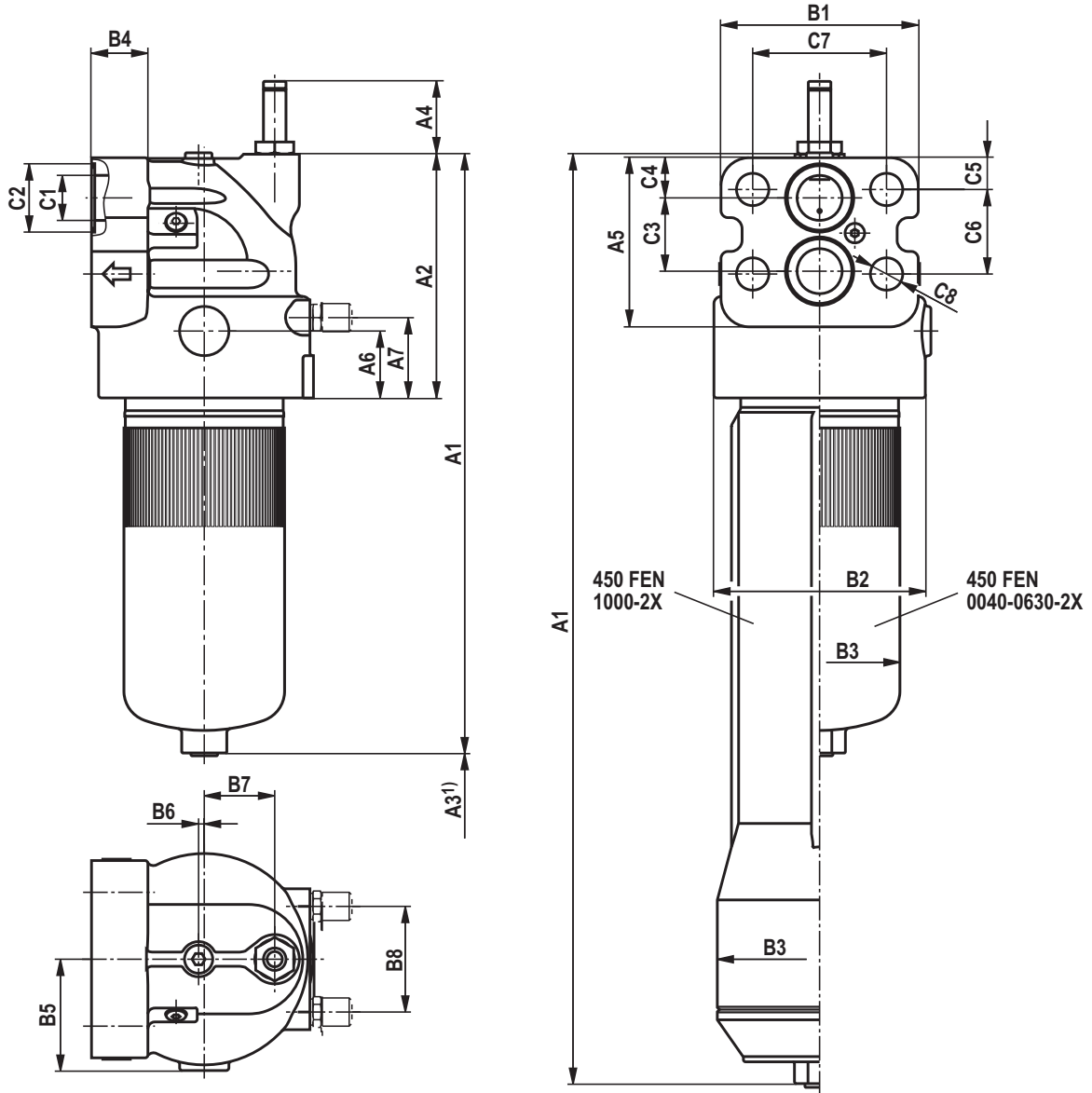
Selection of the correct filter is made possible by our online "Bosch Rexroth FilterSelect" design software.

Oil viscosity:
 ——— 140 mm²/s [649 SUS]
 - · - · 68 mm²/s [315 SUS]
 - - - 30 mm²/s [143 SUS]



Dimensions: Size 0040 – size 1000
 (dimensions in mm [inch])

450FEN0040-1000



Dimensions: Size 0040 – size 1000

(dimensions in mm [inch])

Filter housing for filter elements in accordance with DIN 24550

Type	A1	A2	A3 ¹⁾	A4	A5	A6	A7
450FEN0040	216 [8.50]	130 [5.12]	80 [3.15]	51,7 [2.04]	80 [3.15]	42,5 [1.67]	47 [1.85]
450FEN0063	279 [10.98]						
450FEN0100	369 [14.53]						
450FEN0160	335 [13.19]	173 [6.81]	140 [5.51]		120 [4.72]	47,5 [1.87]	57 [2.24]
450FEN0250	425 [16.73]						
450FEN0400	575 [22.64]						
450FEN0630	653 [25.71]	239 [9.41]	140 [5.51]	160 [6.30]	75	86 [3.39]	
450FEN1000	886 [34.88]		630 [24.80]				

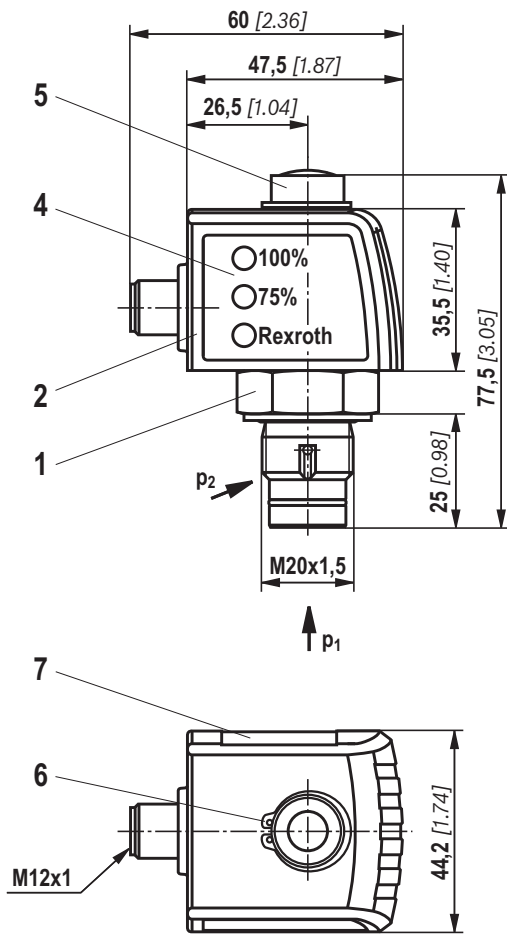
Type	B1	ØB2	ØB3	B4	B5	B6	B7	B8
450FEN0040	80 [3.15]	90 [3.54]	64 [2.52]	24 [0.94]	49 [1.93]	8 [0.31]	30 [1.18]	55 [2.17]
450FEN0063								
450FEN0100								
450FEN0160	140 [5.51]	150 [5.91]	114 [4.49]	39 [1.54]	79 [3.11]	4 [0.16]	50 [1.97]	75 [2.95]
450FEN0250								
450FEN0400								
450FEN0630	190 [7.48]	195 [7.68]	141 [5.55]	41 [1.61]	101,5 [4.00]	4 [0.16]	65 [2.56]	100 [3.94]
450FEN1000			188 [7.40]					

Type	ØC1	ØC2	C3	C4	C5	C6	C7	ØC8	SW
450FEN0040	14 [0.55]	23 [0.91]	28 [1.10]	27 [1.06]	12 [0.47]	45 [1.77]	57 [2.24]	14 [0.55]	24 [0.94]
450FEN0063									
450FEN0100									
450FEN0160	32 [1.26]	47,5 [1.87]	52 [2.05]	28,5 [1.12]	22,5 [0.89]	60 [2.36]	95 [3.74]	23 [0.91]	32 [1.26]
450FEN0250									
450FEN0400									
450FEN0630	50 [1.97]	60 [2.36]	67 [2.64]	41 [1.61]	25 [0.98]	86 [3.39]	140 [5.51]	27 [1.06]	41 [1.61]
450FEN1000									

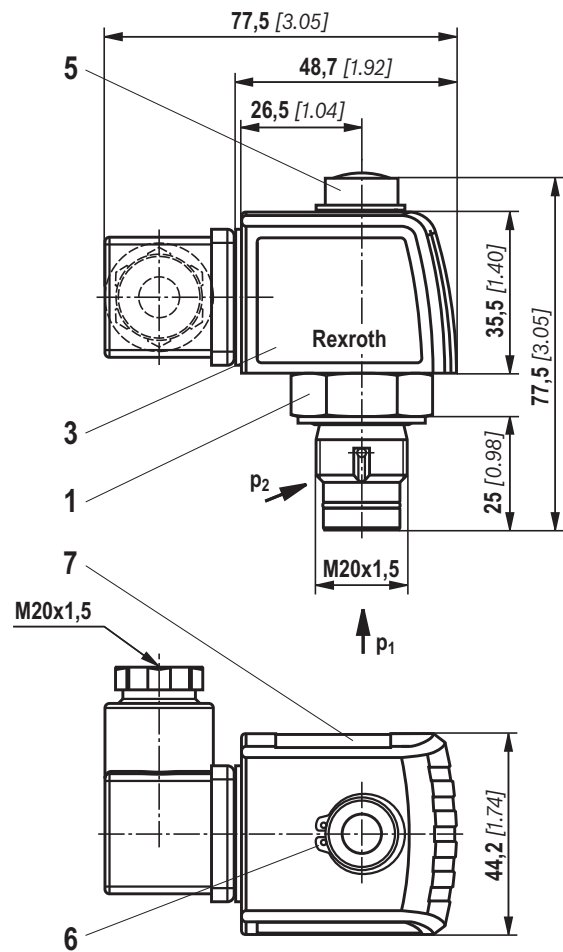
¹⁾ Servicing height for filter element exchange

Maintenance indicator (dimensions in mm [inch])

**Pressure differential indicator with
mounted switching element M12x1**



**Pressure differential indicator with mounted
switching element EN-175301-803**



- 1 Mechanical optical maintenance indicator;
max. tightening torque $M_{A \max} = 50 \text{ Nm}$ [36.88 lb-ft]
- 2 Switching element with locking ring for electrical maintenance indicator (rotatable by 360°); round plug-in connection M12x1, 4-pole
- 3 Switching element with locking ring for electrical maintenance indicator (rotatable by 360°); rectangular plug-in connection EN175301-803
- 4 Housing with three LEDs: 24 V =
green: Stand-by
yellow: Switching point 75%
red: Switching point 100%
- 5 Visual indicator with memory function
- 6 Locking ring DIN 471-16x1,
material no. R900003923
- 7 Name plate

Notices:

Representation contains mechanical optical maintenance indicator (1) and electronic switching element (2) (3).

Ordering code spare parts

Filter element

01	02	03	04	05	06
2.			- B00 -	0	-

Filter element

01	Design	2.
----	--------	----

Size

02	FEN... (Filter elements according to DIN 24550)	0040 0063 0100 0160 0250 0400 0630 1000
----	--	--

Filter rating in µm

03	Absolute (ISO 16889; $\beta_x(c) \geq 200$)	Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
	Nominal	Stainless steel wire mesh, cleanable	G10 G25 G100

Pressure differential

04	Max. admissible pressure differential of the filter element 330 bar [4786 psi], filter without bypass valve	B00
----	--	-----

Bypass valve

05	without bypass valve	0
----	-----------------------------	---

Seal

06	NBR seal	M
	FKM seal	V

Order example:

2.0100 H3XL-B00-0-M

For detailed information on Rexroth filter elements please refer to data sheet 51420.

Preferred program replacement filter element

Replacement filter element 3 micron		Replacement filter element 6 micron		Replacement filter element 10 micron	
R928006654	2.0040 H3XL-B00-0-M	R928006655	2.0040 H6XL-B00-0-M	R928006656	2.0040 H10XL-B00-0-M
R928006708	2.0063 H3XL-B00-0-M	R928006709	2.0063 H6XL-B00-0-M	R928006710	2.0063 H10XL-B00-0-M
R928006762	2.0100 H3XL-B00-0-M	R928006763	2.0100 H6XL-B00-0-M	R928006764	2.0100 H10XL-B00-0-M
R928006816	2.0160 H3XL-B00-0-M	R928006817	2.0160 H6XL-B00-0-M	R928006818	2.0160 H10XL-B00-0-M
R928006870	2.0250 H3XL-B00-0-M	R928006871	2.0250 H6XL-B00-0-M	R928006872	2.0250 H10XL-B00-0-M
R928006924	2.0400 H3XL-B00-0-M	R928006925	2.0400 H6XL-B00-0-M	R928006926	2.0400 H10XL-B00-0-M
R928006978	2.0630 H3XL-B00-0-M	R928006979	2.0630 H6XL-B00-0-M	R928006980	2.0630 H10XL-B00-0-M
R928007032	2.1000 H3XL-B00-0-M	R928007033	2.1000 H6XL-B00-0-M	R928007034	2.1000 H10XL-B00-0-M

Ordering code spare parts

Mechanical optical maintenance indicator

01	02	03	04	05	06
W	O	-	D01	-	-

01	Maintenance indicator	W
----	-----------------------	---

02	Mechanical optical indicator	O
----	------------------------------	---

Version

03	Pressure difference, modular design	D01
----	-------------------------------------	-----

Switching pressure

04	2.2 bar [32 psi]	2,2
	5.0 bar [72.5 psi]	5,0
	8.0 bar [116 psi]	8,0

Seal

05	NBR seal	M
	FKM seal	V

Max. operating pressure

06	Switching pressure 2.2 bar [31.9 psi], 450 bar [6527 psi]	450
	Switching pressure 5.0 bar [72.5 psi], 450 bar [6527 psi]	
	Switching pressure 8.0 bar [116 psi], 450 bar [6527 psi]	

Mechanical optical maintenance indicator

Material no.	Description
R928038783	WO-D01-2,2-M-450
R928038782	WO-D01-2,2-V-450
R901025313	WO-D01-5,0-M-450
R901066235	WO-D01-5,0-V-450
R928038785	WO-D01-8.0-M-450
R928038784	WO-D01-8.0-V-450

Ordering code spare parts

Seal kit

01	02	03	04	05
D	450FEN		- 2X / -	

01	Seal kit	D
02	Series 450FEN	450FEN

Size

03	0040-0100	0040-0100
	0160-0400	0160-0400
	0630-1000	0630-1000
04	Component series 20 ... 29 (20 ... 29: unchanged installation and connection dimensions)	2X

Seal

05	NBR seal	M
	FKM seal	V

Seal kit

Material no.	Description
R961010375	D450FEN0040-0100-2X/-M
R961010376	D450FEN0160-0400-2X/-M
R961010377	D450FEN0630-1000-2X/-M
R961010378	D450FEN0040-0100-2X/-V
R961010379	D450FEN0160-0400-2X/-V
R961010380	D450FEN0630-1000-2X/-V

Assembly, commissioning, maintenance

Assembly

- ▶ The max. operating pressure of the system must not exceed the max. admissible operating pressure of the filter (see type plate).
- ▶ During assembly of the filter (see also chapter “Tightening torques”), the flow direction (direction arrows) and the required servicing height of the filter element (see chapter “Dimensions”) are to be considered.
- ▶ Filter element exchange is made easiest when the filter bowl is oriented downward. The maintenance indicator must be arranged so it is easily viewed in operation.
- ▶ Remove the plastic plugs from the filter inlet and outlet.
- ▶ Ensure that the system is assembled without tension stress.
- ▶ The optional electronic maintenance indicator is connected via the electronic switching element with one or two switching points, which is attached to the mechanical optical maintenance indicator and held by means of the locking ring.

Commissioning

- ▶ Commission the system.

Notice:

There is no bleeding provided at the filter. However, all sizes have optional threaded couplings which may also be used for bleeding.

Maintenance

- ▶ If at operating temperature, the red indicator pin reaches out of the mechanical optical maintenance indicator and/or if the electronic switching element opens / closes the circuit, the filter element is contaminated and needs to be replaced or cleaned respectively.
- ▶ The material number of the corresponding replacement filter element is indicated on the name plate of the complete filter. It must correspond to the material number on the filter element.

- ▶ Decommission the system.
- ▶ The operating pressure is to be built up on the system side.

Notice:

There is no bleeding provided at the filter. However, all sizes have optional threaded couplings which may also be used for bleeding.

- ▶ Using the drain plug (for sizes 0160 and larger) drain the oil from the filter bowl.
- ▶ Unscrew filter bowl (or base with size 1000).
- ▶ Remove the filter element from the spigot by rotating it slightly.
- ▶ Clean the filter components, if necessary.
- ▶ Check the seals at the filter bowl for damage and replace them, if necessary.
For suitable seal kits refer to chapter “Spare parts”.
- ▶ Filter elements made of wire mesh can be cleaned. For detailed cleaning instructions refer to data sheet 51420.
- ▶ Install the new or cleaned filter element on the spigot again by slightly rotating it.
- ▶ The filter is to be assembled in reverse order. **Please note:**
Screw in the filter bowl to the stop, unscrew the filter bowl again by 1/8 to 1/2 rotation so that the filter bowl does not get stuck due to the pressure pulsation and can be loosened easily during maintenance work.
- ▶ The torque specifications (“Tightening torques” chapter) are to be observed.
- ▶ Commission the system.

WARNING!

- | | |
|---|--|
| <ul style="list-style-type: none"> ▶ Assemble and disassemble only with depressurized system! ▶ Filter is under pressure! | <ul style="list-style-type: none"> ▶ Remove the filter bowl only if it is not under pressure! ▶ Do not exchange the mechanical-optical maintenance indicator while the filter is under pressure! |
|---|--|

Notices:

- ▶ All maintenance of the filter should be performed by trained specialists.
- ▶ Functioning and safety are only guaranteed if original Bosch Rexroth filter elements and spare parts are used.
- ▶ Warranty becomes void if the delivered item is changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental condition that do not comply with the installation conditions.

Tightening torques

(dimensions in mm [inch])

Mounting

Series 450 ...	FEN0040	FEN0063	FEN0100	FEN0160	FEN0250	FEN0400	FEN0630	FEN1000
Screw/tightening torque with $\mu_{\text{total}} = 0.14$	M12x35/75 Nm \pm 12% [8.9 lb-ft +/- 12%]			M20x60/400 Nm \pm 5% [296 lb-ft +/- 5%]			M24x65/700 Nm \pm 4% [518 lb-ft +/- 4%]	
Quantity	4							
Recommended property class of screw	8.8							

Maintenance indicator

Series 450 ...	FEN0040	FEN0063	FEN0100	FEN0160	FEN0250	FEN0400	FEN0630	FEN1000
Maintenance indicator	50 Nm [37 lb-ft]							
Cubic connector screw switching element EN-175301-803	max. 50 Nm [37 lb-ft]							

Directives and standardization

Classification according to the Pressure Equipment Directive

Directive

The block mounting filter for hydraulic applications according to 51467 are pressure holding equipment according to article 1, section 2.1.4 of the Pressure Equipment Directive 97/23/EC (PED). However, based on the exception in article 1, section 3.6 of the PED, hydraulic filters are

exempt from the PED if they are not classified higher than category I (guideline 1/19).

The fluids from the chapter "Compatibility with approved pressure fluids" were considered for the classification.

They do not receive a CE mark.

Use in potentially explosive areas according to directive 94/9/EC (ATEX)

The block mounting filter according to 51467 are not equipment or components in the sense of directive 94/9/EC and are not provided with a CE mark. It has been proven with the ignition risk analysis that these inline filters do not have own ignition sources acc. to DIN EN 13463-1:2009.

According to DIN EN 60079-11:2012, electronic maintenance indicators with a switching point:

WE-1SP-M12x1 **R928028409**

WE-1SP-EN175301-803 **R928036318**

are simple, electronic operating equipment that do not have an own voltage source. This simple, electronic operating

equipment may – according to DIN EN 60079-14:2012 – in intrinsically safe electric circuits (Ex ib) be used in systems without marking and certification.

The block mounting filters and the electronic maintenance indicators described here can be used for the following explosive areas

	Zone suitability	
Gas	1	2
Dust	21	22

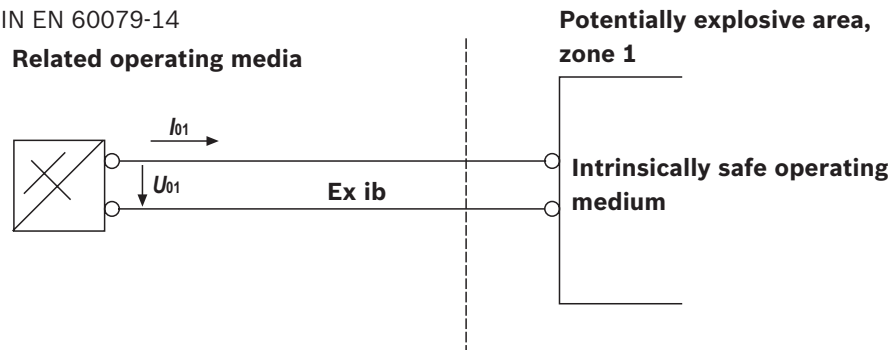
Directives and standardization

Complete filter with mech./opt. Maintenance indicator				
Use/assignment		Gas 2G		Dust 2D
Assignment		Ex II 2G c IIC TX		Ex II 2D c IIC TX
Conductivity of the medium	pS/m	min	300	
Dust accumulation		max	-	0.5 mm

Electronic switching element in the intrinsically safe electric circuit				
Use/assignment		Gas 2G		Dust 2D
Assignment		Ex II 2G Ex ib IIB T4 Gb		Ex II 2D Ex ib IIIC T100 °C Db
Perm. intrinsically safe electric circuits		Ex ib IIC, Ex ic IIC		Ex ib IIIC
Technical data		Values only for intrinsically safe electric circuit		
Switching voltage	Ui	max	150 V AC/DC	
Switching current	li	max	1.0 A	
Switching power	Pi	max	1.3 W T4 T_{max} 40 °C	750 mW T_{max} 40 °C
		max	1.0 W T4 T_{max} 80 °C	550 mW T_{max} 100 °C
Surface temperature ¹⁾		max	-	100 °C
Inner capacity	Ci		negligible	
Inner inductivity	Li		negligible	
Dust accumulation		max	-	0.5 mm

¹⁾ The temperature depends on the temperature of the medium in the filter and must not exceed the value specified here.

Possible circuit according to DIN EN 60079-14



⚠ WARNING!

- ▶ Explosion hazard due to high temperature! The temperature depends on the temperature of the medium in the hydraulic circuit and must not exceed the value specified here. Measures are to be taken so that in the potentially explosive area, the max. admissible ignition temperature is not exceeded.
- ▶ When using the block mounting filters according to 51467 in explosive areas, sufficient potential equaliza-

tion has to be ensured. The filter is preferably to be grounded via the mounting screws.

- ▶ It has to be noted in this connection that painted and oxidized protective layers are not electrically conductive.
- ▶ During filter element exchanges, the packaging material is to be removed from the replacement element outside the explosive area

👉 Notices:

- ▶ All maintenance of the filter should be performed by trained specialists, instruction by the machine end-user acc. to DIRECTIVE 1999/92/EC appendix II, section 1.1
- ▶ Functional and safety warranty only applicable when using genuine Rexroth spare parts

Notes

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It should be taken into consideration that our products are subject to a natural process of wear and aging.

Notes

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Block mounting filter, for sandwich plate mounting

Type 320PZR06/025 to 10/125; 320PZL06/025

RE 51468

Issue: 2014-08



HAD7824_d

- ▶ Size according to **Bosch Rexroth standard:** 06/025 to 10/125
- ▶ Component series 2X
- ▶ Nominal pressure 320 bar [4641 psi]
- ▶ Connection according to ISO4401 NG6 and NG10
- ▶ Operating temperature -10 °C to $+100\text{ °C}$ [14 °F to 212 °F]

Features

The sandwich plate filters are used in hydraulic systems for separating solid materials from fluids and lubricating oils. They are intended for installation in vertical stacking (sandwich plate design).

They distinguish themselves by the following:

- ▶ Filter for sandwich plate mounting, filter bowl left or right
- ▶ Special highly efficient filter materials
- ▶ Filtration of very fine particles and high dirt holding capacity across a broad pressure differential range
- ▶ High collapse resistance of the filter elements
- ▶ By default equipped with mechanical optical maintenance indicator with memory function
- ▶ Various optional electronic switching elements, modular design
- ▶ Porting pattern according to ISO 4401-03-02-0-05 (size 6) or ISO 4401-05-04-0-05 (size 10).
- ▶ High filtration performance due to the tangential cyclone-effect flow path

Contents

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Ordering code

Filters

01	02	03	04	05	06	07	08	09			
320PZ			-	2X	/		B00	-	-	-	

Series

01	Sandwich plate filter 320 bar [4641 psi]	320PZ
----	--	--------------

Filter bowl position

02	Right	R
	Left	L

Size

03	PZR...	06/025 10/075 10/125
	PZL...	06/025

04	Component series 20 ... 29 (20 ... 29: unchanged installation and connection dimensions)	2X
----	--	-----------

Filter rating in µm

05	Absolute (ISO 16889) Glass fiber material, not cleanable	H3PZ H6PZ H10PZ H20PZ
----	---	--

Pressure differential

06	Max. admissible pressure differential of the filter element 330 bar [4786 psi], without bypass valve	B00
----	---	------------

Maintenance indicator

07	Maintenance indicator, mech./optical, switching pressure 5.0 bar [72.5 psi]	V5.0
	Maintenance indicator, mech./optical, switching pressure 8.0 bar [116 psi]	V8.0

Seal

08	NBR seal	M
	FKM seal	V

Supplementary information

09	Manufacturer's inspection certificate M according to DIN 55350 T18	Z1
----	--	-----------

Order example:

320PZR10/125-2X/H10PZB00-V8,0-M

Material no.: R928053411

Further versions are available on request.

Preferred types

NBR seal, without bypass, flow specifications for 30 mm²/s [142 SUS]

Block mounting filter 320 PZR, filter rating 3 µm

Type	Flow in l/min [gpm] at Δp = 2.5 bar [36.25 psi] ¹⁾	Material no. Filter	Material no. replacement element
320PZR06/025-2X/H3PZB00-V8,0-M	17 [4.5]	R928053403	R928051771
320PZR10/075-2X/H3PZB00-V8,0-M	33 [8.7]	R928053406	R928051775
320PZR10/125-2X/H3PZB00-V8,0-M	37 [9.8]	R928053413	R928051779

Block mounting filter 320 PZR, filter rating 6 µm

Type	Flow in l/min [gpm] at Δp = 2.5 bar [36.25 psi] ¹⁾	Material no. Filter	Material no. replacement element
320PZR06/025-2X/H6PZB00-V8,0-M	19 [5.0]	R928053404	R928053299
320PZR10/075-2X/H6PZB00-V8,0-M	35 [9.2]	R928053407	R928051776
320PZR10/125-2X/H6PZB00-V8,0-M	38 [10.0]	R928053414	R928051780

Block mounting filter 320 PZR, filter rating 10 µm

Type	Flow in l/min [gpm] at Δp = 2.5 bar [36.25 psi] ¹⁾	Material no. Filter	Material no. replacement element
320PZR06/025-2X/H10PZB00-V8,0-M	20 [5.3]	R928053402	R928051773
320PZR10/075-2X/H10PZB00-V8,0-M	36 [9.5]	R928053405	R928051777
320PZR10/125-2X/H10PZB00-V8,0-M	42 [11.1]	R928053411	R928051781

Block mounting filter 320 PZL, filter rating 3 µm

Type	Flow in l/min [gpm] at Δp = 2.5 bar [36.25 psi] ¹⁾	Material no. Filter	Material no. replacement element
320PZL06/025-2X/H3PZB00-V8,0-M	17 [4.5]	R928053998	R928051771

Block mounting filter 320 PZL, filter rating 6 µm

Type	Flow in l/min [gpm] at Δp = 2.5 bar [36.25 psi] ¹⁾	Material no. Filter	Material no. replacement element
320PZL06/025-2X/H6PZB00-V8,0-M	19 [5.0]	R928053999	R928053299

Block mounting filter 320 PZL, filter rating 10 µm

Type	Flow in l/min [gpm] at Δp = 2.5 bar [36.25 psi] ¹⁾	Material no. Filter	Material no. replacement element
320PZL06/025-2X/H10PZB00-V8,0-M	20 [5.3]	R928053768	R928051773

¹⁾ An appropriate differential pressure via the filter and measuring device according to ISO 3968. The differential pressure measured on the maintenance indicator is lower.

Ordering code

Accessories

(dimensions in mm [in])

Sandwich plate

Material no.	Description
R900516530	Sandwich plate HSZ 06 A007-3X/M00 (Dimension 65 [2.56] x 44 [1.73] x 20 [0.79])

Please refer to data sheet 48050 for further sandwich plates.

Ordering code**Accessories**

(dimensions in mm [in])

Electronic switching element for maintenance indicators

01	02	03
WE	-	-

Maintenance indicator

01	electronic switching element	WE
----	------------------------------	----

Type of signal

02	1 switching point	1SP
	2 switching points, 3 LED	2SP
	2 switching points, 3 LED and signal suppression up to 30 °C [86 °F]	2SPSU

Connector

03	Round plug-in connection M12 x 1, 4-pole	M12x1
	Rectangular plug-in connection, 2-pole, design A according to EN-175301-803	EN175301-803

Material numbers of the electronic switching elements

Material no.	Type	Signal	Switching points	Connector	LED
R928028409	WE-1SP-M12x1	Changeover	1	M12x1	No
R928028410	WE-2SP-M12x1	Normally open (at 75%) / normally closed contact (at 100%)	2		3 pieces
R928028411	WE-2SPSU-M12x1				
R928036318	WE-1SP-EN175301-803	Normally closed contact	1	EN 175301-803	No

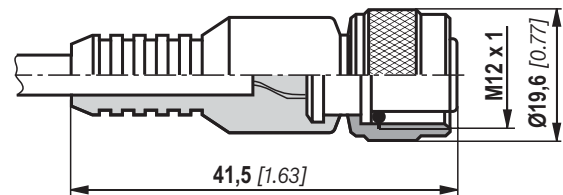
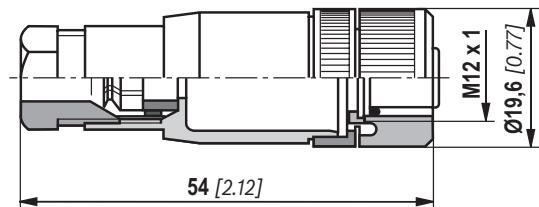
Mating connectors

for electronic switching element with round plug-in connection M12x1

Mating connector suitable for K24 4-pole, M12x1 with screw connection, cable gland Pg9.

Material no. R900031155

Mating connector suitable for K24-3m 4-pole, M12x1 with potted-in PVC cable, 3 m long.

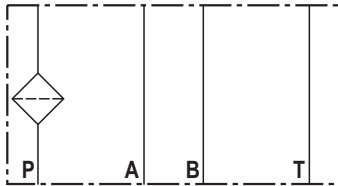
Line cross-section: 4 x 0.34 mm²Core marking: **1** brown **2** white
 3 blue **4** black**Material no. R900064381**

For more round plug-in connections and technical data refer to data sheet 08006.

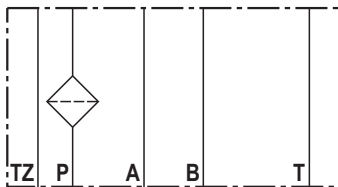
Order example:Block mounting filter for sandwich plate mounting with mechanical optical maintenance indicator for $p_{\text{nominal}} = 320 \text{ bar [4641 psi]}$ without bypass valve, size 10/125, with filter element 10 μm and electronic switching element M12x1 with 1 switching point.**Filter with mech. optical** 320PZR10/125-2X/H10PZB00-V8,0-M**Material no. R928053411****maintenance indicator:****Switching element:** WE-1SP-M12x1**Material no. R928028409****Mating connector:** Mating connector suitable for K24 4-pin, M12x1**Material no. R900031155**

Symbols

Block mounting filters



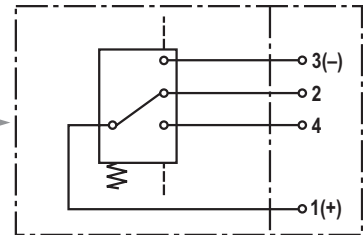
NG025 connection according to ISO4401 NG6



NG075 - 125 connection according to ISO4401 NG10

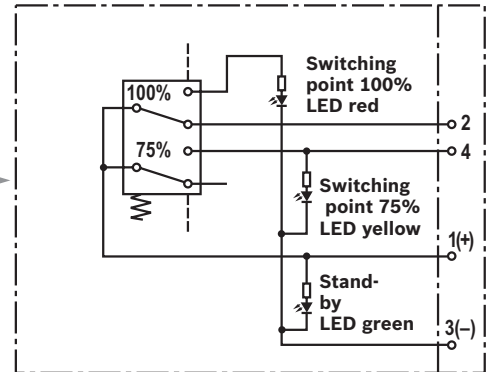
Electronic switching element for maintenance indicator

Switching element Connector



WE-1SP-M12x1

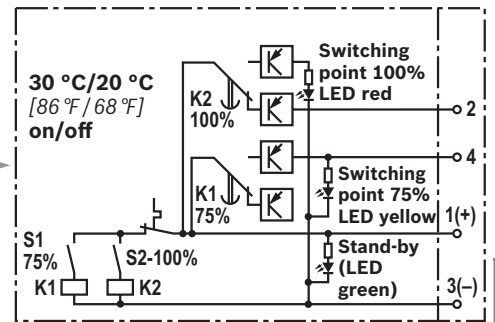
Switching element Connector



WE-2SP-M12x1

Circuit diagram drawn in plugged condition (operating state)

Switching element Connector



WE-2SPSU-M12x1

Circuit diagram drawn in plugged condition at temperature > 30°C [86°F] (operating state)

Function, section

Block mounting filters for sandwich plate mounting are intended for installation in a vertical stack.

They basically consist of filter head (1), a screwable filter bowl (2), filter element (3) as well as a mechanical optical maintenance indicator (4).

The hydraulic fluid reaches the filter element (3) via the inlet bore (bore P / seal side) where it is cleaned.

The dirt particles filtered out collect in the filter bowl (2) and in the filter element (3). On the opposite side, the filtered hydraulic fluid enters the hydraulic circuit via the outlet bore.

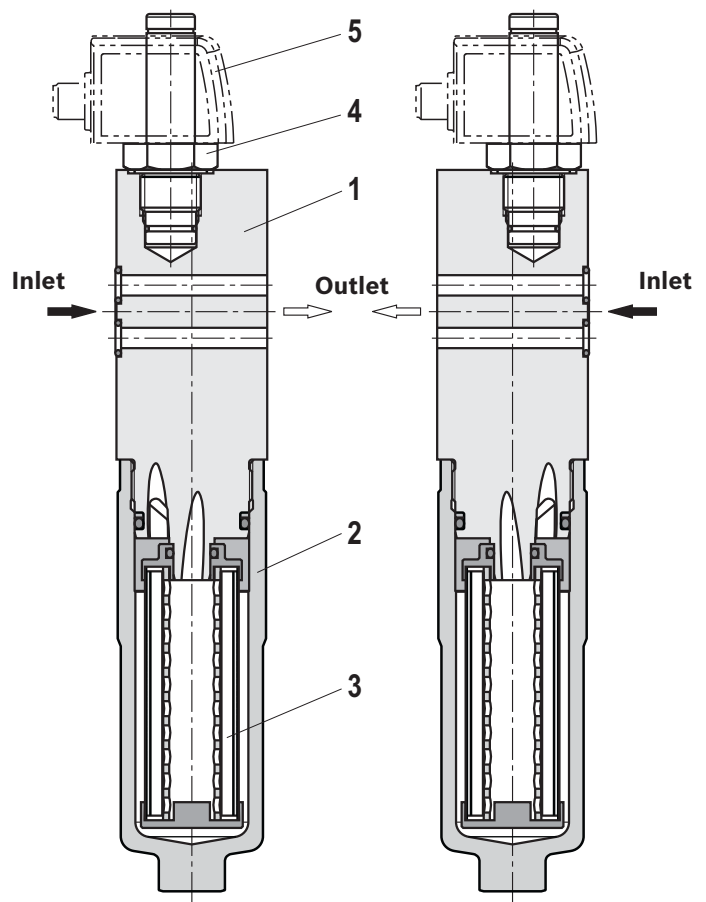
Filter type 320PZ is available in two versions in the size 06/025, left or right.

The filter housing is designed so that pressure peaks - as they may e.g. occur in case of abrupt opening of large control valves due to the accelerated fluid weight - can be securely absorbed.

The filter material H ... PZ is particularly suitable for usual volume fluctuations in this application.

By default, the filter is equipped with mechanical optical maintenance indicator (4). The electronic switching element (5) which has to be ordered separately is attached to the mechanical optical maintenance indicator (4) and held by means of a locking ring.

The electronic switching elements with 1 or 2 switching points are connected via a mating connector according to IEC-60947-5-2 or via a cable connection according to EN17301-803.



Type 320PZL06/25-2x

Type 320PZR06/25-2x

Notice:

For the allocation of the connection designation see chapter "Dimensions"

Technical data

(For applications outside these parameters, please consult us!)

General				
Installation position		Sandwich plate mounting		
Ambient temperature range		°C [°F]	-10 ... +65 [+14... +149] (short-term ... -30 [-22])	
Storage conditions	- NBR seal	°C [°F]	-40 ... +65 [-40... +149]; max. relative air humidity 65%	
	-FKM seal	°C [°F]	-20 ... +65[-4... +149]; max. relative air humidity 65%	
Weight	NS		06/025	10/075
	kg [lbs]		3.5 [7.7]	6.5 [14.4]
Volume	NS		06/025	10/075
	l [US gal]		0.14 [0.037]	0.35 [0.092]
Material	-Filter head	Ductile iron		
	-Filter bowl	Steel		
	- Seals	NBR or FKM		
	- Optical maintenance indicator V5.0; V8.0	Brass		
	- Electronic switching element	Plastic PA6		
Surface requirement tank hydraulic block	- Roughness depth R_z max.	µm	4	
	- Levelness t_E max.	mm	0.01/100	

Hydraulic			
Maximum operating pressure	bar [psi]	320 [4641]	
Hydraulic fluid temperature range	°C [°F]	-10 ... +100 [+14... +212]	
Minimum conductivity of the medium	pS/m	300	
Fatigue strength according to ISO 10771	Load cycles	> 10 ⁶ with max. operating pressure	
Type of pressure measurement of the maintenance indicator	Pressure differential		
Assignment: Response pressure of the maintenance indicator / cracking pressure of the bypass valve		Response pressure of the maintenance indicator	Cracking pressure of the bypass valve
		5.0 ± 0.5 [72 ± 7]	not possible
	bar [psi]	8.0 ± 0.8 [116 ± 11.6]	

Electric (electronic switching element)				
Electrical connection		Round plug-in connection M12x1, 4-pole		Standard connection EN 175301-803
	Version	WE-1SP-M12x1	WE-2SP-M12x1	WE-2SPSU-M12x1
Contact load, direct voltage	$A_{max.}$	1		
Voltage range	$V_{max.}$	150 (AC/DC)	10-30 (DC)	250 (AC)/200 (DC)
max. switching power with resistive load	W	20		70
Switching type	- 75% signal	-	Normally open contact	
	- 100% signal	Changeover	Normally closed contact	
	- 2SPSU		Signal interconnection at 30 °C [86 °F], return switching at 20 °C [68 °F]	
Display via LEDs in the electronic switching element 2SP...		Stand-by (LED green); 75% switching point (LED yellow) 100% switching point (LED red)		
Protection class according to EN 60529	IP	IP 67		IP 65
Ambient temperature range	°C [°F]	-25 ... +85 [-13... +185]		
For direct voltage above 24 V, spark extinguishing is to be provided for protecting the switching contacts.				
Weight	- electronic switching element	kg [lbs]	0.1 [0.22]	

Technical data (For applications outside these parameters, please consult us!)

Filter element			
Glass fiber material H...PZ		Single-use element on the basis of inorganic fiber	
		Filtration ratio according to ISO 16889 up to $\Delta p = 5 \text{ bar [72.5 psi]}$	Achievable oil cleanliness according to ISO 4406 [SAE-AS 4059]
Particle separation	H20PZ	$\beta_{20}(c) \geq 200$	19/16/12 – 22/17/14
	H10PZ	$\beta_{10}(c) \geq 200$	17/14/10 – 21/16/13
	H6PZ	$\beta_6(c) \geq 200$	15/12/10 – 19/14/11
	H3PZ	$\beta_5(c) \geq 200$	13/10/8 – 17/13/10
admissible pressure differential	B00	bar [psi]	330 [4786]

Compatibility with hydraulic fluids

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oil	HLP	NBR	DIN 51524
Biodegradable	– insoluble in water	HETG	VDMA 24568
		HEES	
	– soluble in water	HEPG	VDMA 24568
Flame-resistant	– water-free	HFDU, HFDR	VDMA 24317
	– containing water	HFAS	DIN 24320
		HFAE	NBR
	HFC	NBR	VDMA 24317

**Important information on hydraulic fluids:**

- For more information and data on the use of other hydraulic fluids, please refer to data sheet 90220 or contact us!
- **Flame-resistant – containing water:** Due to possible chemical reactions with materials or surface coatings of machine and system components, the service life with these hydraulic fluids may be less than expected.

Filter materials made of filter paper (cellulose) may not be used, filter elements with glass fiber material have to be used instead.

- **Bio-degradable:** If filter materials made of filter paper are used, the filter life may be shorter than expected due to material incompatibility and swelling.

Characteristic curves

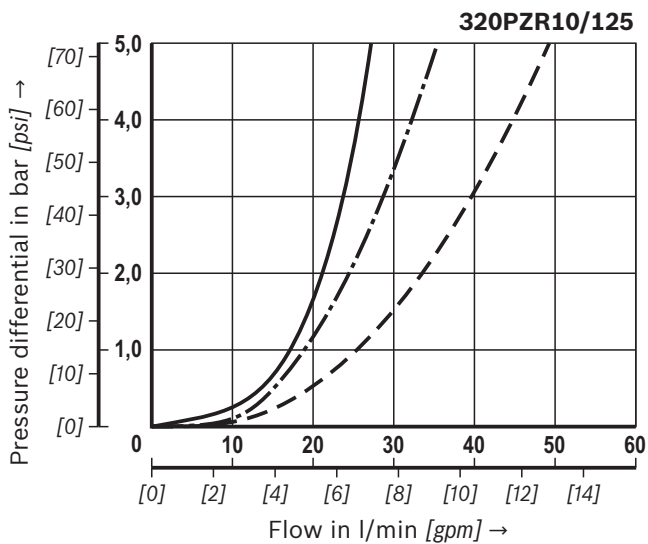
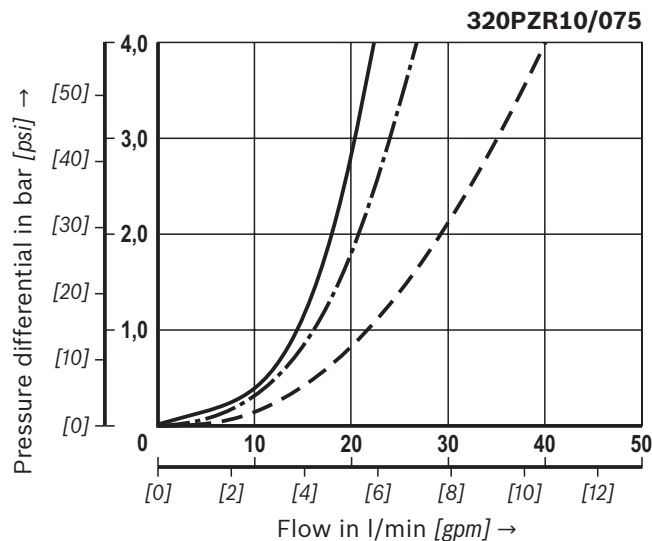
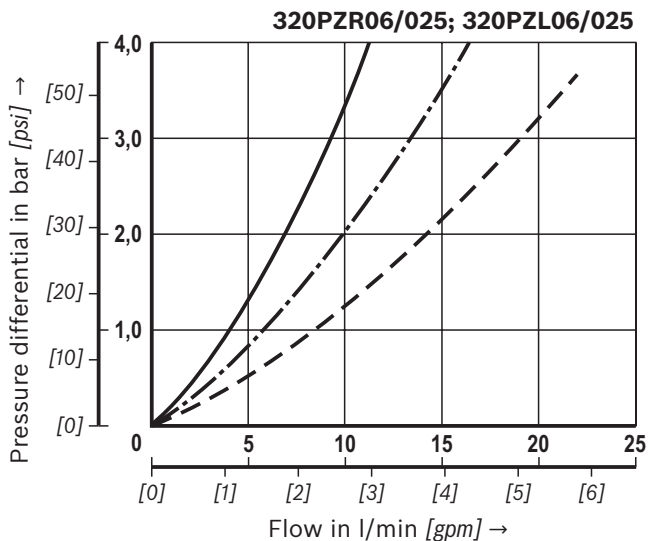
H3PZ...

(measured with mineral oil HLP46 according to DIN 51524)

Spec. weight: < 0.9 kg/dm³ Δp-Q-characteristic curves for complete filters recommended initial Δp for design = 2.5 bar
The selection of the perfect filter is made possible by our online “Bosch Rexroth FilterSelect” design software.

Oil viscosity:

- 140 mm²/s [649 SUS]
- · - 68 mm²/s [315 SUS]
- - - 30 mm²/s [142 SUS]



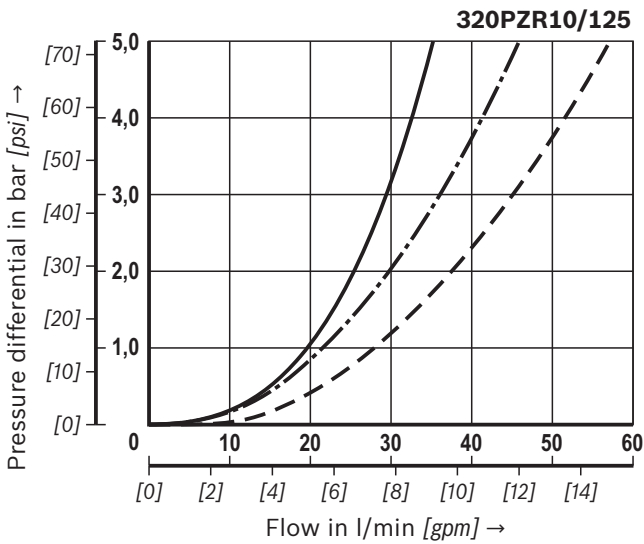
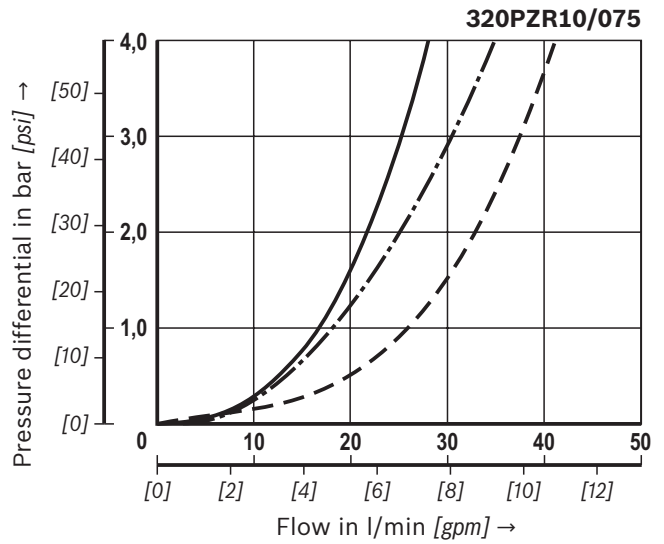
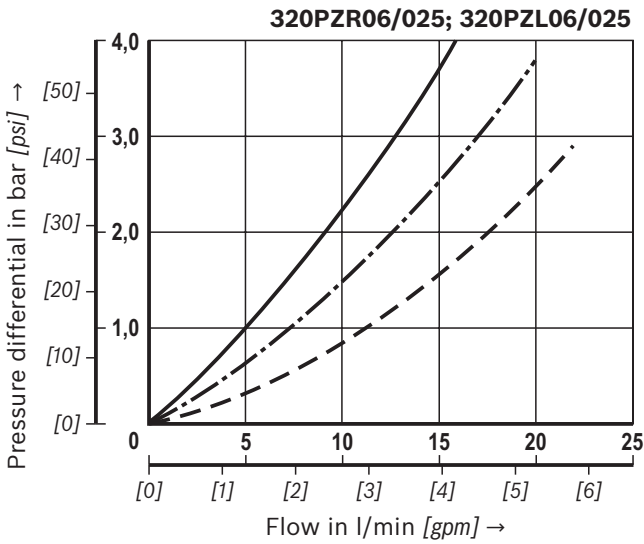
Characteristic curves

(measured with mineral oil HLP46 according to DIN 51524)

Spec. weight: < 0.9 kg/dm³ Δp-Q-characteristic curves for complete filters recommended initial Δp for design = 2.5 bar
 The selection of the perfect filter is made possible by our online “Bosch Rexroth FilterSelect” design software.

