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Flexible Automation

Bosch Servodyn

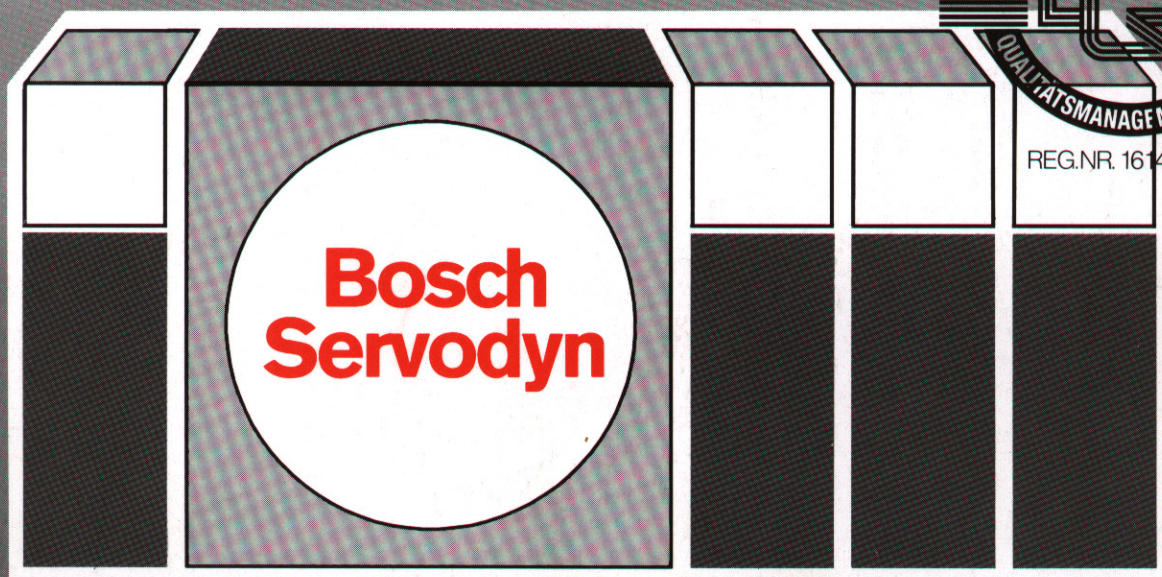
**Servo Motors SD
Manual No. 01**

1070 054 285-104

P.-No. 3830/E4 – 07/90



REG.NR. 16149-01/2



**Antriebstechnik
Drives**

Bosch Schulungszentrum Flexible Automation

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