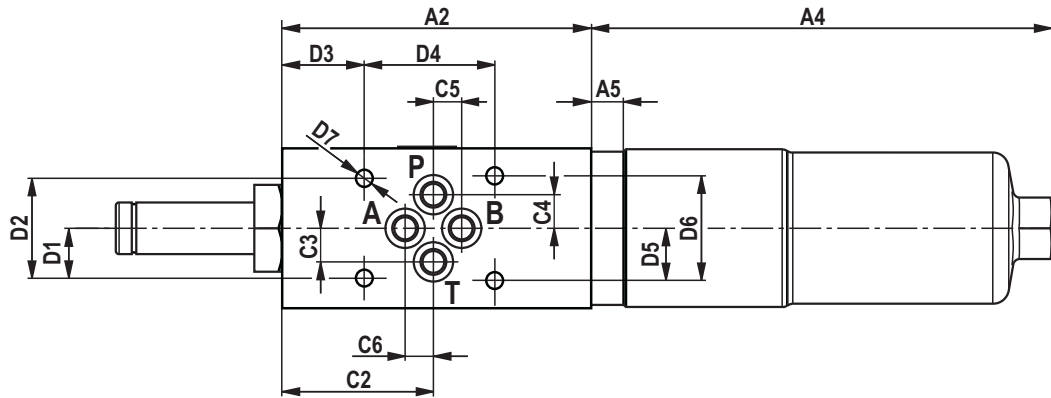
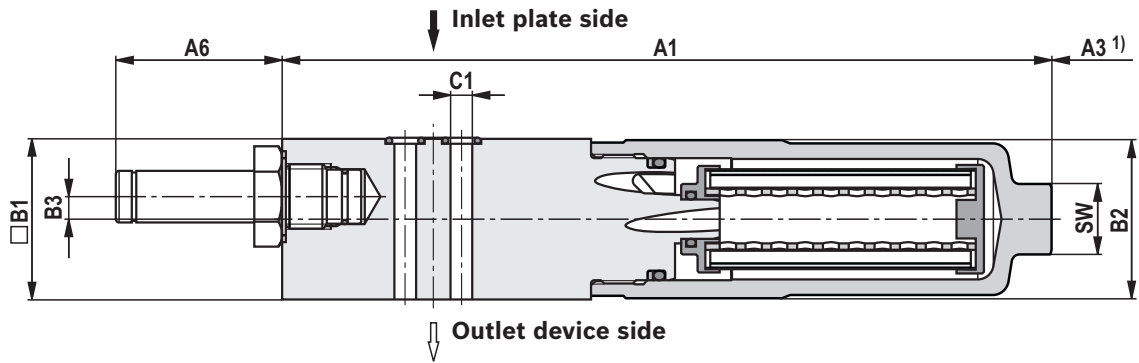
Oil viscosity:

- 140 mm²/s [649 SUS]
- · - 68 mm²/s [315 SUS]
- - - 30 mm²/s [142 SUS]



Dimensions: NG025
(dimensions in mm [in])

320PZR06/025-2x connection according to ISO4401 NG6



Porting pattern according to ISO 4401-03-02-0-05
no locating pin

¹⁾ Servicing height for filter element exchange

- A = Drill hole
- B = Drill hole
- P = Pressure lines
- T = Tank line
- TZ = Tank line, additional

Tolerances:

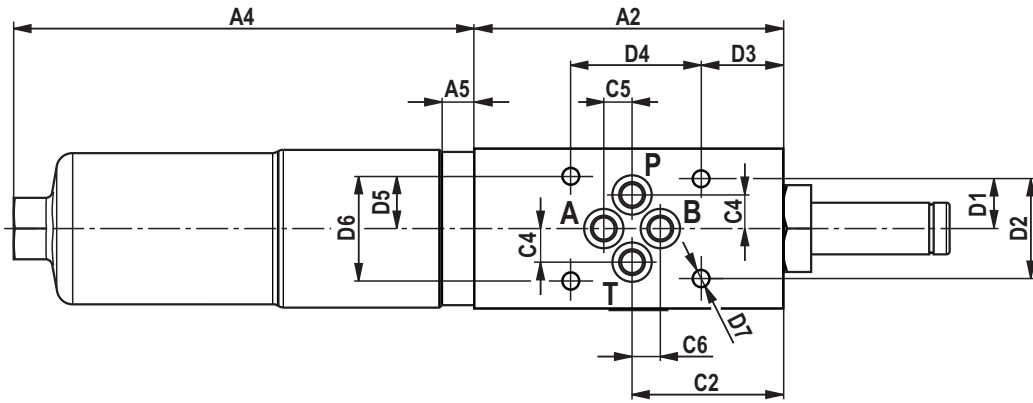
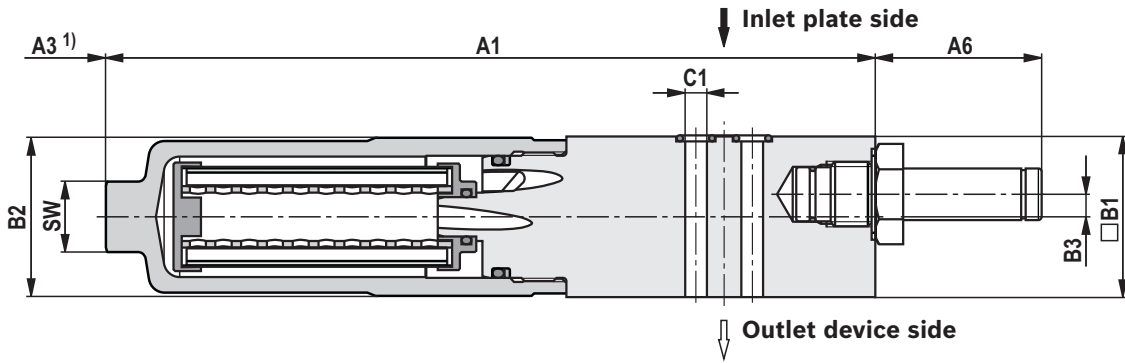
► General tolerances ISO 2768-m

Type	Content in l [US gal]	Weight in kg [lbs]	A1	A2	A3 ¹⁾	A4	A5	A6	ØB1	ØB2	B3
320PZR06/025-2X	0.14 [0.04]	3.5 [7.71]	239 [9.41]	96 [3.78]	80 [3.15]	143 [5.63]	10 [0.39]	51.7 [2.04]	50 [1.97]	49 [1.93]	7 [0.28]

Type	ØC1	C2	C3	C4	C5	C6	D1	D2	D3	D4	D5	D6	ØD7	SW
320PZR06/025-2X	6.8 [0.27]	47 [1.85]	10.4 [0.41]	10.4 [0.41]	8.7 [0.34]	8.8 [0.35]	15.5 [0.61]	31 [1.22]	25.5 [1.00]	40.5 [1.59]	16.25 [0.64]	32.5 [1.28]	5.3 [0.21]	19 [0.75]

Dimensions: NG025
(dimensions in mm [in])

320PZL06/025-2x connection according to ISO4401 NG6



Porting pattern according to ISO 4401-03-02-0-05
no locating pin

1) Servicing height for filter element exchange

- A = Drill hole
- B = Drill hole
- P = Pressure lines
- T = Tank line
- TZ = Tank line, additional

Tolerances:

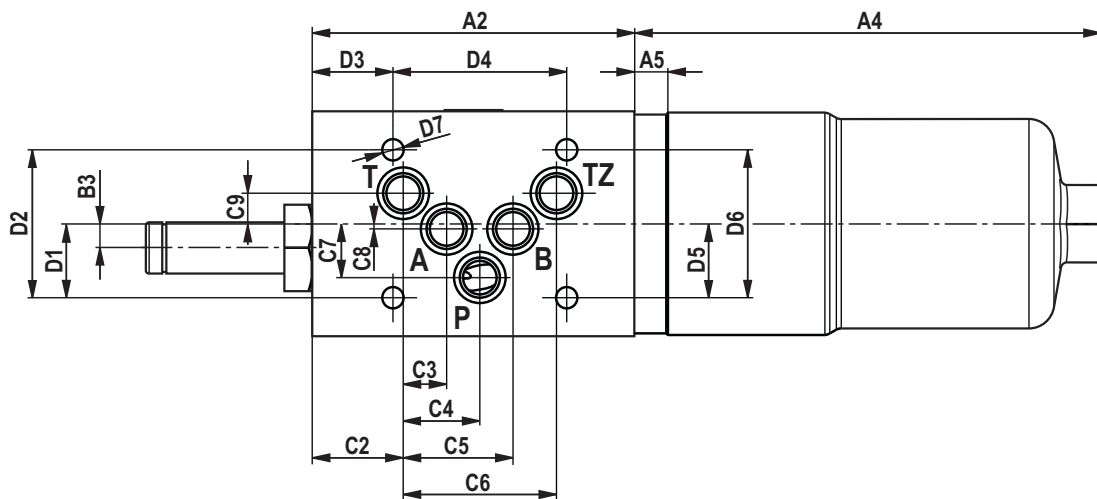
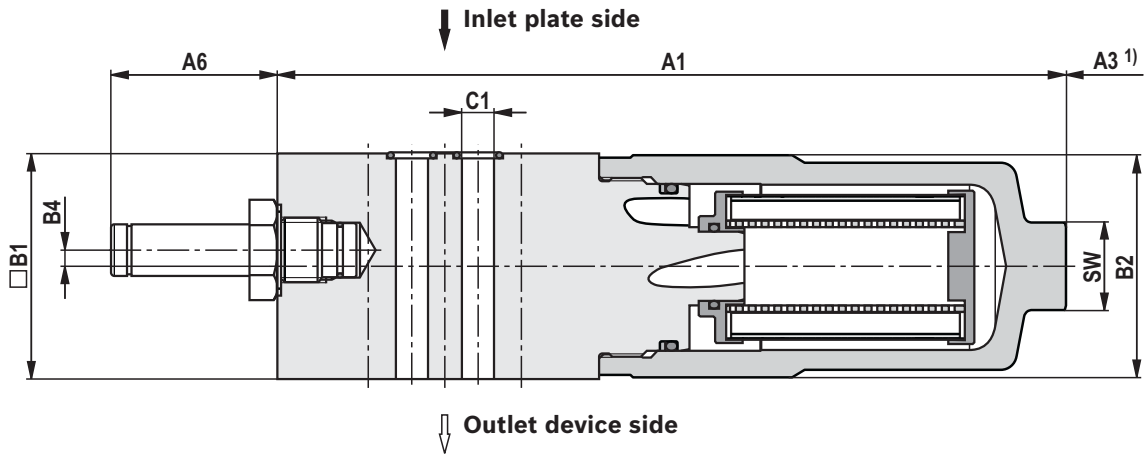
► General tolerances ISO 2768-m

Type	Content in l [US gal]	Weight in kg [lbs]	A1	A2	A3 ¹⁾	A4	A5	A6	ØB1	ØB2	B3
320PZL06/025-2X	0.14 [0.04]	3.5 [7.71]	239 [9.41]	96 [3.78]	80 [3.15]	143 [5.63]	10 [0.39]	51.7 [2.04]	50 [1.97]	49 [1.93]	7 [0.28]

Type	ØC1	C2	C3	C4	C5	C6	D1	D2	D3	D4	D5	D6	ØD7	SW
320PZL06/025-2X	6.8 [0.27]	47 [1.85]	10.4 [0.41]	10.4 [0.41]	8.7 [0.34]	8.8 [0.35]	15.5 [0.61]	31 [1.22]	25.5 [1.00]	40.5 [1.59]	16.25 [0.64]	32.5 [1.28]	5.3 [0.21]	19 [0.75]

Dimensions: NG075 125
(dimensions in mm [in])

320PZR10/075-2X ... 320PZR10/125-2X connection according to ISO4401 NG10



Porting pattern according to ISO 4401-05-04-0-05 no locating pin

- ¹⁾ Servicing height for filter element exchange
- A = Drill hole
- B = Drill hole
- P = Pressure lines
- T = Tank line
- TZ = Tank line, additional

Tolerances:

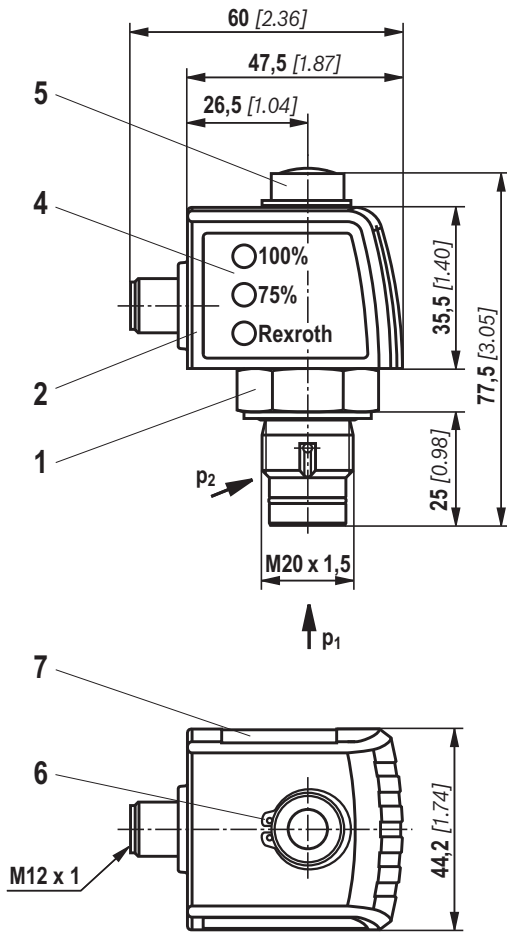
► General tolerances ISO 2768-m

Type	Content in l [US gal]	Weight in kg [lbs]	A1	A2	A3 ¹⁾	A4	A5	A6	ØB1	ØB2	B3	B4	ØC1	C2	C3
320PZR10/075-2X	0.35 [0.09]	6.5 [14.33]	245 [9.65]	100 [3.94]	80 [3.15]	145 [5.71]	10.5 [0.41]	51.7 [2.04]	70 [2.76]	69 [2.72]	7.5 [0.30]	5 [0.20]	10.5 [0.41]	28.2 [1.11]	13.5 [0.53]
			314 [12.36]			214 [8.43]									
320PZR10/125-2X	0.48 [0.13]	7.2 [15.87]	314 [12.36]												

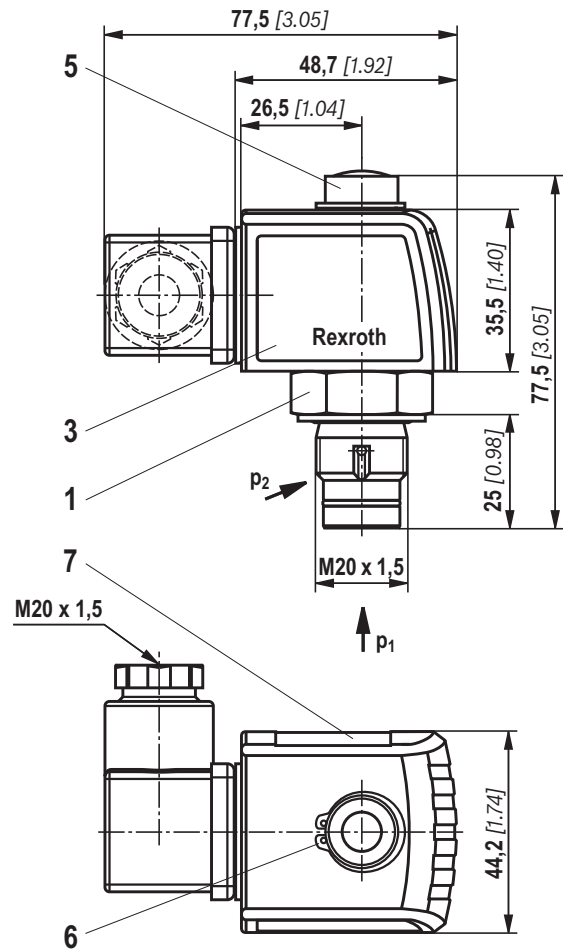
Type	C4	C5	C6	C7	C8	C9	D1	D2	D3	D4	D5	D6	ØD7	SW
320PZR10/075-2X	23.8 [0.94]	34.1 [1.34]	47.6 [1.87]	16.7 [0.66]	1.6 [0.06]	9.5 [0.37]	23 [0.91]	46 [1.81]	25 [0.98]	54 [2.13]	23 [0.91]	46 [1.81]	6.6 [0.26]	24 [0.94]
320PZR10/125-2X														

Maintenance indicator (dimensions in mm [in])

Pressure differential indicator with mounted switching element M12x1



Pressure differential indicator with mounted switching element EN-175301-803



- 1 Mechanical optical maintenance indicator; max. tightening torque $M_{A \max} = 50 \text{ Nm}$ [36.88 lb-ft]
- 2 Switching element with locking ring for electrical maintenance indicator (rotatable by 360°); round plug-in connection M12x1, 4-pole
- 3 Switching element with locking ring for electrical maintenance indicator (rotatable by 360°); rectangular plug-in connection EN175301-803
- 4 Housing with three LEDs: 24 V =
green: Stand-by
yellow: Switching point 75%
red: Switching point 100%
- 5 Visual indicator with memory function
- 6 Locking ring DIN 471-16x1, **material no. R900003923**
- 7 Name plate

Notices:

Representation contains mechanical optical maintenance indicator (1) and electronic switching element (2) (3).

Ordering code

Spare parts

Filter element

01	02	03		04	05	06
2.Z			-	B00	-	0

Filter element

01	Design	2.Z
----	--------	------------

Size

02	PZR...	06/025 10/075 10/125
	PZL...	06/025

Filter rating in µm

03	Absolute (ISO 16889) Glass fiber material, not cleanable	H3PZ H6PZ H10PZ H20PZ
----	---	--

Pressure difference

04	Max. admissible pressure differential of the filter element 330 bar [4786 psi] (without bypass valve)	B00
----	---	------------

Bypass valve

05	without bypass valve	0
----	-----------------------------	----------

Seal

06	NBR seal	M
	FKM seal	V

Order example:

2.Z125 H10PZ-B00-0-M

Material no.: R928051781

For detailed information on Rexroth filter elements please refer to data sheet 51420.

Preferred program replacement elements

Filter element type	Filter material/material no.		
	H3PZ	H6PZ	H10PZ
2.Z025...B00-0-M	R928051771	R928053299	R928051773
2.Z075...B00-0-M	R928051775	R928051776	R928051777
2.Z125...B00-0-M	R928051779	R928051780	R928051781

Ordering code
Spare parts

Mechanical optical maintenance indicator

01	02	03	04	05	06
W	O	-	D01	-	-

01	Maintenance indicator	W
----	-----------------------	---

02	Mechanical optical indicator	O
----	------------------------------	---

Version

03	Pressure differential, modular design	D01
----	---------------------------------------	-----

Switching pressure

04	5.0 bar [72.5 psi]	5.0
	8.0 bar [116.0 psi]	8.0

Seal

05	NBR seal	M
	FKM seal	V

Max. operating pressure

06	Switching pressure 5.0 bar [72.5 psi], 450 bar [6527 psi]	450
	Switching pressure 8.0 bar [116.0 psi], 450 bar [6527 psi]	450

Material no.	Description
R928025313	WO-D01-5.0-M-450
R901066235	WO-D01-5.0-V-450
R928038785	WO-D01-8.0-M-450
R928038784	WO-D01-8.0-V-450

Ordering code

Spare parts

Seal kit

01	02	03	04
320PZ		- 2X	/

01	Series	320PZ
----	---------------	--------------

Size

02	NG06/025	06/025
	NG10/075-10/125	10/075-10/125

03	Component series 20 ... 29 (20 ... 29: unchanged installation and connection dimensions)	2X
----	--	-----------

Seal

04	NBR seal	M
	FKM seal	V

Seal kit

Material no.	Description
R928054066	320PZ06/025-2X/M
R928054067	320PZ06/025-2X/V
R928054068	320PZ10/075-10/125-2X/M
R928054069	320PZ10/075-10/125-2X/V

Assembly, commissioning, maintenance

Installation

- ▶ The max. operating pressure of the system must not exceed the max. admissible operating pressure of the filter (see name plate).
- ▶ During assembly of the filter the flow direction (inlet = P bore / seal side) and the required servicing height of the filter element (see chapter "Dimensions") are to be considered.
- ▶ Filter element exchange is made easiest when the filter bowl is oriented horizontal. The installation position - filter bowl upward - is not permitted.
- ▶ The maintenance indicator must be arranged so it is easily viewed in operation.
- ▶ Remove the protective wrapping from the filter inlet and outlet.
- ▶ The optional electronic maintenance indicator is connected via the electronic switching element with 1 or 2 switching points, which is attached to the mechanical optical maintenance indicator and held by means of the locking ring.

Commissioning

- ▶ Start the system.



Notice:

There is no bleeding provided at the filter.

Maintenance

- ▶ If at operating temperature, the red indicator pin reaches out of the mechanical optical maintenance indicator and/or if the switching process in the

electronic switching element is triggered, the filter element is contaminated and needs to be replaced or cleaned respectively.

- ▶ The material number of the corresponding replacement filter element is indicated on the name plate of the complete filter. It must correspond to the material number on the filter element.
- ▶ Turn off the system.
- ▶ Depressurize the system.



Notice:

There is no bleeding provided at the filter.

- ▶ Unscrew the filter bowl.
- ▶ Remove the filter element from the spigot by rotating it slightly.
- ▶ Clean the filter components, if necessary.
- ▶ Check the seals at the filter bowl for damage and replace them, if necessary. For suitable seal kits refer to chapter "Spare parts".
- ▶ Install the new filter element on the spigot again by slightly rotating it.
- ▶ The filter is to be assembled in reverse order.

Please note:

Screw in the filter bowl to the stop, unscrew the filter bowl again by 1/8 to 1/2 rotation so that the filter bowl does not get stuck due to the pressure pulsation and can be loosened easily during maintenance work.

- ▶ The torque specifications ("Tightening torques" chapter) are to be observed.
- ▶ Start the system.



WARNING!

- | | |
|---|--|
| <ul style="list-style-type: none"> ▶ Assemble and disassemble only with depressurized system! ▶ Filter is under pressure! ▶ Remove the filter bowl only if it is depressurized! ▶ Do not exchange the maintenance indicator while the filter is under pressure! | <ul style="list-style-type: none"> ▶ If the flow direction is not considered during assembly, the filter element will be destroyed. Particles will enter the system and damage downstream components. |
|---|--|



Notices:

- ▶ All filter maintenance should be performed by trained specialists.
- ▶ Proper function and safety are only guaranteed if original Bosch Rexroth filter elements and spare parts are used.

- ▶ Warranty becomes void if the delivered item is changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental condition that do not comply with the installation conditions.

Tightening torque (dimensions in mm [in])

Series	320PZR/PZL06/025	320PZR10/075	320PZR10/125
Filter bowl	Screw in the filter bowl to the stop, unscrew the filter bowl again by 1/8 to 1/2 rotation		
Mechanical optical maintenance indicator	Max. 50 Nm [37lb-ft]		
Cubic connector screw switching element EN-175301-803	M3/0.5 Nm [0.4 lb-ft]		

Directives and standardization

Classification according to the Pressure Equipment Directive

The block mounting filter for hydraulic applications according to 51468 are pressure holding equipment according to article 1, section 2.1.4 of the Pressure Equipment Directive 97/23/EC (PED). However, based on the exception in article 1, section 3.6 of the PEG, hydraulic

filters are exempt from the PED if they are not classified higher than category I (guideline 1/19).

The fluids from the chapter "Compatibility with approved pressure fluids" were considered for the classification. They do not receive a CE mark.

Use in potentially explosive areas according to directive 94/9/EC (ATEX)

The block mounting filter according to 51468 are not equipment or components in the sense of directive 94/9/EC and are not provided with a CE mark. It has been proven with the ignition risk analysis that these block mounting filters do not have own ignition sources acc. to DIN EN 13463-1:2009.

According to DIN EN 60079-11:2012, electronic maintenance indicators with a switching point:

WE-1SP-M12x1	R928028409
WE-1SP-EN175301-803	R928036318

are simple, electronic operating equipment that do not have an own voltage source. This simple, electronic operating equipment may - according to DIN EN 60079-14:2012 - in intrinsically safe electric circuits (Ex ib) be used in systems without marking and certification. The block mounting filters and the electronic maintenance indicators described here can be used for the following explosive areas:

	zone suitability	
Gas	1	2
Dust	21	22

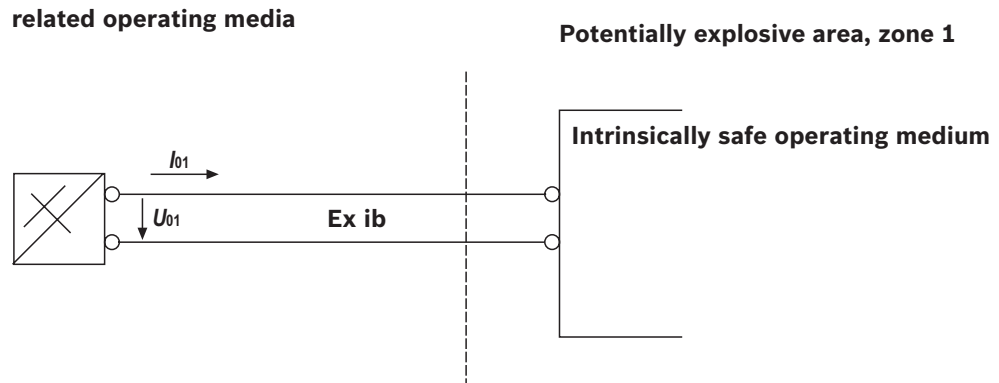
Complete filter with mech./opt. Maintenance indicator			
Use /assignment		Gas 2G	Dust 2D
Assignment		Ex II 2G c IIC TX	Ex II 2D c IIC TX
Conductivity of the medium	pS/m min	300	
Dust accumulation	max	-	0.5 mm

electronic switching element in the intrinsically safe electric circuit			
Use /assignment		Gas 2G	Dust 2D
Assignment		Ex II 2G Ex ib IIB T4 Gb	Ex II 2D Ex ib IIIC T100°C Db
perm. intrinsically safe electric circuits		Ex ib IIC, Ex ic IIC	Ex ib IIIC
Technical data		Values only for intrinsically safe electric circuit	
Switching voltage	Ui max	150 V AC/DC	
Switching current	Ii max	1.0 A	
Switching power	Pi max	1.3 W T4 T _{max} 40 °C	750 mW T _{max} 40 °C
		1.0 W T4 T _{max} 80 °C	550 mW T _{max} 100 °C
Surface temperature ¹⁾	max	-	100 °C
inner capacity	Ci	negligible	
inner inductivity	Li	negligible	
Dust accumulation	max	-	0.02 in

¹⁾ The temperature depends on the temperature of the medium in the filter and must not exceed the value specified here.

Directives and standardization

Possible circuit according to DIN EN 60079-14



⚠ WARNING!

- ▶ Explosion hazard due to high temperature!
The temperature depends on the temperature of the medium in the hydraulic circuit and must not exceed the value specified here. Measures are to be taken so that in the potentially explosive area, the max. admissible ignition temperature is not exceeded.
- ▶ When using the block mounting filters according to 51 468 in explosive areas, sufficient potential

- equalization has to be ensured. The filter is preferably to be grounded via the mounting screws. It has to be noted in this connection that paintings and oxidic protective layers are not electrically conductive.
- ▶ During filter element exchanges, the packaging material is to be removed from the replacement element outside the explosive area

👉 Notices:

- ▶ Maintenance only by specialists, instruction by the machine end-user acc. to DIRECTIVE 1999/92/EC appendix II, section 1.1
- ▶ Functional and safety warranty only applicable when using genuine Rexroth spare parts

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Spin-on filter according to Bosch Rexroth standard:

Type 50 SL 30 to 80D

RE 51476

Edition: 2015-06



56558_d

- ▶ Nominal sizes: 30 to 80D
- ▶ Connection up to G1; SAE 10

Features

Spin-on filters are used in hydraulic systems for separating solid material from fluids and lubricating oils.

They come with the following features:

- ▶ Filter for inline installation
- ▶ Optimized for mobile hydraulics, space-saving, service-friendly
- ▶ Installation in suction, pressure or return lines possible
- ▶ Special, highly efficient filter materials
- ▶ Filtration of ultra-fine particles and high dirt holding capacity
- ▶ Optional version with maintenance indicator
- ▶ Optional bypass valve integrated in the filter housing
- ▶ Spin-on element 82 with various connections available as spare part

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Filter ordering code

01	02	03	04	05	06	07	08	09	10	11	12
50 SL			- S00	-	0			-		0	0

Series

01	Spin-on filter	50 SL
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Size

02	According to Bosch Rexroth standard Model with UNF thread	30 45 60 80
	According to Bosch Rexroth standard Model with UN thread	30D 45D 60D 80D

Filter grade in μm

03	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$)	Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
	Nominal	Paper, not cleanable	P10 P25

Pressure differential

04	Max. pressure differential of the filter element of 5 bar [72 psi]	S00
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Magnet

05	Without	0
----	---------	---

Bypass valve

06	Without	0
	Cracking pressure 2.5 bar [36.3 psi] – configurable with maintenance indicator M1.5	5
	Cracking pressure 3.5 bar [50.8 psi] – configurable with maintenance indicator M2.5	7

Maintenance indicator

07	Without	0 ¹⁾
	Pressure differential indicator, electric	M

Switching pressure

08	Switching pressure 1.5 bar [21.8 psi]	1.5		
	Switching pressure 2.5 bar [36.3 psi]	2.5		
09	Installation size	50 SL 30; 45 (D)	50 SL 60; 80 (D)	
	Connection			
	ISO 228	G3/4	G1	R0
	SAE J 1926	SAE 10 (7/8-14 UNF-2B)		U0

Seal

10	NBR	M
	FKM	V

Housing material

11	Standard material	0
----	-------------------	---

Filter ordering code

01	02	03	04	05	06	07	08	09	10	11	12		
50 SL			-	S00	-	0				-		0	0

Supplementary information

12	Without	0
----	---------	---

¹⁾ Without bypass valve cracking pressure 2.5 bar [36.3 psi] configurable

Order example:

50 SL 60 H10XL-S00-07M2,5-R0M00

Material no.: R928054914

Further models on request.

Preferred types

50 SL, flow specification for 30 mm²/s [143 SUS]

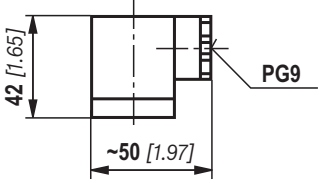
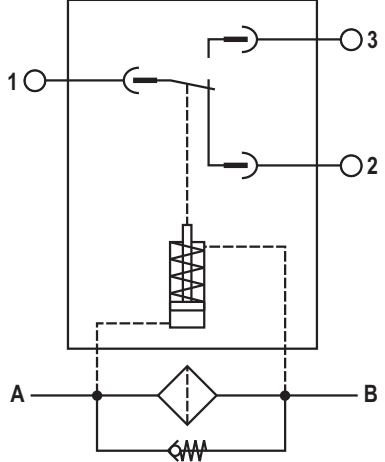
Filter grade 10 µm

Type	Flow in l/min [gpm] and $\Delta p = 0.5$ bar [7.25 psi] ¹⁾	Material no. Filter	Material no. Spin-on
50 SL 30 H10XL-S00-07M2,5-R0M00	25 [362.60]	R928054912	R928038865
50 SL 45 H10XL-S00-07M2,5-R0M00	40 [580.16]	R928054913	R928019444
50 SL 60 H10XL-S00-07M2,5-R0M00	90 [1305.36]	R928054914	R928019719
50 SL 80 H10XL-S00-07M2,5-R0M00	100 [1450.40]	R928054987	R928054791
50 SL 30D H10XL-S00-07M2,5-R0M00	25 [362.60]	R928054915	R928019173
50 SL 45D H10XL-S00-07M2,5-R0M00	40 [580.16]	R928054916	R928019180
50 SL 60D H10XL-S00-07M2,5-R0M00	90 [1305.36]	R928054917	R928019183
50 SL 80D H10XL-S00-07M2,5-R0M00	100 [1450.40]	R928054918	R928019720

¹⁾ Measured pressure differential across filter and measuring equipment in accordance with ISO 3968. The measured pressure differential at the maintenance indicator is lower.

Symbols

(Dimensions in mm [inch])

Spare part	Drawing	Ordering code in the type key	Symbol
Optical/electrical with connector		M	

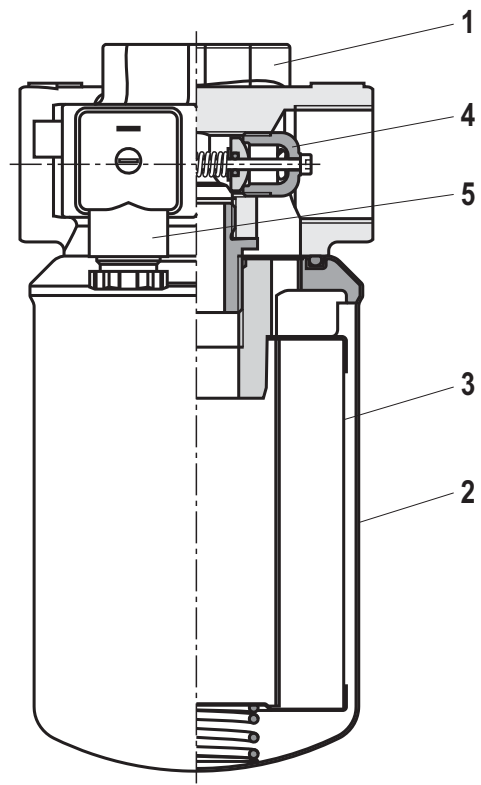
Function, cross-section

The spin-on filter is suited for direct installation in pressure or return lines. It is installed upstream from components to be protected.

It consists primarily of a filter head (1), a threaded spin-on element (2) with built-in filter element (3). Optionally, a maintenance indicator (5) and a bypass valve (4) can also be configured for the filter.

The maintenance indicator housing is integrated in the filter head.

The fluid passes through the inlet to the spin-on element, where it is cleaned. Any dirt particles filtered out collect in the filter element. The filtered fluid then enters the hydraulic circuit through the outlet.




50 SL 30 ... 80D

Technical data

(Please consult us for applications outside these parameters)

General					
Installation position		Vertical			
Ambient temperature range		°C [°F]	-40 ... +65 [-40... +149]		
Storage conditions	▶ NBR seal	°C [°F]	-40 ... +65 [-40... +149]; max. relative air humidity: 65%		
	▶ FKM seal		-20 ... +65 [-4... +149]; max. relative air humidity: 65%		
Mass	Size		30(D)	45(D)	60(D)
	kg [lbs]		1.1 [2.4]	1.5 [3.3]	1.8 [4.0]
Flow	Size		30(D)	45(D)	60(D)
	l [US gal]		0.6 [0.16]	0.9 [0.24]	1.3 [0.34]
Material	▶ Filter head	Aluminum			
	▶ Spin-on element	Steel / aluminum			
	▶ Maintenance indicator	Aluminum / brass / plastic			

Hydraulic					
Max. operating pressure	▶ Filter head	bar [psi]	50 [725]		
	▶ Spin-on element	bar [psi]	40 [580] ¹⁾		
Hydraulic fluid temperature range		°C [°F]	-10 ... +100 [+14... +212]		
 Note about cold start:			-40... -10 [-40...+14] During a cold start up, expect a sudden pressure increase and a flow of at least 50% in each case. A bypass valve is essential		
Min. medium conductivity		pS/m	300		

Maintenance indicator			Pressure differential indicator, electric		
Letter order option			M		
Model			W...GW0200...		
Contact load, DC voltage		A _{max.}	0.25		
Voltage range		V _{max.}	175 AC/DC		
Max. switching power		VA	5		
Switching type		▶ 100 % signal	Changeover		
IP rating as per EN 60529		IP	65		
Ambient temperature range		°C [°F]	-10 ... +85 [+14... +185]		
Operating temperature		°C [°F]	-10 ... +100 [+14... +212]		
For direct voltage above 24 V, spark extinguishing is to be provided for protecting the switching contacts.					
Mass		kg [lbs]	0.3 [0.66]		
Material	▶ Housing	Aluminum / Plastic/ Brass			
	▶ Seals	NBR or FKM			

¹⁾ Validation according to ISO 10771

Technical data

(Please consult us for applications outside these parameters)

Filter element			
Glass fiber material H...XL		Inorganic fiber-based single-use element	
		Filtration ratio as per ISO 16889 up to $\Delta p = 5 \text{ bar [72.5 psi]}$	Best oil cleanliness as per ISO 4406 [SAE-AS 4059]
Particle separation	H20XL	$\beta_{20}(c) \geq 200$	19/16/12 – 22/17/14
	H10XL	$\beta_{10}(c) \geq 200$	17/14/10 – 21/16/13
	H6XL	$\beta_6(c) \geq 200$	15/12/10 – 19/14/11
	H3XL	$\beta_5(c) \geq 200$	13/10/8 – 17/13/10
Pressure differential	► S00 bar [psi]	5 [72.5]	

Compatibility with permitted hydraulic fluids

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oils	HLP	NBR	DIN 51524

Characteristic curves

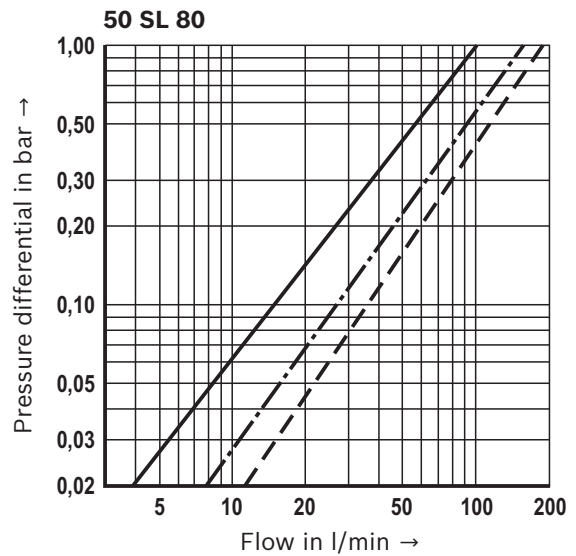
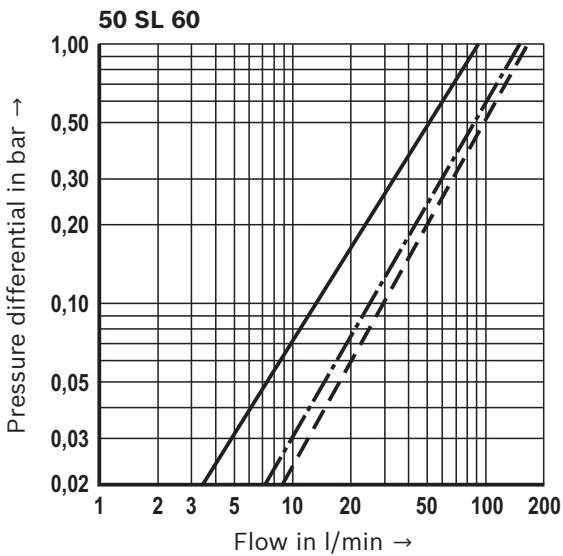
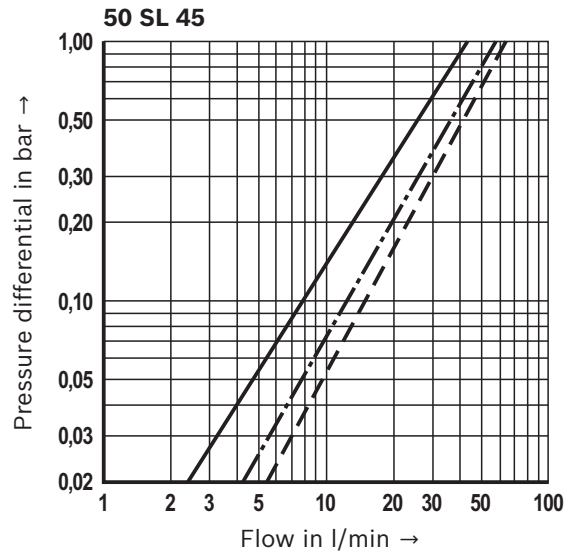
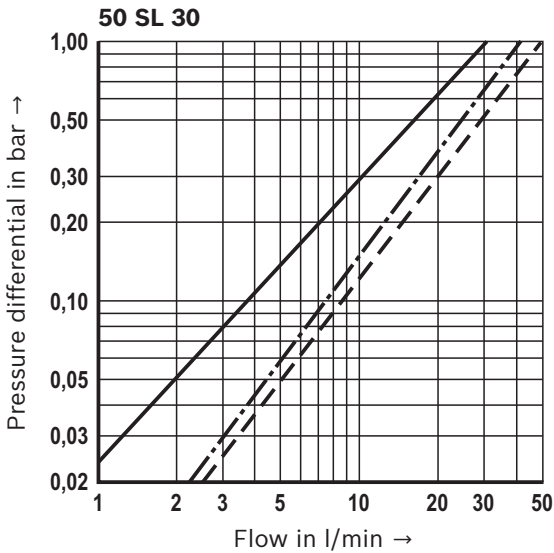
(measured with mineral oil HLP46 according to DIN 51524)

Spec. Weight: < 0.9 kg/dm³

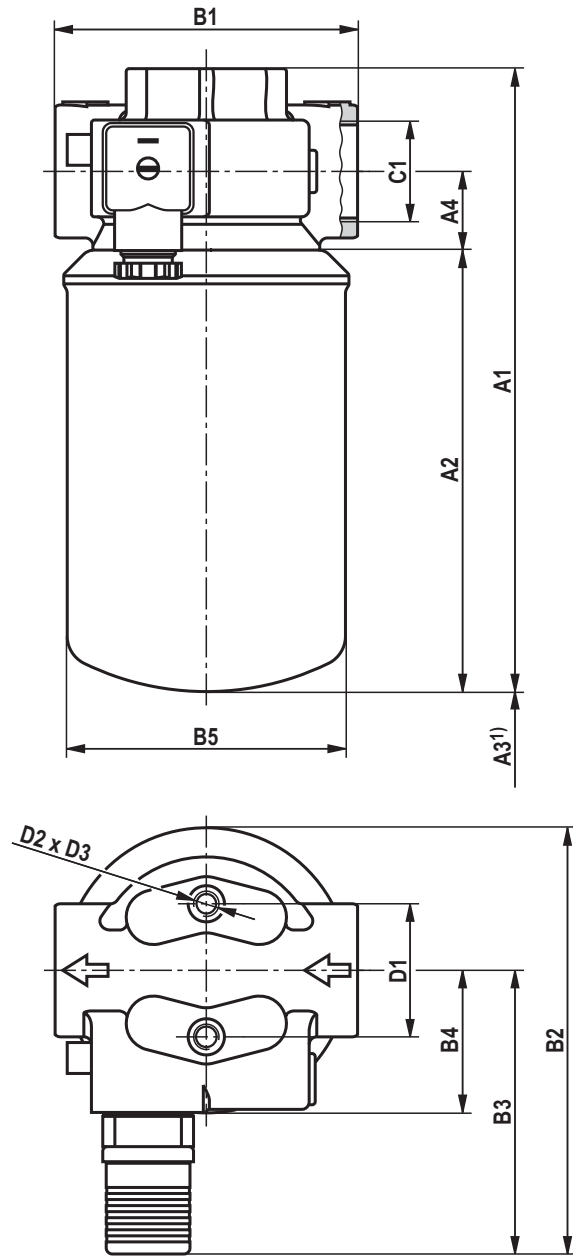
Δp -Q characteristic curves for complete filter recommended start Δp for design = 0.5 bar [7.25 psi]

Our online design software “Bosch Rexroth FilterSelect” allows you to choose the best filter.

—— H3XL - · - · H10XL - - - P10



Dimensions: 50 SL 30 ... 80D
(Dimensions in mm [inch])



Filter type	A1	A2	A3 ¹⁾	A4	B1	B2	B3	B4	ØB5	Connections		D1	D2	D3	Spin-on filter connection
										C1 R0	U0				
50 SL 30	173	113	20 [0.79]	26 [1.02]	100 [3.94]	140 [5.51]	94 [3.70]	47 [1.85]	92±0.3 [3.62±0.01]	G3/4	SAE 10 (7/8-14 UNF)	44 [1.73]	M8	12 [0.47]	UNF 1"-12
50 SL 30D	[6.81]	[4.45]													UNF 1 3/8"-12
50 SL 45	209	149													UNF 1"-12
50 SL 45D	[8.23]	[5.87]													UNF 1 3/8"-12
50 SL 60	275	215													UNF 1"-12
50 SL 60D	[10.83]	[8.46]													UNF 1 3/8"-12
50 SL 80D	300 [11.81]	240 [9.45]								G1	UNF 1 3/8"-12				

¹⁾ Servicing height for spin-on element

Spare parts ordering codes

Spin-on element

01	02	03	04	05	06
82			- S00	- 0	-

Spin-on element

01	Design	82
----	--------	----

Size

02	According to Bosch Rexroth standard Model with UNF thread	30 45 60 80
	According to Bosch Rexroth standard Model with UN thread	30D 45D 60D 80D

Filter grade in μm

03	Absolute (ISO 16889; $\beta_x(c) \geq 200$)	Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
	Nominal	Paper, not cleanable	P10 P25

Pressure differential

04	Max. pressure differential of the filter element of 5 bar [72 psi]	S00
----	--	-----

Bypass valve

05	Without bypass valve	0
----	-----------------------------	---

Seal

06	NBR	M
	FKM	V

Order example:

82.45 H10XL-S00-0-M

Material no.: R928019444

Preferred program spin-on filters

Spin-on filter type	Filter material/material no.	
	H10XL	P10
82.30...S00-0-M	R928038865	R928046556
82.45...S00-0-M	R928019444	R928025436
82.60...S00-0-M	R928019719	R928046571
82.80...S00-0-M	R928054791	R928054790

 Note:

The maintenance indicator is not offered as a spare part as it is integrated in the filter head.

Assembly, commissioning, maintenance

Installation

- ▶ The max. operating pressure of the system must not exceed the max. operating pressure of the filter (see type plate).
- ▶ During assembly of the filter the flow direction (direction arrows) and the required servicing height of the spin-on element (see chapter "Dimensions") are to be considered.
- ▶ Element replacement is made easiest when the spin-on element is oriented downward with the installation position.
- ▶ Remove the plastic plugs from the filter inlet and outlet.
- ▶ The connection of the electrical maintenance indicator is via a mating connector that is attached to the maintenance indicator contacts and held by a screw.

Commissioning

- ▶ Commission the system.

Note:

The filter has no bleeding mechanism.

Maintenance

- ▶ If the switching operation is triggered in the electrical maintenance indicator, this means the spin-on element is contaminated and will require replacing. Spin-on elements must be replaced after 6 months at latest or a max. of 1,000 operating hours.
- ▶ The material number of the correct spin-on element is on the name plate of the complete filter. Verify that it matches the material number on the spin-on filter.
- ▶ Decommission the system.
- ▶ Release operating pressure on the system side.

Note:

The filter has no bleeding mechanism.

- ▶ Unscrew the spin-on element.
- ▶ Screw on the new spin-on element hand-tight.
- ▶ **Please note:**
If necessary, carefully tighten it by 30° in the depressurized state (use a band wrench where necessary)
- ▶ Commission the system.
- ▶ If filter loosens between the spin-one element and filter head after commissioning, the spin-on element will need to be tightened up.

Application notes:

- ▶ Under dynamic loads, the spin-on element housing could be elastically deformed.
- ▶ Spin-on elements are not rigid.

WARNING!

- ▶ Only install or remove when system is not pressurized.
- ▶ Tank is pressurized!
- ▶ Only remove spin-on element when it is not pressurized.
- ▶ Do not replace maintenance indicator when filter is pressurized.
- ▶ Failure to observe flow of direction during assembly will cause filter element to be damaged beyond repair. Particles will enter the system and damage downstream components.

Important:

- ▶ Only trained specialists may work on the filter.
- ▶ Proper function and safety are only guaranteed if original Bosch Rexroth spin-on elements and spare parts are used.
- ▶ Warranty becomes void if the delivered item is

changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental condition that do not comply with the installation conditions.

Tightening torques

(dimensions in mm [inch])

Series 50 SL...		30(D)	45(D)	60(D)	80(D)
Tightening screws with $\mu_{\text{total}} = 0.14$	Nm [lb-ft]	max. 30 [22]			
mounting screw		M8			
Minimum screw-in depth mounting	mm [inch]	8 [0.3]			

Directives and standardization

Classification according to the Pressure Equipment Directive

The spin-on filters for hydraulic applications according to 51476 are pressure holding equipment according to article 1, section 2.1.4 of the Pressure Equipment Directive 97/23/EC (PED). However, under Article 1 Section 3.6 PED, hydraulic filters are exempt from the PED if they are not classified higher than Category I (Guideline 1/19).

The fluids from the chapter “Compatibility with approved pressure fluids” were considered for the classification. The intended use is only permitted with fluids in group 2 and within the specified operating limits (see “Technical data”).

These filters do not receive a CE mark.

Use in explosive areas according to Directive 94/9/EC (ATEX)

The spin-on filters without maintenance indicator according to 51476 are no equipment or components in the sense of directive 94/9/EC and are not provided with a CE mark. It has been proven with the ignition risk analysis that these spin-on filters do not have own ignition sources acc. to DIN EN 13463-1:2009.

The spin-on filters without maintenance indicators can be used for the following explosive areas:

	Zone suitability	
Gas	1	2
Dust	21	22

Complete filter without maintenance indicator				
Use /assignment			Gas 2G	Dust 2D
Assignment ¹⁾			Ex II 2G c IIC TX	Ex II 2D c IIC TX
Medium conductivity	pS/m	min.	300	
Dust accumulation		max.	–	0.5 mm

¹⁾ TX = max. temperature range: see chapter “Technical data”

Directives and standardization

WARNING!

- ▶ Explosion hazard due to high temperature! Temperature is based on temperature of medium in hydraulic circuit and cannot exceed this value. Take steps to make sure max. admissible ignition temperature is not exceeded in explosive area.
- ▶ When using the spin-on filters according to 51476 in explosive areas, sufficient equipotential bonding has to be ensured. Grounding the filter with mounting screws is recommended. It has to be noted in this connection that paintings and oxidic protective layers are not electrically conductive.
- ▶ During spin-on filter replacement, the packaging material is to be removed from the replacement element outside the potentially explosive area

Important:

- ▶ Maintenance may only be performed by specialists on instruction of the owner in accordance with Directive 1999/92/EC Annex II Section 1.1.
- ▶ Functional and safety warranty is only applicable when using genuine Rexroth spare parts

Environmental safety and recycling

- ▶ The used spin-on element should be disposed of in accordance with the respective country-specific legal regulations of environmental protection.
- ▶ After completion of the filter life, the components of the filter, in accordance with the respective country-specific legal regulations of environmental protection, should be recycled.

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Spin-on filter according to Bosch Rexroth standard

Type 7 SL 30 ... 260; 7 SLS 90 ... 260

RE 51426

Edition: 2015-03

Replaces: 01.10



- ▶ Nominal sizes: 7 SL 30 ... 260; 7 SLS 90 ... 260
- ▶ Nominal pressure 7 bar [101 psi]
- ▶ Connection up to G1 1/2, SAE 20

Features

Spin-on filters are used in mobile and industrial hydraulic systems for separating solid material from fluids and lubricating oils.

They distinguish themselves by the following:

- ▶ Filter for inline installation
- ▶ Optimized for mobile hydraulics, space-saving, service-friendly
- ▶ 7 SLS version with isolator valve, patented and environmentally-friendly
- ▶ Installation in suction, pressure or return lines possible
- ▶ Special, highly-efficient filter materials
- ▶ Filtration of ultra-fine particles and high dirt-holding capacity
- ▶ Optional version with maintenance indicator, pressure gauge or vacuum meter
- ▶ Optional bypass valve integrated in the filter housing

Contents

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Filter ordering codes

01	02	03	04	05	06	07	08	09	10	11	12
7				- S00	-	0			-		M 0

Pressure

01	Spin-on filter 7 bar [101 psi]	7
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Series

02	Spin-on filter without isolator valve	SL
	Spin-on filter with isolator valve	SLS

Size

03	7 SL...	30/21 45/21 60/21 90 130 180 ¹⁾ 260 ²⁾
	7 SLS...	90 130 180 ¹⁾ 260 ²⁾

Filter rating in µm

04	Absolute (ISO 16889; β _{x(c)} ≥ 200)	Glass fiber material, not cleanable	H3XL H6XL H10XL H20XL
	Nominal	Paper, not cleanable	P10 P25

Pressure differential

05	Max. admissible pressure differential of the filter element of 5 bar [72 psi]	S00
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Solenoid

06	Without	0
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Bypass valve

07	Without	0
	Cracking pressure 0.3 bar [4.4 psi] – with maintenance indicator C; F0.2; G0.2 configurable	1
	Cracking pressure 2.5 bar [36.3 psi] – with maintenance indicator A; D1.5; H1.5; J1.5; P1.5 configurable	5

Maintenance indicator

08	Without	0
	Pressure gauge 0 ...6 bar [0 ... 87 psi]	A ³⁾
	Vacuum meter -1 ...0.6 bar [-14.5 ... 8.7 psi]	C
	Back pressure indicator, optical	D1.5
	Vacuum switch, normally open contact	F0.2
	Vacuum switch, normally closed contact	G0.2
	Pressure switch, normally open contact	H1.5
	Pressure switch, normally closed contact	J1.5
	Pressure differential indicator opt. / electr. with connector, changeover (only for 7 SL 90 ... 260)	P1.5

Ordering codes filter

01	02	03	04	05	06	07	08	09	10	11	12			
7				-	S00	-	0			-		M	0	

Port

09	Installation size	7 SL 30/21 ... 60/21	7 SL / SLS 90 ... 130	7 SL / SLS 180 ... 260	
	Port				
	ISO 228	G3/4	G1 1/4	G1 1/2	R0
	SAE flange 3000 psi			SAE1 1/2"	S0
	SAE J 1926		SAE20		U0

Seal

10	NBR		M
----	-----	--	---

Housing material

11	Standard material		0
----	-------------------	--	---

Supplementary information

12	Without		0
	Check valve in outlet (only with 7 SLS without bypass valve, not to be installed in suction lines)		R

- 1) The filter 7 SL(S) 180 contains two spin-on elements of size 90.
- 2) The filter 7 SL(S) 260 contains two spin-on elements of size 130.
- 3) When using a pressure gauge, the maximum admissible operating pressure is reduced to 6 bar [87 psi].

Order example:

7 SL 45/21 P10-S00-00H1,5-R0M00

Further versions (filter materials, connections,...) are available on request.

Preferred types

Spin-on filter, nominal pressure 7 bar, filter material and rating glass fiber material 10 µm

Type	Flow in l/min [gpm] with $v = 30 \text{ mm}^2/\text{s}$ [142 SUS] and $\Delta p = 0.5 \text{ bar}$ [7.25 psi] ¹⁾	Material no. Filter	Material no. Spin-on element
7 SL 45/21 H10XL-S00-05A-ROM00	40 [10.57]	R928028294	1x R928016611
7 SL 90 H10XL-S00-05A-ROM00	140 [36.98]	R928027821	1x R928016614
7 SL 130 H10XL-S00-05A-ROM00	150 [39.63]	R928025538	1x R928016617
7 SL 180 H10XL-S00-05A-ROM00	235 [62.08]	R928028301	2x R928016614
7 SL 260 H10XL-S00-05A-ROM00	255 [67.36]	R928028302	2x R928016617

Spin-on filter, nominal pressure 7 bar, filter material and rating paper, 10 µm

Type	Flow in l/min [gpm] with $v = 30 \text{ mm}^2/\text{s}$ [142 SUS] and $\Delta p = 0.5 \text{ bar}$ [7.25 psi] ¹⁾	Material no. Filter	Material no. Spin-on element
7 SL 45/21 P10-S00-05A-ROM00	45 [11.89]	R928028307	1x R928016609
7 SL 90 P10-S00-05A-ROM00	185 [48.87]	R928028310	1x R928016612
7 SL 130 P10-S00-05A-ROM00	190 [50.19]	R928028313	1x R928016615
7 SL 180 P10-S00-05A-ROM00	295 [77.93]	R928028316	2x R928016612
7 SL 260 P10-S00-05A-ROM00	300 [79.25]	R928028319	2x R928016615

Spin-on filter with return flow block, nominal pressure 7 bar, filter material and rating glass fiber material, 10 µm

Type	Flow in l/min [gpm] with $v = 30 \text{ mm}^2/\text{s}$ [142 SUS] and $\Delta p = 0.5 \text{ bar}$ [7.25 psi] ¹⁾	Material no. Filter	Material no. Spin-on element
7 SLS 90 H10XL-S00-05A-ROM00	135 [35.66]	R928028323	1x R928016614
7 SLS 130 H10XL-S00-05A-ROM00	150 [39.63]	R928028340	1x R928016617

Spin-on filter with return flow block, nominal pressure 7 bar, filter material and rating paper, 10 µm

Type	Flow in l/min [gpm] with $v = 30 \text{ mm}^2/\text{s}$ [142 SUS] and $\Delta p = 0.5 \text{ bar}$ [7.25 psi] ¹⁾	Material no. Filter	Material no. Spin-on element
7 SLS 90 P10-S00-05A-ROM00	185 [48.87]	R928028344	1x R928016612
7 SLS 130 P10-S00-05A-ROM00	190 [50.19]	R928028348	1x R928016615

¹⁾ Measured pressure differential across filter and measuring equipment in accordance with ISO 3968. The measured pressure differential at the maintenance indicator is lower.

Symbols (Dimensions in mm [inch])

Spare part	Back pressure gauge M 010	Vacuum gauge M 070	Optical/mechanical P1,500000M
Drawing			
Ordering code in the type key	A	C	D
Symbol			

Spare part	Pressure switch Normally open contact H1.5 HS 32 00M Normally closed contact H1.5 HA 32 00M	Vacuum switch Normally open contact IO.2 HS 32 00V Normally closed contact IO.2 HA 32 00V	Optical/electrical with connector
Drawing			
Ordering code in the type key	Normally open contact H Normally closed contact J	Normally open contact F Normally closed contact G	Changeover P
Symbol	<p>H: Normally open contact</p> <p>J: Normally closed contact</p>	<p>F: Normally open contact</p> <p>G: Normally closed contact</p>	

Function, section

General:

The spin-on filter is suited for direct installation in suction, pressure or return lines. It is installed upstream from components to be protected.

It consists primarily of a filter head (1), a threaded spin-on element (2) with built-in filter element (or two spin-on elements for sizes 180 and 260).

Optionally, a maintenance indicator (3) and a bypass valve (4) can also be configured for the filter.

The fluid passes through the inlet to the spin-on element (2), where it is cleaned. Any dirt particles that are filtered out collect in the filter element. The filtered fluid then enters the hydraulic circuit through the outlet. For sizes 180 and 260, fluid flows through both spin-on elements at the same time.

Spin-on filter with isolator valve 7 SLS:

The integrated check valve in the filter head prevents fluid from draining from the system while replacing the filter element (5) of the 7 SLS. During filter element change, the inlet side is blocked.

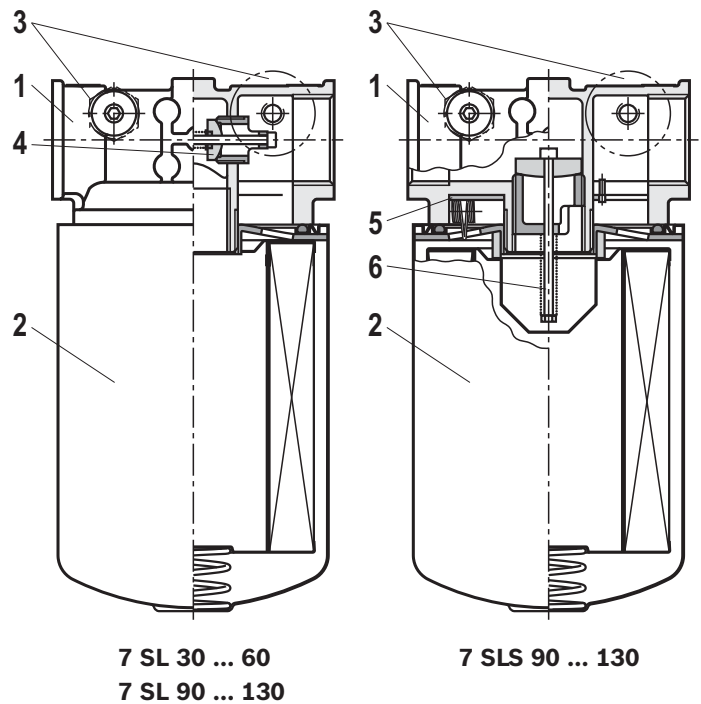
With the check valve (6) at the outlet - see supplementary information R - leakage is prevented from occurring on the clean side. (The filter is not suitable for installation in suction lines with this model.)

Maintenance indicator:

Special maintenance indicators are possible for the following applications:

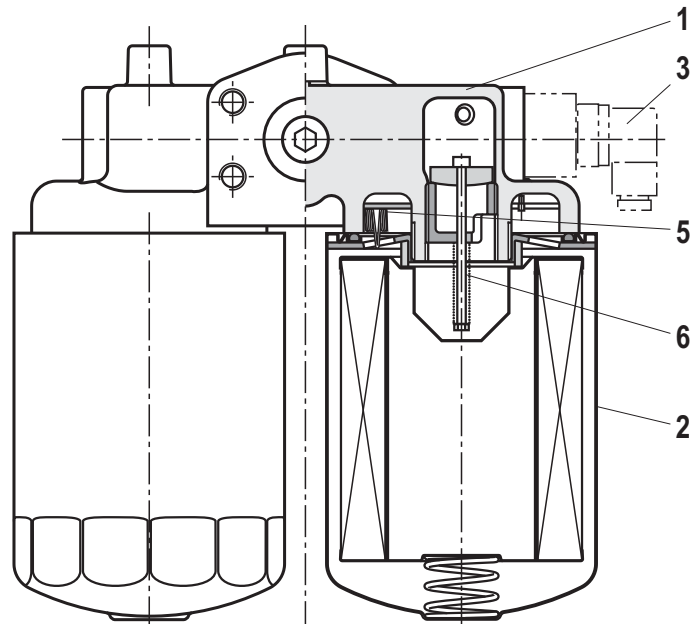
- Suction line: Vacuum meter or vacuum switch
- Return line: Pressure gauge or pressure switch
- Pressure line: Differential pressure switch

The location of the respective maintenance indicators is depicted in the chapter on "Dimensions".



7 SL 30 ... 60
7 SL 90 ... 130

7 SLS 90 ... 130




7 SLS 180 ... 260

Note:

If the maintenance indicator is ignored when a spin-on element change is required, there is the possibility the filter will go into bypass and contaminated oil will pass to the clean side of the filter outlet. Therefore the filtration effectiveness is no longer guaranteed. This means that some of the flow will enter unfiltered into the clean side of the filter. Effective filtration is no longer be guaranteed.

Technical data

(Please consult us for applications outside these parameters!)

General						
Installation position		Vertical				
Ambient temperature range	°C [°F]	-40 ... +65 [-40... +149]				
Storage conditions	▶ NBR seal	°C [°F]	-40 ... +65 [+14... +149]; max. relative air humidity of 65%			
Mass	▶ 7 SL	Size	30/21	45/21	60/21	
		kg [lbs]	0.8 [1.8]	0.9 [2.0]	1.1 [2.4]	
	▶ 7 SLS	Size	90	130	180	260
		kg [lbs]	1.6 [3.5]	1.9 [4.2]	3.0 [6.6]	3.2 [7.1]
		Size	90	130	180	260
		kg [lbs]	1.8 [4.0]	2.1 [4.6]	3.3 [7.3]	3.5 [7.7]
Volume	▶ 7 SL	Size	30/21	45/21	60/21	
		l [US gal]	0.5 [0.1]		1.2 [0.3]	
	▶ 7 SLS	Size	90	130	180	260
		l [US gal]	2.0 [0.5]	2.7 [0.7]	2x 2.0 [2x 0.5]	2x 2.7 [2x 0.7]
		Size	90	130	180	260
		l [US gal]	2.0 [0.5]	2.7 [0.7]	2x 2.0 [2x 0.5]	2x 2.7 [2x 0.7]
Material	▶ Filter head	Aluminum				
	▶ Spin-on element	Steel				
	▶ Maintenance indicator	Aluminum / steel / brass / plastic				
Hydraulics						
Max. operating pressure	bar [psi]	7 [101.5]				
Hydraulic fluid temperature range	°C [°F]	-10 ... +100 [+14... +212]				
 Note about cold start:		-40 ... -10 [-40...+14] During the cold start up, expect a sudden pressure increase and a flow of at least 50% in each case. A bypass valve is essential.				
Min. medium conductivity	pS/m	300				
Fatigue strength as per ISO 10771	Load cycles	> 10 ⁶ at max. operating pressure				

Technical data (Please consult us for applications outside these parameters!)

Maintenance indicator	Pressure gauge 0 ... 6 bar	Vacuum meter -1 ... +0.6 bar	Optical	Differential pressure indicator optical/electric	
Letter order option	A	C	D1.5	P1.5	
Model	M010	M070	P1.5000000M	F1.5GW0200M	
Contact load, direct voltage	-			0.25	
Voltage range				175 AC/DC	
Max. switching power				5	
Switching type				Changeover	
Protection class as per EN 60529				65	
Ambient temperature range	-10 ... +60 [°F] [+14 ... +140]	-10 ... +60 [°F] [+14 ... +140]	-10 ... +85 [°F] [+14 ... +185]	-10 ... +85 [°F] [+14 ... +185]	
Operating temperature	-10 ... +60 [°F] [+14 ... +140]	-10 ... +60 [°F] [+14 ... +140]	-10 ... +85 [°F] [+14 ... +185]	-10 ... +100 [°F] [+14 ... +212]	
Include spark extinguishing for DC voltage above 24 V to protect the switching contacts.					
Mass	kg [lbs]	0.06 [0.13]	0.05 [0.11]	0.02 [0.04]	0.3 [0.66]
Material	► Housing	Plastic/brass	Plastic/steel/ phosphor bronze	Aluminum / plastic/steel	Aluminum / plastic/brass
	► Seals	-	-	NBR	NBR

Maintenance indicator	Back pressure indicator electrical	Back pressure indicator electrical	Vacuum switch electrical	Vacuum switch electrical	
Letter order option	H1.5	J1.5	F0.2	G0.2	
Model	H1.5HS3200M	H1.5HA3200M	I0.2HS3200V	I0.2HA3200V	
Contact load, direct voltage	4				
Voltage range	42 AC				
Max. switching power	100				
Switching type	► 100% signal	Normally open contact	Normally closed contact	Normally open contact	Normally closed contact
Protection class as per EN 60529	IP	54			
Ambient temperature range	-10 ... +100 [°F] [+14 ... +212]	-20 ... +85 [°F] [-4 ... +185]	-10 ... +70 [°F] [14 ... +158]	-20 ... +70 [°F] [-4 ... +158]	
Operating temperature	-10 ... +100 [°F] [+14 ... +212]	-20 ... +100 [°F] [-4 ... +212]	-10 ... +100 [°F] [+14 ... +212]	-20 ... +100 [°F] [-4 ... +212]	
Include spark extinguishing for DC voltage above 24 V to protect the switching contacts.					
Mass	kg [lbs]	0.1 [0.22]	0.1 [0.22]	0.17 [0.37]	0.17 [0.37]
Material	► Housing	Steel	Steel	Brass	Brass
	► Seals	NBR	NBR	FKM	FKM

Technical data (Please consult us for applications outside these parameters!)

Filter element				
Glass fiber material H...XL			Inorganic fiber-based single-use element	
			Filtration ratio as per ISO 16889 up to $\Delta p = 5 \text{ bar}$ [72.5 psi]	Best oil cleanliness as per ISO 4406 [SAE-AS 4059]
Particle separation	H20XL		$\beta_{20}(c) \geq 200$	19/16/12 – 22/17/14
	H10XL		$\beta_{10}(c) \geq 200$	17/14/10 – 21/16/13
	H6XL		$\beta_6(c) \geq 200$	15/12/10 – 19/14/11
	H3XL		$\beta_5(c) \geq 200$	13/10/8 – 17/13/10
Permissible pressure differential	– S00	bar [psi]	5 [72.5]	

Compatibility with permitted hydraulic fluids

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oils	HLP	NBR	DIN 51524

Characteristic curves

(measured with mineral oil HLP46 according to DIN 51524)

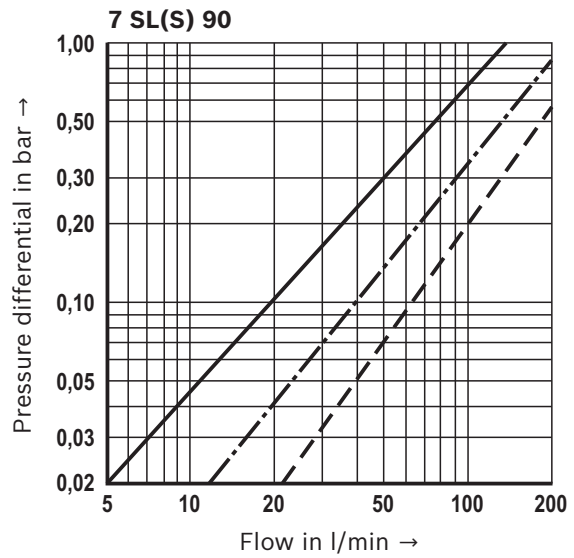
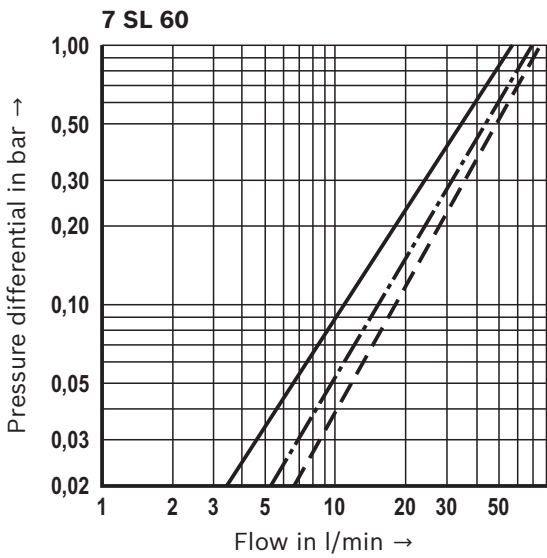
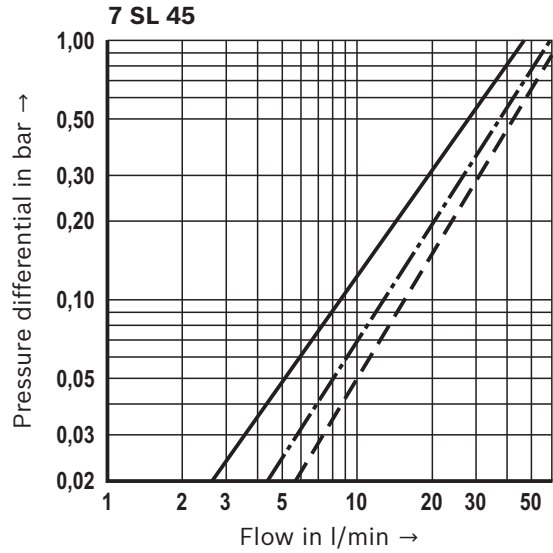
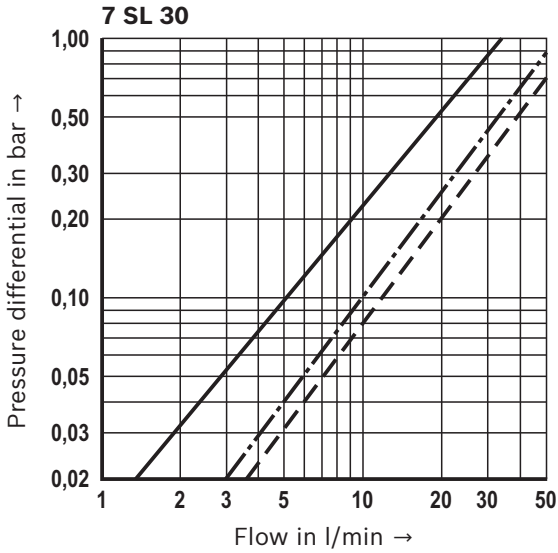
Spec. Weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filter

recommended start Δp for design = 0.5 bar [7.25 psi]

Our online design software “Bosch Rexroth FilterSelect” allows you to choose the best filter.

—— H3XL - . - . H10XL - - - P10



Characteristic curves

(measured with mineral oil HLP46 according to DIN 51524)

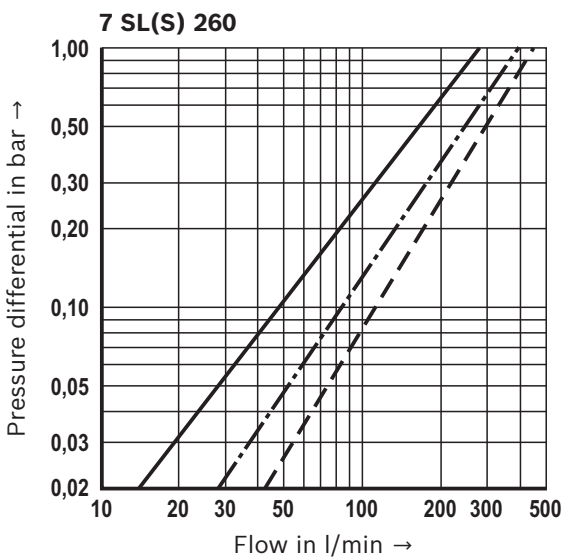
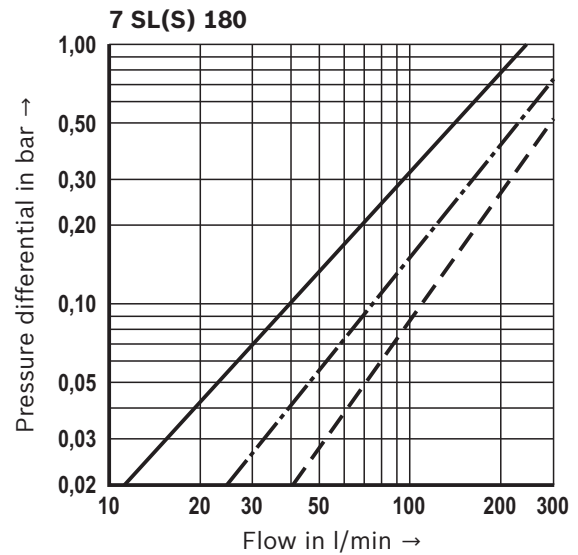
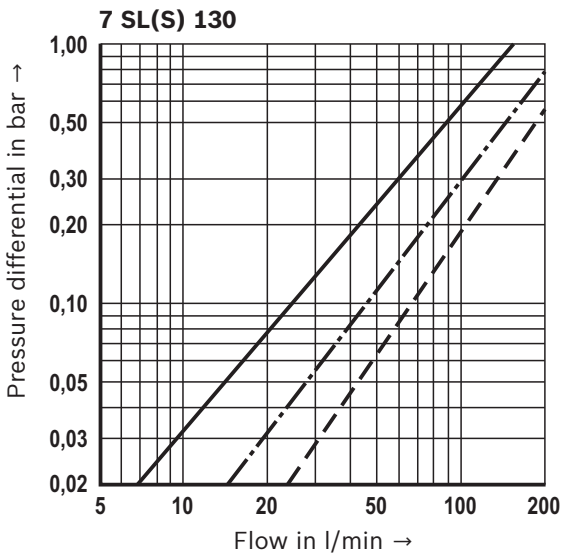
Spec. Weight: < 0.9 kg/dm³

Δp -Q characteristic curves for complete filter

recommended start Δp for design = 0.5 bar [7.25 psi]

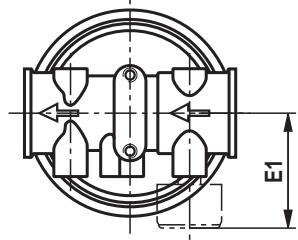
Our online design software "Bosch Rexroth FilterSelect" allows you to choose the best filter.

—— H3XL - . - . H10XL - - - P10

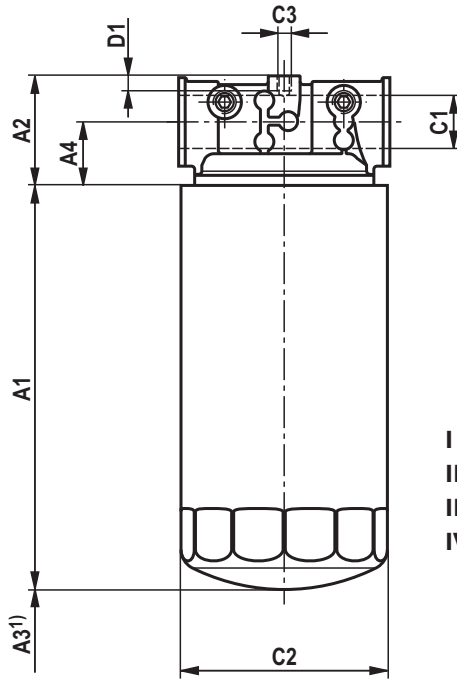


Dimensions: 7 SL 30 ... 60, 7 SL 90 ... 130, 7 SLS 90 ... 130
 (dimensions in mm [inch])

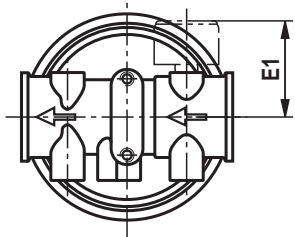
7 SL 30 ... 60
 7 SL 90 ... 130
 7 SLS 90 ... 130



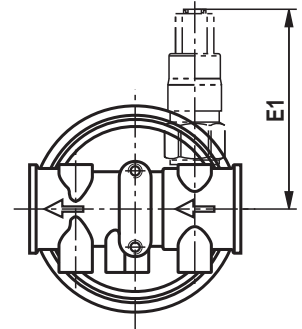
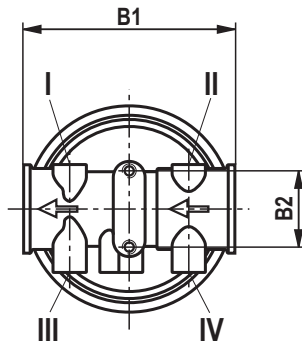
A = M010
 Pressure gauge for size 30 ... 60
 in port D



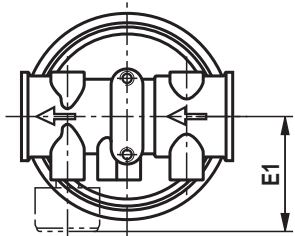
- I = Vacuum meter/vacuum switch**
 - II = Pressure gauge/pressure switch**
 - III = Vacuum meter/vacuum switch**
 - IV = Pressure gauge/pressure switch**
- (only with size 30 ... 60)



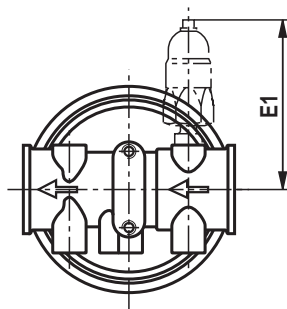
A = M010
 Pressure gauge for size 90 ... 130
 in port B



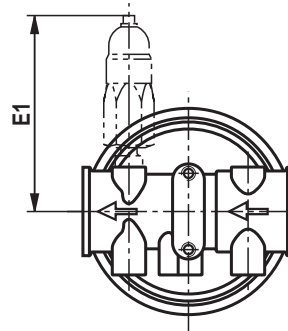
D1.5 = P1.5
 Back pressure indicator
 optical in port B



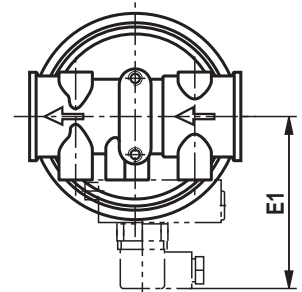
C = M070
 Vacuum meter
 in connection C



H1.5 = H1.5HS3200M
 Pressure switch normally
 open contact
J1.5 = H1.5HA3200M
 Pressure switch normally
 closed contact in port B



F0.2 = I0.2HS3200V
 Vacuum switch normally
 open contact
G0.2 = I0.2HA3200V
 vacuum switch normally
 closed contact in port A



P1.5 = P1.5GW0200M
 Pressure differential
 indicator optical-electr.,
 changeover with
 connector at flange
 connection

Dimensions: 7 SL 30 ... 60, 7 SL 90 ... 130, 7 SLS 90 ... 130
(dimensions in mm [inch])

Filter type	I	II	III	IV	WA flange connection
7 SL 30 ... 60	G1/8	G1/8	G1/8	G1/8	not possible
7 SL 90 ... 130	G1/8	G1/8	G1/8	-	optional

Filter type	A1	A2	A3 ¹⁾	A4	B1	B2	C1			ØC2	C3
							R...	S...	U...		
7 SL 30/21	95 [3.74]	41 [1.61]	20 [0.79]	20 [0.79]	95 [3.74]	38 [1.50]	G3/4	-	-	92 [3.62]	M8
7 SL 45/21	146 [5.75]										
7 SL 60/21	205 [8.07]										
7 SL 90	183 [7.20]	69 [2.72]		40 [1.57]	133 [5.24]	48 [1.89]	G1 1/4	-	1 5/8"-12 UN	128 [5.04]	
7 SL 130	231 [9.09]								-		
7 SLS 90	183 [7.20]			-							
7 SLS 130	231 [9.09]	-	-	-	-	-	-	-	-	M12	

Filter type	D1	E1 approx.								Connection spin-on element
		A	C	D1.5	F0.2	G0.2	H1.5	J1.5	P1.5	
7 SL 30/21	10 [0.39]	54	54	118	116	116	99	99	-	G3/4
7 SL 45/21		[2.13]	[2.13]	[4.65]	[4.57]	[4.57]	[3.90]	[3.90]	-	
7 SL 60/21										
7 SL 90	15 [0.59]	72	72	124	122	122	117	117	107	G1 1/4
7 SL 130		[2.83]	[2.83]	[4.88]	[4.80]	[4.80]	[4.61]	[4.61]	[4.21]	
7 SLS 90		-	70	-	120	120	-	-	-	M 42 x 2
7 SLS 130			[2.76]		[4.72]	[4.72]				

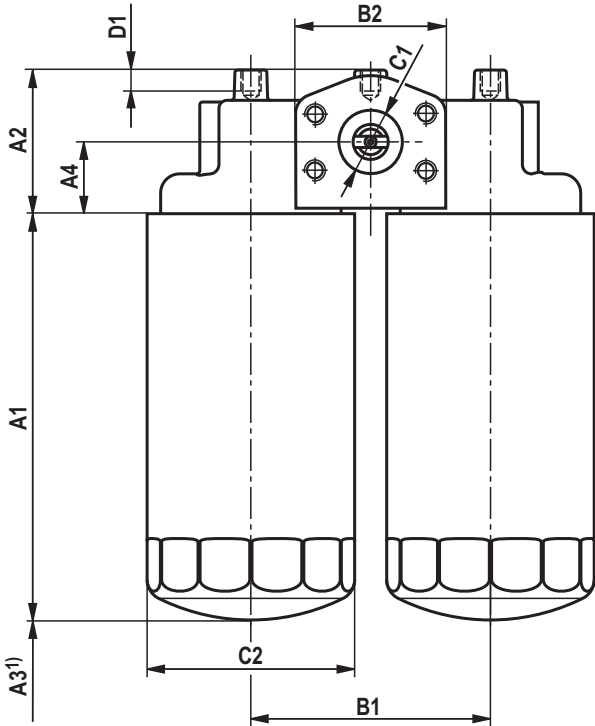
Filter type	Installation position - maintenance indicator								
	A	C	D1.5	F0.2	G0.2	H1.5	J1.5	P1.5	
	M010 Pressure gauge	M070 Vacuum meter	P1.5 Back pressure indicator	I0.2HS3200M Vacuum switch normally open contact	I0.2HA3200M Vacuum switch normally closed contact	H1.5HS3200M Pressure switch normally open contact	H1.5HA3200M Pressure switch nor- mally closed contact	F1.5GW0200M Differential pressure indicator optical-electr. with connector	
7 SL 30 ... 60	IV	III	II	I	I	II	II	-	
7 SL 90 ... 130	II	III	II	I	I	II	II	Flange connection	
7 SL 180 ... 260	II	-	II	-	-	II	II	Flange connection	
7 SLS 90 ... 130	-	III	-	I	I	-	-	-	
7 SLS 180 ... 260	II	-	II	-	-	II	II	Flange connection	

¹⁾ Servicing height for spin-on element

Dimensions: 7 SL 180 ... 260, 7 SLS 180 ... 260
(dimensions in mm [inch])

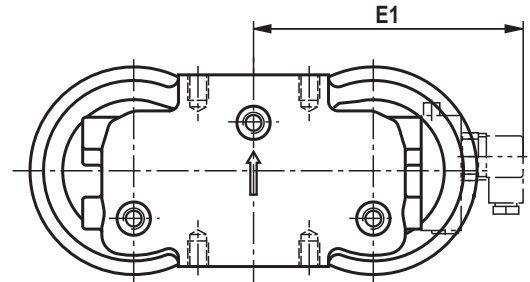
7 SL 180 ... 260

7 SLS 180 ... 260



Port for:

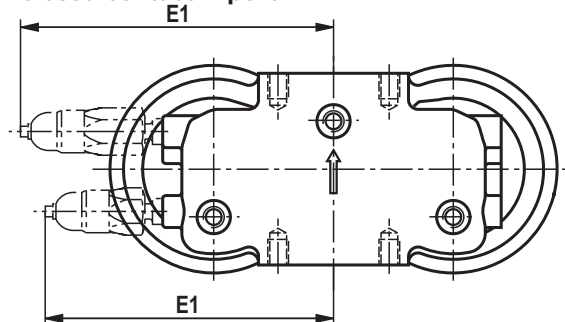
- I = Vacuum meter/vacuum switch
- II = Pressure gauge/pressure switch
- III = Differential pressure indicator



P1.5 = F1.5GW0200M

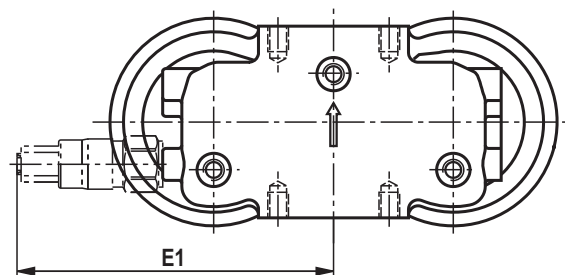
Pressure differential indicator optical/ electric with connector at flange connection

F0.2 = IO.2HS3200V, Vacuum switch normally open contact
G0.2 = IO.2HA3200V, Vacuum switch normally closed contact in port A

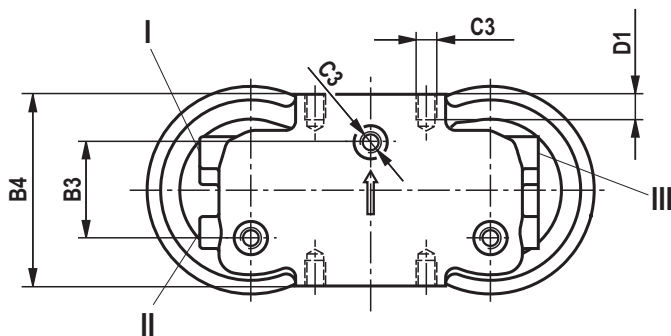


H1.5 = H1.5HS3200M, Pressure switch normally open contact

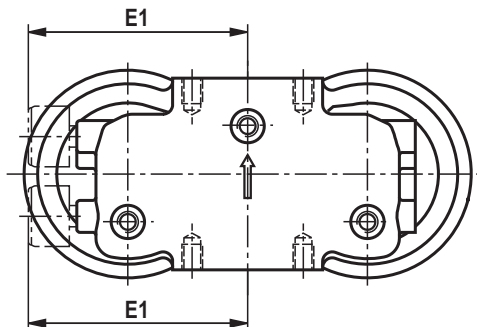
J1.5 = H1.5HA3200M Pressure switch normally closed contact in port B



D1.5 = P1.5, Back pressure indicator optical in port B



C = M070, Vacuum meter in port A



A = M010, Pressure gauge in port B

Dimensions: 7 SL 180 ... 260, 7 SLS 180 ... 260

(dimensions in mm [inch])

Filter type	I	II	III	WA flange connection
7 SL 180 ... 260	–	G1/8	–	possible
7 SLS 90 ... 130	G1/4	M14 x 1.5	G1/4	not possible
7 SLS 180 ... 260	–	G1/8	–	possible

Filter type	A1	A2	A3 ¹⁾	A4	B1	B2	B3	B4	R...	C1			ØC2	C3	
										S...	U...				
7 SL 180	183 [7.20]	90 [3.54]	20 [0.79]	44 [1.73]	150 [5.91]	94 [3.70]	60 [2.36]	120 [4.72]	G1 1/2	SAE 1 1/2"-3000psi			–	128 [5.04]	M12
7 SL 260	231 [9.09]			40 [1.57]						SAE1 1/4" - 3000 psi					
7 SLS 180	183 [7.20]	85 [3.35]	40 [1.57]	SAE1 1/2" - 3000 psi											
7 SLS 260	231 [9.09]														

Filter type	D1	E1 approx.								Connection spin-on element
		A	C	D1.5	F0.2	G0.2	H1.5	J1.5	P1.5	
7 SL 180	15 [0.59]	140 [5.51]	–	204 [8.03]	–	–	185 [7.28]	185 [7.28]	175 [6.89]	G1 1/4
7 SL 260										M 42 x 2
7 SLS 180										
7 SLS 260										

Filter type	Installation position - maintenance indicator								
	A	C	D1.5	F0.2	G0.2	H1.5	J1.5	P1.5	
	M010 Pressure gauge	M070 Vacuum meter	P1.5 Back pressure indicator	I0.2HS3200M Vacuum switch normally open contact	I0.2HA3200M Vacuum switch normally closed contact	H1.5HS3200M Pressure switch normally open contact	H1.5HA3200M Pressure switch normally closed contact	F1.5GW0200M Differential pressure indicator optical-electr. with connector	
7 SL 180 ... 260	II	–	II	–	–	II	II		Flange connection
7 SLS 90 ... 130	–	III	–	I	I	–	–		–
7 SLS 180 ... 260	II	–	II	–	–	II	II		Flange connection

¹⁾ Servicing height for spin-on element

Spare parts ordering codes

Spin-on element

01	02	03	04	05	06
			- S00	- 0	- M

Design

01	7 SL 30/20 ... 130	80
	7 SLS 90 ... 130	81

Size

02	7 SL... for 7 SL 180, 2 spin-on elements 80.90 are required for 7 SL 260, 2 spin-on elements 80.130 are required	30/21 45/21 60/21 90 130
	7 SLS... for 7 SLS 180, 2 spin-on elements 81.90 are required for 7 SLS 260, 2 spin-on elements 80.130 are required	90 130

Filter rating in μm

03	Absolute Glass fiber material, not cleanable (ISO 16889; $\beta_x(c) \geq 200$)	H3XL H6XL H10XL H20XL
	Nominal Paper, not cleanable	P10 P25

Pressure differential

04	Max. admissible pressure differential of the filter element of 5 bar [72 psi]	S00
----	---	-----

Bypass valve

05	Without bypass valve	0
----	----------------------	---

Seal

06	NBR	M
----	-----	---

Order example:

80.45/21 P10-S00-0-M

Maintenance indicator

Description	Material no.
M010 ¹⁾	R928019224 (without seal)
M070	R928025266 (without seal)
P1.5000000M	R928019225
H1.5HS3200M	R928019219
H1.5HA3200M	R928019205
I0.2HS3200V	R928035839
I0.2HA3200V	R928037068
F1.5GW0200M	R928019336

¹⁾ When using a pressure gauge, the maximum admissible operating pressure is reduced to 6 bar [87 psi].

Installation, commissioning, maintenance

Installation

- ▶ The max. operating pressure of the system cannot exceed the max. admissible operating pressure of the filter (see name plate).
- ▶ During assembly of the filter the flow direction (direction arrows) and the required servicing height of the spin-on element (see chapter "Dimensions") are to be considered.
- ▶ Cartridge replacement is made easiest when the spin-on element is oriented downward with the installation position.
- ▶ The maintenance indicator must be arranged so it is easily viewed in operation.
- ▶ Remove the plastic plugs from the filter inlet and outlet.
- ▶ The connection of the electrical maintenance indicator is via a mating connector that is attached to the maintenance indicator contacts and held by a screw or, in the cases of versions H, J, F and G, it is laid directly onto the contacts using a rubber bushing.

Commissioning

- ▶ Commission the system.

Note:

The filter has no bleeding mechanism.

Maintenance

- ▶ If at operating temperature, the red indicator pin reaches out of the mechanical optical maintenance indicator or if the switching process in the electronic switching element is triggered, the spin-on element is dirty and needs to be replaced.

Note:

Sizes 180 and 260 have two spin-on elements, through which fluid flows at the same time and which need to be replaced during maintenance.

- ▶ The material number of the correct spin-on element is on the name plate of the filter assembly. Verify that it matches the material number on the spin-on element.
- ▶ Decommission the system.
- ▶ Release operating pressure on the system side.

Note:

The filter has no bleeding mechanism.

- ▶ Unscrew the spin-on element.

Note:

Sizes 180 and 260 have two spin-on elements, through which fluid flows at the same time and which need to be replaced during maintenance.

- ▶ Screw on the new spin-on element hand-tight.

Please note:

If necessary, carefully tighten it in the depressurized state (use a band wrench if necessary)

- ▶ Commission the system.
- ▶ If filter loosens between the spin-on element and filter head after commissioning, the spin-on element will need to be tightened up.

WARNING!

- | | |
|---|---|
| <ul style="list-style-type: none"> ▶ Only install or remove when system is not pressurized. ▶ Tank is pressurized! ▶ Only remove spin-on element when it is not pressurized. ▶ Do not replace maintenance indicator when filter is pressurized. | <ul style="list-style-type: none"> ▶ Failure to observe flow of direction during assembly will cause filter element to be damaged beyond repair. Particles will enter the system and damage downstream components. |
|---|---|

Important:

- ▶ Only trained specialists may work on the filter.
- ▶ Proper function and safety are only guaranteed if original Bosch Rexroth spin-on elements and spare parts are used.
- ▶ Warranty becomes void if the delivered item is changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental condition that do not comply with the installation conditions.

Tightening torques

(dimensions in mm [inch])

Series 7 SL...	30/21	45/21	60/21	90	130	180	260
Tightening screws with $\mu_{\text{total}} = 0.14$ Nm [lbf-ft]	Max. 6 [4.4]			Max. 10 [7.4]		Max. 20 [14.8]	
Mounting screw	2 x M8					3 x M12	
Minimum screw-in depth mounting	8 [0.31]			12 [0.47]		10 [0.39]	

Series 7 SLS...	90	130	180	260
Tightening screws with $\mu_{\text{total}} = 0.14$ Nm [lbf-ft]	Max. 10 [7.4]		Max. 20 [14.8]	
Mounting screw	2 x M8		2 x M12	
Minimum screw-in depth mounting	12 [0.47]		10 [0.39]	

Maintenance indicators

Type	M010	M070	P1.5000000M	F1.5GW0200M	H1.5HS3200M	H1.5HA3200M	I0.2HS3200V	I0.2HA3200V
Screw/tightening torque with $\mu_{\text{total}} = 0.14$ Nm [lbf-ft]	conically sealing / no information possible		Max. 20 [14.8]		Max. 40 [29.5]		Max. 20 [14.8]	
Quantity	-		4		-			

Directives and standardization

Classification according to the Pressure Equipment Directive

The spin-on filters for hydraulic applications according to 51426 are pressure holding equipment according to article 1, section 2.1.4 of the Pressure Equipment Directive 97/23/EC (PED). However, under Article 1 Section 3.6 PED, hydraulic filters are exempt from the PED

if they are not classified higher than Category I (Guideline 1/19).

The fluids from the chapter “Compatibility with approved pressure fluids” were considered for the classification. They do not receive a CE mark.

Use in explosive areas according to Directive 94/9/EC (ATEX)

The spin-on filters without maintenance indicator or with a mechanical-optical maintenance indicator according to 51426 are not equipment or components in the sense of directive 94/9/EC and are not provided with a CE mark. The ignition risk analysis showed that these spin-on filters do not have their own ignition sources as per DIN EN 13463-1:2009.

Spin-on filters and the mechanical-optical maintenance indicators described here can be used in the following explosive areas:

	Zone suitability	
	1	2
Gas	1	2
Dust	21	22

Complete filter with mech./opt. Maintenance indicator, pressure gauge, vacuum meter				
Use/assignment			Gas 2G	Dust 2D
Assignment			Ex II 2G c IIC TX	Ex II 2D c IIC TX
Medium conductivity	pS/m	min.	300	
Dust accumulation		max.	–	0.5 mm

WARNING!

- ▶ Explosion hazard due to high temperature! Temperature is based on temperature of medium in hydraulic circuit and cannot exceed this value. Take steps to make sure max. admissible ignition temperature is not exceeded in explosive area.
- ▶ When using the spin-on filters according to 51426 in explosive areas, sufficient equipotential bonding has to be ensured. Grounding the filter with mounting screws is recommended. It has to be noted in this connection that paintings and oxidic protective layers are not electrically conductive.
- ▶ During spin-on filter replacement, the packaging material is to be removed from the replacement element outside the potentially explosive area.

Important:

- ▶ Maintenance may only be performed by specialists on instruction of the owner in accordance with Directive 1999/92/EC Annex II Section 1.1.
- ▶ Functional and safety warranty is only applicable when using original Rexroth spare parts

Notes

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The data specified above only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. This information also does not release the user from exercising his/her own judgment and conducting his/her own testing. Our products are subject to a natural process of wear and aging.

Spin-on elements

Type 80, 81 and 82

RE 51478

Edition: 2015-06



- ▶ Sizes according to **according to Bosch Rexroth standard:** 30 to 130
- ▶ Pressure differential resistance up to 5 bar [72.5 psi]
- ▶ Filter rating: 1 to 20 µm
- ▶ Filter area: max. 3820 cm² [592 in²]

Features

- ▶ Filter media made of glass fiber material and filter paper
- ▶ Diverse connection threads available in many different versions and pressure ratings
- ▶ Max. oil cleanliness up to ISO 13/10/8 (ISO 4406)
- ▶ Large filter area in small installation area
- ▶ With bypass valve upon request
- ▶ Other models upon request

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Ordering code

Spin-on elements

Type 80.

01	02	03	04	05	06
80			- S00 -		

Spin-on element

01	Design	80
----	--------	----

Size

02	According to Bosch Rexroth standard	Size	Connection thread	
		30	3/4"-16 UNF	30/20
		45	3/4"-16 UNF	45/20
		45	G3/4	45/21
		60	1"-12 UNF	60/20
		60	G3/4	60/21
		90	G1 1/4	90
		130	G1 1/4	130

Filtration rating in μm

03	Absolute (ISO 16889; $\beta_x(c) \geq 200$)	Glass fiber material (not cleanable)	H3XL H6XL H10XL H20XL
	Nominal	Filter paper (not cleanable)	P10 P25

Pressure differential

04	Max. pressure differential of the spin-on element of 5 bar [72.5 psi]	S00
----	---	-----

Bypass valve

05	Without bypass valve	0
	With bypass valve – release pressure 0.3 bar [4.4 psi]	1
	With bypass valve – release pressure 2.0 bar [29.0 psi]	4
	With bypass valve – release pressure 2.5 bar [36.3 psi]	5

Seal

06	NBR seal	M
	FKM seal	V

Order example:

80.90 H10XL-S00-0-M

Material no.: R928016614

Ordering code Spin-on elements

Type 81.

01	02	03	04	05	06			
81			-	S00	-	0	-	

Spin-on element

01	Design	81
----	--------	-----------

Size

02	According to Bosch Rexroth standard	90 130
----	--	-------------------------

Filtration rating in μm

03	Absolute (ISO 16889; $\beta_x(c) \geq 200$)	Glass fiber material (not cleanable)	H3XL H6XL H10XL H20XL
	Nominal	Filter paper (not cleanable)	P10 P25

Pressure differential

04	Max. pressure differential of the spin-on element of 5 bar [72.5 psi]	S00
----	---	------------

Bypass valve

05	Without bypass valve	0
----	-----------------------------	----------

Seal

06	NBR seal	M
	FKM seal	V

Order example:

81.90 H10XL-S00-0-M

Material no.: R928035941

Ordering code

Spin-on elements

Type 82.

01	02	03	04	05	06
82			- S00	- 0	-

Spin-on element

01	Design	82
----	--------	----

Size

02	According to Bosch Rexroth Standard design with UNF thread	30 45 50 60 80
	According to Bosch Rexroth Standard design with UN thread	30D 45D 50D 60D 80D

Filtration rating in μm

03	Absolute (ISO 16889; $\beta_x(c) \geq 200$)	Glass fiber material (not cleanable)	H3XL H6XL H10XL H20XL
		Glass fiber material (not cleanable)	H10
	Nominal	Filter paper (not cleanable)	P10 P25

Pressure differential

04	Max. pressure differential of the spin-on element of 5 bar [72.5 psi]	S00
----	---	-----

Bypass valve

05	Without bypass valve	0
	With bypass valve – release pressure 2.0 bar [29.0 psi]	4
	With bypass valve – release pressure 2.5 bar [36.3 psi]	5

Seal

06	NBR seal	M
	FKM seal	V

Order example:

82.45 H10XL-S00-0-M

Material no.: R928019444

Preferred types

Spin-on element type 80, NBR seal

Type	Material no. Spin-on element, filter rating in μm	
	H10XL	P10
80.30/20 ...-S00-0-M	R928054793	R928054792
80.45/20 ...-S00-0-M	R928019736	R928022583
80.45/21 ...-S00-0-M	R928016611	R928016609
80.60/20 ...-S00-0-M	R928019738	R928038378
80.60/21 ...-S00-0-M	R928018950	R928018951
80.90 ...-S00-0-M	R928016614	R928016612
80,130 ...-S00-0-M	R928016617	R928016615

Spin-on element type 81, NBR seal

Type	Material no. Spin-on element, filter rating in μm	
	H10XL	P10
81.90 ...-S00-0-M	R928035941	R928025526
81,130 ...-S00-0-M	R928035943	R928025391

Spin-on element type 82, NBR seal

Type	Material no. Spin-on element, filter rating in μm	
	H10XL	P10
82.30 ...-S00-0-M	R928038865	R928046556
82.45 ...-S00-0-M	R928019444	R928025436
82.50 ...-S00-0-M	R928046564	R928046566
82.60 ...-S00-0-M	R928019719	R928046571
82.80 ...-S00-0-M	R928054791	R928054790

Assignment of spin-on elements to filter series

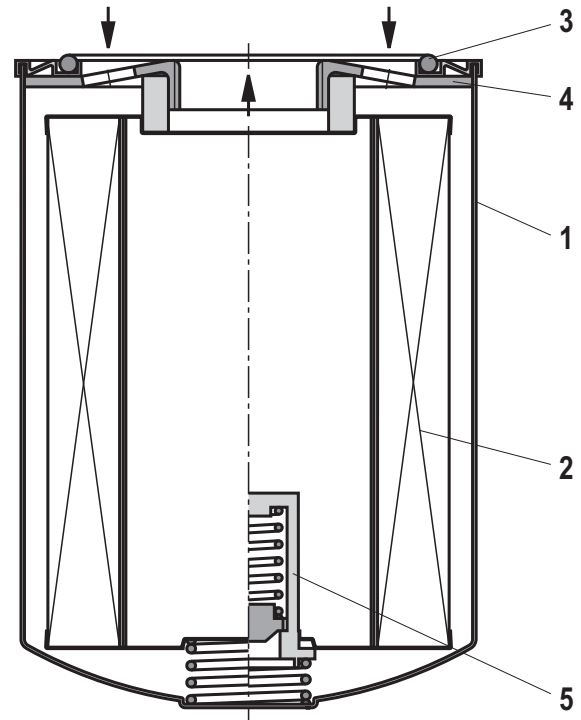
Spin-on element (type)	Series	Application	Data sheet no. ¹⁾
80	7 SL	Spin-on filter	51426
Spin-on element (type)	Series	Application	Data sheet no. ¹⁾
81	7 SLS	Spin-on filter with check valve	51426
Spin-on element (type)	Series	Application	Data sheet no. ¹⁾
82	50 SL	Spin-on filter	51476

¹⁾ For further information, please refer to the respective data sheet

Function, cross-section

80 and 81 Spin-on elements

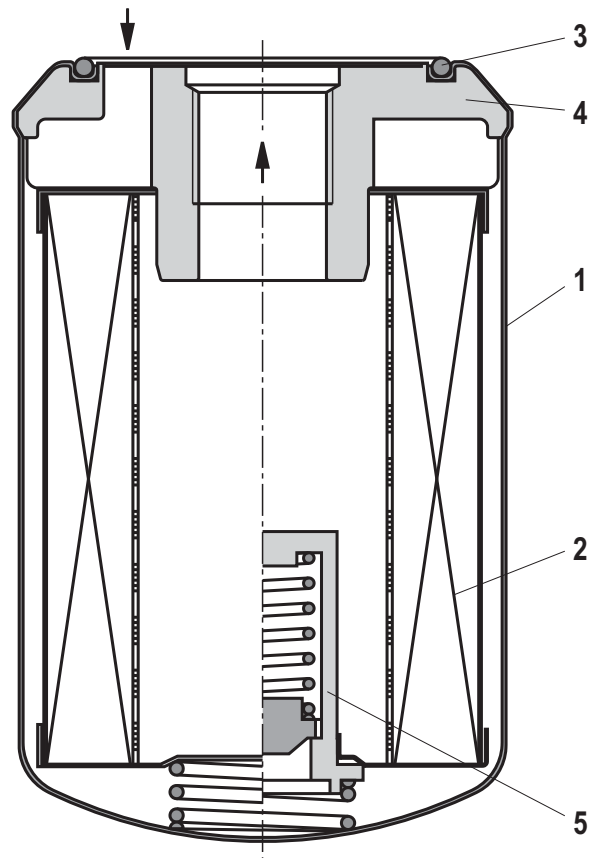
Essentially, the spin-on element consists of a filter bowl (1), a filter element (2), a seal (3), a threaded mounting plate (4) incl. connection thread and an optional bypass valve (5). Operating pressure max. 7 bar [101.5 psi]. The actual filtration process takes part in the filter element. The main filter variables, such as retention capacity, dirt holding capacity and pressure loss, are determined by the filter elements and the filter media used to construct them. The flow is generally from outside to inside.



Spin-on element 80 / 81

82 Spin-on elements

Essentially, the spin-on element consists of a filter bowl (1), a filter element (2), a seal (3), a threaded mounting piece (4) incl. connection thread and an optional bypass valve (5). Operating pressure max. 40 bar [580 psi]. The actual filtration process takes part in the filter element. The main filter variables, such as retention capacity, dirt holding capacity and pressure loss, are determined by the filter elements and the filter media used to construct them. The flow is generally from outside to inside.



Spin-on element 82

Filter variables

Filter rating and attainable oil cleanliness

The main goal when using industrial filters is not only the direct protection of machine components but to attain the required oil cleanliness. Oil cleanliness is defined on the

basis of oil cleanliness classes which classify how the amount of particles of the existing contamination is distributed in the operating liquid.

Filtration performance

Filtration ratio $\beta_{x(c)}$ (β value)

The retention capacity of hydraulic filters against contamination in a hydraulic system is characterized by the filtration ratio $\beta_{x(c)}$. This variable is the most important performance characteristic of a hydraulic filter. It is measured in the multipass test, and is the average value of the specified initial and final pressure differential according to ISO 16889 using ISOMTD test dust.

The filtration ratio $\beta_{x(c)}$ is defined as the ratio of the particle count of the respective particle size on both sides of the filter.

Dirt holding capacity

It is also measured using the multipass test and determines the amount of test dust ISOMTD which is fed to the filter medium until a specified pressure differential increase has been reached.

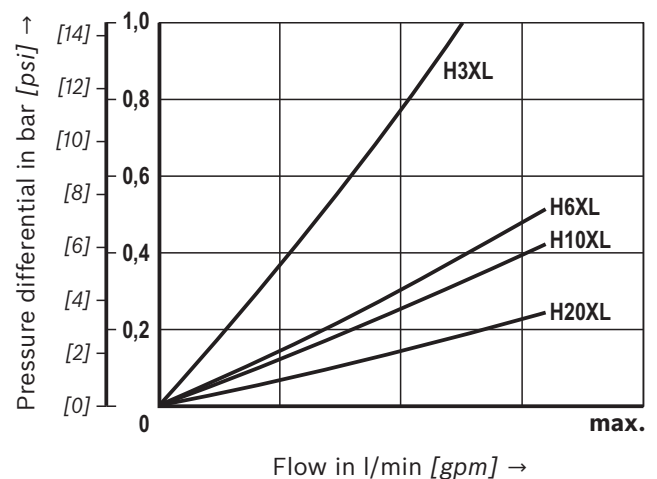
Pressure loss (also pressure differential or delta p)

The pressure loss of the spin-on element is the relevant characteristic value for the determination of the filter size. Here it concerns the filter manufacturer's recommendations or the filter user's specifications. This characteristic value depends on many factors. These are mainly: the rating of the filter medium, its geometry and arrangement in the filter element, the filter area, the operating viscosity of the fluid and the flow.

The term "delta p" is often also expressed with the symbol: " Δp ".

When sizing the complete filter with a spin-on element, an initial pressure loss is determined which must not be exceeded by the new spin-on element based on the aforementioned conditions.

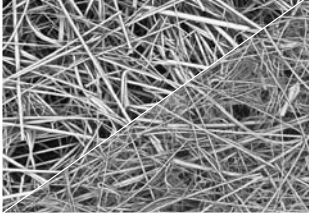
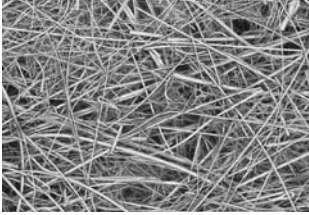
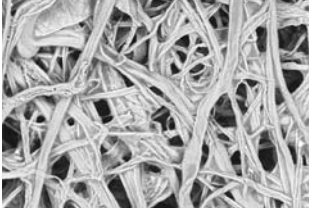
The following diagram shows the typical pressure loss behavior of spin-on elements with different material ratings at different flow rates.



Filter variables


Overview

For the separation of particles different filter media in various ratings are used according to application and requirement.

Filter medium/set-up	electron microscope image
<p>H...XL, Glass fiber material Depth filter, combination of inorganic micro glass filter medium. High dirt holding capacity due to multi-layer technology.</p>	
<p>H..., glass fiber material Depth filter, combination of inorganic micro glass filter medium. Single-layer constructed variant of H... XL.</p>	
<p>P..., Filter paper Inexpensive depth filter made of filter paper with supporting tissue. Made of specially coated cellulose fiber preventing humidity and swelling.</p>	

Technical data preferred program

(for applications outside these parameters, please consult us!)

General				
Ambient temperature range	°C [°F]	-40 ... +65 [-40 ... +149]		
Storage conditions	▶ NBR seal	°C [°F] -40 ... +65 [-40 ... +149]; max. relative air humidity: 65%		
	▶ FKM seal	°C [°F] -20 ... +65 [-4 ... +149]; max. relative air humidity: 65%		
Weight 80 Spin-on elements ¹⁾	Size	30/20	45/20	45/21
	kg	0.7	0.7	0.7
	[lbs]	[1.5]	[1.5]	[1.5]
	Size	60/21	90	130
Weight 81 Spin-on elements ¹⁾	kg	1.4		1.5
	[lbs]	[3.09]		[3.31]
Weight 82 Spin-on elements ¹⁾	Size	30 (D)	45 (D)	50 (D)
	kg	0.7	0.7	0.7
	[lbs]	[1.5]	[1.5]	[1.5]
	Size	60 (D)	80 (D)	
Material 80 and 81 Spin-on elements	▶ Threaded mounting plate	Galvanized steel		
	▶ Filter element base/cover	Tin-coated steel		
	▶ Support tube	Galvanized steel		
	▶ Filter bowl	Galvanized steel		
	▶ Seals	NBR or FKM		
Material 82 Spin-on elements	▶ Threaded mounting piece	Aluminum		
	▶ Filter element base/cover	Tin-coated steel		
	▶ Support tube	Galvanized steel		
	▶ Filter bowl	Galvanized steel		
	▶ Seals	NBR or FKM		
Hydraulics				
Max. operating pressure	▶ 80 and 81	bar [psi]	7 [101.5]	
	▶ 82	bar [psi]	40 [580] ²⁾	
Hydraulic fluid temperature range	°C [°F]	-10 ... +100 [+14 ... +212]		
 Note to cold start:		-40 ... -10 [-40 ... +14] A reduction of pressure as well as flow rate, each a min. of 50% must be taken into account during a cold startup. A bypass valve is essential.		
Min. medium conductivity	pS/m	300		
Filtration direction		From the outside to the inside		
Fatigue strength as per ISO 10771	Load cycles	44,500 with max. operating pressure		

¹⁾ Weights are based on glass fiber material.

²⁾ Validation according to ISO 10779

Operating temperature range, depending on the material combination

Material	Code letter	Operating temperature range °C [°F]
Seal		
NBR	M	-40 ... +100 [-40 ... +212]
FKM	V	-20 ... +210 [-4 ... +410]

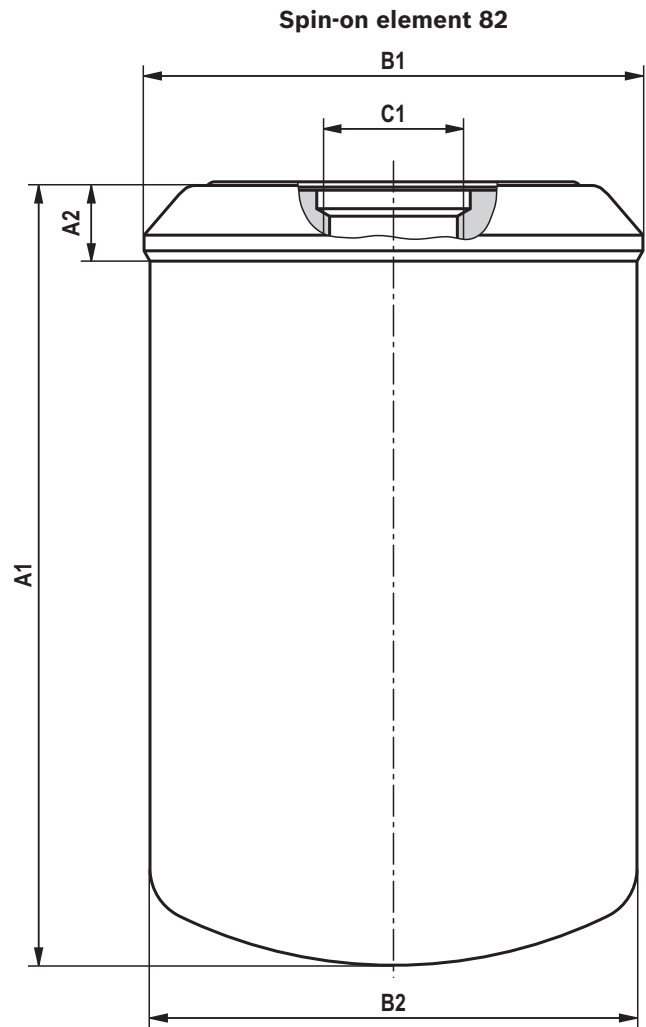
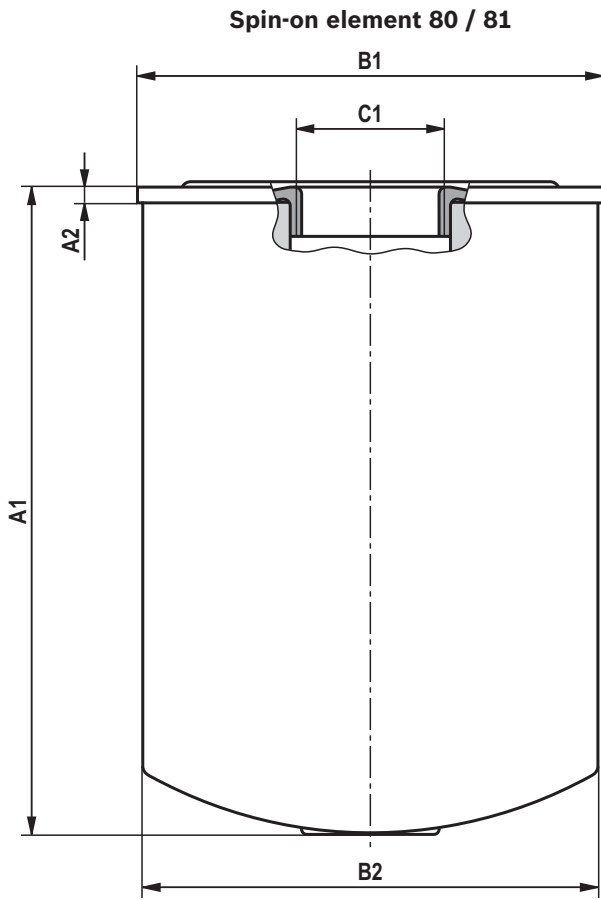
Compatibility with permitted hydraulic fluids

Hydraulic fluid	Classification	Suitable sealing materials	Standards
Mineral oil	HLP	NBR	DIN 51524

Important information on hydraulic fluids:

For more information and data on the use of other hydraulic fluids, please refer to data sheet 90220 or contact us.

Dimensions: Spin-on element 80 / 81, 82
(dimensions in mm [in])

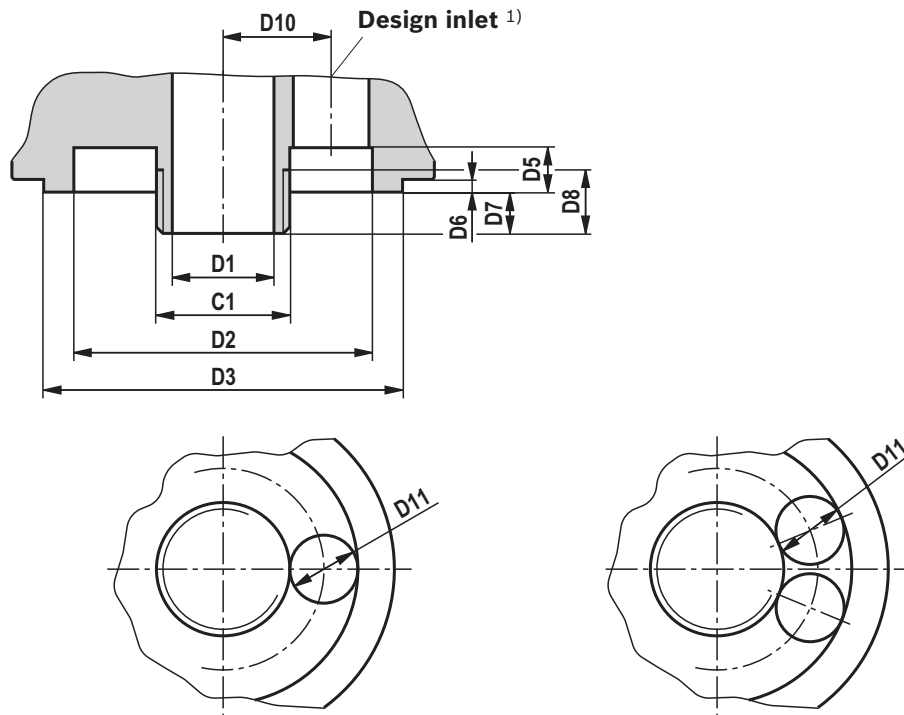


Type	A1	A2	ØB1	ØB2	C1
80.30/20	95 [3.74]	3 [0.12]	93 [3.66]	92 [3.62]	3/4"-16 UNF
80.45/20	145.5 [5.73]				3/4"-16 UNF
80.45/21					G3/4
80.60/20	205 [8.07]				1"-12 UNF
80.60/21					G3/4
80.90	182.5 [7.19]	4.5 [0.18]	129 [5.08]	128 [5.04]	G1 1/4
80,130	230.5 [9.07]				
81.90	182.5 [7.19]	4.5 [0.18]	129 [5.08]	128 [5.04]	M42x2
81,130	230.5 [9.07]				

Type	A1	A2	ØB1	ØB2	C1
82.30	110 [4.33]	14 [0.55]	94.3 [3.71]	92 [3.62]	1"-12 UNF
82.30D					1 3/8"-12 UN
82.45	1"-12 UNF				
82.45D	1 3/8"-12 UN				
82.50	172 [6.77]				1"-12 UNF
82.50D		1 3/8"-12 UN			
82.60	212 [8.35]	1"-12 UNF			
82.60D			1 3/8"-12 UN		
82.80	237 [9.33]	1"-12 UNF			
82.80D		1 3/8"-12 UN			

Installation station: Spin-on element 80 / 81

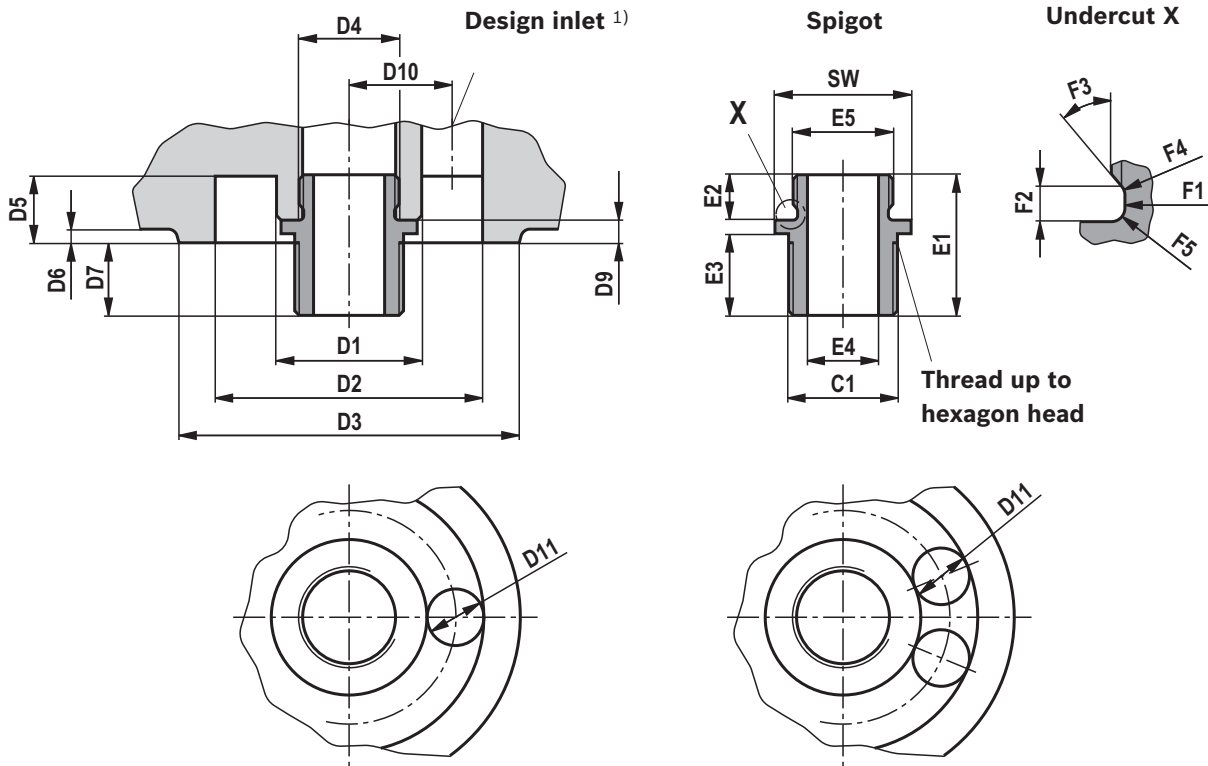
(dimensions in mm [in])



Type	C1	ØD1	ØD2	ØD3	D5	D6	D7	D8	D10	ØD11
80.30/20	3/4"-16 UNF	13 [0.51]	59 [2.32]	75 [2.95]	2 [0.08]	2 [0.08]	16 [0.63]	15.5 [0.61]	67 [2.64]	max. 8 [0.31]
80.45/20	3/4"-16 UNF									
80.45/21	G3/4									
80.60/20	1"-12 UNF									
80.60/21	G3/4									
80.90	G1 1/4	32 [1.26]	95 [3.74]	113 [4.45]	14 [0.55]	12 [0.47]	13 [0.51]	20 [0.79]	104 [4.09]	max. 9 [0.35]
80,130			94 [3.70]						103.5 [4.07]	
81.90	M42x2	32 [1.26]	94 [3.70]	113 [4.45]	14 [0.55]	12 [0.47]	13 [0.51]	20 [0.79]	103.5 [4.07]	
81,130									103.5 [4.07]	

¹⁾ Cross section inlet must correspond approx. to cross section inlet "E4", therefore, one or two holes with a maximum diameter of "D11" depending on the flow, flow velocity < 3 m/s in the inlet.

Installation station: Spin-on element 82
(dimensions in mm [in])

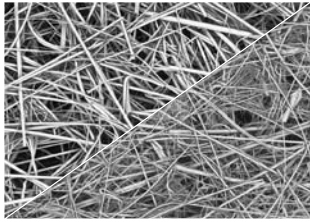


Type	ØD1	ØD2	ØD3	D4	D5	D6	D7	D9	D10	ØD11
82.30	34 [1.34]	59 [2.32]	75 [2.95]	M22x1.5	6.5 [0.26]	4 [0.16]	16 [0.63]	5 [0.20]	67 [2.64]	max. 8 [0.31]
82.30D										
82.45										
82.45D										
82.50										
82.50D										
82.60										
82.60D										
82.80										
82.80D										

Type	E1	E2	E3	ØE4	E5	SW	ØF1	F2	F3	F4	F5
82.30	31 [1.22]	10 [0.39]	18 [0.71]	16 [0.63]	M22x1.5	30 [1.18]	20 [0.79]	2.5 [0.10]	40°	R1	R1
82.30D	35 [1.38]		25 [0.98]								
82.45			18 [0.71]								
82.45D	25 [0.98]										
82.50											
82.50D	35 [1.38]										
82.60											
82.60D	35 [1.38]										
82.80											
82.80D	35 [1.38]										

1) Cross section inlet must correspond approx. to cross section outlet "E4", therefore, one or two holes with a maximum diameter of "D11" depending on the flow, provide flow velocity < 3 m/s in the inlet.

Filter media

Technical data	H...XL
<p>Glass fiber material, H...XL</p> <p>The filter medium achieves the best possible degree of purity compared to other filter media. It is suitable for fluids such as hydraulic oils, lubricants, chemical and industrial liquids. Due to its designed retention capacity (ISO 16889), it offers therefore highly effective protection for machine and system components which are sensitive to contamination.</p> <ul style="list-style-type: none"> ▶ H...XL depth filter made of inorganic glass fiber material ▶ Absolute filtration/defined retention capacity according to ISO 16889 ▶ High dirt holding capacity due to multi-layer set-up ▶ Non-reusable filter (not cleanable due to the depth filtration effect) 	
<p>Filter rating and attainable oil cleanliness</p> <p>The following table provides recommendations for the selection of a filter medium in dependency of the application and indicates the average oil cleanliness class attainable according to ISO 4406 or SAE-AS 4059.</p>	

glass fiber material

oil cleanliness class ISO 4406	to be achieved with filter			Hydraulic system
	$\beta_{x(c)} = 200$	Material	Possible arrangement	
13/10/8 - 17/13/10	3 μm	Glass fiber material H...XL	Return flow filter or pressure filter	----- Servo valves
15/12/10 - 19/14/11	6 μm			----- High-response valves
17/14/10 - 21/16/13	10 μm			--- Proportional valves
19/16/12 - 22/17/14	20 μm			- General pumps and valves

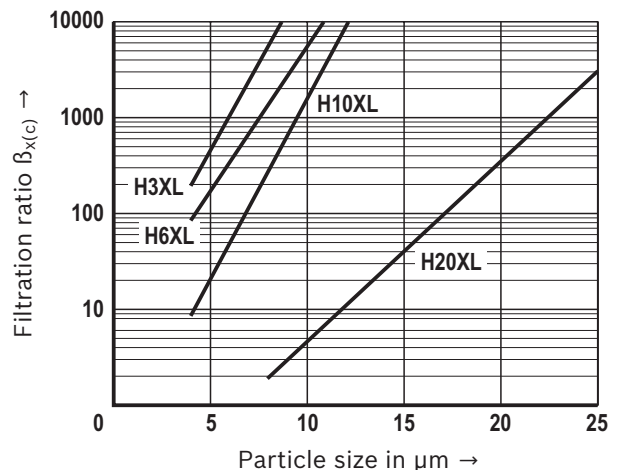
Achievable filtration ratio $\beta_{x(c)}$ (β value)

Typical β values up to 2.2 bar [31.9 psi] Δp pressure increase at the filter element ¹⁾

Filter medium	Particle size "x" for different β values, measurement according to ISO 16889		
	$\beta_{x(c)} \geq 75$	$\beta_{x(c)} \geq 200$	$\beta_{x(c)} \geq 1000$
H3XL	4.0 $\mu\text{m}(c)$	< 4.5 $\mu\text{m}(c)$	5.0 $\mu\text{m}(c)$
H6XL	4.8 $\mu\text{m}(c)$	5.5 $\mu\text{m}(c)$	7.5 $\mu\text{m}(c)$
H10XL	6.5 $\mu\text{m}(c)$	7.5 $\mu\text{m}(c)$	9.5 $\mu\text{m}(c)$
H20XL	18.5 $\mu\text{m}(c)$	20.0 $\mu\text{m}(c)$	22.0 $\mu\text{m}(c)$

¹⁾ Filtration ratio $\beta_{x(c)}$ for other filter media upon request

Filtration ratio $\beta_{x(c)}$ as a function of the particle size $\mu\text{m}(c)$





Filter media

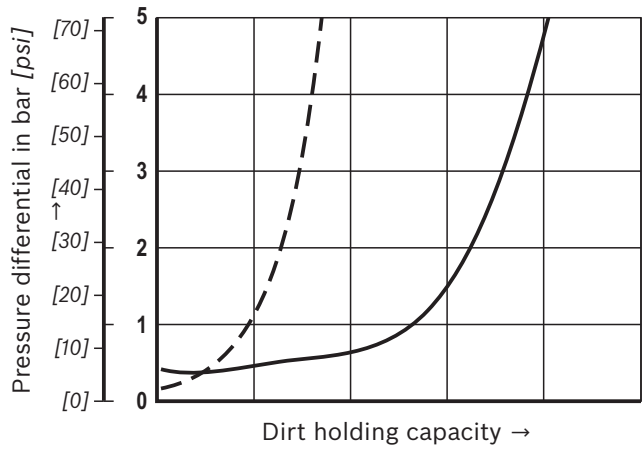
Technical data H...XL

Dirt holding capacity

Compared to conventional filter media with insertion technology, the filter material H...XL features a high dirt holding capacity because it is made of two separate filter layers connected in series.

Superior dirt holding capacity of H...XL filter elements

Conventional filter element 
 (single-layer glass fiber material)
Rexroth H...XL filter element 
 (multi-layer glass fiber material)

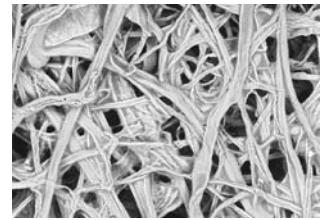


Technical data P...

Filter paper, P...

Filter paper is used for the filtration of lubricating oil and for pre-filtration. Filter paper has the following features:

- ▶ Depth filter made of cellulose fibers
- ▶ Specially coated to prevent swelling caused by humidity
- ▶ Pleated design, single, two or three-layer design
- ▶ Non-reusable filter (not cleanable due to the depth filtration effect)



Filter medium	Nominal filter rating	Filtration ratio β values ¹⁾	Retention rate at 10 μm ¹⁾
P10	10 μm	$\beta_{10(c)} > 2.0$	50%
P25	25 μm	$\beta_{10(c)} > 1.25$	20%

¹⁾ in accordance with ISO 16889

Filter paper

oil cleanliness class ISO 4406	to be achieved with filter			Hydraulic system
	$\beta_{x(c)} = 200$	Material	Possible arrangement	
20/19/14 - 22/20/15	10 μm	Paper P...	Return flow or pressure filters	----- For production facilities
21/20/15 - 22/21/16	25 μm			

Assembly, commissioning, maintenance

When should the spin-on element be replaced or cleaned?

As soon as the dynamic pressure or the pressure differential set on the maintenance indicator is reached, the red push button of the optical-mechanical maintenance indicator pops out. In addition an electrical signal is given if an electronic switching element is present.

If the filter does not have a maintenance indicator, we recommend exchanging the spin-on element at least every 6 months or a maximum of 1000 hours operation, as spin-on elements have no fatigue limit rating.

Exchanging the spin-on element

- ▶ Switch off the system and discharge the filter on the pressure side.

Detailed instructions with regard to the exchange of spin-on elements can be found on the data sheet of the relevant filter series.

Application notes:

- ▶ The spin-on element housing is elastically deformed under dynamic stress.
- ▶ Spin-on elements have no fatigue limit rating.

WARNING!

- | | |
|---|---|
| ▶ Filters are containers under pressure. Before opening the filter housing, check whether the system pressure in the filter has been decreased to ambient pressure. | Only then may the filter housing be opened for maintenance. |
|---|---|

Note:

- ▶ From a cold start the preset optical maintenance indicator signal may be exceeded due to the high viscosity. After reaching the operating temperature, the mechanical optical display can be reset manually. The electrical signal will go out after the operating temperature has been reached.
- ▶ If the maintenance indicator is disregarded, the increasing pressure differential may damage the filter element (collapse).
- ▶ Warranty becomes void if the delivered item is changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental condition that do not comply with the installation conditions.

Directives and standardization

Rexroth spin-on elements are tested and quality-monitored according to different ISO test standards:

Filtration performance test (multipass test)	ISO 16889:2008-06
Δp (pressure loss) characteristic curves	ISO 3968:2001-12
Compatibility with hydraulic fluid	ISO 2943:1998-11
Collapse pressure test	ISO 2941:2009-04

The development, manufacture and assembly of Rexroth industrial filters and Rexroth filter elements is carried out within the framework of a certified quality management system in accordance with ISO 9001:2000.

Environmental safety and recycling

- The used spin-on element should be disposed of in accordance with the respective country-specific legal regulations of environmental protection.

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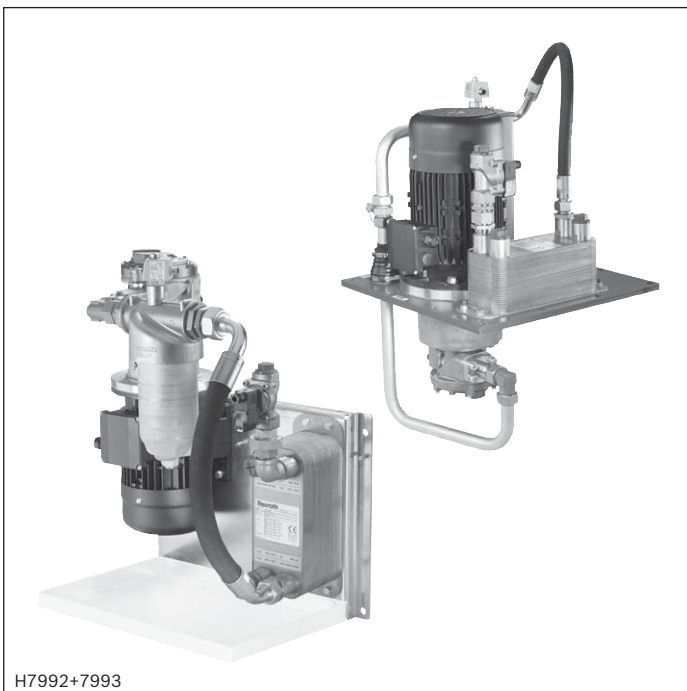
Filter cooler unit with inline filter according to DIN24550

Type ABUGK

RE 50125

Edition: 2013-04

Replaces: 50126



- ▶ Component series 4X
- ▶ With gerotor pump, external gear pump SILENCE PLUS or screw spindle pump
- ▶ With electric motors sizes 90 S to 132 S
- ▶ With low-pressure inline filter according to DIN 24550
- ▶ With plate heat exchanger
- ▶ Maximum operating pressure 10 bar

Contents

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▶ Type ABUGK-..K... base (console mounting)	10
▶ Type ABUGK-..K... noise-optimized (console mounting)	11
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▶ Type ABUGK-..V... base (tank top mounting)	13
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Port sizes for flanges and fittings	17
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Features

- ▶ Compact unit with pump, installed low-pressure filter and plate heat exchanger
- ▶ Modular design
- ▶ Mounting as required on a console or on installation plate
- ▶ Low-noise versions available

Features (continued)

Application range

Any hydraulic system, in which heat is generated through power losses, requires active cooling during continuous operation.

The dissipation capacity of the tank is often not sufficient to ensure a stable heat balance during long duty cycles.

Due to their compact design, these units can be mounted to the tank walls, on top of the tank or on other machine components.

The basic element is the gerotor pump. Low-noise versions are based on external gear pumps (SILENCE PLUS) or screw spindle pumps, low-pressure filters and plate heat exchangers.

General information

The units are fitted with a low-pressure filter. Electrical maintenance indicators signal when an element has to be changed.

The water consumption depends on the utilization of the power unit and the inlet temperature difference.

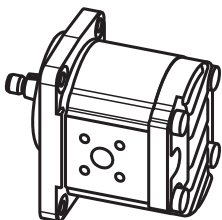
The water supply for cooling purposes is regulated by an electrically operated water valve.

Circulation units of version ABUKG-..K are optionally fitted with a collecting pan for collecting oil that is spilled during filter exchanges.

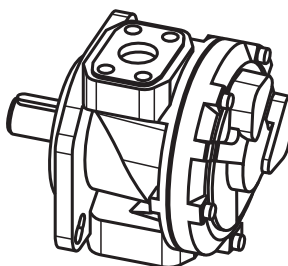
Noise guide values

Cooling power in kW ¹⁾	Base	Noise-optimized
	Sound pressure level in dB(A)	
	External gear pump SILENCE PLUS	
4	59	
7.5	59	
	Gerotor pump	Screw spindle pump
11	64	59
15	64	59
22	66	60
30	68	62
37	70	63
45	69	63
55	72	65
75	74	66

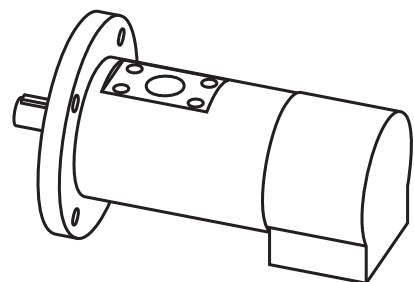
External gear pump SILENCE PLUS



Gerotor pump



Screw spindle pump



Noise levels are measured according to DIN EN ISO 11202

Accuracy class 3

Measuring distance 1 m;

Measured at 1450 min⁻¹;

with an operating temperature of $v = 50$ °C;

Hydraulic fluid: Mineral oil HLP according to DIN 51524, part 2 ¹⁾ (Characteristic curves see page 7)

Bosch Rexroth AG, RE 50125, edition: 2013-04

Ordering code

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
ABUKG	-		-	4X	/		K	/		/		4	5	/	HOY

01	Filter cooler unit	ABUKG
----	--------------------	-------

Cooling power with inlet temperature difference 35 K

02	4 ... 75 kW (characteristic curves see page 7)	04 ... 75
----	--	-----------

Design principle

03	Console mounting	K
	Tank top mounting	V

04	Component series 40 to 49 (40 to 49: Unchanged installation and connection dimensions)	4X
----	--	----

Heat exchanger

05	Size	0
06	Version	K
07	Number of plates	48

Pump

08	Displacement (in l/min with 1450 min ⁻¹)	
	116 l/min	116
09	Noise behavior	
	Base	B
	Noise-optimized	G

Electric motor

10	Motor power (in kW)	
	3 kW	3.00
11	Rated voltage	
	230/400V - 50 Hz	CA
	400/690V - 50 Hz	CB
12	Number of pole pairs	
	4-pole	4
13	Rated frequency	
	50 Hz	5

Filter

14	Size, inline filter DIN 24550 according to data sheet 51447	160
----	---	-----

Oil pan

15	Without oil pan	-
	With oil pan	T

Motor supplier

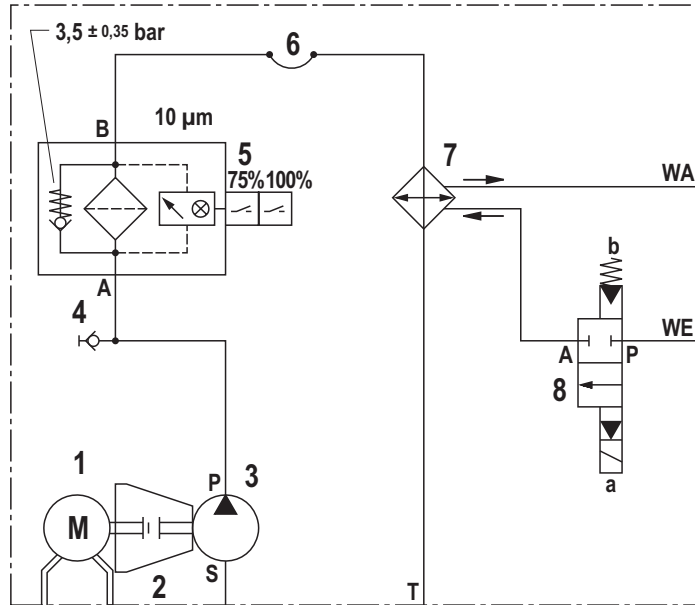
16	Hoyer Motors	HOY
----	--------------	-----

Order example:

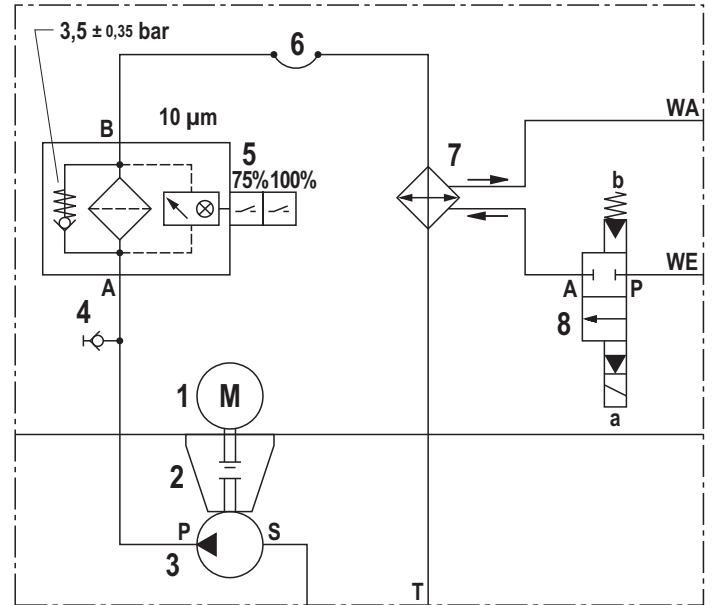
ABUKG-37K-4X/0K48/116B/3,0CA45/160 HOY

Circuit diagram

Type ABUKG-..K...



Type ABUKG-..V...



- 1 Electric motor
- 2 Pump carrier + coupling
- 3 Displacement pump

- 4 Pressure measuring port
- 5 Inline filter with maintenance indicator

- 6 Hose line
- 7 Oil-water heat exchanger
- 8 Electrically operated water valve

Selection table of standard/preferred types ABUKG 4X

Console mounting

Frequency		50 Hz	Electric motor frame size	Power in kW	Pump	ABUKG-...K... material no (console mounting)	MKZ ²⁾	Weight in kg	
Cooling power in kW ¹⁾	q_v max in l/min	p max. in bar							
4.0	17	10	90S	1.10	External gear pump SILENCE PLUS	R901337662	A2	38	
7.5	23	10	90S	1.10		R901337663	A2	39	
11.0	28	10	90L	1.50	Gerotor pump (base)	R901355119	A3	60	
15.0	46	10	100L	2.20		R901337655	A3	62	
22.0	71	10	100L	2.20		R901337656	A3	61	
30.0	88	10	100L	3.00		R901337657	A3	63	
37.0	116	10	100L	3.00		R901337658	A3	67	
45.0	88	10	100L	3.00		R901337659	A3	83	
55.0	144	10	112M	4.00		R901337660	A3	85	
75.0	186	10	132S	5.50		R901337661	A3	118	
11.0	29	10	90S	1.10		Screw spindle pump (noise-optimized)	R901355118	A2	48
15.0	38	10	90S	1.10			R901337664	A2	51
22.0	74	10	100L	2.20	R901337665		A2	67	
30.0	89	10	100L	3.00	R901337666		A3	73	
37.0	105	10	100L	3.00	R901337667		A3	73	
45.0	105	10	100L	3.00	R901337668		A3	89	
55.0	105	10	112M	4.00	R901337669		A3	90	
75.0	166	10	132S	5.50	R901337670		A3	133	

Tank top mounting

Frequency		50 Hz	Electric motor frame size	Power in kW	Pump	ABUKG-...V... material no (tank top mounting)	MKZ ²⁾	Weight in kg	
Cooling power in kW ¹⁾	q_v max in l/min	p max. in bar							
4.0	17	10	90S	1.10	External gear pump SILENCE PLUS	R901338099	A3	47	
7.5	23	10	90S	1.10		R901338103	A3	47	
11.0	28	10	90L	1.50	Gerotor pump (base)	R901355121	A3	75	
15.0	46	10	100L	2.20		R901338092	A3	79	
22.0	71	10	100L	2.20		R901338093	A3	77	
30.0	88	10	100L	3.00		R901338094	A3	82	
37.0	116	10	100L	3.00		R901338095	A3	86	
45.0	88	10	100L	3.00		R901338096	A3	101	
55.0	144	10	112M	4.00		R901338097	A3	117	
75.0	186	10	132S	5.50		R901338098	A3	141	
11.0	29	10	90S	1.10		Screw spindle pump (noise-optimized)	R901355120	A3	60
15.0	38	10	90S	1.10			R901338104	A3	63
22.0	74	10	100L	2.20	R901338105		A3	80	
30.0	89	10	100L	3.00	R901338106		A3	92	
37.0	105	10	100L	3.00	R901338107		A3	91	
45.0	105	10	100L	3.00	R901338108		A3	108	
55.0	105	10	112M	4.00	R901338109		A3	132	
75.0	166	10	132S	5.50	R901338111		A3	156	

1) Cooling power with inlet temperature difference of approx. 35 K (characteristic curves see page 7)

2) MKZ = material mark

A2 = Preferred delivery range

A3 = Standard delivery range

Technical data

(for applications outside these parameters, please consult us!)

Line connections (see page 17)	▶ Oil side	Connection thread according to ISO 1179 Pipe connections according to DIN 2353 / ISO 8434 Flanges according to ISO 6162		
	▶ Water side	Thread according to ISO 228/1		
Type of piping	Fitting according to DIN 2353 light / heavy series For ABUKG-V: Precision steel pipes According to DIN 2391/C, DIN EN ISO 1127			
Hydraulic fluids	Mineral oil HLP46 according to DIN 51524, part 2 (other hydraulic fluids upon request) Please observe our specifications and data sheet 90220.			
Hydraulic fluid temperature range	°C	25 ... 80; for other temperatures please consult us		
Installation position	Vertical			
Coolant	Potable, process, stream and river water (filtration recommended) Min. cooling water need: $V_K = 0.5 \times V_{oil}$ [l/min] (min. 0.1 bar at water valve) Heating (H ₂ O): $\Delta v = 14 \times \text{power loss (kW)} / V_K$ [°K]			
Adm. operating pressures at inlet (absolute)	▶ Oil side	– Gerotor pump	bar	0.7 ... 2 (short-time, upon start 0.5 bar)
		– Screw spindle pump	bar	0.3 ... 4
		– External gear pump SILENCE PLUS	bar	0.7 ... 3
		– p_{max}	bar	10
	▶ Water side		bar	16 (at least 3 ... 5 bar)
Motor voltage /	▶ 4 ... 45 kW cooling power (motor 90S-100L)	230/400 V – 50 Hz		
frequency	▶ 55 ... 75 kW cooling power (motor 112M-132S)	400/690 V – 50 Hz		
Direction of rotation of pump	Clockwise			
Water valve	Type ABZAW-G1-G24K4 according 50235 (included in the scope of delivery)			
Cleanliness classes according to ISO code	Maximum admissible degree of contamination of the hydraulic fluid according to ISO 4406 (c) and according to the pump type used. At least cleanliness class 20/18/15 must be achieved.			
Filter rating	µm	10 (further ratings on request)		
Surface protection	By default, all steel components and components are at least provided with temporary corrosion protection (e.g. for transport).			

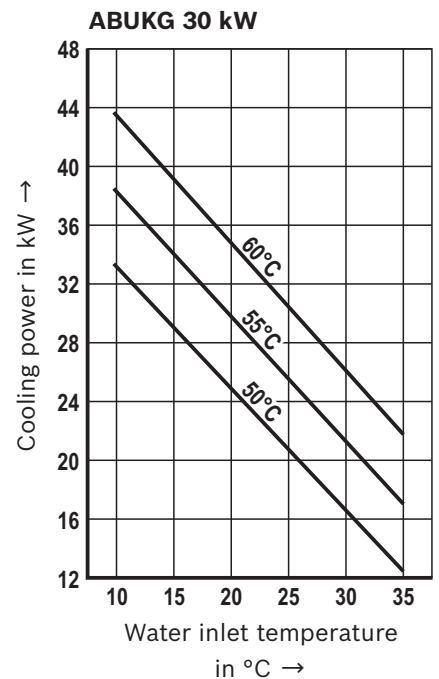
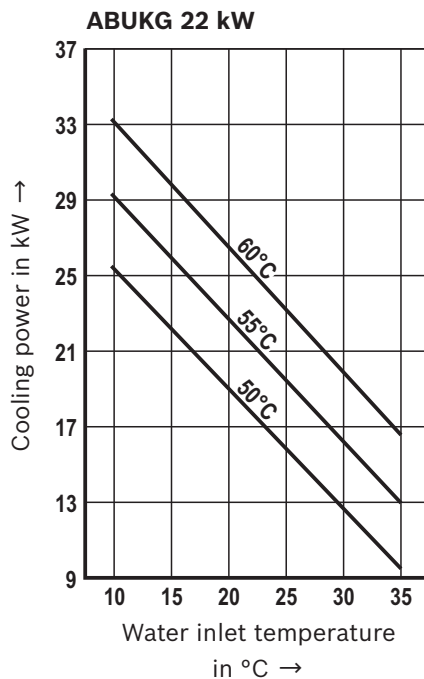
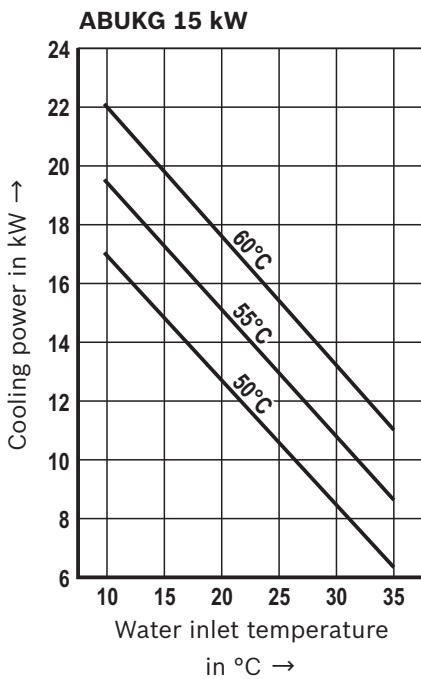
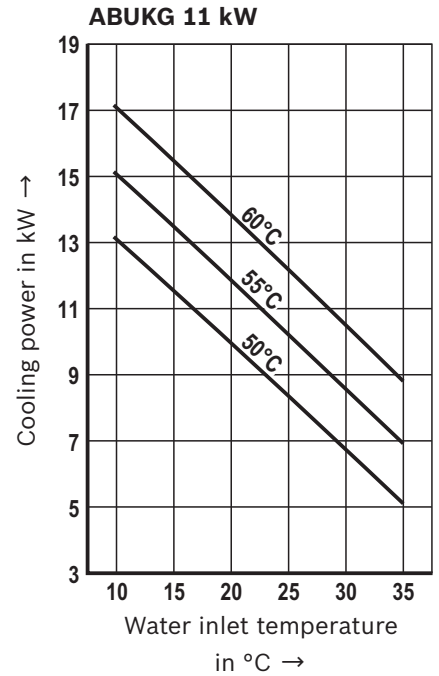
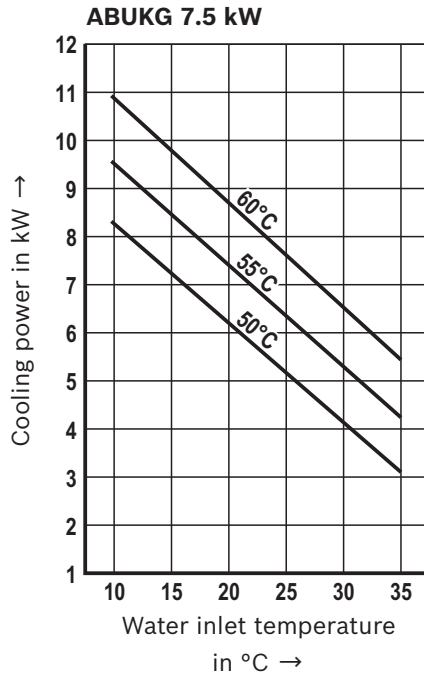
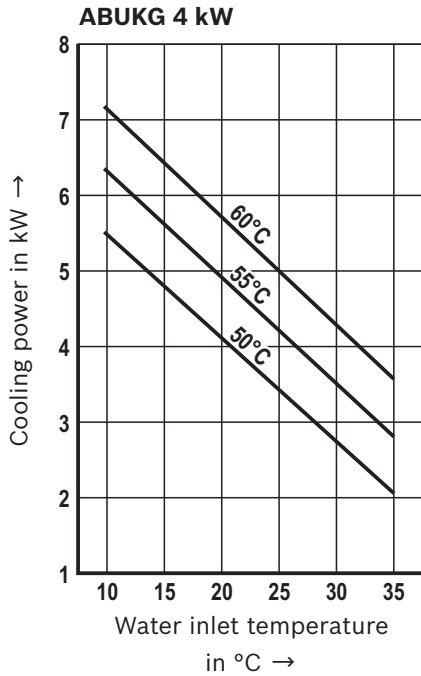
For assembly, commissioning and maintenance of oil hydraulic systems please observe the data sheet 07900!

Further data sheets: **AB 32-12 Heat exchanger oil/water system: Plate heat exchanger**
51447 Inline filter with filter element according to DIN 24550
10545 Gerotor pump PGZ
10094 External gear pump SILENCE PLUS

The units are designed and manufactured in accordance with the harmonized EN standards / specifications.

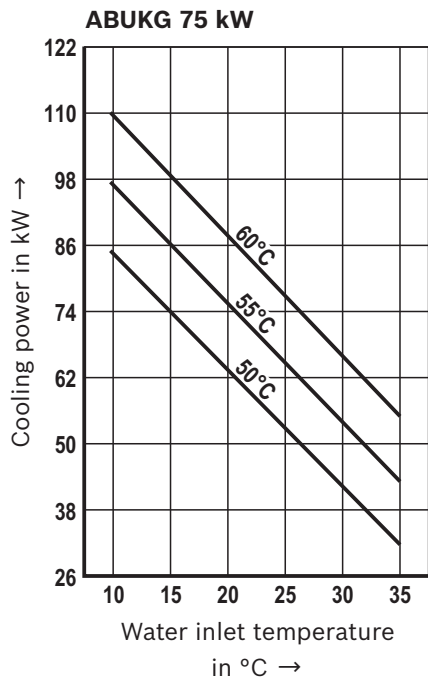
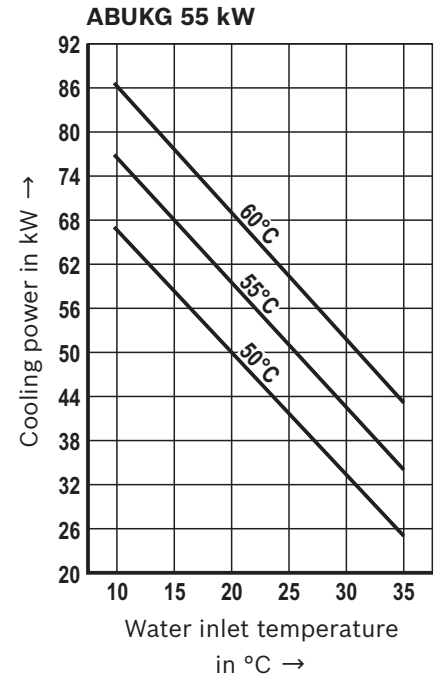
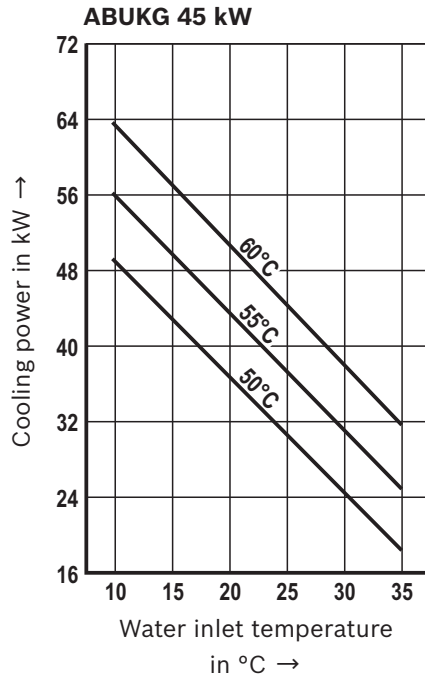
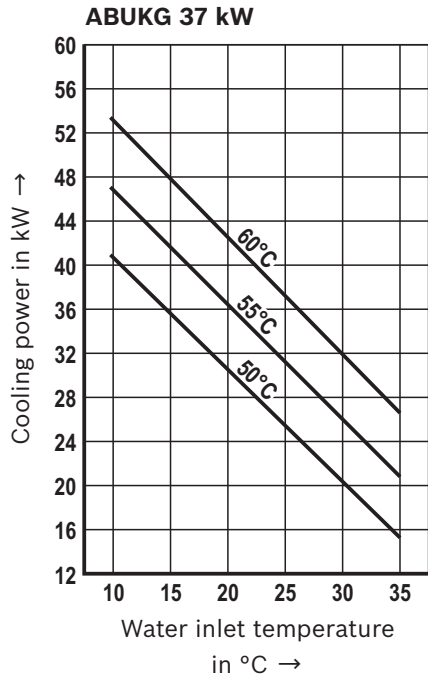
Cooling power characteristic curves

The cooling powers of the individual units differ depending on the water and oil inlet temperatures. The selected oil inlet temperatures were 50, 55 and 60 °C.

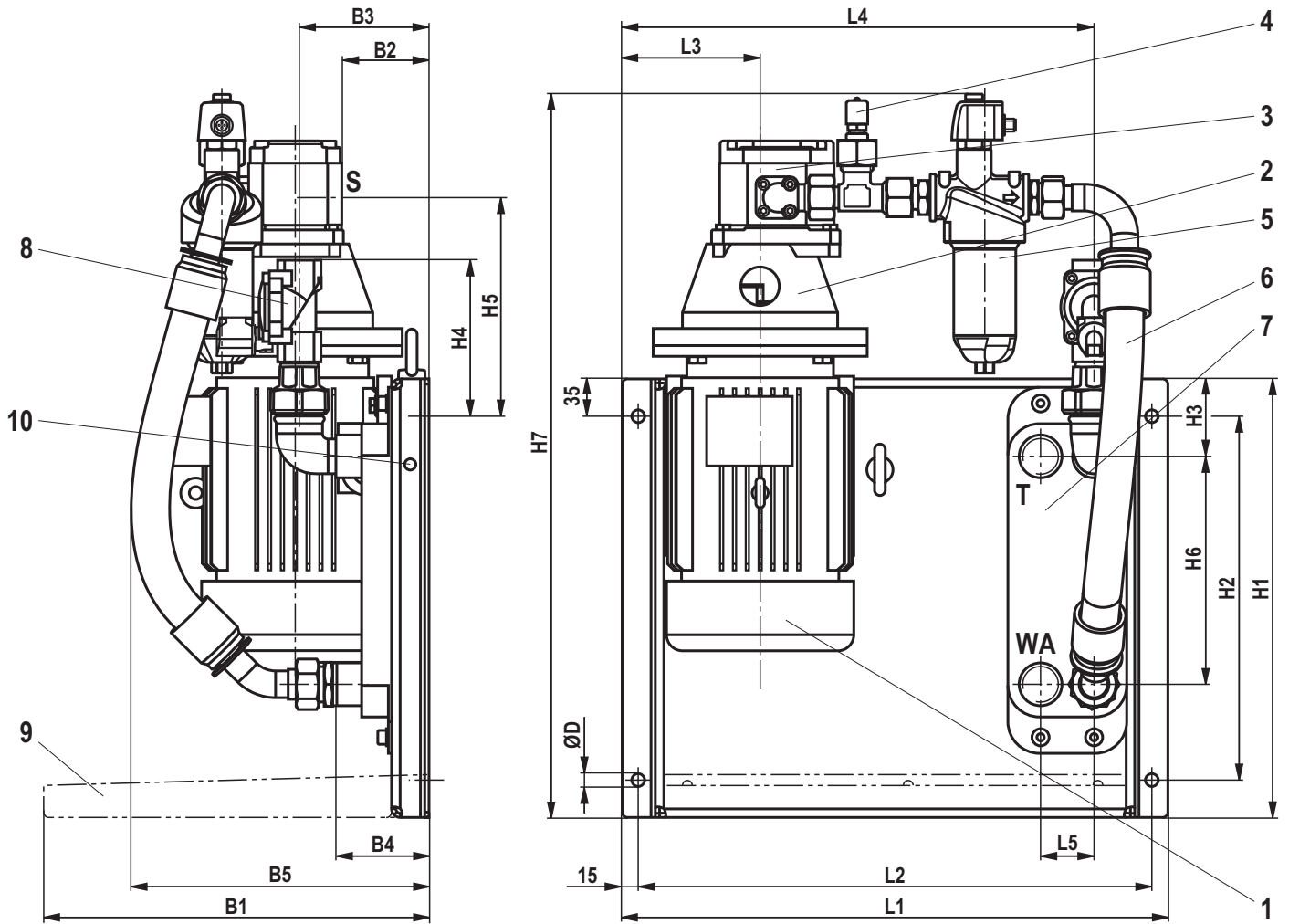


Cooling power characteristic curves

The cooling powers of the individual units differ depending on the water and oil inlet temperatures. The selected oil inlet temperatures were 50, 55 and 60 °C.



Dimensions: Type ABUKG-..K... 4 and 7.5 kW (dimensions in mm)



- 1 Electric motor
- 2 Pump carrier + coupling
- 3 Silence Plus pump
- 4 Pressure measuring port
- 5 Inline filter with maintenance indicator
- 6 Hose line
- 7 Oil-water heat exchanger
- 8 Electrically operated water valve
- 9 Oil pan (optional)
- 10 Equipotential bonding

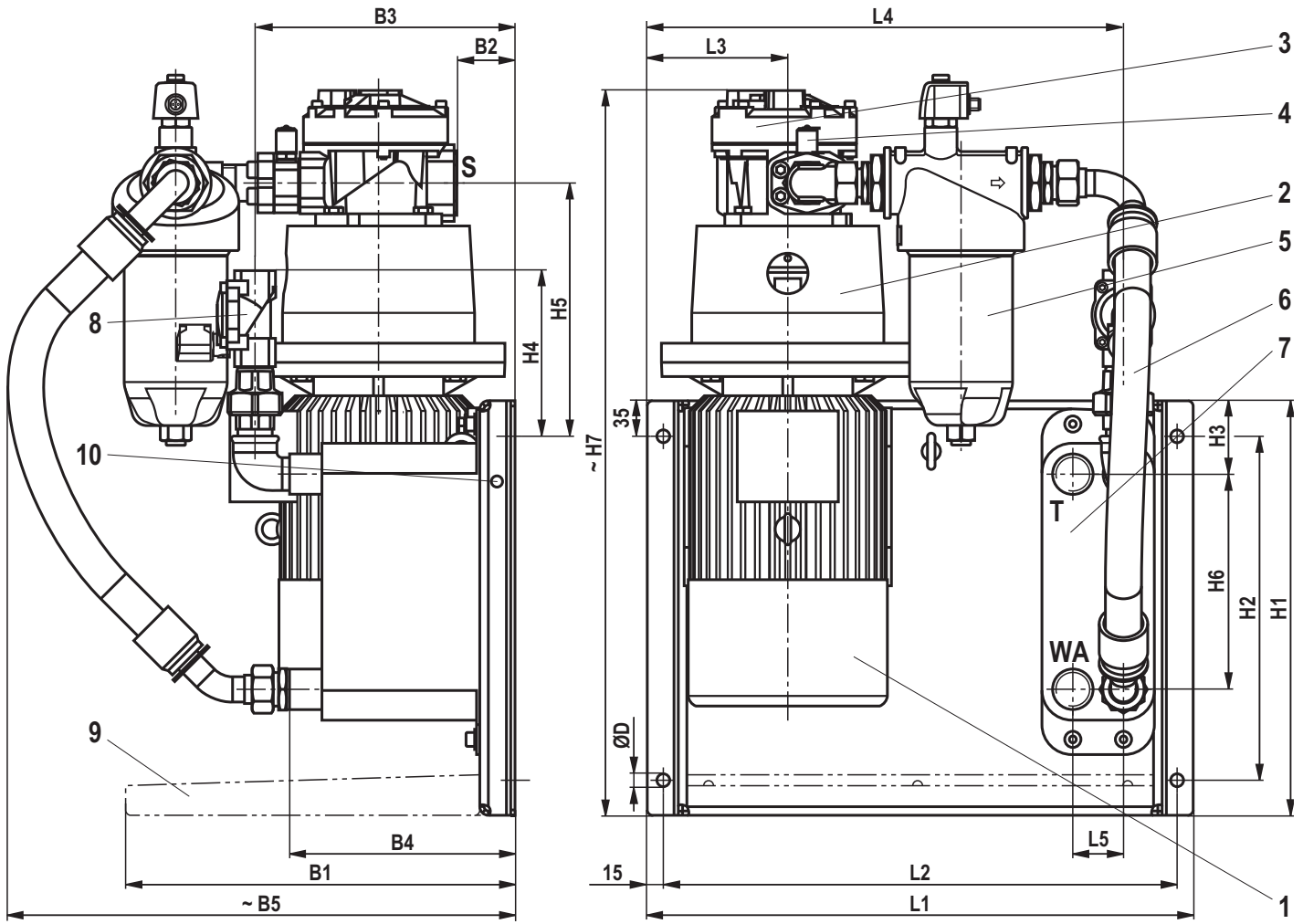
Cooling power in kW	Dimensions																	
	L1	L2	L3	L4	L5	B1	B2	B3	B4	B5	H1	H2	H3	H4	H5	H6	H7	D1
4	510	480	129	441	50	385	81.5	118	87	300	410	340	72.5	146	205	213	700	12
7.5	510	480	129	441	50	385	81.5	122	111	350	410	340	72.5	146	209	213	700	12

Port sizes S, T, WE and WA see page 17 bottom.

Tolerances according to:

- ▶ General tolerances ISO 2768-mK
- ▶ Tolerancing principle ISO 8015

Dimensions: Type ABUKG-..K... base (dimensions in mm)



- 1 Electric motor
- 2 Pump carrier + coupling
- 3 Gerotor pump
- 4 Pressure measuring port
- 5 Inline filter with maintenance indicator
- 6 Hose line
- 7 Oil-water heat exchanger
- 8 Electrically operated water valve
- 9 Oil pan (optional)
- 10 Equipotential bonding

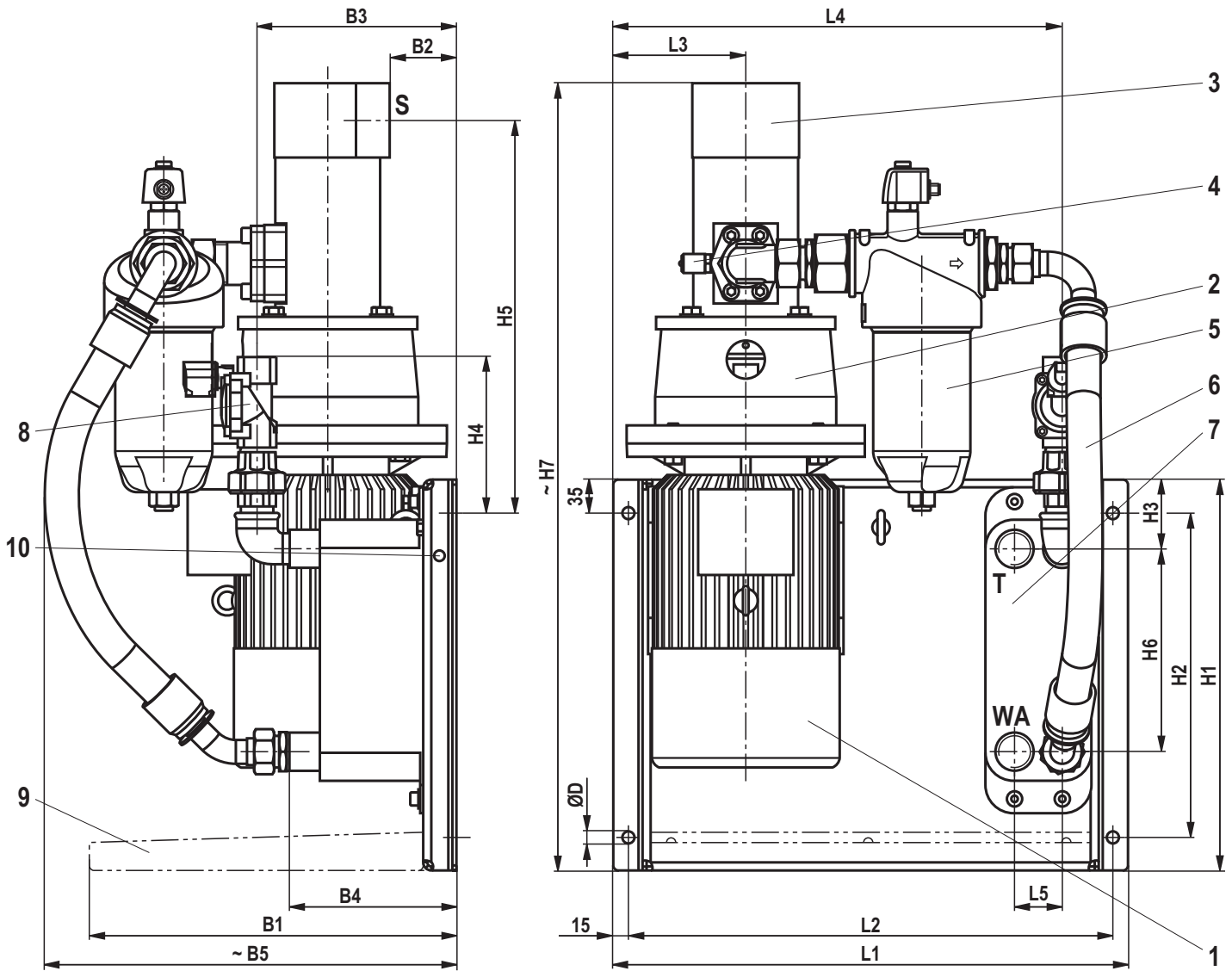
Cooling power in kW	Dimensions																	
	L1	L2	L3	L4	L5	B1	B2	B3	B4	B5	H1	H2	H3	H4	H5	H6	H7	D1
11	510	480	129	471	50	385	58	195	159	500	410	340	72.5	146	250.5	213	740	12
15	510	480	129	441	50	385	58	226	191	500	410	340	72.5	146	250.5	213	740	12
22	540	510	139	471	50	385	58	210	175	500	410	340	72.5	164	250.5	213	740	12
30	540	510	139	471	50	385	58	258	223	550	410	340	72.5	164	250.5	213	740	12
37	540	510	139	471	50	385	58	258	223	550	410	340	72.5	164	250.5	213	740	12
45	710	680	144	630	94	395	70	297	247	600	550	480	79	159	235.5	309	850	14
55	710	680	149	630	94	395	84	317	271	600	550	480	79	159	242.5	309	870	14
75	710	680	172	630	94	395	105	345	295	650	550	480	79	159	282.5	309	920	14

Port sizes S, T, WE and WA see page 17 bottom.

Tolerances according to:

- ▶ General tolerances ISO 2768-mK
- ▶ Tolerancing principle ISO 8015

Dimensions: Type ABUKG-..K... noise-optimized (dimensions in mm)



- 1 Electric motor
- 2 Pump carrier + coupling
- 3 Screw spindle pump
- 4 Pressure measuring port
- 5 Inline filter with maintenance indicator
- 6 Hose line
- 7 Oil-water heat exchanger
- 8 Electrically operated water valve
- 9 Oil pan (optional)
- 10 Equipotential bonding

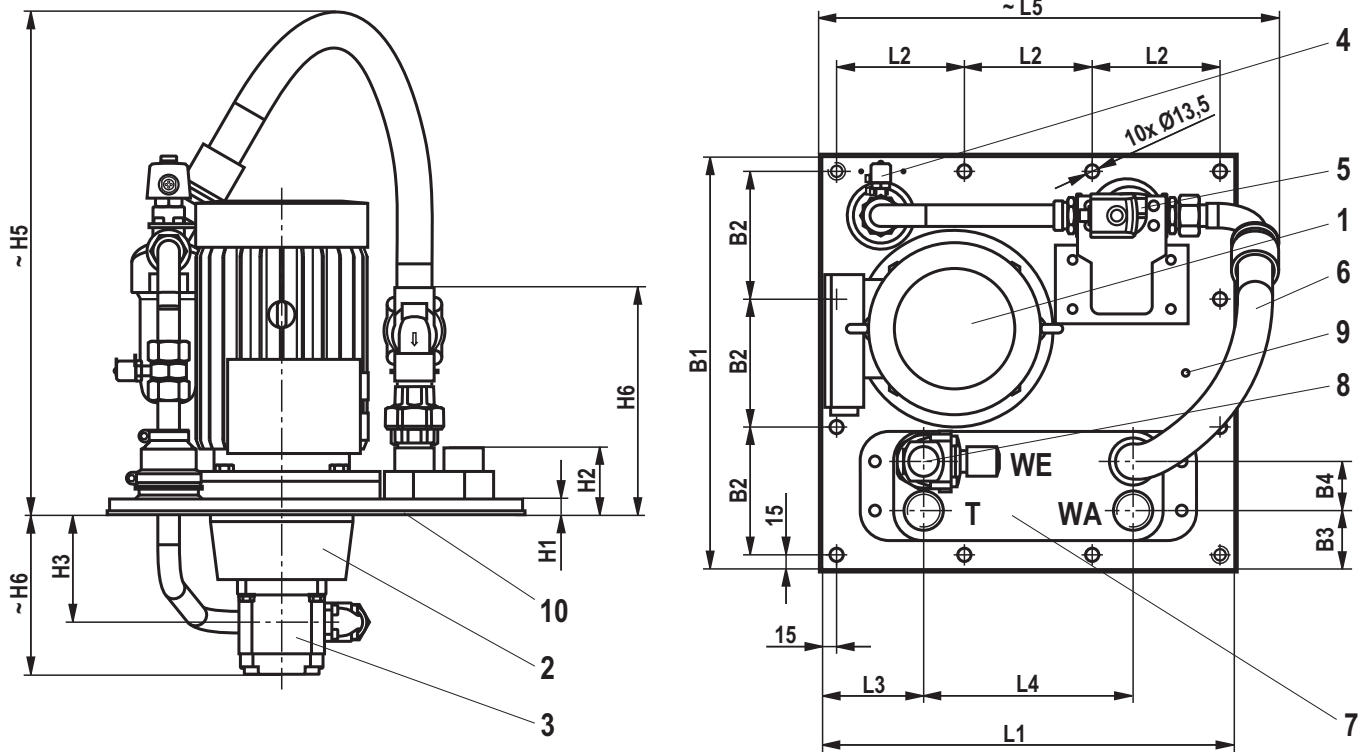
Cooling power in kW	Dimensions																	
	L1	L2	L3	L4	L5	B1	B2	B3	B4	B5	H1	H2	H3	H4	H5	H6	H7	D1
11	510	480	129	471	50	385	70	195	159	500	410	340	72.5	146	360	213	770	12
15	540	480	129	441	50	385	70	226	191	500	410	340	72.5	164	360	213	770	12
22	540	510	139	471	50	385	70	210	175	500	410	340	72.5	164	412.5	213	827	12
30	540	510	139	471	50	385	50	258	223	550	410	340	72.5	164	486.5	213	907	12
37	540	510	139	471	50	385	51.5	258	223	550	410	340	72.5	164	486	213	907	12
45	710	680	144	630	94	395	61.5	297	247	600	550	480	79	159	471	309	1032	14
55	710	680	149	630	94	395	73.5	317	271	600	550	480	79	159	478	309	1039	14
75	710	680	172	630	94	395	82	345	295	650	550	480	79	159	539.5	309	1007	14

Port sizes S, T, WE and WA see page 17 bottom.

Tolerances according to:

- ▶ General tolerances ISO 2768-mK
- ▶ Tolerancing principle ISO 8015

Dimensions: Type ABUKG-..V... 4 and 7.5 kW (dimensions in mm)



- | | | | |
|---------------------------|--|-------------------------------------|-----------------------------------|
| 1 Electric motor | 4 Pressure measuring port | 6 Hose line | 9 Equipotential bonding |
| 2 Pump carrier + coupling | 5 Inline filter with maintenance indicator | 7 Oil-water heat exchanger | 10 Cork seal according to AB03333 |
| 3 Silence Plus pump | | 8 Electrically operated water valve | |

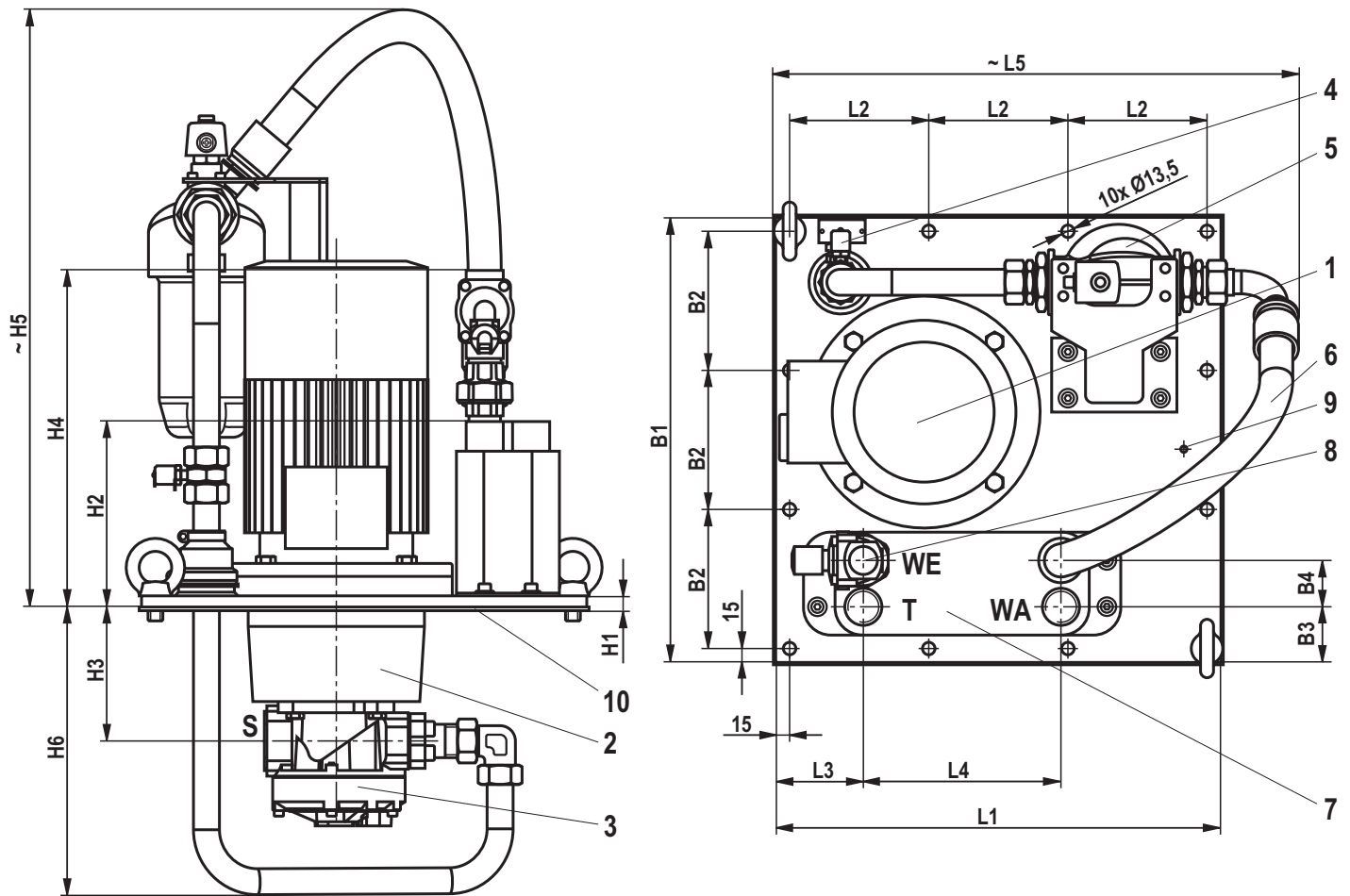
Cooling power in kW	Dimensions														
	L1	L2	L3	L4	L5	B1	B2	B3	B4	H1	H2	H3	H4	H5	H6
4	420	130	103.5	213	500	420	130	60	50	16	68	109.5	231	550	163
7.5	420	130	103.5	213	500	420	130	60	50	16	92	113.5	255	600	170

Port sizes S, T, WE and WA see page 17 bottom.

Tolerances according to:

- ▶ General tolerances ISO 2768-mK
- ▶ Tolerancing principle ISO 8015

Dimensions: Type ABUKG-..V... base (dimensions in mm)



- | | | | |
|---------------------------|---------------------------|--|-------------------------------------|
| 1 Electric motor | 3 Gerotor pump | 5 Inline filter with maintenance indicator | 8 Electrically operated water valve |
| 2 Pump carrier + coupling | 4 Pressure measuring port | 6 Hose line | 9 Equipotential bonding |
| | | 7 Oil-water heat exchanger | 10 Cork seal according to AB03333 |

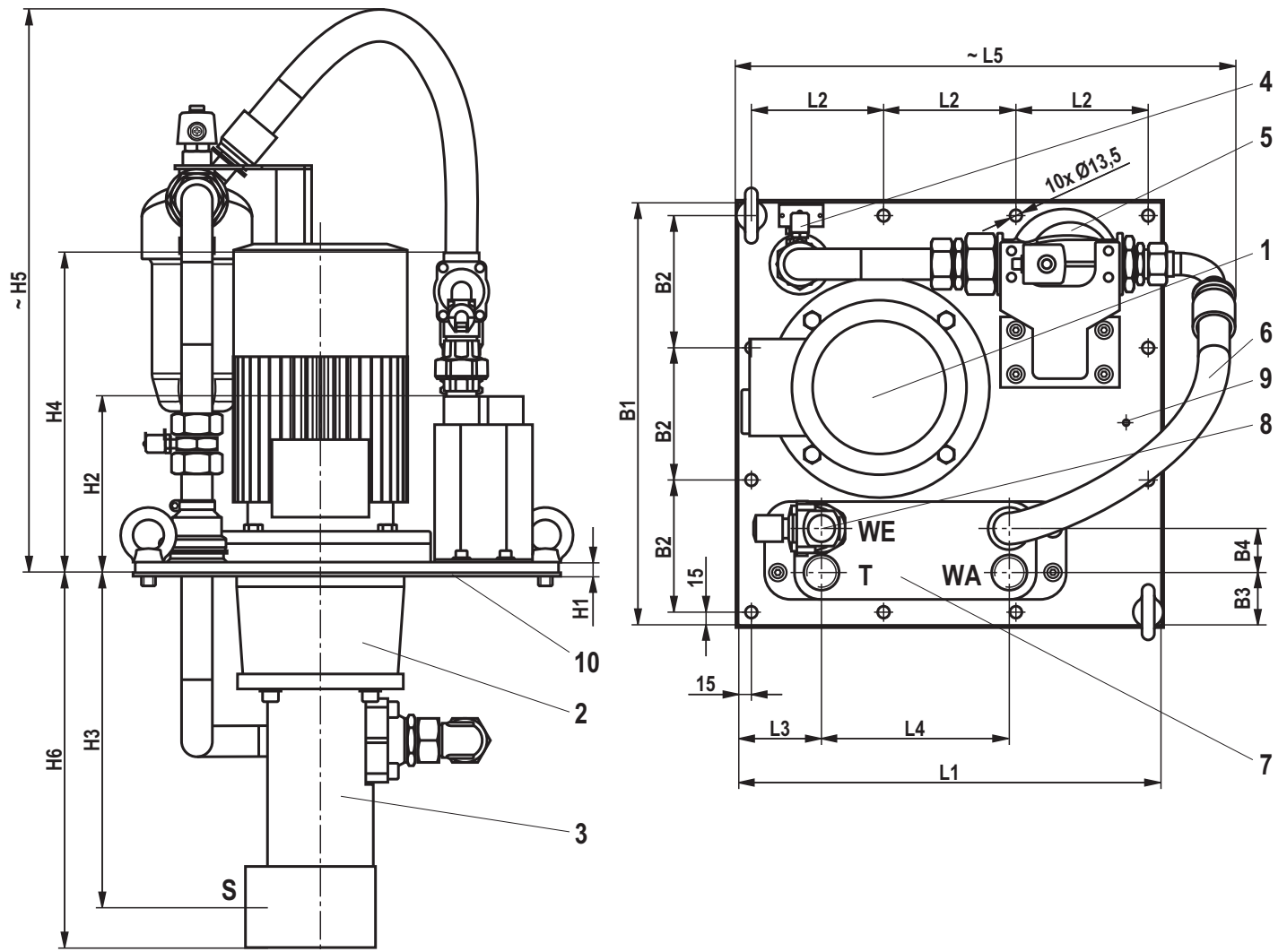
Cooling power in kW	Dimensions														
	L1	L2	L3	L4	L5	B1	B2	B3	B4	H1	H2	H3	H4	H5	H6
11	420	130	103.5	213	550	420	130	60	50	16	172	140.5	335	650	320
15	420	130	103.5	213	550	420	130	60	50	16	172	140.5	335	650	320
22	480	150	94.5	213	600	480	150	60	50	16	156	140.5	318	650	320
30	480	150	94.5	213	600	480	150	60	50	16	204	140.5	367	650	320
37	480	150	94.5	213	600	480	150	60	50	16	244	140.5	407	750	320
45	570	180	116	309	700	570	180	64	94	16	194	140.5	372	750	320
55	570	180	116	309	700	570	180	64	94	16	242	140.5	420	850	350
75	630	200	126	309	700	630	200	71	94	16	266	159.5	444	950	400

Port sizes S, T, WE and WA see page 17 bottom.

Tolerances according to:

- ▶ General tolerances ISO 2768-mK
- ▶ Tolerancing principle ISO 8015

Dimensions: Type ABUKG-..V... noise-optimized (dimensions in mm)

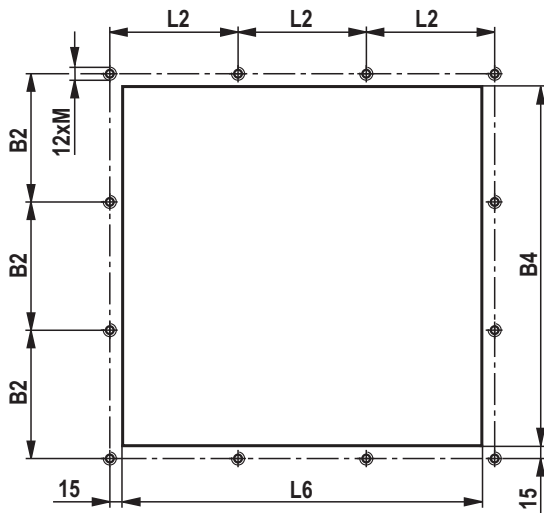


- 1 Electric motor
- 2 Pump carrier + coupling
- 3 Screw spindle pump
- 4 Pressure measuring port
- 5 Inline filter with maintenance indicator
- 6 Hose line
- 7 Oil-water heat exchanger
- 8 Electrically operated water valve
- 9 Equipotential bonding
- 10 Cork seal according to AB03333

Cooling power in kW	Dimensions														
	L1	L2	L3	L4	L5	B1	B2	B3	B4	H1	H2	H3	H4	H5	H6
11	420	130	103.5	213	550	420	130	60	50	16	172	260	335	650	294
15	420	130	103.5	213	550	420	130	60	50	16	172	260	335	650	294
22	480	150	94.5	213	600	480	150	60	50	16	156	302	318	650	341
30	480	150	94.5	213	600	480	150	60	50	16	204	376.5	367	650	421.5
37	480	150	94.5	213	600	480	150	60	50	16	244	376	407	750	421.5
45	570	180	116	309	700	570	180	64	94	16	194	376	372	750	421.5
55	570	180	116	309	700	570	180	64	94	16	242	376	420	850	421.5
75	630	200	126	309	700	630	200	71	94	16	266	419.5	444	950	469

Dimensions: Type ABUGG-..V... noise-optimized (dimensions in mm)

Recommended tank break-through for ABUGG-..V...



Port sizes S, T, WE and WA see page 17 bottom.

Tolerances according to:

- ▶ General tolerances ISO 2768-mK
- ▶ Tolerancing principle ISO 8015

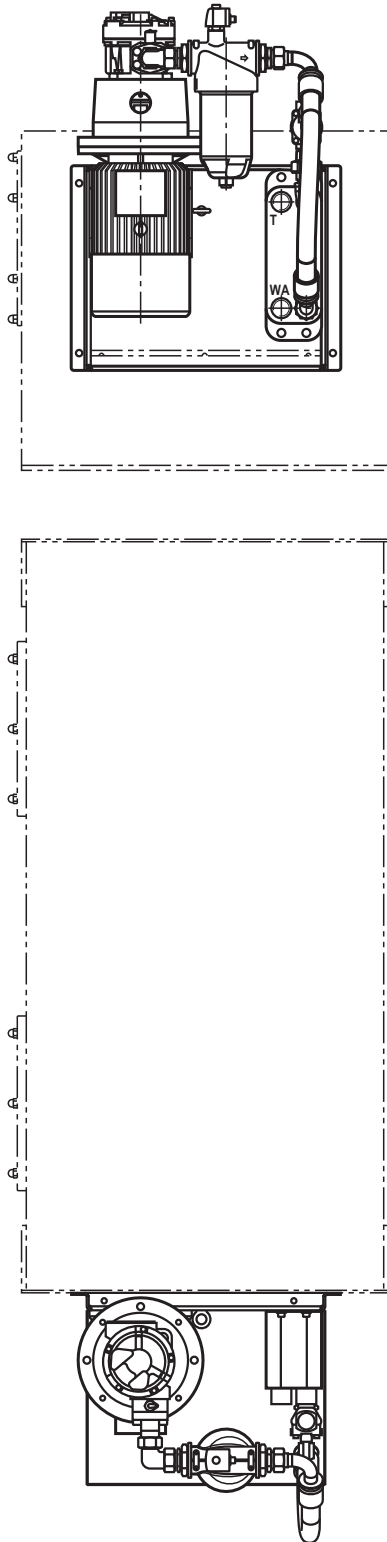
Cooling power in kW	Dimensions				
	L2	L6	B2	B5	M
4 / 7.5 / 11 / 15 ¹⁾	130	360	130	360	M12
15 ²⁾ / 22 / 30 / 37	150	420	150	420	M12
45 / 55	180	510	180	510	M12
75	200	570	200	570	M12

¹⁾ Noise-optimized

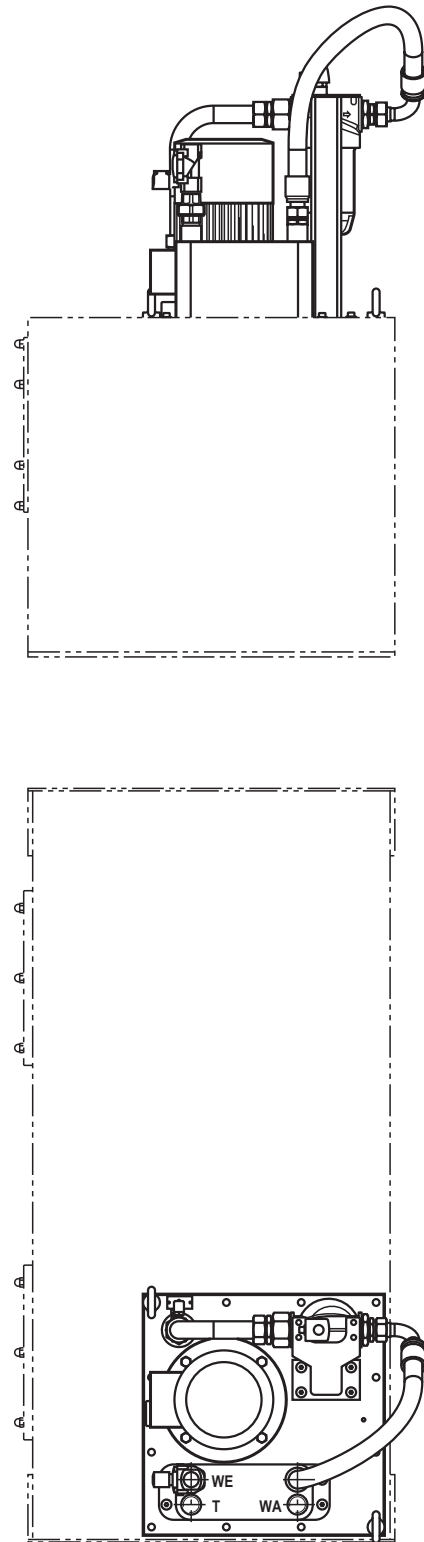
²⁾ Base

Mounting option

The filter cooler unit version **ABUKG-..K-...** is to **be mounted preferably to the side** of a hydraulic tank. It may also be mounted separately.



The filter cooler unit version **ABUKG-..V-...** is to **be mounted preferably on top** of a hydraulic tank. It cannot be mounted separately without an appropriate bracket.



Optional accessories and spare parts

Suction port

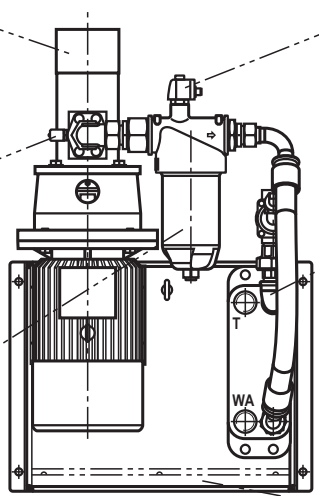
Flange connections for suction line
(see page 18)

Measuring port

Pressure gauge data sheet 50205
DC-FS measurement technology data sheet 51501

Filters and filter elements

(included in the scope of delivery)
Data sheet 51447



Maintenance indicator

Electronic switching element
Data sheet 51450 (included in the scope of delivery)
Mating connectors data sheet 08006

Water on

Pressure gauge data sheet 50205
DC-FS measurement technology data sheet 51501
Isolator valve data sheet 50235 (included in the scope of delivery)
Dirt trap AB 42-25

Oil pan

4 - 15 ¹⁾ kW	R901343957
15 ²⁾ - 37 kW	R901343958
45 - 75 kW	R901343959

Port sizes for flanges and fittings

Cooling power in kW	Type ABUKG-.. base				Type ABUKG-.. noise-optimized			
	Suction port S	Oil outlet T	Water on WE	Water off WA	Suction port S	Oil outlet T	Water on WE	Water off WA
4	-	-	-	-	Square flange 20X40 M6x13	G1	G1	G1
7.5	-	-	-	-				
11	SAE 1 1/2"	G1	G1	G1	SAE 1 1/4"	G1 1/2	G1 1/2	G1 1/2
15					SAE 1 1/2"			
22					SAE 2"			
30								
37								
45	SAE 2"	G1 1/2	G1 1/2	G1 1/2	SAE 2 1/2"			
55								
75								

¹⁾ Noise-optimized

²⁾ Base

Flange connections for suction line (dimensions in mm)

Figure 1

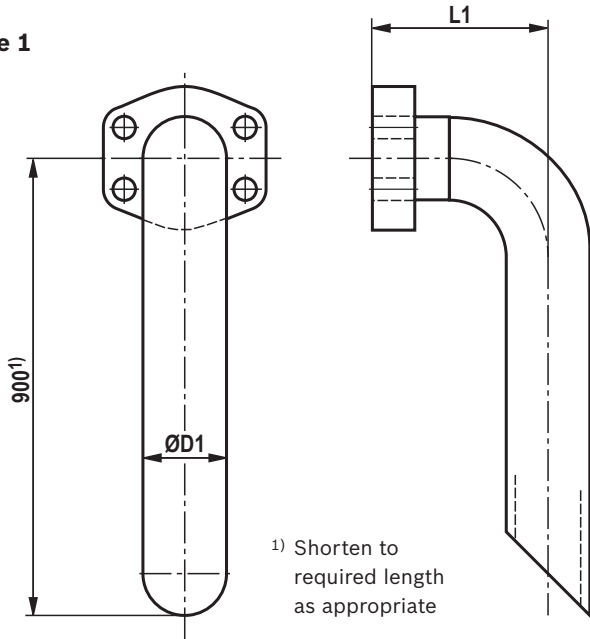


Figure 2

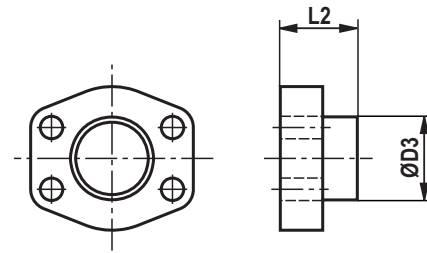
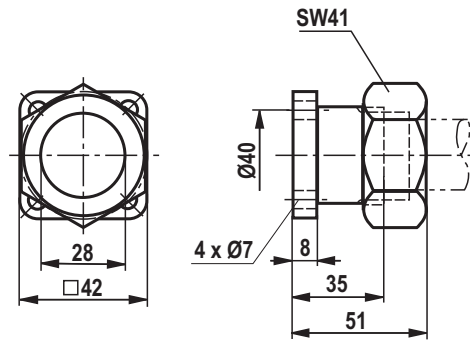


Figure 3



ABUKG-..K-...

Cooling power in kW	Material no.	Base		Noise-optimized			Figure
		L1	ØD1	Material no.	L1	ØD1	
4	R900323237	-	-	-	-	-	3
7.5							
11	R900026561	103.5	48.3	R900722888	100	42	1
15				R900026561	103.5	48.3	
22							
30							
37							
45	R900026562	123	60.3	R900026562	123	60.3	1
55							
75				R900026563	147	76.1	

ABUKG-..V-...

Cooling power in kW	Material no.	Base		Noise-optimized			Figure
		L2	ØD2	Material no.	L2	ØD2	
4	R900323237	-	-	-	-	-	3
7.5							
11	R900013501	57	42	R900012341	41	42	2
15				R900013501	57	42	
22							
30							
37							
45	R900013502	42	60.3	R901013502	42	60.3	2
55							
75				R901013503	50	77	

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 It must be remembered that our products are subject to a natural process of wear and aging.

Filter unit
with inline filter

Type ABUFG

RE 50124

Edition: 2015-11



- ▶ Component series 1X
- ▶ with gerotor pump or external gear pump
- ▶ with electric motors sizes 90S to 132S
- ▶ with low-pressure-inline filter
- ▶ maximum operating pressure 10 bar

Features

- ▶ Compact unit with pump and installed low-pressure filter
- ▶ Modular design

The operating filtration in the is a common method to keep the hydraulic fluid at a certain level of cleanliness. The combination of pump and appropriately rated filter circulates the oil independent from the overall system under constant conditions and relieves the filters in the main flow of the system in this way.

These bypass filters also operate when no oil is transported in the main system.

Contents

Features	1
Ordering code	2
Circuit diagram	3
Selection table of standard/preferred types ABUFG 1X	3
Technical data	4, 5
Dimensions	6 ... 8
Optional accessories and spare parts	9

Ordering code

01	02	03	04	05	06	07	08	09	10	11	12	13	
ABUFG	-	1X	-		Z	/		CA	4	5	/	/	

Device designation

01	Filter unit	ABUFG
----	-------------	-------

Series

02	Component series 10 to 19 (10 to 19: unchanged installation and connection dimensions)	1X
----	--	----

Pump

03	Displacement (in l/min with 1450 min ⁻¹)	
	5 l/min	5
	15 l/min	15
	30 l/min	30
	60 l/min	60
	90 l/min	90
04	Pump type	
	External gear pump AZPF or gerotor pump PGZ from 30 l/min	Z

Electric motor

05	Motor power (in kW)	
	1.5 kW	1.50
06	Rated voltage	
	230/400 V	CA
07	Number of pole pairs	
	4-pole	4
08	Rated frequency	
	50 Hz	5
09	Efficiency class	
	IE0	0
	IE2	2

Filter

10	Filter type	
	Replacement cartridge filter size 130	7SL130
	Inline filter size 630 with filter element according to DIN 24550	FLEN630
	Inline filter size 120 with filter element according to DCFS standard	FLE120
11	Filter rating in µm	
	1 µm	1
	3 µm	3
	10 µm	10
12	Filter material	
	Micro glass	...XL

Motor supplier

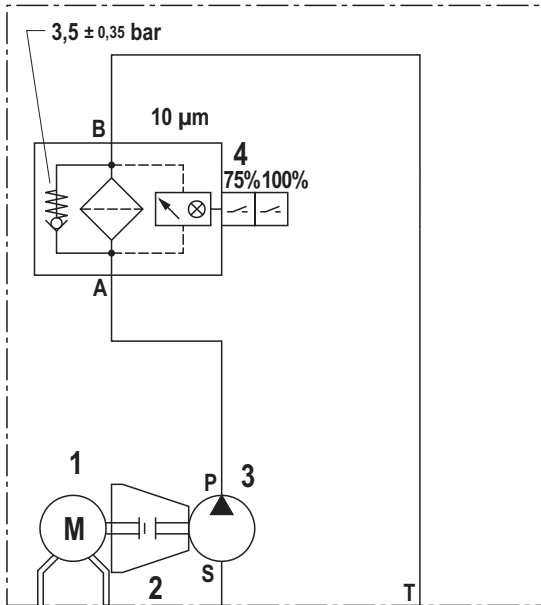
13	Hoyer Motors	HOY
	Siemens	SIE

Order example:

ABUFG-1X- 15Z/0.25CA453/7SL130 /H3XL SIE

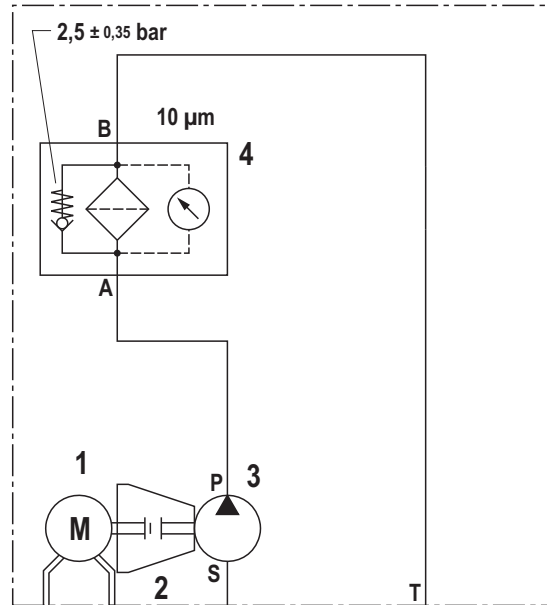
Circuit diagram

ABUFG...FLE...



- 1 Electric motor
- 2 Pump carrier + coupling

ABUFG...7SL...



- 3 Displacement pump
- 4 Inline filter with maintenance indicator

Selection table of standard/preferred types ABUFG 1X

Filter type	Frequency 50 Hz 1450 rpm		Electric motor frame size	Power in kW	Motor manufacturer	Design	Material no. 1 µm	Material no. 3 µm	Material no. 10 µm	Total weight in kg
	$q_{v \max}$ in l/min	p_{\max} in bar								
7SL130	5	10	71M	0.25	SIE	Filter suspended	R901421149	R901416297	R901421141	14
7SL130	15	10	71M	0.25			R901421150	R901421140	R901421142	14.5
FLEN 0630	28	9	90S	1.10	HOY	Console	R901421152	R901419897	R901421143	66
FLEN 0630	58	8	90L	1.50			R901421153	R901417540	R901421144	69
FLE 0120	58	8	90L	1.50			R901421154	R901419899	R901421145	75
FLE 0120	88	9	100L	2.20			R901421155	R901419901	R901421146	87
FLE 0270	88	9	100L	2.20			R901421156	R901419904	R901421147	147
FLE 0270	186	7	112M	4.00			R901421157	R901419907	R901421148	162

Technical data

(For applications outside these values, please consult us!)

Line connections (see page 6 ...8)	► Oil side			Connection thread according to ISO 1179 Pipe connections according to DIN 2353 / ISO 8434 Flanges according to ISO 6162
Hydraulic fluids				Mineral oil HLP46 according to DIN 51524, part 2 (other hydraulic fluids available on request) Minimum conductivity of the fluid > 300 pS Please observe our regulations and data sheet 90220.
Hydraulic fluid temperature range			°C	25 ... 80; for other temperatures please consult us, observe viscosity range!
Viscosity range				Refer to selection aid! The bypass valves of the filters open at 2.5 bar (replacement cartridge filter) or 3.5 bar (inline filter). The identification of the perfect filter is made possible by our online "Bosch Rexroth FilterSelect" design software. Starting Δp with clean element: 0.15 bar
Adm. operating pressures at input (absolute)	► Oil side	– Gerotor pump	bar	0.7 ... 2 (short-time, upon start 0.5 bar)
		– External gear pump SILENCE PLUS	bar	0.7 ... 3
		– p_{max}	bar	10
Motor voltage / frequency				230/400 V – 50 Hz
Direction of rotation of pump				Clockwise
Cleanliness classes according to ISO code				Maximum admissible degree of contamination of the hydraulic fluid according to ISO 4406 (c) and according to the pump type used. At least cleanliness class 20/18/15 must be achieved.
Filter rating			μm	1; 3; 10 (others on request)
Surface protection				By default, all steel components and components are at least provided with temporary corrosion protection (e.g. for transport).

For assembly, commissioning and maintenance of oil hydraulic systems please observe the data sheet 07900!

Other data sheets:

- 51426 Replacement cartridge filter**
- 51401 Inline filter**
- 51450 Maintenance indicator for filters** (inline filter)
- 10545 Gerotor pump PGZ**
- 10089 External gear pump SILENCE PLUS**

The units are constructed and manufactured in accordance with the harmonized EN standards / specifications.

Technical data

(For applications outside these values, please consult us!)

Selection aid:

For all units: Viscosity at least 12 mm²/s

Filter rating 10 µm:

Filter type	q _{v max} in l/min	Recommended viscosity in mm ² /s																		
		100	200	300	400	500	600	700	800	900										
7SL130	5																			
7SL130	15																			
FLEN 0630	28																			
FLEN 0630	58																			
FLE 0120	58																			
FLE 0120	88																			
FLE 0270	88																			
FLE 0270	186																			

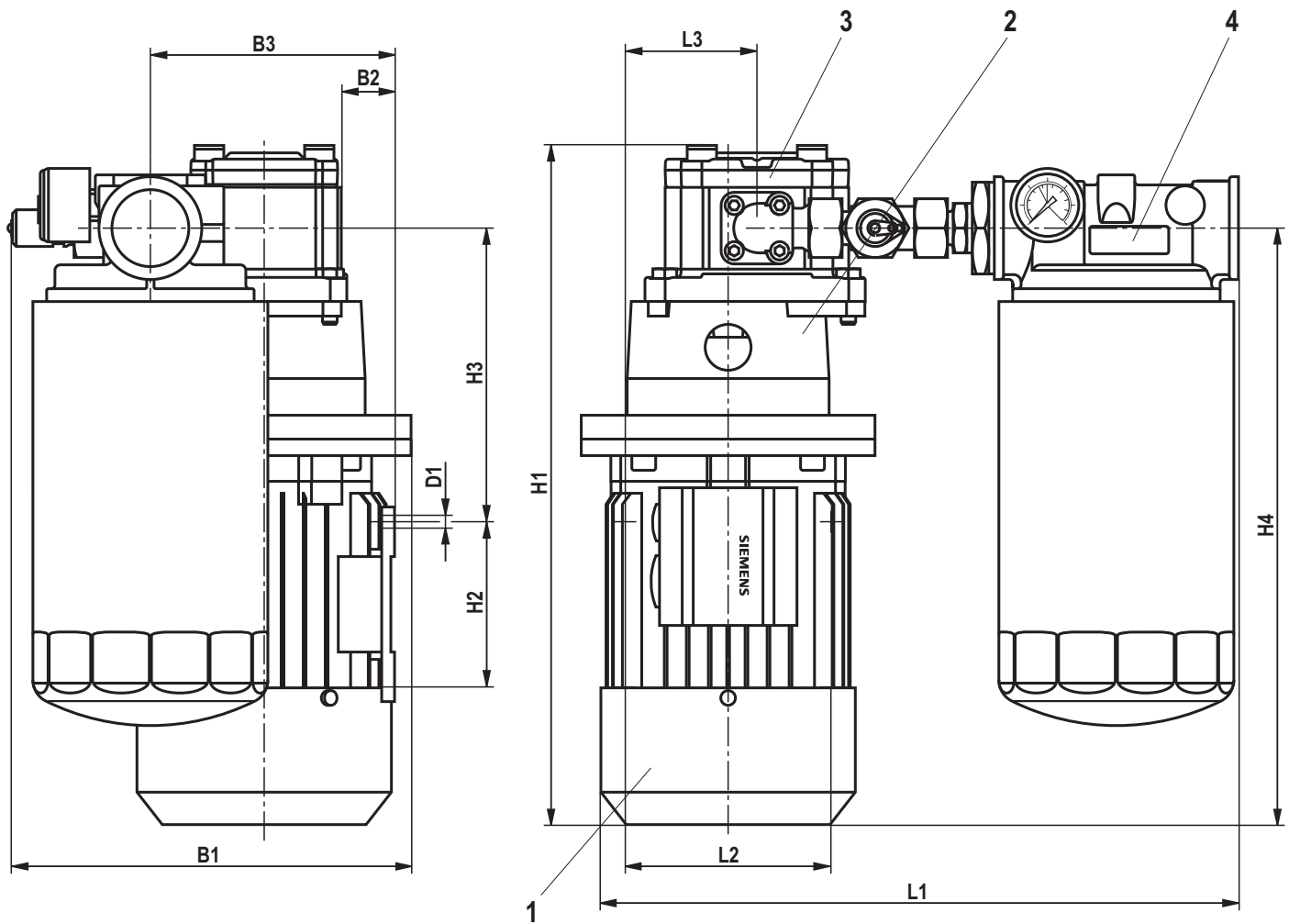
Filter rating 3 µm:

Filter type	q _{v max} in l/min	Recommended viscosity in mm ² /s																		
		100	200	300	400	500	600	700	800	900										
7SL130	5																			
7SL130	15																			
FLEN 0630	28																			
FLEN 0630	58																			
FLE 0120	58																			
FLE 0120	88																			
FLE 0270	88																			
FLE 0270	186																			

Filter rating 1 µm:

Filter type	q _{v max} in l/min	Recommended viscosity in mm ² /s																		
		100	200	300	400	500	600	700	800	900										
7SL130	5																			
7SL130	15																			
FLEN 0630	28																			
FLEN 0630	58																			
FLE 0120	58																			
FLE 0120	88																			
FLE 0270	88																			
FLE 0270	186																			

Dimensions: Type ABUFG...7SL130...
(dimensions in mm)



- 1 Electric motor
- 2 Pump carrier + coupling

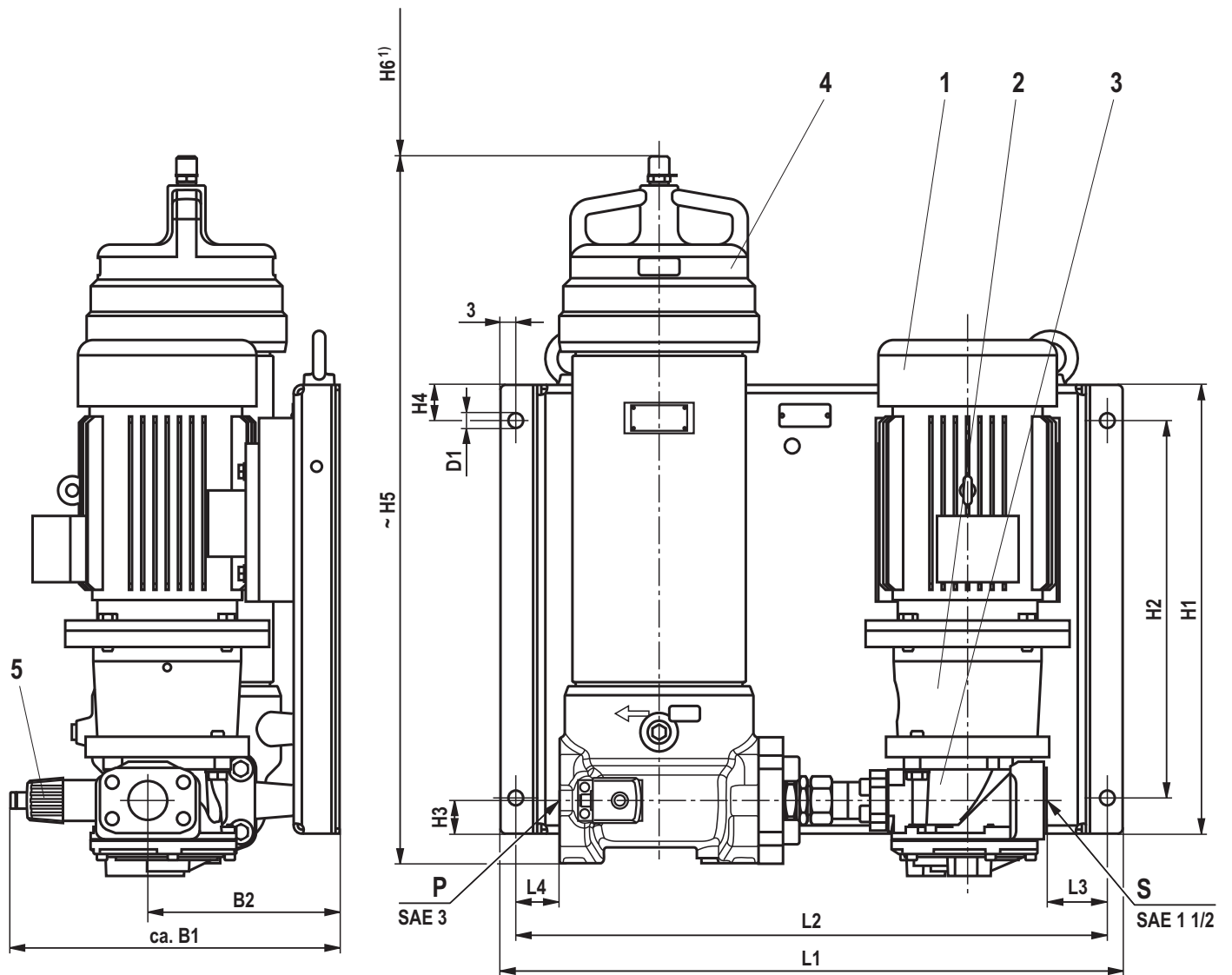
- 3 Pump AZPF
- 4 Inline filter with back pressure gauge

Filter type	$q_{v \max}$ in l/min	Frame size	S	P	L1	L2	L3	B1	B2	B3	H1	H2	H3	H4	D1
7SL130	5	71M	Square flange 15x40 M6x13	G 1 1/4	347	112	72	217	29	133	370	90	160	325	7
7SL130	15	71M	Square flange 20X40 M6x13		347	112	72	217	29	133	380	90	167	332.1	7

Tolerances according to:

- ▶ General tolerances ISO 2768-mK
- ▶ Tolerancing principle ISO 8015

Dimensions: Type ABUFG...FLEN0630... and ABUFG...FLE0120...
(dimensions in mm)



- 1 Electric motor
- 2 Pump carrier + coupling
- 3 Gerotor pump
- 4 Inline filter with maintenance indicator
- 5 Maintenance indicator with electronic switching element

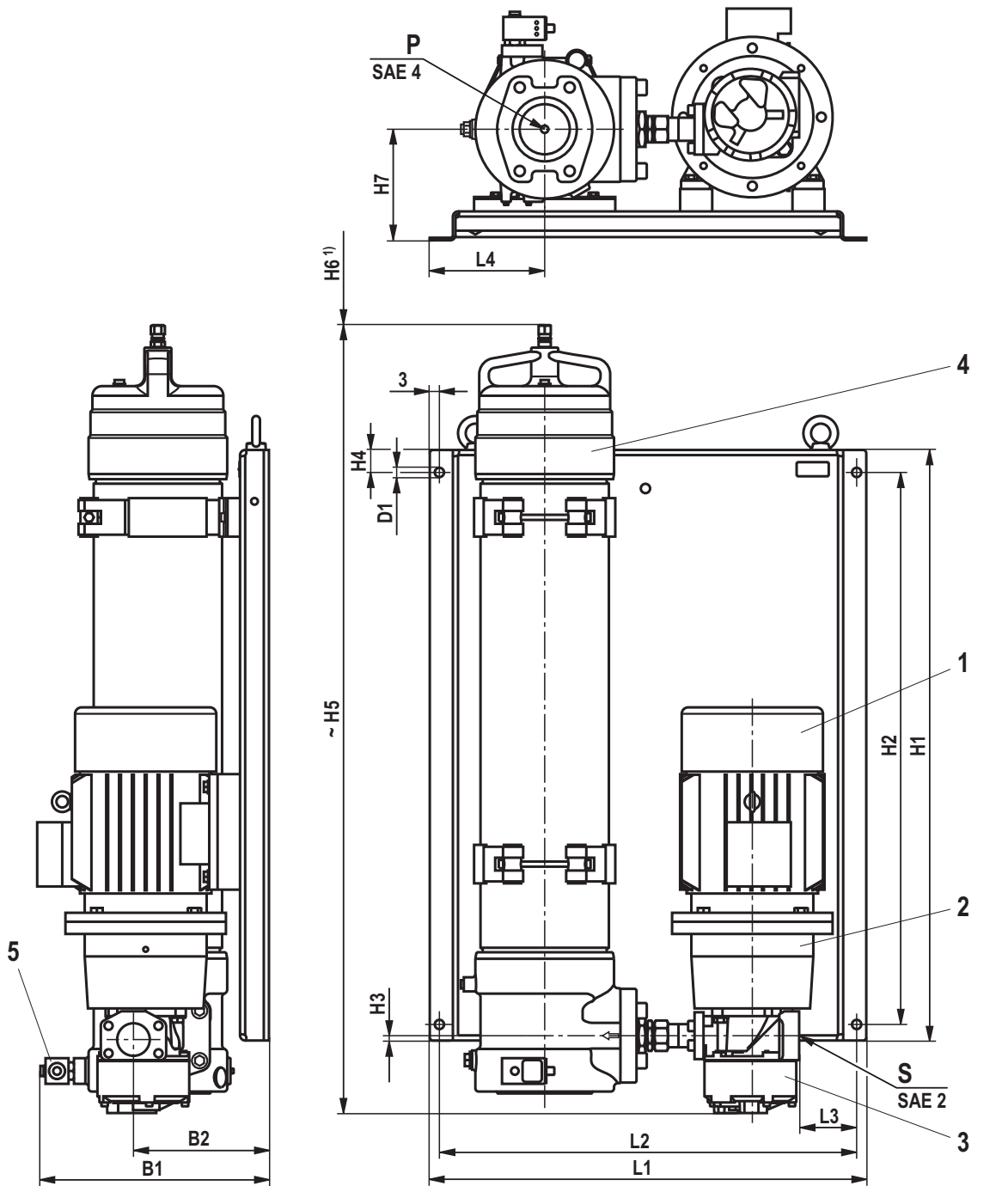
Filter type	q_v max in l/min	Frame size	S	P	L1	L2	L3	L4	B1	B2	H1	H2	H3	H4	H5	H6 ¹⁾	D1	
FLEN 0630	28	90S	SAE 1 1/2"	SAE 3"	610	580	75	58	350	188	440	370	32.5	35	700	400	14.5	
FLEN 0630	58	90L			610	580	75	58	350	188	440	440	370	32.5	35	700	400	14.5
FLE 0120	58	90L			610	580	75	59	350	188	440	440	370	32.5	35	1100	750	14.5
FLE 0120	88	100L			610	580	74	58	350	194	440	440	370	32.5	35	1100	750	14.5

¹⁾ Servicing height for filter element exchange

Tolerances according to:

- ▶ General tolerances ISO 2768-mK
- ▶ Tolerancing principle ISO 8015

Dimensions: Type ABUFG...FLE0270...
(dimensions in mm)



- 1 Electric motor
- 2 Pump carrier + coupling
- 3 Gerotor pump
- 4 Inline filter with maintenance indicator
- 5 Maintenance indicator with electronic switching element

Filter type	$q_{v \max}$ in l/min	Frame size	S	P	L1	L2	L3	L4	B1	B2	H1	H2	H3	H4	H5	H6 ¹⁾	D1
FLE 0270	88	100L	SAE 1 1/2"	SAE 4"	680	650	100	164	356	199	920	860	-7.5	35	1200	992	14.5
FLE 0270	186	112M	SAE 2"		680	650	90	117.9	356	211	920	860	-7.5	35	1250	992	14.5

¹⁾ Servicing height for filter element exchange

Tolerances according to:

- ▶ General tolerances ISO 2768-mK
- ▶ Tolerancing principle ISO 8015

Optional accessories and spare parts**Filter elements / replacement cartridge**

Filter type	Data sheet	Material no. 1 µm	Material no. 3 µm	Material no. 10 µm
7SL130	51426	R928055387	R928055460	R928046509
FLEN 0630	51401	R928055495	R928006015	R928006017
FLE 0120		R928045099	R928005763	R928005765
FLE 0270		R928055496	R928005826	R928005828

Notes

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Filter elements

Type 1.; 2.; 4.; 6.; 7. and 20. filter elements

RE 51420

Edition: 2014-12

Replaces: 05/14



HAD8040_d

- ▶ Sizes according to **DIN 24550**:
1. and 2. 0040 ... 1000
- ▶ Additional sizes:
1.0045 ... 2500; 2.0130; 2.0150
4.06 ... 4.20; 6.56 ... 560; 7.002 ... 008
20.0101 ... 1051
- ▶ Pressure differential resistance up to 330 bar [4786 psi]
- ▶ Filter rating: 1 to 800 μm
- ▶ Filter area: up to 4.8 m² [7440 in²]
- ▶ Operating temperature: -10 °C ... +100 °C [+14 °F ... +212 °F]

Features

- ▶ Filter media for numerous application ranges made of glass fiber material (water-absorbing also available), filter paper, wire mesh, fleece material and metal fiber fleece
- ▶ Cleanable wire mesh filter media
- ▶ Attainable oil cleanliness up to ISO 10/6/4 (ISO 4406)
- ▶ High dirt holding capacity and filtration performance due to multi-layer glass fiber technology and simultaneously a low initial pressure differential (ISO 3968)
- ▶ Extended product range for non-mineral oil based fluids
- ▶ Filter elements with high pressure differential stability

Contents

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Function, section	15
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Compatibility with permitted hydraulic fluids	19
Filter media	20 ... 28
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Ordering code

Filter element

Filter element type 1.

01	02	03	04	05	06	07	08
1.			-			-	0 -

Filter element ¹⁾

01	Design	1.
----	--------	----

Size

02	In accordance with DIN 24550	0040 0063 0100 0160 0250 0400 0630 1000
	In accordance with Bosch Rexroth standard	0045 0055 0120 0130 0150 0200 0270 2000 2500

Filter rating in μm

03	Nominal	Stainless steel wire mesh, recyclable (cleanable)	G10 G25 G40 G60 G100 G200 G500 G800
		Filter paper, non-reusable (not cleanable)	P10 P25
		Fleece material, non-reusable (not cleanable)	VS25 VS40 VS60
	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$)	Glass fiber material, non-reusable (not cleanable)	H1XL H3XL H6XL H10XL H20XL
		Metal fiber fleece, non-reusable (not cleanable)	M5 M10
	Water absorbing	Non-reusable (not cleanable)	AS3 ²⁾ AS6 ²⁾ AS10 ²⁾ AS20 ²⁾

Pressure differential

04	Max. admissible pressure differential of the filter element of 30 bar [435 psi]	A
	Max. admissible pressure differential of the filter element of 160 bar [2321 psi]	C

Ordering code Filter element

Filter element type 1.

01	02	03	04	05	06	07	08
1.			-			-	0

Element design

05	Standard adhesive	0
	Special adhesive	H ³⁾

Element design

06	Standard material	0
	Stainless steel 1.4571	V ⁴⁾

Bypass valve

07	Without bypass valve	0
----	----------------------	---

Seal

08	NBR seal	M
	FKM seal	V

1) For the admissible temperature ranges, see chapter "Technical data".

2) Only configurable with pressure differential A = 30 bar [435 psi]

3) Improved temperature and media resistance, only in conjunction with FKM "V" seal.

4) Only in conjunction with "H" special adhesive and FKM "V" seal

Order example:

1.0040 H10XL-A00-0-M

Material no.: R928005837

Other filter ratings and seal materials upon request.

Ordering code

Filter element

Filter element type 2.

01	02	03	04	05	06	07	08
2.			-			-	0 -

Filter element ¹⁾

01	Design	2.
----	--------	----

Size

02	In accordance with DIN 24550	0040 0063 0100 0160 0250 0400 0630 1000
	In accordance with Bosch Rexroth standard	0130 0150

Filter rating in μm

03	Nominal	Stainless steel wire mesh, recyclable (cleanable)	G10 G25 G40 G60 G100 G200 G500 G800
		Filter paper, non-reusable (not cleanable)	P10 P25
		Fleece material, non-reusable (not cleanable)	VS25 VS40 VS60
	Absolute (ISO 16889; $\beta_{x(e)} \geq 200$)	Glass fiber material, non-reusable (not cleanable)	H1XL H3XL H6XL H10XL H20XL
		Metal fiber fleece, non-reusable (not cleanable)	M5 M10
	Water absorbing	Non-reusable (not cleanable)	AS3 ²⁾ AS6 ²⁾ AS10 ²⁾ AS20 ²⁾

Pressure differential

04	Max. admissible pressure differential of the filter element of 30 bar [435 psi]	A
	Max. admissible pressure differential of the filter element of 330 bar [4786 psi]	B

Ordering code Filter element

Filter element type 2.

01	02	03	04	05	06	07	08
2.			-			-	0

Element design

05	Standard adhesive	0
	Special adhesive	H ³⁾

Element design

06	Standard material	0
	Stainless steel 1.4571	V ⁴⁾

Bypass valve

07	Without bypass valve	0
----	----------------------	---

Seal

08	NBR seal	M
	FKM seal	V

1) For admissible temperature ranges, see chapter, "Technical data".

2) Only configurable with pressure differential A = 30 bar [435 psi]

3) Improved temperature and media resistance, only in conjunction with FKM "V" seal

4) Only in conjunction with "H" special adhesive and FKM "V" seal

Order example:

2.0040 H10XL-A00-0-M

Material no.: R928006647

Other filter ratings and seal materials upon request.

Ordering code

Filter element

Filter element type 2.Z for 320PZR sandwich plate filter

01	02	03	04	05	06		
2.Z			-	B00	0	-	

Filter element ¹⁾

01	Design	2.Z
----	--------	------------

Size

02	In accordance with Bosch Rexroth standard	025 075 125
----	---	--

Filter rating in μm

03	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$)	Glass fiber material, non-reusable (not cleanable)	H3PZ H6PZ H10PZ H20PZ
----	---	--	--

Pressure differential

04	Max. admissible pressure differential of the filter element of 330 bar [4786 psi]	B00
----	---	------------

Bypass valve

05	Without bypass valve	0
----	-----------------------------	----------

Seal

06	NBR seal	M
	FKM seal	V

¹⁾ For admissible temperature ranges, see chapter, "Technical data"

Order example:

2.Z125 H10PZ-B00-0-M

Material no.: R928051781

Ordering code Filter element

Filter element type 2.0058 and 2.0059
for 16 FE inline filter and 16 FD duplex filter

01	02	03	04	05	06
2.			- A00 -		

Filter element ¹⁾

01	Design	2.
----	--------	----

Size

02	In accordance with Bosch Rexroth standard	0058 0059
----	---	--------------

Filter rating in μm

03	Nominal	Stainless steel wire mesh, recyclable (cleanable)	G10 G25 G40 G60 G100 G200 G500 G800
		Filter paper, non-reusable (not cleanable)	P10 P25
		Fleece material, non-reusable (not cleanable)	VS25 VS40 VS60
	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$)	Glass fiber material, non-reusable (not cleanable)	H1XL H3XL H6XL H10XL H20XL
	Water absorbing	Non-reusable (not cleanable)	AS3 AS6 AS10 AS20

Pressure differential

04	Max. admissible pressure differential of the filter element of 30 bar [435 psi]	A00
----	---	-----

Bypass valve

05	Filter element without bypass valve	0
	Filter element with bypass ventill – cracking pressure of 3 bar [43.5 psi]	6

Seal

06	NBR seal	M
	FKM seal	V

¹⁾ For admissible temperature ranges, see chapter, "Technical data"

Order example:
2.0058 H10XL-A00-6-M

Material no. R928007115

Other filter ratings and seal materials upon request

Ordering code

Filter element

Filter element type 4.

For 20 L inline filter

01	02	03	04	05	06	07	08
4.			-	A		-	0

Filter element ¹⁾

01	Design	4.
----	--------	----

Size

02	In accordance with Bosch Rexroth standard	06 10 20
----	---	----------------

Filter rating in μm

03	Nominal	Stainless steel wire mesh, recyclable (cleanable)	G10 G25 G40 G60 G100 G200 G500 G800
		Filter paper, non-reusable (not cleanable)	P10 P25
	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$)	Glass fiber material, non-reusable (not cleanable)	H1XL H3XL H6XL H10XL H20XL

Pressure differential

04	Max. admissible pressure differential of the filter element of 30 bar [435 psi]	A
----	---	---

Element design

05	Standard adhesive	0
	Special adhesive	H ²⁾

Element design

06	Standard material	0
	Stainless steel 1.4571	V ³⁾

Bypass valve

07	Without bypass valve	0
----	-----------------------------	---

Seal

08	NBR seal	M
	FKM seal	V

¹⁾ For admissible temperature ranges, see chapter "Technical data"

²⁾ Improved temperature and media resistance,
only in conjunction with FKM "V" seal

³⁾ Only in conjunction with "H" special adhesive and FKM "V" seal

Order example:

4.20 H10XL-A00-0-M

Material no.: R928046366

Other filter ratings and seal materials upon request.

Bosch Rexroth AG, RE 51420, edition: 2014-12

Ordering code Filter element

Filter element type 6.

For SE housing suction filter

01	02	03	04	05	06
6.			- S00 -	0	- 0

Filter element ¹⁾

01	Design	6.
----	--------	----

Size

02	In accordance with Bosch Rexroth standard	56 90 140 225 360 460 560
----	---	---

Filter rating in μm

03	Nominal	Stainless steel wire mesh, recyclable (cleanable)	G10 G25 G40 G60 G100 G200 G500 G800
		Filter paper, non-reusable (not cleanable)	P10 P25
		Fleece material, non-reusable (not cleanable)	VS25 VS40 VS60
	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$)	Glass fiber material, non-reusable (not cleanable)	H1XL H3XL H6XL H10XL H20XL

Pressure differential

04	Admissible pressure differential of the filter element of 1 bar [14.5 psi]	S00
----	--	-----

Bypass valve

05	Without bypass valve	0
----	-----------------------------	---

Seal

06	Without seal	0
----	---------------------	---

¹⁾ For admissible temperature ranges, see chapter "Technical data"

Order example:

6.140 H10XL-A00-0-0

Material no.: R928019715

Other filter ratings and seal materials upon request.

Ordering code

Filter element

Filter element type 7.

For TLF tank breathing filter

01	02	03	04	05	06
7.			-	-	0

Filter element ¹⁾

01	Design	7.
----	--------	----

Size

02	In accordance with Bosch Rexroth standard	002 004 006 007 008
----	---	---------------------------------

Filter rating in μm

03	Nominal	Stainless steel wire mesh, recyclable (cleanable)	G10 G25 G40 G60 G100 G200 G500 G800
		Filter paper, non-reusable (not cleanable)	P10 P25
	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$)	Glass fiber material, non-reusable (not cleanable)	H1XL H3XL H6XL H10XL H20XL
	Water absorbing	Non-reusable (not cleanable)	AS3 AS6 AS10 AS20

Pressure differential

04	Admissible pressure differential of the filter element of 1 bar [14.5 psi] – material standard	S00
	Admissible pressure differential of the filter element of 1 bar [14.5 psi] – stainless steel material	S0V ²⁾

Bypass valve

05	Without bypass valve	0
----	-----------------------------	---

Seal

06	NBR seal	M
	FKM seal	V

¹⁾ For admissible temperature ranges, see chapter, "Technical data"

²⁾ Only in conjunction with "H" special adhesive and FKM "V" seal

Order example:

7.006 H10XL-A00-0-M

Material no.: R928016626

Other filter ratings and seal materials upon request.

Ordering code Filter element

Filter element type 20.

For tank mounted return line filter 25TE

01	02	03	04	05	06
20.			- E00 -		

Filter element ¹⁾

01	Design	20.
----	--------	-----

Size

02	In accordance with Bosch Rexroth standard	0101 0201 0351 1051
----	---	------------------------------

Filter rating in µm

03	Nominal	Stainless steel wire mesh, recyclable (cleanable)	G10 G25 G40 G60 G100
		Filter paper, non-reusable (not cleanable)	P10 P25
	Absolute (ISO 16889; $\beta_{x(c)} \geq 200$)	Glass fiber material, non-reusable (not cleanable)	H3XL H6XL H10XL H20XL
		Water absorbing Non-reusable (not cleanable)	AS6 AS10 AS20

Pressure differential

04	Max. admissible pressure differential of the filter element of 20 bar [290 psi]	E00
----	---	-----

Bypass valve

05	With bypass valve	6
	Without bypass valve	0

Seal

06	NBR seal	M
	FKM seal	V

¹⁾ For the admissible temperature ranges, see chapter, "Technical data".

Order example:

20.0101 H10XL-E00-6-M

Material no.: R928053667

Other filter ratings and seal materials upon request.

Preferred types

Filter elements, type 1.

Type	Material no. Filter element, Filter rating in μm		
	H3XL	H6XL	H10XL
1.0040 H..XL-A00-0-M	R928005835	R928005836	R928005837
1.0063 H..XL-A00-0-M	R928005853	R928005854	R928005855
1.0100 H..XL-A00-0-M	R928005871	R928005872	R928005873
1.0130 H..XL-A00-0-M	R928037178	R928045104	R928037180
1.0150 H..XL-A00-0-M	R928037181	R928037182	R928037183
1.0160 H..XL-A00-0-M	R928005889	R928005890	R928005891
1.0250 H..XL-A00-0-M	R928005925	R928005926	R928005927
1.0400 H..XL-A00-0-M	R928005961	R928005962	R928005963
1.0630 H..XL-A00-0-M	R928005997	R928005998	R928005999
1.1000 H..XL-A00-0-M	R928006033	R928006034	R928006035
1.2000 H..XL-A00-0-M	R928041312	R928048158	R928040797
1.2500 H..XL-A00-0-M	R928041314	R928046806	R928040800

Filter elements, type 2.

Type	Material no. Filter element, Filter rating in μm		
	H3XL	H6XL	H10XL
2.0040 H..XL-A00-0-M	R928006645	R928006646	R928006647
2.0063 H..XL-A00-0-M	R928006699	R928006700	R928006701
2.0100 H..XL-A00-0-M	R928006753	R928006754	R928006755
2.0130 H..XL-A00-0-M	R928022274	R928022275	R928022276
2.0150 H..XL-A00-0-M	R928022283	R928022284	R928022285
2.0160 H..XL-A00-0-M	R928006807	R928006808	R928006809
2.0250 H..XL-A00-0-M	R928006861	R928006862	R928006863
2.0400 H..XL-A00-0-M	R928006915	R928006916	R928006917
2.0630 H..XL-A00-0-M	R928006969	R928006970	R928006971
2.1000 H..XL-A00-0-M	R928007023	R928007024	R928007025

Filter elements, type 2.Z

Type	Material no. Filter element, Filter rating in μm		
	H3PZ	H6PZ	H10PZ
2.Z025 H...PZ-B00-0-M	R928051771	R928053299	R928051773
2.Z075 H...PZ-B00-0-M	R928051775	R928051776	R928051777
2.Z125 H...PZ-B00-0-M	R928051779	R928051780	R928051781

Filter elements, type 2.0058 and 2.0059

Type	Material no. Filter element, Filter rating in μm		
	H3XL	H6XL	H10XL
2.0058 H...XL-A00-6-M	R928007113	R928007114	R928007115
2.0059 H...XL-A00-6-M	R928007131	R928007132	R928007133

Preferred types

Filter elements, type 4.

Type	Material no. Filter element, Filter rating H10XL in µm
4.06 H..XL-A00-0-M	R928028880
4.10 H..XL-A00-0-M	R928046351
4.20 H..XL-A00-0-M	R928046366

Filter element type 6.

Type	Material no. Filter element, Filter rating in µm	
	H10XL	G10
6.56 ...-S00-0-0	R928053777	R928046438
6.90 ...-S00-0-0	R928046448	R928046444
6.140 ...-S00-0-0	R928019715	R928027883
6.225 ...-S00-0-0	R928040938	R928046428
6.360 ...-S00-0-0	R928052226	R928046432
6.460 ...-S00-0-0	R928046435	R928037008
6.560 ...-S00-0-0	R928054604	R928039963

Filter elements, type 7.

Type	Material no. Filter element, Filter rating in µm P10
7.002 ...-S00-0-M	R928039681
7.004 ...-S00-0-M	R928016621
7.006 ...-S00-0-M	R928016624
7.007 ...-S00-0-M	R928016627

Filter elements, type 20.

Type	Material no. Filter element, Filter rating in µm			
	H3XL	H6XL	H10XL	H20XL
20.0101 ...-E00-6-M	R928054019	R928054020	R928053667	R928054021
20.0201 ...-E00-6-M	R928054022	R928054023	R928053669	R928054024
20.0351 ...-E00-6-M	R928054025	R928054026	R928053671	R928054027
20.1051 ...-E00-6-M	R928054028	R928054029	R928053672	R928054030

Assignment of filter elements to filter series

Element type (type)	Series	Application	Data sheet no. ¹⁾
1.	40FLE(N)	Inline filter	51401
	100FLE(N)		51402
	40FLD(N)	Duplex filter	51408
	100FLD(N)		51409
	40FLDK(N)		51407
	63FLDK(N) -1X		51445
	10TE(N)	Tank mounted return line filter	51424
	10FRE(N)		51425
	10TD(N)-1X	Tank mounted return line filters, switchable	51454
	10 FRD(N)		-

Element type (Type)	Series	Application	Data sheet no. ¹⁾
2.	40LE(N)	Inline filter	51400
	100LE(N)		51400
	50LE(N)		51447
	110LE(N)		51448
	245LE(N)		51421
	350LE(N)		51422
	445LEN		51423
	16FE		51403
	40/160 LD(N)	Duplex filter	51406
	250/450 LD(N)		51411
	50LD(N)		51453
	150LD(N)		51446
	400LD(N)		51429
	16FD		51410
	250/450FE(N)	Block mounting filter	51405
	245PSF(N)		51418
	350PSF(N)		51419
	450PBF(N)		51417

Element type (type)	Series	Application	Data sheet no. ¹⁾
2.Z	320PZR	Sandwich plate filter	51427
	320PZR/PZL-2X	Sandwich plate filter, generation 2X	51468

Element type (type)	Series	Application	Data sheet no. ¹⁾
4.	20 L	Inline filter	-

Element type (type)	Series	Application	Data sheet no. ¹⁾
6.	SE	Housing suction filter	-

Element type (type)	Series	Application	Data sheet no. ¹⁾
7.	TLF	Tank breathing filter	51415

Element type (type)	Series	Application	Data sheet no. ¹⁾
20.	25TE	Tank mounted return line filter	51472

¹⁾ For further information, please refer to the respective data sheet

Function, section

The filter element is the central component of industrial filters. The actual filtration process takes part here. The main filter variables, such as the retention capacity, dirt holding capacity and pressure loss, are determined by the filter elements used and the filter media used in them. Rexroth filter elements are used for the filtration of hydraulic fluids in the hydraulic system as well as for the filtration of lubricants, industrial fluids and gases.

1.; 2. and 20. filter elements

Filter elements consist of a combination of star-like, pleated filter media (3) which are laid around a perforated support tube (2). The 20. filter element also has a band to protect the filter element mat. The filter element is sealed in longitudinal direction with a two-component adhesive and the support tube and filter mat are connected to both end disks (1). One or two seal rings are provided to seal the filter element towards the filter housing.

Series 2.0058 and 2.0059 can be selected optionally with a bypass valve on the base of the filter element. The flow is generally from the outside to the inside.

All 1. and 2. filter elements of the Rexroth preferred program are made of zinc-free components to prevent the formation of zinc-soap, in particular if water-containing fluids (HFA/HFC) and synthetic oils are used.

The use of zinc-free filter elements prevents early “element blocking”, thus considerably increasing the life cycle of the elements.

Therefore, Rexroth filter elements can be used universally for typical hydraulic fluids and lubricants.

4. and 7. filter elements

Filter elements consist of a combination of star-like, pleated filter media (3) which are laid around a perforated support tube (2). The filter element is vertically sealed with a two-component adhesive and the support tube and filter mat are connected to both end disks (1). One or two seal rings are provided to seal the filter element towards the filter housing.

The flow is generally from the outside to the inside.

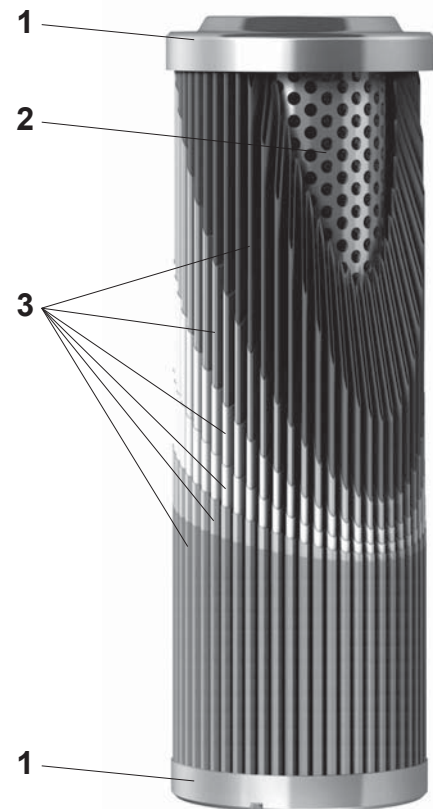
When using HFA/HFC and synthetic oils, a filter element made of stainless steel must be used.

6. filter elements

Filter elements consist of a composite of star-like, pleated filter media which are placed in perforated and external support tubes. The filter element is sealed in longitudinal direction with a two-component adhesive and the support tube and filter mat are connected to both end disks. The sealing of the filter element is part of the filter housing.

The flow is generally from the inside outwards.

When using HFA/HFC and synthetic oils, a filter element made of stainless steel must be used.



Type 2.0250

Filter variables

(for series 1.; 2.; 4.; 6. and 20.)

Filter rating and attainable oil cleanliness

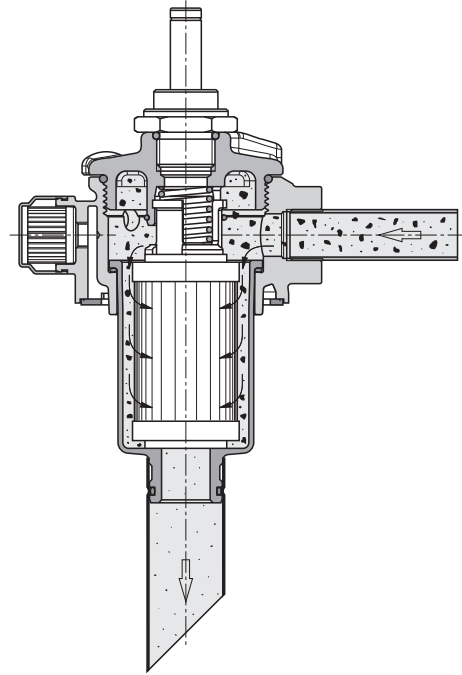
The main goal when using an industrial filter is not only the direct protection of machine components but to attain the required oil cleanliness. It is defined on the basis of oil

cleanliness classes which classify how the amount of particles of the existing contamination is distributed in the operating liquid.

Filtration performance

Filtration ratio $\beta_{x(c)}$ (β value)

The retention capacity of a hydraulic filter against contamination in a hydraulic system is characterized by the filtration ratio $\beta_{x(c)}$. This characteristic is the most important performance characteristic of a hydraulic filter. It is measured during the multipass test and is the average value between the defined initial and final pressure differential according to ISO 16889 using ISOMTD test dust. The filtration ratio $\beta_{x(c)}$ is defined as the quotient of the particle count of the respective particle size on both sides of the filter.



Dirt holding capacity

It is also measured using the multipass test and determines the amount of test dust ISOMTD which is fed to the filter medium until a specified pressure differential increase has been reached.

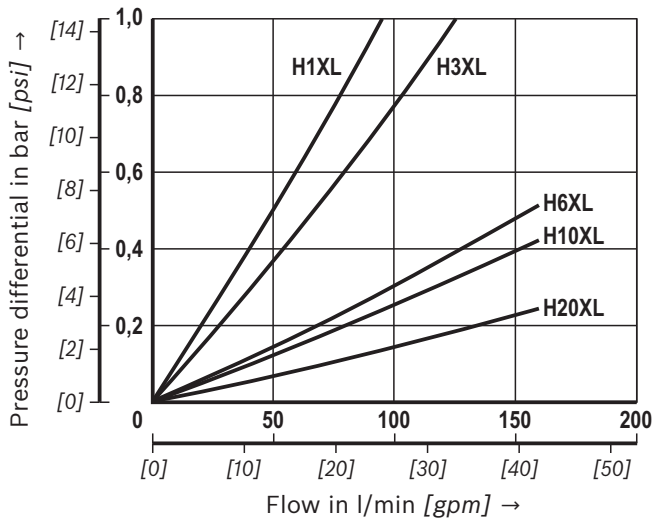
Pressure loss (also pressure differential or delta p)

The pressure loss of the filter element is the relevant characteristic value for the determination of the filter size. Here it concerns the filter manufacturer's recommendations or the filter user's specifications. This characteristic value depends on many factors. These are mainly: the rating of the filter medium, its geometry and arrangement in the filter element, the filter area, the operating viscosity of the fluid and the flow.

The term "delta p" is also indicated by the symbol: " Δp ". When dimensioning the complete filter with a filter element, an initial pressure loss is determined which must not be exceeded by the new filter element based on the aforementioned conditions.

The dimensioning of a Rexroth filter element and the new complete filter by means of the initial Δp or Δp pressure loss can easily be carried out via our online design software "BOSCH REXROTH FILTERSELECT".

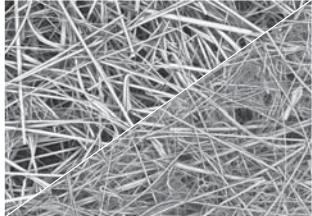
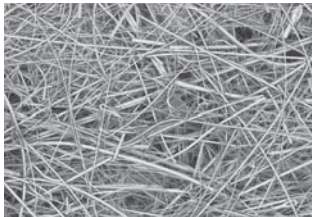
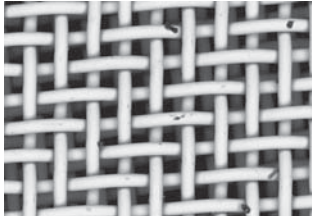
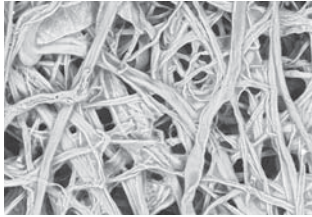
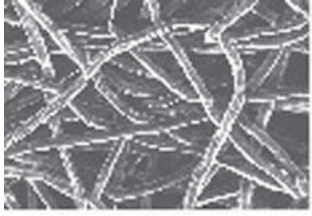
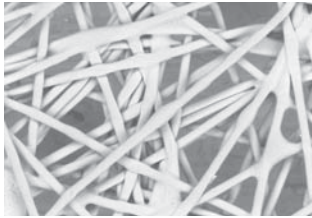
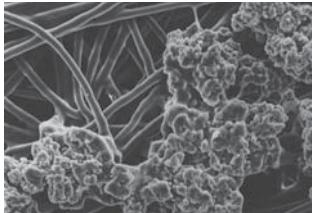
The following diagram shows the typical pressure loss behavior of filter elements with different filter media at different flow rates.



Filter variables

Overview

Different filter media in various ratings are used for the separation of particles, depending on the application and requirement.

Filter medium/set-up	Electron microscope image
<p>H...XL, glass fiber material Depth filter, combination of inorganic micro glass filter medium High dirt holding capacity due to multi-layer technique.</p>	
<p>H...PZ, glass fiber material Depth filter, combination of inorganic micro glass filter medium. Single-layer set-up variant by H...XL for use in sandwich plate filters.</p>	
<p>G..., stainless steel wire mesh material 1.4401 or 1.4571 Surface filter made of stainless steel wire mesh with supporting mesh.</p>	
<p>P..., filter paper Inexpensive depth filter made of filter paper with supporting mesh. Made of specially impregnated cellulose fibers to prevent humidity and swelling.</p>	
<p>M..., metal fiber fleece material 1.4404 Depth filter made of stainless steel fibers with supporting mesh.</p>	
<p>VS..., fleece material Surface filter made of extremely solid fiber composite materials in the form of polyethylene-covered polypropylene fibers.</p>	
<p>AS..., water absorbing Depth filter, fleece material with water-absorbing material, combined with micro glass filter media.</p>	

Technical data, preferred program

(please consult us for applications outside the specified values!)

General								
Weight (1. filter elements) ¹⁾	Size	1.0040	1.0063	1.0100	1.0130	1.0150	1.0160	
	kg	0.16	0.24	0.38	0.59	0.67	0.74	
	[lbs]	[0.35]	[0.53]	[0.83]	[1.30]	[1.47]	[1.63]	
	Size	1.0250	1.0400	1.0630	1.1000	1.2000	1.2500	
	kg	1.07	1.48	2.42	3.44	4.8	9.14	
	[lbs]	[2.36]	[3.26]	[5.33]	[7.58]	[10.58]	[20.15]	
Weight (2. filter elements) ¹⁾	Size	2.0040	2.0063	2.0100	2.0130	2.0150		
	kg	0.1	0.17	0.28	0.29	0.32		
	[lbs]	[0.22]	[0.38]	[0.61]	[0.66]	[0.7]		
	Size	2.0160	2.0250	2.0400	2.0630	2.1000		
	kg	0.5	0.75	1.14	1.5	2.58		
	[lbs]	[1.1]	[1.65]	[2.51]	[3.31]	[5.68]		
	Size	2.0058	2.0059	2.2025	2.2075	2.20125		
	kg	3.4	3.8	0.09	0.16	0.3		
	[lbs]	[7.7]	[8.5]	[0.2]	[0.35]	[0.66]		
Weight (4. filter elements) ¹⁾	Size	4.06		4.10		4.20		
	kg	0.170		0.200		0.225		
	[lbs]	[0.37]		[0.44]		[0.51]		
Weight (6. filter elements) ¹⁾	Size	6.56	6.90	6.140	6.225	6.360	6.560	
	kg	0.14	0.40	0.50	0.70	0.75	1.2	
	[lbs]	[0.31]	[0.88]	[1.10]	[1.54]	[1.65]	[2.65]	
Weight (7. filter elements) ¹⁾	Size	7.002	7.004	7.006	7.007	7.008		
	kg	0.12	0.26	0.46	1.28	1.6		
	[lbs]	[0.26]	[0.57]	[1.01]	[2.82]	[3.53]		
Weight (20. filter elements) ¹⁾	Size	20.0101	20.0201	20.0351	20.1051			
	kg	0.12	0.36	0.80	1.74			
	[lbs]	[0.26]	[0.79]	[1.76]	[3.84]			
Filtration direction	▶ 1.; 2.; 4.; 7.; 20. filter elements	from the outside inwards						
	▶ 6. filter elements	from the inside outwards						
Ambient temperature range		°C [°F]	-10 ... +65 [+14 ... +149] (for a short time down to -30 [-22])					
Storage conditions	▶ NBR seal	°C [°F]	-40 ... +65 [-40 ... +149]; max. relative humidity of 65 %					
	▶ FKM seal	°C [°F]	-20 ... +65 [-4 ... +149]; max. relative humidity of 65 %					
Material 1. and 2. filter elements	▶ Differential pressure stability	bar [psi]	30 [435]		160 [2321]		330 [4786]	
	▶ Cover/base		Polyamide		Galvanized steel	Galvanized aluminum		
	▶ Support tube		Galvanized steel					
	▶ Seals		NBR or FKM					
Material 4. filter elements	▶ Differential pressure stability	bar [psi]	30 [435]					
	▶ Cover		Polyamide					
	▶ Base		Galvanized steel					
	▶ Support tube		Galvanized steel					
	▶ Seals		NBR or FKM					
Material 6. filter element	▶ Differential pressure stability	bar [psi]	1 [14.5]					
	▶ Cover/base		Galvanized steel					
	▶ Support tube		Galvanized steel					
Material 7. filter element	▶ Differential pressure stability	bar [psi]	1 [14.5]					
	▶ Cover/base		Galvanized steel					
	▶ Support tube		Galvanized steel					
	▶ Seals		NBR or FKM					
Material 20. filter element	▶ Differential pressure stability	bar [psi]	20 [290]					
	▶ Cover/base		Plastic					
	▶ Support tube		Galvanized steel					
	▶ Seals		NBR or FKM					
	▶ Protective cage		Plastic					

¹⁾ Net weights are based on glass fiber material

Technical data, preferred program

(please consult us for applications outside the specified values!)

Hydraulic		
Minimum conductivity of the medium	pS/m	300

Admissible operating temperature range depends on the combination of materials.

Material	Code letter	Operating temperature range °C [°F]
Seal		
NBR	M	-40 ... +100 [-40 ... +212]
FKM	V	-20 ... +210 [-4 ... +410]
Filter element adhesive		
Standard	O	-40 ... +100 [-40 ... +212]
Special	H	-55 ... +170 [-67 ... +338]
Filter element material (cover, base, support tube)		
Standard	O	-40 ... +100 [-40 ... +212]
Stainless steel	V	-55 ... +170 [-67 ... +338]
Filter element material (filter material)		
Aquasorb	AS...	0 ... +160 [32 ... +320]
Stainless steel wire mesh	G...	-55 ... +500 [-67 ... +932]
Glass fiber material	H...XL	Up to +160 [up to +320]
Metal fiber fleece	M...	-55 ... +250 [-67 ... +482]
Filter paper	P...	Up to +130 [up to +266]
Fleece material	VS...	Up to +80 [up to +176]

Compatibility with permitted hydraulic fluids

Hydraulic fluid	Classification	1. ; 2. and 20. filter elements	Design, type key		Suitable sealing materials	Standards	
			4. and 7. filter elements	6. filter elements			
Mineral oil	HLP	A00 or B00 or C00 or E00	A00 or S00	S00	NBR	DIN 51524	
Bio-degradable ▶ Insoluble in water	HETG		A0V or S0V (stainless steel)	A0V or S0V (stainless steel)	Not possible	NBR	VDMA 24568
	HEES					FKM	
▶ Soluble in water	HEPG		FKM			VDMA 24568	
Flame-resistant ▶ Water free	HFDU, HFDR		FKM			VDMA 24317	
	▶ Containing water		HFAS			NBR	DIN 24320
			HFAE			NBR	
			HFC			NBR	VDMA 24317

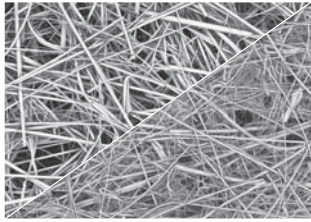
**Important information on hydraulic fluids:**

- ▶ For more information and data on the use of other hydraulic fluids, refer to data sheet 90220 or contact us!
- ▶ **Flame resistant - containing water:** due to possible chemical reactions with materials or surface coatings of machine and system components, the service life with these hydraulic fluids may be less than expected.

Filter materials made of filter paper (cellulose) must not be used, filter elements with glass fiber material must be used instead.

- ▶ **Bio-degradable:** If filter materials made of filter paper are used, the filter life may be shorter than expected due to material incompatibility and swelling.

Filter media

Technical data	H...XL
<p>Glass fiber fleece, H...XL</p> <p>The filter medium achieves the best possible degree of cleanliness compared to other filter media. It is suitable for fluids such as hydraulic oils, lubricants and chemical and industrial fluids. Due to its defined retention capacity (ISO 16889), it offers highly effective protection for machines and system components which are sensitive to contamination.</p> <ul style="list-style-type: none"> ▶ H...XL depth filter made of inorganic glass fiber material ▶ Absolute filtration/defined retention capacity according to ISO 16889 ▶ High dirt holding capacity due to multi-layer design ▶ Non-reusable filter (not cleanable due to depth filtration effect) 	
<p>Filter rating and attainable oil cleanliness</p> <p>The following table provides recommendations for the selection of a filter medium depending on the application and specifies the average oil cleanliness class attainable according to ISO 4406 or SAE-AS 4059.</p>	

Glass fiber material

Oil cleanliness class ISO 4406	to be achieved with filter			Hydraulic system	
	$\beta_{x(c)} = 200$	Materials	Possible arrangement		
10/6/4 - 14/8/6	1 μm	Glass fiber material H...XL	Return flow or pressure filter	-----	Special applications
13/10/8 - 17/13/10	3 μm			-----	Servo valves
15/12/10 - 19/14/11	6 μm			-----	High-response valves
17/14/10 - 21/16/13	10 μm			---	Proportional valves
19/16/12 - 22/17/14	20 μm			-	General pumps and valves

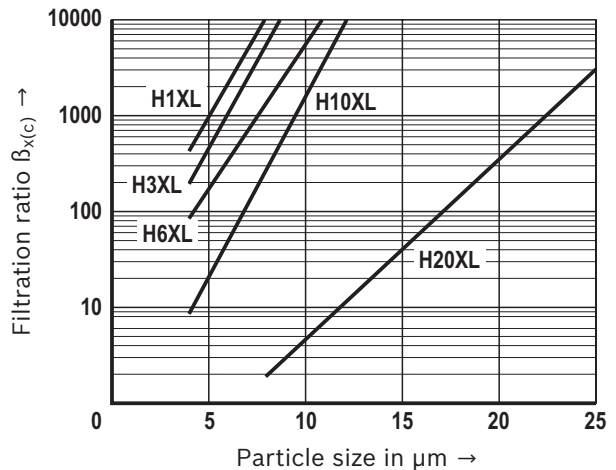
Achievable filtration ratio $\beta_{x(c)}$ (β value)

Typical β values up to 2.2 bar [31.9 psi] Δp pressure increase at the filter element ¹⁾

Filter medium	Particle size "x" for various β values, measurement according to ISO 16889		
	$\beta_{x(c)} \geq 75$	$\beta_{x(c)} \geq 200$	$\beta_{x(c)} \geq 1000$
H1XL	< 4.0 $\mu\text{m}(c)$	< 4.0 $\mu\text{m}(c)$	< 4.0 $\mu\text{m}(c)$
H3XL	4.0 $\mu\text{m}(c)$	< 4.5 $\mu\text{m}(c)$	5.0 $\mu\text{m}(c)$
H6XL	4.8 $\mu\text{m}(c)$	5.5 $\mu\text{m}(c)$	7.5 $\mu\text{m}(c)$
H10XL	6.5 $\mu\text{m}(c)$	7.5 $\mu\text{m}(c)$	9.5 $\mu\text{m}(c)$
H20XL	18.5 $\mu\text{m}(c)$	20.0 $\mu\text{m}(c)$	22.0 $\mu\text{m}(c)$

¹⁾ Filtration ratio $\beta_{x(c)}$ for other filter media upon request

Filtration ratio $\beta_{x(c)}$ as a function of the particle size $\mu\text{m}(c)$





Filter media

Technical data

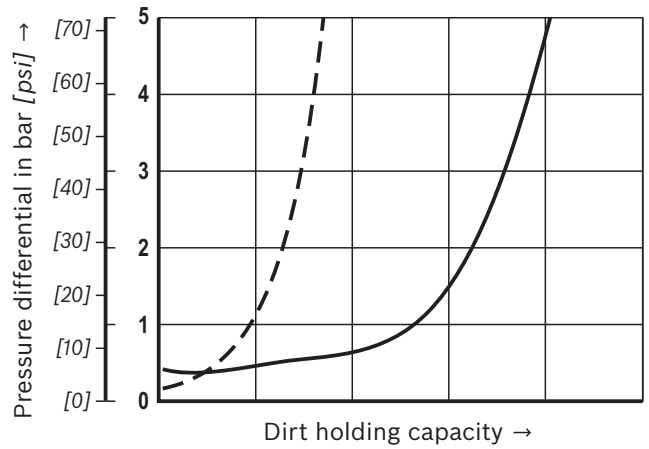
H...XL

Dirt holding capacity

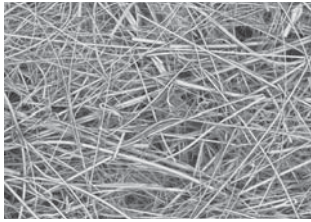
Compared to conventional filter media with single layer technology, the filter material H...XL features a high dirt holding capacity because it is made of two separate filter layers connected in series.

Conventional filter element 
 (single-layer glass fiber material)
Rexroth H...XL filter element 
 (multi-layer glass fiber material)

Superior dirt holding capacity of H...XL filter elements



Filter media

Technical data	H...PZ
<p>Glass fiber material, H...PZ The filter medium achieves the best possible degree of cleanliness compared to other filter media. It is suitable for hydraulic oil. Due to its defined retention capacity (ISO 16889), it offers highly effective protection for machines and system components which are sensitive to contamination.</p> <ul style="list-style-type: none"> ▶ Depth filter made of inorganic glass fiber material ▶ Absolute filtration/defined retention capacity according to ISO 16889 ▶ Non-reusable filter (not cleanable due to depth filtration effect) 	
<p>Filter rating and attainable oil cleanliness The following table provides recommendations for the selection of a filter medium depending on the application and specifies the average oil cleanliness class attainable according to ISO 4406 or SAE-AS 4059.</p>	

Glass fiber material

Oil cleanliness class ISO 4406	to be achieved with filter			Hydraulic system
	$\beta_{x(c)} = 200$	Material	Possible arrangement	
13/10/8 - 17/13/10	3 μm	Glass fiber material H...PZ	Sandwich plate filter 320PZ...	Vertical stacking (sandwich plate assembly)
15/12/10 - 19/14/11	6 μm			
17/14/10 - 21/16/13	10 μm			
19/16/12 - 22/17/14	20 μm			

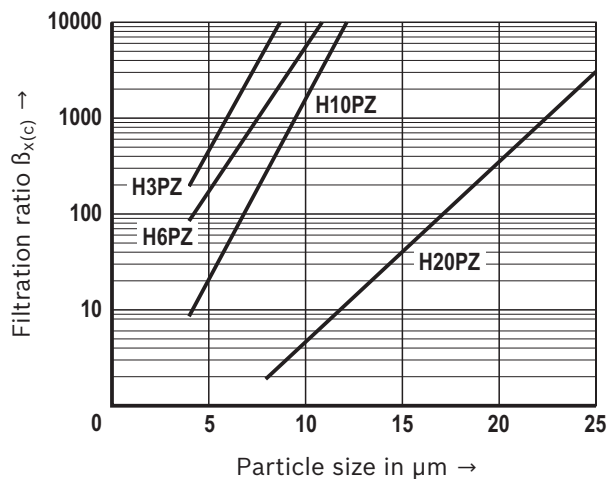
Achievable filtration ratio $\beta_{x(c)}$ (β value)

Typical β values up to 2.2 bar [31.9 psi] Δp pressure increase at the filter element ¹⁾

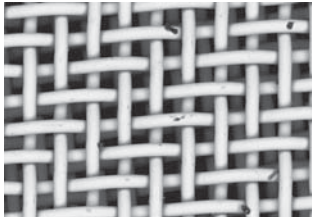
Filter medium	Particle size "x" for various β values, measurement according to ISO 16889		
	$\beta_{x(c)} \geq 75$	$\beta_{x(c)} \geq 200$	$\beta_{x(c)} \geq 1000$
H3PZ	4.0 $\mu\text{m}(c)$	< 4.5 $\mu\text{m}(c)$	5.0 $\mu\text{m}(c)$
H6PZ	4.8 $\mu\text{m}(c)$	5.5 $\mu\text{m}(c)$	7.5 $\mu\text{m}(c)$
H10PZ	6.5 $\mu\text{m}(c)$	7.5 $\mu\text{m}(c)$	9.5 $\mu\text{m}(c)$
H20PZ	18.5 $\mu\text{m}(c)$	20.0 $\mu\text{m}(c)$	22.0 $\mu\text{m}(c)$

¹⁾ Filtration ratio $\beta_{x(c)}$ for other filter media upon request

Filtration ratio $\beta_{x(c)}$ as a function of the particle size $\mu\text{m}(c)$



Filter media

Technical data	G...
<p>Stainless steel wire mesh, G... There is a comprehensive field of applications for wire mesh filter media. Not only pre-filtration is possible, but also the filtration of lubricating oils, hydraulic oils, coolants and water-like fluids.</p> <p>Wire mesh G10 ... G40 As surface filters, these materials are generally cleanable. Due to their fine mesh, however, cleaning is more difficult than with coarser filter meshes. Therefore, we recommend cleaning them in an ultrasonic bath.</p> <p>Wire mesh G60 ... G800 Due to their coarser mesh sizes, these filter media are more easier to clean.</p> <ul style="list-style-type: none"> ▶ Surface filter made of stainless steel wire mesh ▶ Recyclable, cleanable ▶ Pleated design: single, two or three-layer design 	

Filter medium	Design	Mesh size
G10	Special Dutch weave	10 µm nom.
G25	Woven roving	25 µm nom.
G40		40 µm nom.
G60 ... G800	Plain woven cloth	60 ... 800 µm nom.

Stainless steel wire mesh

Oil cleanliness class ISO 4406	To be achieved with filter			Fluid system
	Nominal	Material	Possible arrangement	
20/18/13 - 21/20/15	10 µm	Stainless steel wire mesh, G...	Return flow, pressure or suction filter	----- For existing systems (hydraulic) and as a protection filter (G10, G25)
Not applicable for wire mesh > 10 µm	25 ... 800 µm			All fluids e.g.: <ul style="list-style-type: none"> ▶ Lubricants: ▶ Petrochemicals ▶ Water filters ▶ Cooling systems/thermal oils

Filter media

Technical data

G...

Cleaning of filter elements

Cleaning or replacing

Before cleaning a G...- element, the filter element has to be dismantled first and then checked whether it makes sense to clean the element. For example, effective and complete cleaning is not possible in many cases if the cloth contains many fibrous substances and consists of a material finer than G40. Filter mesh which has visible damage due to frequent cleaning must be replaced. In general, the following applies: the finer the cloth, the thinner the wire. Therefore, especially fine mesh must be cleaned gently to protect the material. Cracks in the seams of the wire mesh are to be avoided. Otherwise, the filter capacity will be insufficient.

Cleaning frequency

Experience has shown that filter elements made of G10, G25 and G40 can be cleaned up to ten times. Filter mesh > 60 µm can usually be cleaned more than ten times. Re-usability, however, very much depends on the type of contamination as well as on the pressurization (final Δp before dismantling the filter element). For maximum re-usability, we therefore recommend replacing in particular the fine mesh at a final Δp of 2.2 bar [31.9 psi] at the latest. Due to the given reasons, the aforementioned values must be regarded as reference values for which we do not assume any liability.

Recommendations for cleaning

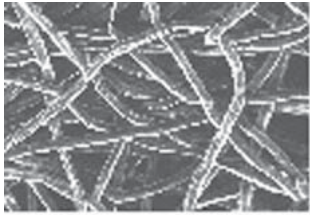
Manual and simple cleaning method for G... elements

Procedure	Wire mesh G10, G25, G40	Wire mesh G60 ... G800
Chemical pre-cleaning	Let the filter element drain for approx. 1 hour after disassembly. Wash it out in solvent afterwards.	
Mechanical pre-cleaning	Remove rough dirt with a brush or scrubber. Do not use any hard or pointed objects which could damage the filter medium.	
Mechanical/chemical main cleaning	Put a pre-cleaned element in an ultrasonic bath with special solvent. Clean the element in the ultrasonic bath until any visible contamination is removed.	Evaporate with hot washing solution (water with corrosion protection agent)
Inspection	Visually inspect whether the material is intact. Replace the filter element if you identify any obvious damage.	
Preservation	After drying, you must spray the cleaned element with preservative agent and store it sealed against dust in a plastic foil.	

Automated cleaning for G... elements

Procedure	Wire mesh G10, G25, G40, G60 ... G800
Chemical pre-cleaning	Let the filter element drain for approx. 1 hour after disassembly. Wash it out in solvent afterwards.
Mechanical/chemical main cleaning	By means of special cleaning systems for filter elements. Most of these systems are provided with fully automated and combined cleaning including ultrasonic as well as mechanical and chemical cleaning. This allows for best possible cleaning results with gentle cleaning processes.

Filter media

Technical data	M...
<p>Metal fiber fleece, M... Metal fiber fleece is used to achieve a high degree of cleanliness for special fluids or high operating temperatures. It provides effective protection for machine parts sensitive to contamination due to absolute filtration. Since this material is made of stable and tightly bound interwoven stainless steel fibers, it counts as a depth filter media and is classified as not cleanable.</p> <ul style="list-style-type: none"> ▶ Absolute filtration, measurement according to ISO 16889 ▶ Depth filter made of stainless steel fibers ▶ Non-reusable filter ▶ Pleated design: two or three-layer design ▶ Supporting mesh: epoxy or stainless steel wire mesh 	

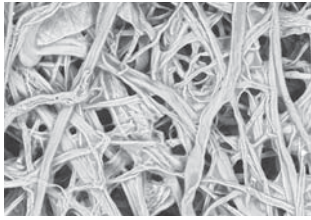
Filter medium	Particle size for filtration ratio > 75 ¹⁾
M5	5 µm
M10	10 µm

¹⁾ in accordance with ISO 16889

Metal fiber fleece

Oil cleanliness class ISO 4406	To be achieved with filter			Hydraulic system
	$\beta_{x(c)} = 75$	Material	Possible arrangement	
16/13/10 - 20/15/11	5 µm	Metal fiber fleece M...	Return flow or pressure filter	----- Filter material for special applications
18/14/10 - 21/17/13	10 µm			

Filter media

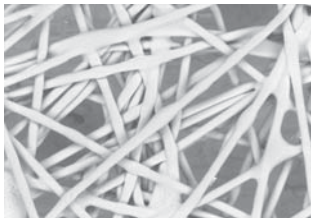
Technical data	P...
<p>Filter paper, P... Filter paper is used for the filtration of lubricating oil and for pre-filtration. It has the following features:</p> <ul style="list-style-type: none"> ▶ Depth filter made of cellulose fibers ▶ Specially impregnated against swelling caused by humidity ▶ Pleated design: single, two or three-layer design ▶ Non-reusable filter (not cleanable due to the depth filtration effect) 	

Filter medium	Nominal filter rating	Filtration ratio β values ¹⁾	Retention rate at 10 μm ¹⁾
P10	10 μm	$\beta_{10(c)} > 2.0$	50 %
P25	25 μm	$\beta_{10(c)} > 1.25$	20 %

¹⁾ in accordance with ISO 16889

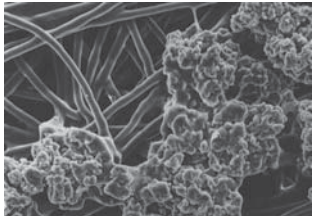
Filter paper

Oil cleanliness class ISO 4406	To be achieved with filter			Hydraulic system
	$\beta_{x(c)} = 200$	Material	Possible arrangement	
20/19/14 - 22/20/15	10 μm	Paper P...	Return flow or pressure filter	----- For existing systems
21/20/15 - 22/21/16	25 μm			

Technical data	VS...
<p>Fleece material, VS... The fleece material VS... serves for filtration of coolants, water and water-based media. It is also possible to use this filter medium for the filtration of emulsions or generally for pre-filtration.</p> <ul style="list-style-type: none"> ▶ Depth filter material made of polyolefin fibers ▶ Free of binding agents ▶ Heat-set ▶ Extremely resistant ▶ Pleated design: one or two layer design ▶ Supporting mesh: epoxy-coated or stainless steel wire mesh ▶ Non-reusable filter (not cleanable due to the depth filtration effect) 	

Filter medium	Nominal filter rating
VS 25	25 μm
VS 40	40 μm
VS 60	60 μm


Filter media

Technical data	AS...
<p>Water absorbing, AS...</p> <p>AS ... Aquasorb filter elements adsorb humidity from ventilation filters as well as free water from hydraulic fluids and lubricating oils. Water can accelerate oil aging through oxidation even at low concentration above the saturation point of the oil. This results in increased corrosion and increased wear. In certain oil additives it can also cause a change or a failure in the form of solid, mucus-like substances which then prematurely clog the pores of the filter. Highly effective separation of contamination is additionally provided by its combination with glass fiber filter media.</p> <ul style="list-style-type: none"> ▶ Absolute filtration ISO 16889 ▶ Surface filter made of water-absorbing filter fleece ▶ Combined with non-woven glass fiber media ▶ Non-reusable filter (not cleanable due to the depth filtration effect) ▶ Pleated design: multi-layer design 	

Filter medium	Particle size $\beta_{x(c)} = 200$ ¹⁾	Particle size $\beta_{x(c)} = 1000$ ¹⁾
AS3	4.5 $\mu\text{m}(c)$	5.0 $\mu\text{m}(c)$
AS6	5.5 $\mu\text{m}(c)$	7.5 $\mu\text{m}(c)$
AS10	7.5 $\mu\text{m}(c)$	9.5 $\mu\text{m}(c)$
AS20	20 $\mu\text{m}(c)$	22 $\mu\text{m}(c)$

¹⁾ in accordance with ISO 16889

Aquasorb

Oil cleanliness class ISO 4406	To be achieved with filter			Hydraulic system		
	$\beta_{x(c)} = 200$	Material	Possible arrangement			
13/10/8 - 17/13/10	3 μm	Aquasorb AS...	Return flow, bypass or breathing filter		-----	Servo valves
15/12/10 - 19/14/11	6 μm				-----	High-response valves
17/14/10 - 21/16/13	10 μm				---	Proportional valves
19/16/12 - 22/17/14	20 μm				-	General pumps and valves

Functional principle

Rexroth Aquasorb filter elements are pleated just like Rexroth industrial filter elements, however they contain a layer of fleece material on a water-binding fabric in the form of a fine granulate. The corresponding non-woven glass fiber media is combined behind this fleece material, depending on the filter rating.

Effectiveness

The effectiveness of the Rexroth Aquasorb elements has been proven by internal testing and by a scientific examination at an independent institute. The water content (free water) can be reduced to the saturation point of the oil. The effectiveness and water absorption depend on the load on filter area, the viscosity of the oil and the oil temperature. The values of water absorption and the change at higher viscosities are specified below.

Design and area of application

Rexroth Aquasorb filter elements must be dimensioned so that an initial pressure drop of 0.2 bar [2.9 psi] is not exceeded. They should be preferably used as a bypass filter in the low pressure range < 5 bar [72.5 psi]. The replacement of the filter element must be carried out at a pressure differential of at least 2.2 bar [31.9 psi].

Rexroth Aquasorb can be used only in HLP and HEES.

Filter media

Technical data	AS...
-----------------------	--------------

Type	Rated flow in l/min [US gpm]	Calculated water absorption			
		at 15 cst in ml	at 30 cst in ml	at 46 cst in ml	at 120 cst in ml
1.0040	5 [1.33]	60	40	35	20
1.0063	8 [2.21]	100	70	55	35
1.0100	14 [3.57]	160	110	90	60
1.0130	19 [5.01]	225	155	130	85
1.0150	30 [8.03]	360	250	210	135
1.0160	20 [5.25]	265	185	155	100
1.0250	32 [8.57]	435	305	255	165
1.0400	40 [10.57]	785	550	455	300
1.0630	66 [17.32]	1290	900	750	490
1.1000	97 [25.67]	1435	1005	830	545
1.2000	189 [49.85]	2785	1950	1615	1055
1.2500	197 [51.94]	3650	2555	2115	1385

Type	Rated flow in l/min [US gpm]	Calculated water absorption			
		at 15 cst in ml	at 30 cst in ml	at 46 cst in ml	at 120 cst in ml
2.0040	3 [0.74]	35	25	20	15
2.0063	5 [1.25]	55	40	30	20
2.0100	8 [2.01]	90	65	50	35
2.0130	9 [2.48]	110	75	65	40
2.0150	12 [3.24]	145	105	85	55
2.0160	17 [4.50]	200	140	115	75
2.0250	28 [7.27]	325	225	190	125
2.0400	45 [11.90]	525	370	305	200
2.0630	46 [12.17]	715	500	415	270
2.1000	73 [19.40]	835	585	485	315
2.0058	105 [27.7]	1545	1080	895	585
2.0059	121 [32.05]	1790	1250	1035	680

Installation, commissioning, maintenance

When does the filter element have to be replaced or cleaned?

As soon as the dynamic pressure or the pressure differential set on the maintenance indicator is reached, the red pushbutton of the optical-mechanical maintenance indicator pops out. In addition an electrical signal is issued if an electronic switching element is present. In this case, the filter element must be replaced or cleaned.

If the filter does not have a maintenance indicator, we recommend replacing or cleaning filter elements after a maximum of 6 months.

Filter element exchange

- ▶ With single filters:
Switch off the system and relieve the filter on the pressure side.
- ▶ With duplex switch filters installed:
Refer to the relevant maintenance instructions according to the data sheet.

Detailed instructions with regard to the exchange of filter elements can be found on the data sheet of the relevant filter series.

WARNING!	
<ul style="list-style-type: none"> ▶ Filters are containers under pressure. Before opening the filter housing, check whether the system pressure at the filter has been decreased to the ambient 	<p style="margin: 0;">pressure. Only then may the filter housing be opened for maintenance purposes.</p>

Note:

- ▶ From a cold start, the preset optical maintenance indicator signal may be exceeded due to the high viscosity. After reaching the operating temperature, the mechanical optical display can be acknowledged manually. The electrical signal will go out after the operating temperature has been reached. If the maintenance indicator signal is ignored, the disproportionately increasing

pressure differential may damage the filter element (causing it to collapse).

- ▶ Warranty will become void if the delivered item is modified by the ordering party or third parties or improperly mounted, installed, serviced, repaired or used or exposed to environmental conditions that do not comply with the installation conditions.

Directives and standardization

Rexroth filter elements are tested and quality-monitored according to different ISO test standards:

Filtration performance test (multipass test)	ISO 16889:2008-06
Δp (pressure loss) characteristic curves	ISO 3968:2001-12
Compatibility with the hydraulic fluid	ISO 2943:1998-11
Collapse pressure test	ISO 2941:2009-04

The development, manufacture and installation of Rexroth industrial filters and Rexroth filter elements is carried out within the framework of a certified quality management system in accordance with ISO 9001:2000.

Notes

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The data specified only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release users from the responsibility of making their own judgment and verification.
It must be remembered that our products are subject to a natural process of wear and aging.

Maintenance indicator for filters

RE 51450/03.11

1/8

Type WE and WO

Pressure differential indicators WO for filters in pressure lines
 Backpressure indicators WO for return line filters
 Electronic switching elements WE

Nominal pressure 10, 160 and 450 bar [145, 2321 and 6527 psi]
 Operating temperature WO -30 °C to $+100\text{ °C}$ [-22 °F to 212 °F]
 Operating temperature WE -30 °C to $+85\text{ °C}$ [-22 °F to 185 °F]



H7857_d

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Features

- Maintenance indicators serve the monitoring of filters by indicating the exceedance of a pressure differential and/or a backpressure in the filter.
- They distinguish themselves by the following:
- Modular structure
 - Mechanical-optical indicators WO with one switching point and memory function
 - Electronic switching elements WE with one or two switching points
 - Possibility to suppress the signal during cold start

Ordering code

of the mechanical optical maintenance indicator

WO	—	—	—	—	—
----	---	---	---	---	---

Maintenance indicator

Mechanical optical

= WO

Design

Backpressure, connection M30x1.5

= S01

Pressure differential, connection M20x1.5

= D01

Switching pressure

bar	S01	S01 (PA)	D01 (160 bar)	D01 (450 bar)	
0,8	X		X		= 0.8
1.5	X		X		= 1.5
2.2	X	X	X	X	= 2.2
5.0				X	= 5.0
8.0				X	= 8.0

Complementary details

without = No complementary details

-PA = Backpressure indicator mode of plastic (only with S01-2.2)

Max. operating pressure

S01

10 bar [145 psi]

D01

160 bar [2321 psi]

160 = 160 bar [2321 psi]

450 = 450 bar [6527 psi]

Seal

NBR seal

M =

FKM seal

V =

Material numbers of the mechanical optical maintenance indicators - Pressure differential

Material no.	Type	Switching pressure in bar [psi]	Tolerance in bar [psi]	Material	Maximum operating pressure in bar [psi]
R901025313	WO-D01-5,0-M-450	5,0	±0,5	Brass	up to 450 [6527]
R901066235	WO-D01-5,0-V-450	[72.5]	[7.3]		
R928038785	WO-D01-8,0-M-450	8,0	±0,8		
R928038784	WO-D01-8,0-V-450	[116]	[11.6]		
R928038783	WO-D01-2,2-M-450	2.2	±0.3		
R928038782	WO-D01-2,2-V-450	[31.9]	[4.4]		
R901025312	WO-D01-2,2-M-160	2.2	±0.3	Aluminum	up to 160 [2321]
R901066233	WO-D01-2,2-V-160	[31.9]	[4.4]		
R928038781	WO-D01-1,5-M-160	1.5	±0.2		
R928038780	WO-D01-1,5-V-160	[21.8]	[2.9]		
R928038779	WO-D01-0,8-M-160	0.8	±0.15		
R928038778	WO-D01-0,8-V-160	[11.6]	[2.2]		

Material numbers of the mechanical optical maintenance indicators - Backpressure

Material no.	Type	Switching pressure in bar [psi]	Tolerance in bar [psi]	Material	Maximum operating pressure in bar [psi]
R901025310	WO-S01-2,2-M-10	2.2	±0.3	Aluminum	up to 10 [145]
R901066232	WO-S01-2,2-V-10	[31.9]	[4.4]		
R928038776	WO-S01-1,5-M-10	1.5	±0.2		
R928038774	WO-S01-1,5-V-10	[21.8]	[2.9]		
R928038773	WO-S01-0,8-M-10	0.8	±0.15		
R928038772	WO-S01-0,8-V-10	[11.6]	[2.2]		
R928038771	WO-S01-2,2-M-10-PA	2.2	±0.44 [6.4]	PA6.6	up to 10 [145]
R928038769	WO-S01-2,2-V-10-PA	[31.9]	±0.3 [4.4]		

Ordering code

of the electronic switching element

WE		
Maintenance indicator		Connector
Electronic switching element	= WE	M12x1 = Round plug-in connection M12x1, 4-pin
Type of signal		EN 175301-803 = Rectangular plug-in connection, 2-pin design A according to EN-175301-803
1 switching point	= 1SP	
2 switching points, 3 LED	= 2SP	
2 switching points, 3 LED and signal suppression at 30°C [86 °F]	= 2SPSU	

Material numbers of the mechanical optical maintenance indicators

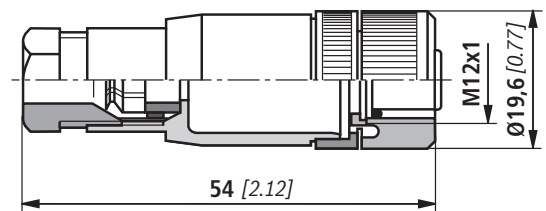
Material no.	Type	Signal	Switching points	Connector	LED
R928028409	WE-1SP-M12x1	Changeover	1	M12x1	No
R928028410	WE-2SP-M12x1	Normally open (at 75 %) / normally closed contact (at 100 %)	2		3 pieces
R928028411	WE-2SPSU-M12x1				No
R928036318	WE-1SP-EN175301-803	Normally closed contact	1	EN 175301-803	No

Mating connectors according to IEC 60947-5-2 (dimensions in mm [inch])

For electronic switching element with round plug-in connection M12x1

Mating connector suitable for K24 4-pin, M12x1 with screw connection, cable gland Pg9.

Material no. R900031155



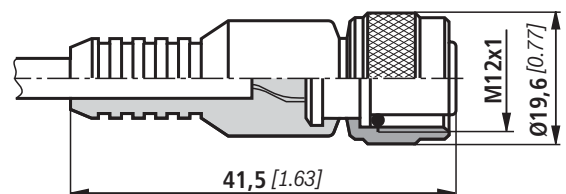
Mating connector suitable for K24-3m 4-pin, M12x1 with potted-in PVC cable, 3 m long.

Line cross-section: 4 x 0.34 mm²

Core marking:

1	Brown
2	White
3	Blue
4	Black

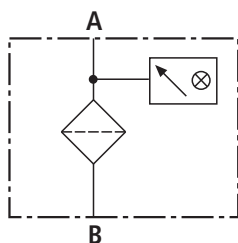
Material no. R900064381



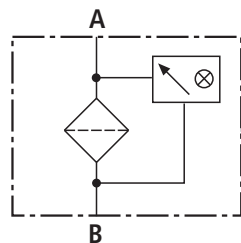
For more round plug-in connections refer to data sheet 08006.

Symbols

Mechanical optical backpressure indicator
with a return line filter without bypass



B

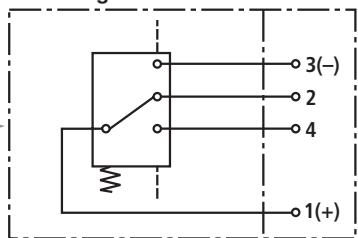


B

Mechanical optical pressure differential indicator
with a line filter without bypass

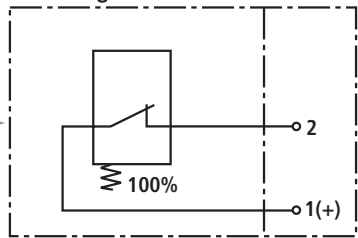
**Electronic switching element
for maintenance indicator**

Switching element Connector



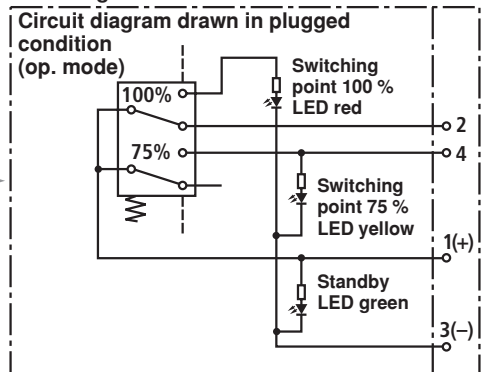
WE-1SP-M12x1

Switching element Connector



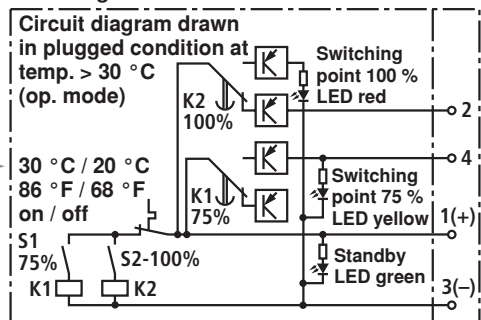
WE-1SP-EN175301-803

Switching element Connector



WE-2SP-M12x1

Switching element Connector



WE-2SPSU-M12x1

Function, section

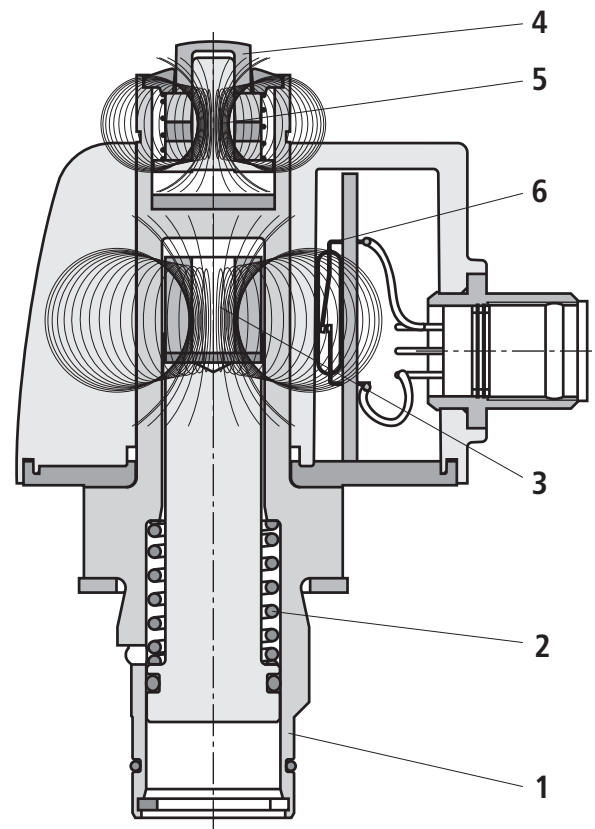
By default, the Rexroth filters are supplied with a mechanical optical maintenance indicator (WO). The electronic switching element (WE) is available as accessory and compatible with the mechanical optical maintenance indicator. The electronic switching element is attached to the optical maintenance indicator and fixed by means of a locking ring. The electronic maintenance indicator is not dependent on the nominal filter pressure.

The increasing backpressure and/or pressure difference pushes a spool (1) against a spring (2) upwards. The solenoid (3) mounted on the spool is moved together with the spool. The optical pin (4) can take two valid positions. If the position of the spool (1) with solenoids (3) is below the nominal pressure of the maintenance indicator, the optical pin remains in retracted "rest position". If the nominal pressure is exceeded for the first time, the position of the optical pin (5) is changed suddenly into the second possible "on condition" by repulsion of the solenoid of pin (5) to the solenoid of the spool (3). The pin will remain visible in this extended position on a permanent basis, even after the machine has been switched off (or after pressure drop or cold start) (memory function). It has to be acknowledged.

The reed contact (6) integrated in the switching element is operated by the magnetic field change. In case of two switching points, two reed contacts are installed.

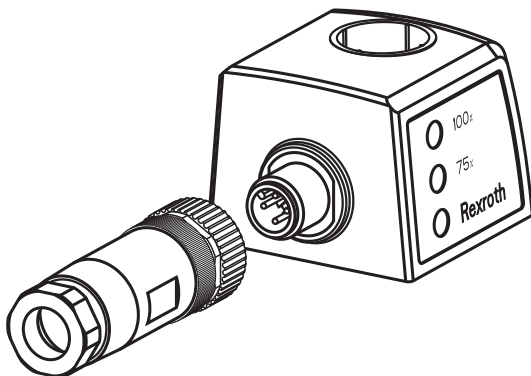
For the electronic switching element WE-2SPSU, the temperature for the temperature suppression is dissipated via the housing of the mechanical optical maintenance indicator.

The electronic switching element WE-2SPSU is not suitable for the mechanical optical maintenance indicator made of polyamide (WO-S01-2,2-...-PA).



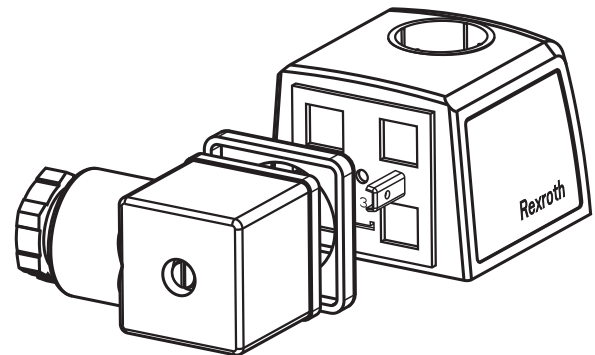
WE-2SP-M12x1

with mating connector (not included in the delivery)



WE-1SP-EN175301-803

with plug-in connection



Technical Data (For applications outside these parameters, please consult us!)**of the mechanical optical maintenance indicator**

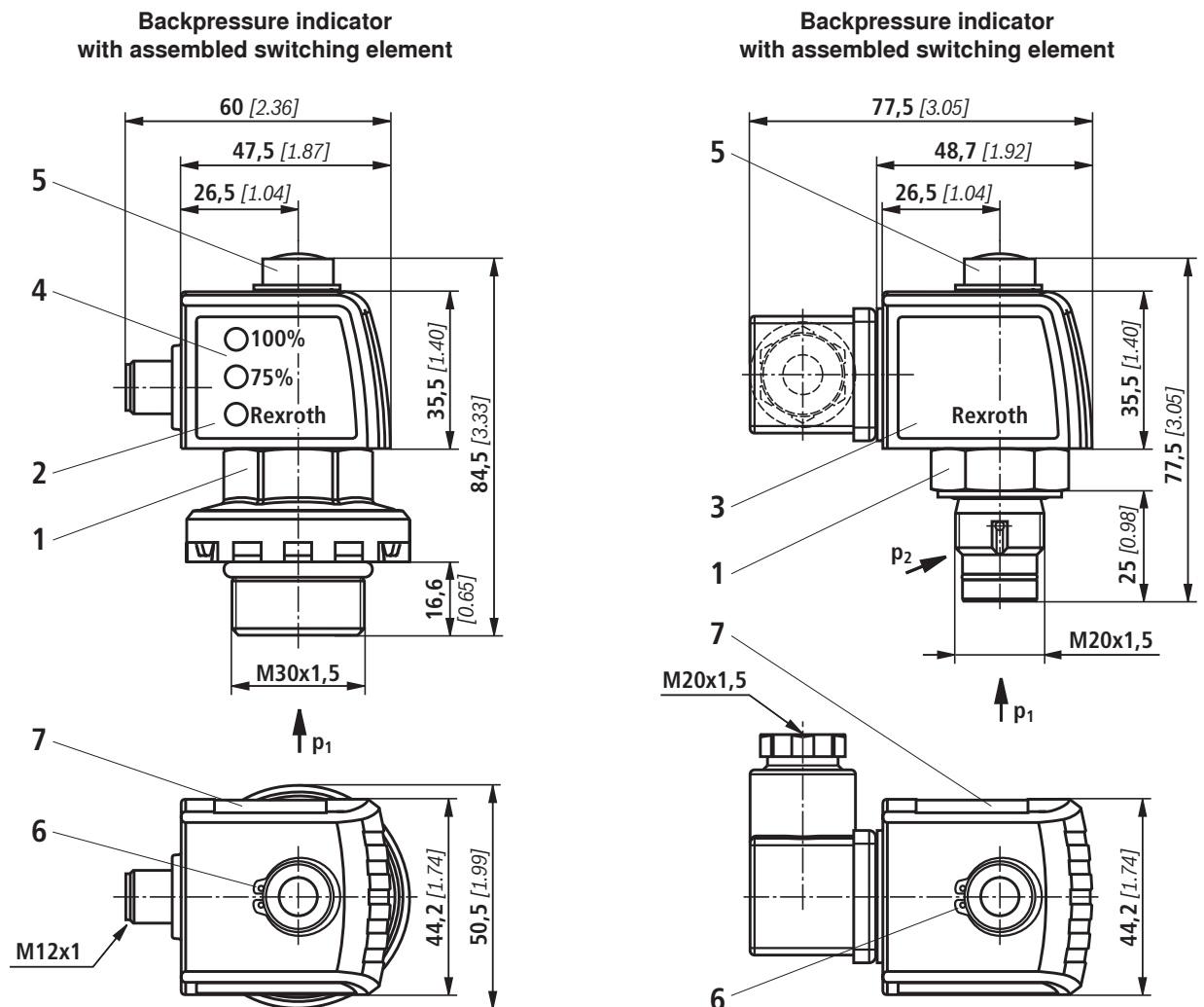
Material	Version	D01 (450 bar)	D01 (160 bar)	S01	S01 (PA)
	Material	Brass	Aluminum	Aluminum	PA6.6

Sealing material		NBR	FKM
Temperature range	°C [°F]	-30...+100 [-22...212]	-20...+120 [-4...248]

of the electronic switching element

Electrical connection		Round plug-in connection M12x1, 4-pin		Rectangular plug-in connection EN 175301-803
	Version	1SP-M12x1	2SP-M12x1	2SP-M12x1
				1SP-EN175301-803
Contact load, direct voltage	$A_{max.}$	1		
Voltage range	$V_{max.}$	150 (AC/DC)	10-30 (DC)	250 (AC) / 200 (DC)
Max. switching power with resistive load	W	20		70
Switching type	75 % signal	–	Normally open contact	
	100 % signal	Change-over	Normally closed contact	
	2SPSU			Signal switching through at 30 °C [86 °F], Return switching at 20 °C [68 °F]
Display via LEDs in the electronic switching element 2SP...			Stand-by (LED green); 75 % switching point (LED yellow) 100 % switching point (LED red)	
Protection class according to EN 60529		IP 67		IP 65
Ambient temperature range	°C [°F]	-25 to +85 [-13 to +185]		
For direct voltage above 24 V, spark extinguishing is to be provided for protecting the switching contacts.				
Weight	Electronic switching element: – with round plug-in connection M12x1	kg [lbs]	0.1 [0.22]	

Maintenance indicator (dimensions in mm [inch])



- 1 Mechanical optical maintenance indicator; max. tightening torque $M_{A \max} = 50 \text{ Nm}$ [36.88 lb-ft] tightening torque for backpressure indicator in PA6.6 $M_{A \max} = 35 \text{ Nm}$ [25.82 lb-ft]
- 2 Switching element with locking ring for electrical maintenance indicator (rotatable by 360°); round plug-in connection M12x1, 4-pin
- 3 Switching element with locking ring for electrical maintenance indicator (rotatable by 360°); rectangular plug-in connection EN175301-803
- 4 Housing with three LEDs: 24 V =
Green: Stand-by
Yellow: Switching point 75 %
Red: Switching point 100 %
- 5 Optical indicator bistable
- 6 Locking ring DIN 471-16x1, **Material no. R900003923**
- 7 Name plate

Notes:

Presentation contains mechanical optical maintenance indicator (1) and electronic switching element (2) (3).

Switching elements with increased switching power at request.

Installation, operating and maintenance instructions

Connection of the electronic switching elements

By default, the filter is equipped with a mechanical optical maintenance indicator WO (4). The electronic switching element (2) is attached to the mechanical optical maintenance indicator (1) and fixed by means of a locking ring (6).

The following must generally be observed with Rexroth filters:

- Make sure that the components are assembled in a stressless form.
- The filter housing must always be grounded.

When must the filter element be exchanged or cleaned respectively?

- After initial start-up of the system, the filter element is to be exchanged.
- Upon start-up in cold condition, the red pushbutton of the optical maintenance indicator (4) may jump out and an electrical signal is output via the switching element. Only push the red pushbutton in again after the operating temperature has been reached. If it jumps out again immediately or if the electric signal has not gone out at operating temperature, the filter element must be exchanged or cleaned respectively.
- The filter element should be replaced or cleaned after max. 6 months.

Quality and standardization

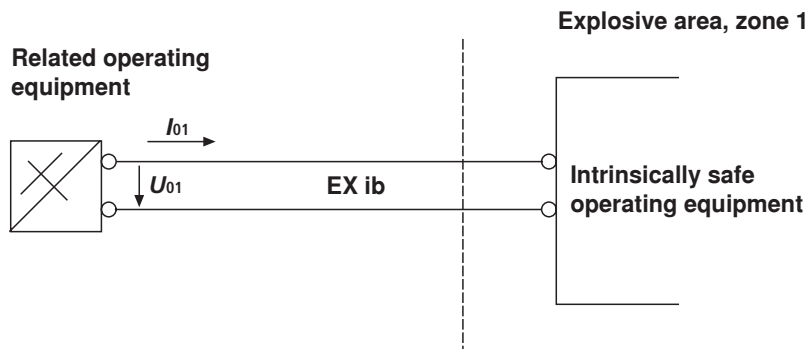
Use in explosive areas according to directive 94/9/EC (ATEX)

According to DIN EN 60079-11, the electronic maintenance indicators WE-1SP-M12x1 are simple, electronic operating equipment not having an own voltage source. This simple, electronic operating equipment may - according to DIN EN 60079-14 - in intrinsically safe electrical circuits

(EEx ib) be used in systems for device group II, category 2G (zone 1) and category 3G (zone 2) without marking and certification. The operating equipment is assigned to explosion group II B and temperature class T5.

When using Rexroth filters in explosive areas, potential equalization must always be ensured.

Possible circuit according to DIN EN 60079-14



The declaration of incorporation according to DIN EN 13463 is available for this filter separately, with **Material no. R928028899**.

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Oil Measurement Technology

Designation	Abriebsdrehmoment	Data sheet	Page
Online Particle Counter	OPM II	51460	835
Online water content measurement device	WGMS	51439	841
Online water content measurement device	WGM07	51438	849

Online particle monitor OPM II

Type OPM II

RE 51460

Edition: 2013-11



- ▶ Nominal pressure up to 420 bar dynamic / 600 bar static
- ▶ Nominal flow 50 to 400 ml/min
- ▶ Operating temperature -20 to +80 °C

**Features**

The OPM II is a visual online particle monitor that operates on the light-extinction principle.

The degree of contamination and the purity trend of fluids can be accurately monitored and documented. An alarm triggered when limit values are exceeded allows a fast reaction.

- ▶ Cleanliness class display according to ISO 4406:99 or SAE AS4059E
- ▶ Suitable for mineral and bio-oils; diesel fuel
- ▶ Easily configurable from the display; has an integrated data memory

Contents

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Ordering code	2
Function, section	3
Accessories	3
Technical data	4
Dimensions	4
Components	5
Assembly, commissioning, maintenance	5

Ordering code

Basic device

Material no.	Type key	Basic device
R928052298	OPM II – 1X – M	Online particle monitor OPM II (basic device with NBR seal)
R928052660	8874-19-01.03-BR	Software for PC evaluation

Accessories for hydraulic connections

Material no.	Type key	Accessories for hydraulic connections
R928052661	2103-A0-02.00	Flow controller with screen 125 µm (pressure window at 30 cSt: 2 ... 300 bar)
R900025012	ANSCHLUESSTUECK AB20-11/C G1/4"	Direct connection 1620 ISO228-G1/4 inside
R900981026	SCHLAUCH AB20-11/630-630BAR	Hose DN2, 2x screw connection m16x2, length 630 mm
R900083425	SCHLAUCH AB20-11/1000-630BAR	Hose DN2, 2x screw connection m16x2, length 1000 mm
R900054614	SCHLAUCH AB20-11/2000-630BAR	Hose DN2, 2x screw connection m16x2, length 2000 mm
R900033690	SCHLAUCH AB20-11/630-G1/4	Hose DN2, with hose connection M16x2 and pressure gauge connection G1/4, length 630 mm
R900033691	SCHLAUCH AB20-11/1000-G1/4	Hose DN2, with hose connection M16x2 and pressure gauge connection G1/4, length 1000 mm
R900033693	SCHLAUCH AB20-11/2000-G1/4	Hose DN2, with hose connection M16x2 and pressure gauge connection G1/4, length 2000 mm

Accessories for electrical connections

Material no.	Type key	Accessories for electrical connections
R928052662	8812-00-00.38	Power supply unit M12x1; socket 8-pole BU, with 4x country adapter
R913023441	VERTEILERSTUECK 8808-50-01.03	Y distributor, M12x1, 8-pole, socket to connector/socket
R928052663	8824-T4-02.00-BR	USB-CAN adapter with cable for connection to PC (connector M12x1, 8-pole - USB connector - cable length 2 m)
R913002642	LEITUNGSDOSE 8P 7000-17121-2911000	Connection (CAN) to existing system environment (measuring cable M12x1; straight socket, 8-pole/open end - cable length 10 m)
R901351431	LEITUNGSDOSE 7000-17141-2911000	Connection (CAN) to existing system environment (measuring cable M12x1; angled socket, 8-pole/open end - cable length 10 m)

Function, section

The **OPM II** is a visual particle monitor that operates on the light-extinction principle.

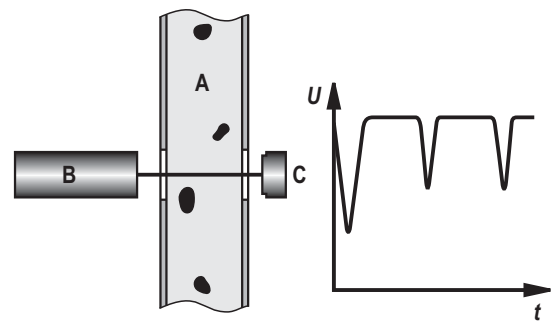
It consists of a flown-through measuring cell (A), a laser (B) and a photo diode (C). The laser radiates through the measuring cell and hits the photo diode. If a particle passes through the laser beam, the intensity reflected by the photo diode is reduced. The larger the particle, the less intensive the reflected light.

Using the **OPM II**, the level of contamination and the purity trend of non-aggressive fluids can be monitored. Potential variations in the absolute accuracy compared to particle counters calibrated according to ISO 11171:99 are below an ordinal number.

Due to the continuous purity monitoring, changes in a system are quickly identified and consequential damage can be avoided.

The cleanliness class is optionally displayed according to ISO 4406:99 or SAE AS4059E.

The device measures the temperature on the electronic circuit board and has an operating hours counter. After the current interruption, the counter re-starts counting at the last stored time value before the interruption.



Accessories

The OPM II can be integrated into external systems or operated alone. There is the possibility to transfer the data to a PC and analyze it there.

Integration of the OPM II into an external system:

- ▶ OPM II (basic device)
- ▶ Connection (CAN) to an external control system
- ▶ Hydraulic connections

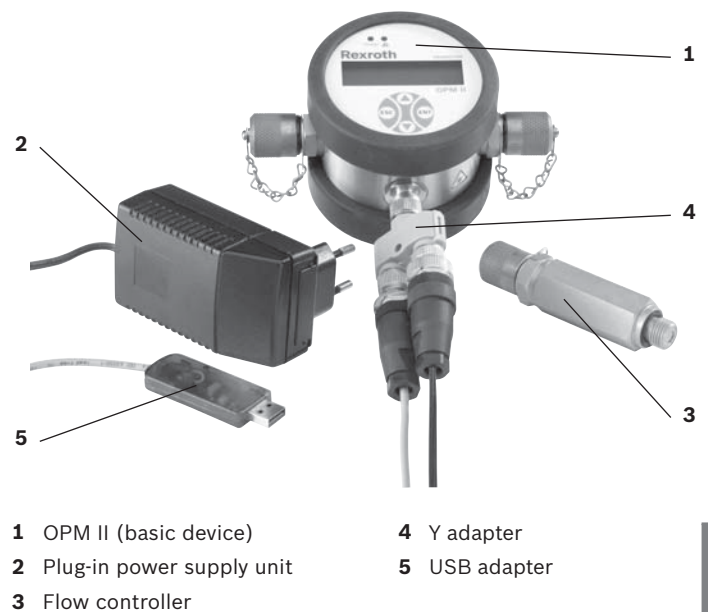
Operation of the OPM II as stand-alone variant:

- ▶ OPM II (basic device)
- ▶ Plug-in power supply unit with country adapters
- ▶ Hydraulic connections

OPM II to PC for the read out of data:

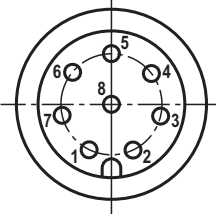
- ▶ Y distributor (for simultaneous connection of plug-in power supply unit and USB-CAN adapter)
- ▶ USB-CAN adapter with cable for connection to PC
- ▶ PC software for evaluation

OPM II and accessories



Technical data

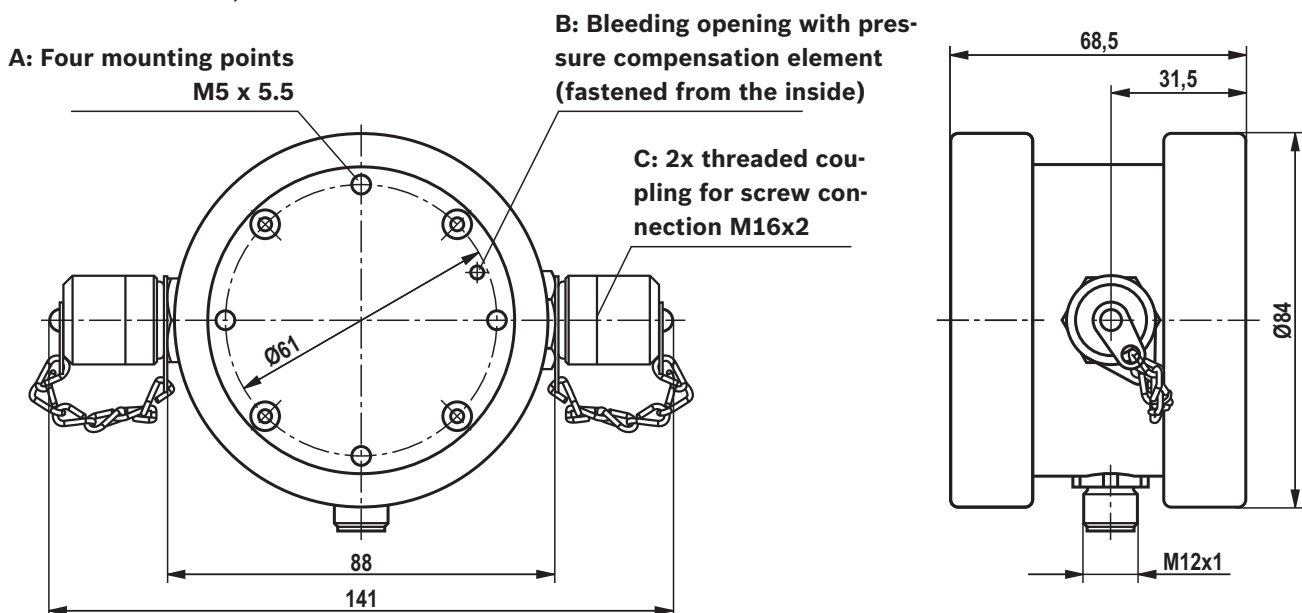
(For applications outside these parameters and high vibration loads, please consult us!)

Pin assignment	Designation	No.	Function
 M12x1 8-pole	+UB (24 VDC)	1	Supply
	GND	2	Ground
	CANL; TxD	3	CAN bus; transmitting
	CANH; RxD	4	CAN bus; reading
	NC; digital input	5	–
	IOUT1	6	4 ... 20 mA
	Open collector, alarm out	7	Alarm output
	SGND	8	Signal ground

Operating conditions	– Admissible operating pressure	bar [psi]	420 [6091] (dynamic)/600 [8702] (static)
	– Ambient temperature	°C [°F]	–20 ... 80 [–4 ... 176]
	– Humidity	%	0 ... 95
Fluids	– Admissible fluids		Mineral and ester fluids; poly-alpha-olefins
	– Temperature fluid	°C [°F]	–20 ... 80 [–4 ... 176]
	– Fluid connections		2x threaded coupling AB20-11/K1 G1/4
	– Admissible flow	ml/min	50 ... 400
Wetted materials			Stainless steel, sapphire, NBR
Sealing material			NBR
Voltage supply	V DC		9 ... 36
Current consumption	mA		Max. 300
Current outputs	mA		4 ... 20
Interfaces			RS 232, CANopen
Alarm contact			Open collector output
Electrical connection			8-pole connector M12x1
Measurement range according to ISO 4406:99			0 ... 24 (ordinal number)
Calibrated measurement range			10 ... 22 (ordinal number)
Measurement accuracy			±1.0 (ordinal number)

Dimensions

(dimensions in mm)



Components

Supply/discharge fluid (1) (6)

The device is equipped with two threaded couplings for screw connection M16x2. Hoses with measuring ports are usually connected here by means of which the particle counter is connected to the fluid-containing system. Adapters also allow for the conversion to G1/4 inside.

Display (2) (5)

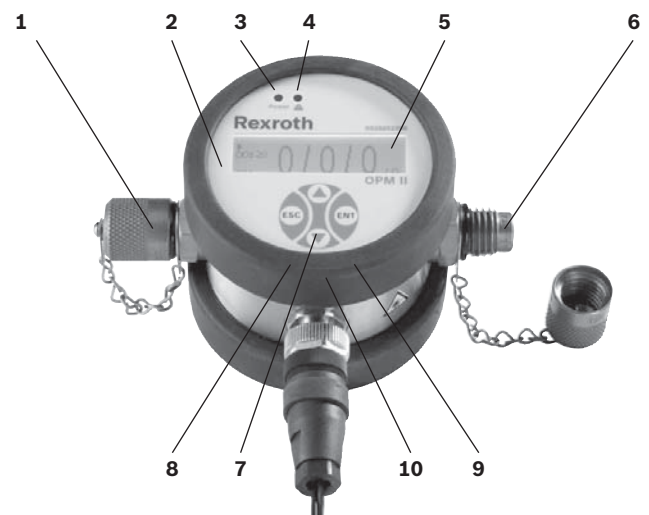
The front side of the device can be rotated by approx. 190° so that irrespective of the assembly, the display can always be positioned horizontally. The SW display shows the last determined cleanliness classes as well as the time until the next measurement and/or the remaining time of the measurement.

"Power" indicator (3)

This indicator shows in green whether operating voltage is available.

"Alarm" indicator (4)

This indicator shows in red that an alarm is pending. In the device, two alarms can be programmed.



- | | |
|--------------------------|-------------------|
| 1 Fluid supply | 6 Fluid discharge |
| 2 Rotatable device front | 7 "Up" key |
| 3 "Power" indicator | 8 "Escape" key |
| 4 "Alarm" indicator | 9 "Enter" key |
| 5 Display | 10 "Down" key |

Assembly, commissioning, maintenance

Please observe this information when determining the site of installation:

- ▶ Connect the OPM II to a pressure line using the T branch in the bypass.
- ▶ The flow direction is irrelevant.
- ▶ At the connection point, the pressure conditions should be as constant as possible. The pressure may vary, there must, however not be any pressure peaks or strong fluctuations.
- ▶ Connection to the control line is recommendable; alternatively, you can use the filter or cooling circuit.
- ▶ The flow should be constant and lie between 50 ... 400 ml/min.
- ▶ Flow control or pressure reduction units should always be installed downstream the particle counter as such equipment may create particles or air bubbles leading to measuring errors.
- ▶ If a pump is necessary to create the required flow, it should be of low-pulsation design and be installed upstream the particle counter. Otherwise, bubbles might be created in case of arrangement on the suction side leading to measuring errors.

Please also observe the following information before the installation:

- ▶ Ensure during installation that afterwards, the display will be easily readable. For simplification, the display can be rotated by approx. 190°.
- ▶ The following is true for connection lines: The shorter the better. With the length of the line, the risk of settlement of larger particles increases.
- ▶ Ensure particularly with higher viscosities and when using lines that the pressure is high enough in order to set a flow between 50 ... 400 ml/min.
- ▶ Make sure that the measured fluid is free from bubbles and drops. Bubbles and droplets in the oil can mostly be identified from very high ordinal numbers and/or identical ordinal numbers in different size channels. Such bubbles and droplets are hardly visible to the naked eye.
- ▶ Warranty becomes void if the delivered item is changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental condition that do not comply with the installation conditions.

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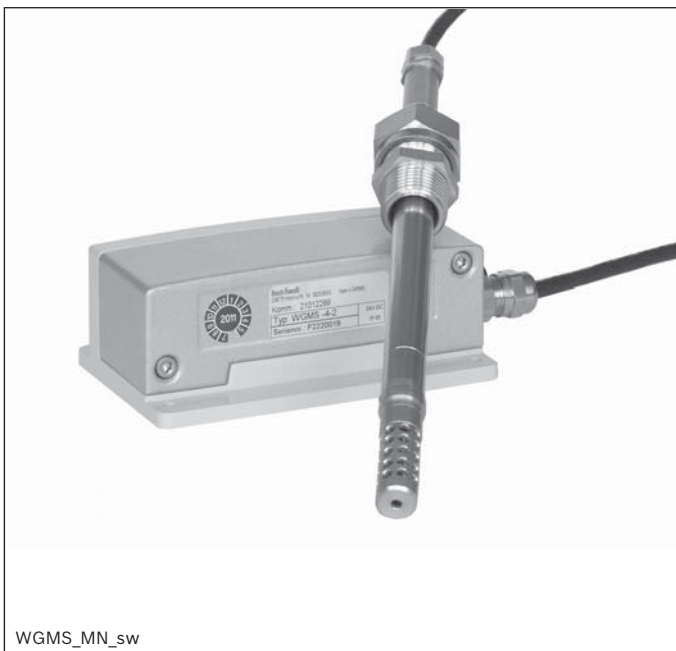
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Online water content measurement device

Type WGMS

RE 51439

Edition: 01.15



- ▶ Nominal pressure 40 bar
- ▶ Analog output 4...20 mA
- ▶ Water activity a_w :
 - ± 0.02 (0...0.9)
 - ± 0.03 (0.9...1.0)

Features

Online water content measurement devices allow the water activity in hydraulic and lubricating oils to be monitored online quickly and reliably.

They distinguish themselves by the following:

- ▶ Permanent measurement of the humidity and temperature
- ▶ Fast display of changes
- ▶ High measurement accuracy and measurement stability
- ▶ Simple connection to an external control system
- ▶ With ball valve installation, switching off the process or draining the oil is not necessary

Contents

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Ordering information for online water content measurement device

01	02	03	04
WGMS	-	-	2

Series

01	Online water content measurement device (without display)	WGMS
----	---	-------------

Version

02	Standard version consisting of: - Sensor for determining water activity and temperature - Sensor cable, length 2 m - Sensor protection (stainless steel grid) - Serial interface RS 232 C - Analog output signal: 4...20 mA Channel 1: 0...1 Channel 2: 0...+100 °C - Measurement for analog output Channel 1: Water activity a_w Channel 2: oil temperature T in °C	4
	Like version 4, but with sensor cable, length 5 m	5
	Like version 4, but with sensor cable, length 10 m	6

Supply voltage

03	24 V	2
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Amending information

04	Ball valve installation kit	K
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Order example:

WGMS-4-2

Material no.: R928022617

Preferred types

Material no.	Online water content measurement device
R928022617	WGMS-4-2
R928022618	WGMS-5-2
R928022619	WGMS-6-2

Ordering code accessories

Ball valve installation kit

01	02	03
Z	WGM	- KHI

01	Accessories	Z
02	Water content measurement device	WGM
03	Ball valve installation kit	KHI

Material number

Material no.	Ball valve installation kit
R928028819	ZWGM - KHI

Function

The WGMS oil humidity and temperature measurement encoder allows fast and reliable measurement of the humidity content in oils.

The devices are used to monitor humidity in real time and to control dryers and oil conditioners so that they are only activated as needed. Efficient monitoring helps to save oil and is good for the environment. With the WGMS, the humidity content in oil can be monitored simply and cost-effectively.

Measurement of the water activity

The WGMS measures the oil humidity in the form of water activity (a_w) and also the oil temperature (T). The water activity is a direct indicator of whether there is a risk of water separation as a phase. The measurement is carried out independently of the type, age and temperature of the oil.

Calculation of the water content

The WGMS indicates the water activity (a_w) and oil temperature (T). It is possible to calculate the average mass concentration of water in oil in ppm using this information. For this purpose, only the oil-specific conversion coefficients have to be determined.

Technical data

(For applications outside these values, please consult us!)

General		
Operating temperature range	°C [<i>°F</i>]	0... +60 [<i>+32...+140</i>]
Storage conditions	°C [<i>°F</i>]	-40 ... +65 [<i>-40 ... +149</i>]; max. relative air humidity 65%
Weight	kg [<i>lbs</i>]	approx. 1.5 kg [<i>3.3</i>]
Measurements		
Measuring point		Piping with flows up to 40 bar [<i>580 psi</i>] or turbulent tank installation location
Response time	min.	10
Water activity		
Measurement range	a _w	0...1
Accuracy	a _w	0...0.9 +/-0.02
		0.9...1 +/-0.03
Sensor		Capacitive thin-film polymer sensor
Temperature		
Measurement range	°C [<i>°F</i>]	0...+100 [<i>+32...+212</i>]
Accuracy	°C [<i>°F</i>]	+/- 0.2 [<i>0.36</i>]
Sensor		Pt100
Electrical connections		
Analog output	mA	4...20
Supply voltage	V	10 ... 35 VDC, 24 VAC ± 20%
Current consumption at +20 °C [<i>68 °F</i>] (U _{in} 24 VDC) I _{out} 2 x 0...20 mA	mA	max. 40
Housing protection class	IP	65
Sensor protection		Stainless steel grid filter
EMC		as per EN61326-1, industr. requirements

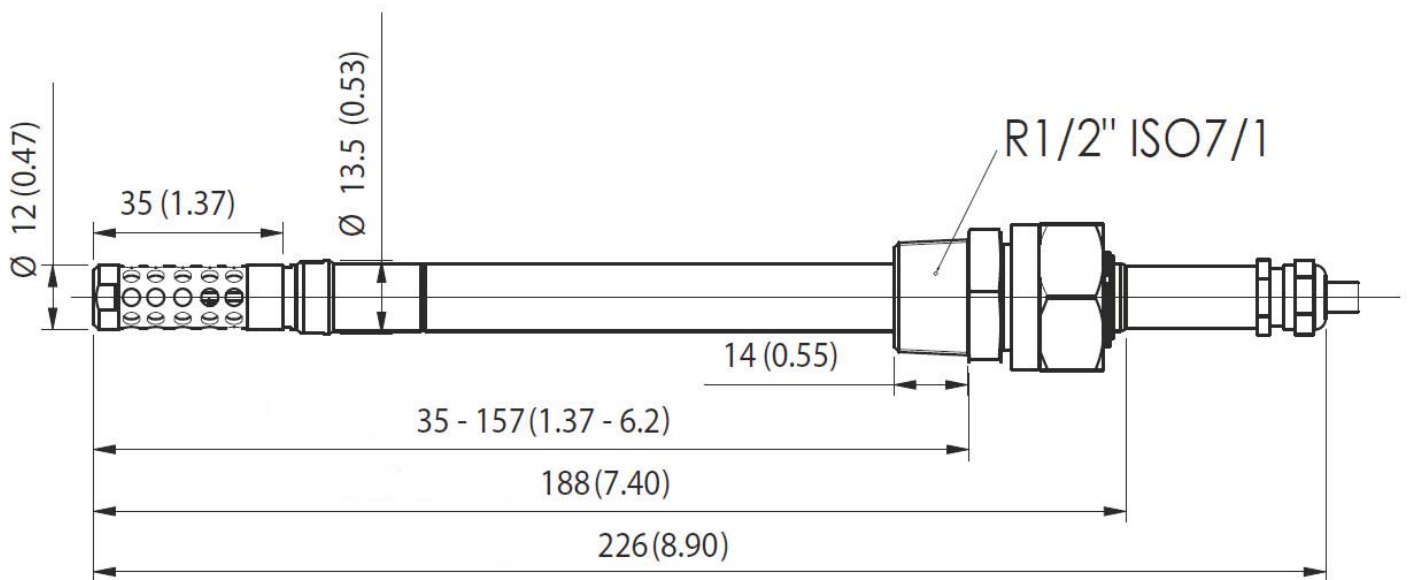
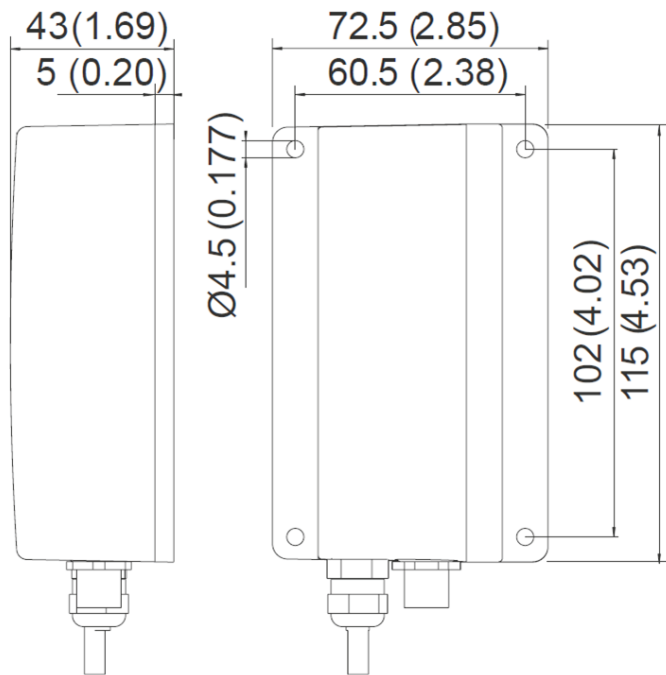
Compatibility with permitted hydraulic fluids

Hydraulic fluid	Classification	Standards
Mineral oils	HLP	DIN 51524

 **Important information on hydraulic fluids:**

- For more information and data on the use of other hydraulic fluids, please refer to data sheet 90220 or contact us!

Dimensions
(in mm [inch])



Assembly, commissioning, maintenance

Assembly

The maximum operating pressure at the selected place of installation must not exceed the permissible operating pressure of the sensor.

When installing the sensor, ensure that the flow velocity does not exceed 1 m/s.

With the optional ball valve installation kit, it is possible to remove or install the sensor during system operation without having to drain the oil.

Commissioning

Electrically connect the sensor.

Important: when using the ball valve installation kit, leaks will occur when removing or inserting the sensor.

Warning

Hot oil can cause burns when removing or inserting the sensor.



Note:

- ▶ All work on the device must be performed by trained specialists only.
- ▶ Warranty becomes void if the delivered item is changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental condition that do not comply with the installation conditions.

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Online water content measurement device

Type WGM07

RE 51438

Edition: 2014-11



- ▶ Nominal pressure 40 bar [580 psi]
- ▶ Analog output 4...20 mA
- ▶ Water activity a_w : ± 0.02 (0...0.9)
 ± 0.03 (0.9...1.0)

Features

The online water content measurement devices allow the water activity in hydraulic and lubricating oils to be monitored online quickly and reliably.

They distinguish themselves by the following:

- ▶ Permanent measurement of the humidity and temperature
- ▶ Fast display of changes
- ▶ High measurement accuracy and measurement stability
- ▶ Simple connection to an external control system
- ▶ With ball valve installation, switching off the process or draining the oil is not necessary

Content

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Function	3
Technical data	4
Compatibility with permitted hydraulic fluids	4
Dimensions	5
Assembly, commissioning, maintenance	6

Ordering information for online water content measurement device

01	02	03
WGM07	-	-

Series

01	Online water content measurement device	WGM07
----	---	--------------

Version

02	Standard version consisting of: - Sensor for determining water activity and temperature - Integrated LC display - Sensor cable, length 2 m - Sensor protection (stainless steel grid) - Serial interface RS 232 C - Analog output signal: 4...20 mA Channel 1: 0...1 Channel 2: 0...+100°C - Measurement for analog output Channel 1: water activity a_w Channel 2: oil temperature T in °C	1
	Like version 1, but with sensor cable, length 5 m	2
	Like version 1, but with sensor cable, length 10 m	3
	Like version 1, but without display	4
	Like version 2, but without display	5
	Like version 3, but without display	6

Supply voltage

03	220 V	1
	24 V	2

Order example:**WGM07-1-1****Material no.: R928027995****Preferred types**

Material no.	Online water content measurement device
R928027995	WGM07-1-1
R928028814	WGM07-3-2

Ordering information for accessories

Ball valve installation kit

01	02	03
Z	WGM	- KHI

01	Accessories	Z
02	Water content measurement device	WGM
03	Ball valve installation kit	KHI

Material number

Material no.	Ball valve installation kit
R928028819	ZWGM - KHI

Function

The WGM07 oil humidity and temperature measurement encoder allows fast and reliable measurement of the humidity content in oils.

The devices are used to monitor humidity in real time and to control dryers and oil conditioners so that they are only activated as needed. Efficient monitoring helps to save oil and is good for the environment. With the WGM07, the humidity content in oil can be monitored simply and cost-effectively.

Measurement of the water activity

The WGM07 measures the oil humidity in the form of water activity (a_w) and also the oil temperature (T). The water activity is a direct indicator of whether there is a risk of water separation as a phase. The measurement is carried out independently of the type, age and temperature of the oil.

Calculation of the water content

The WGM07 indicates the water activity (a_w) and oil temperature (T). It is possible to calculate the average mass concentration of water in oil in ppm using this information. For this purpose, only the oil-specific conversion coefficients have to be determined.

Technical data

(For applications outside these parameters, please consult us.)

General		
Ambient temperature range	°C [°F]	0 ... +60 [+32 ... +140]
Storage conditions	°C [°F]	-40 ... +65 [-40 ... +149]; max. relative air humidity 65%
Mass	kg [lbs]	approx. 2 kg [4.4]

Measurements		
Measuring point		Piping with flows up to 40 bar [580 psi] or turbulent tank installation location
Response time	min.	10

Water activity

Measurement range	a _w	0...1
Accuracy	a _w	0...0.9 +/-0.02 0.9...1 +/-0.03
Sensor		Capacitive thin-film polymer sensor

Temperature

Measurement range	°C [°F]	0...+100 [+32...+212]
Accuracy	°C [°F]	+/- 0.2 [0.36]
Sensor		Pt100

Electrical connections

Analog output	mA	4...20
Supply voltage	V	10 ... 35 VDC, 24 VAC ± 20%
Current consumption at +20°C [68°F] (U _{in} 24 VDC) I _{out} 2 x 0...20 mA	mA	max. 60
Display with lighting	mA	+20
Housing protection class	IP	65
Sensor protection		Stainless steel grid filter
EMC		as per EN61326-1, industr. requirements

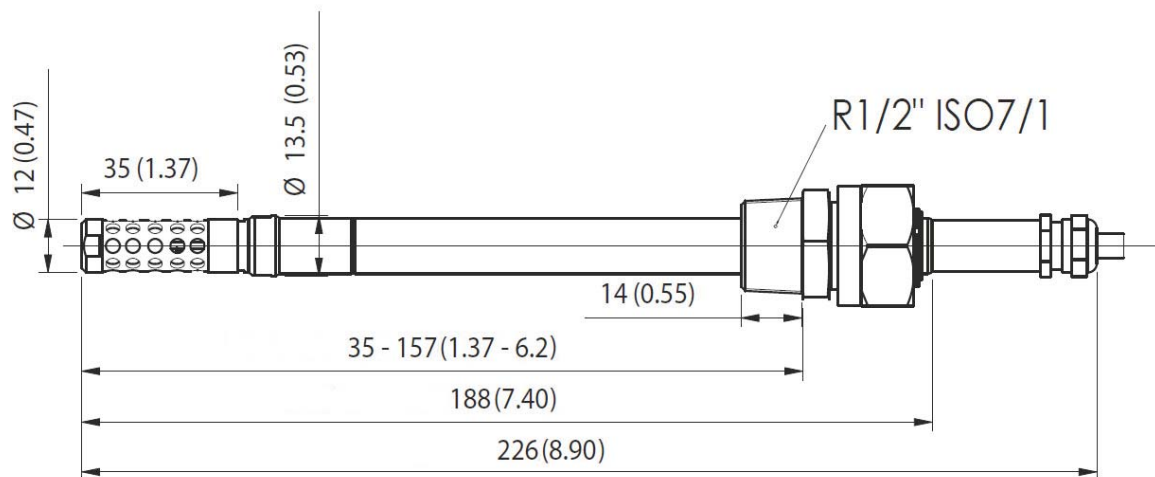
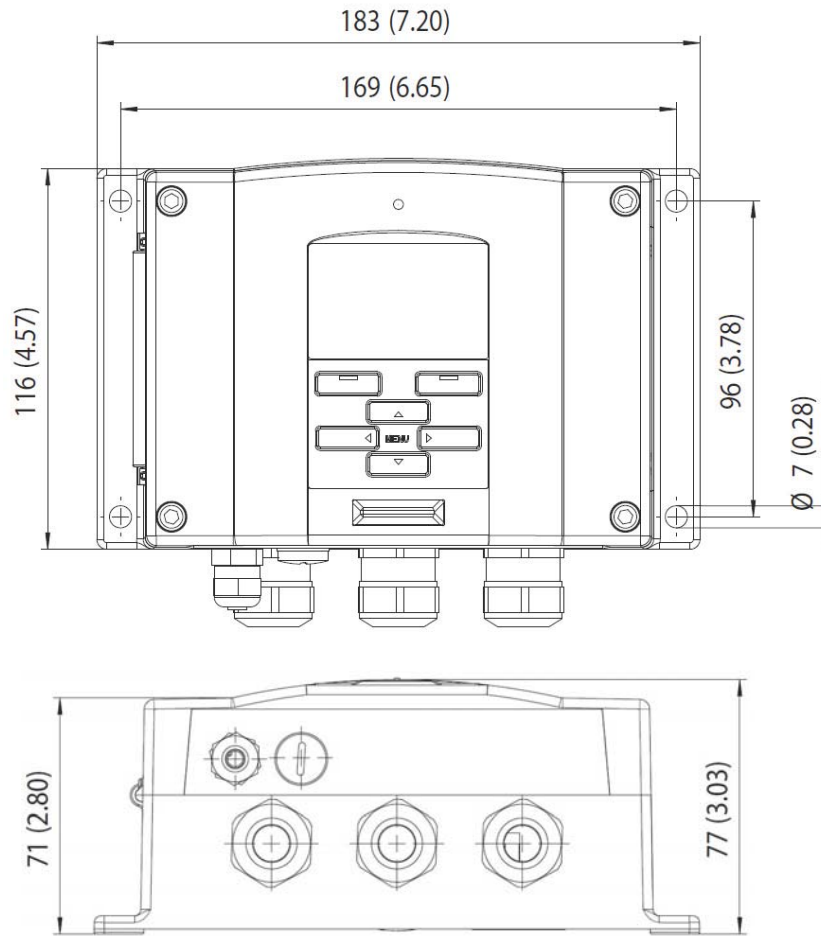
Compatibility with permitted hydraulic fluids

Hydraulic fluid	Classification	Standards
Mineral oils	HLP	DIN 51524

 **Important information about hydraulic fluids:**

- For more information and data on the use of other hydraulic fluids, please refer to data sheet 90220 or contact us.

Dimensions
(in mm [inch])



Assembly, commissioning, maintenance

Assembly

The maximum operating pressure at the selected place of installation must not exceed the permissible operating pressure of the sensor.

When installing the sensor, ensure that the flow velocity does not exceed 1 m/s [3.3 ft/s].

With the optional ball valve installation kit, it is possible to remove or install the sensor during system operation without having to drain the oil.

Commissioning

Electrically connect the sensor.

Important: when using the ball valve installation kit, leaks will occur when removing or sliding in the sensor.

Warning

Hot oil can cause burns when removing or sliding in the sensor.



Important:

- ▶ All work on the device must be performed by trained specialists only.
- ▶ Warranty becomes void if the delivered item is changed by the ordering party or third parties or improperly mounted, installed, maintained, repaired, used or exposed to environmental conditions that do not comply with the installation conditions.

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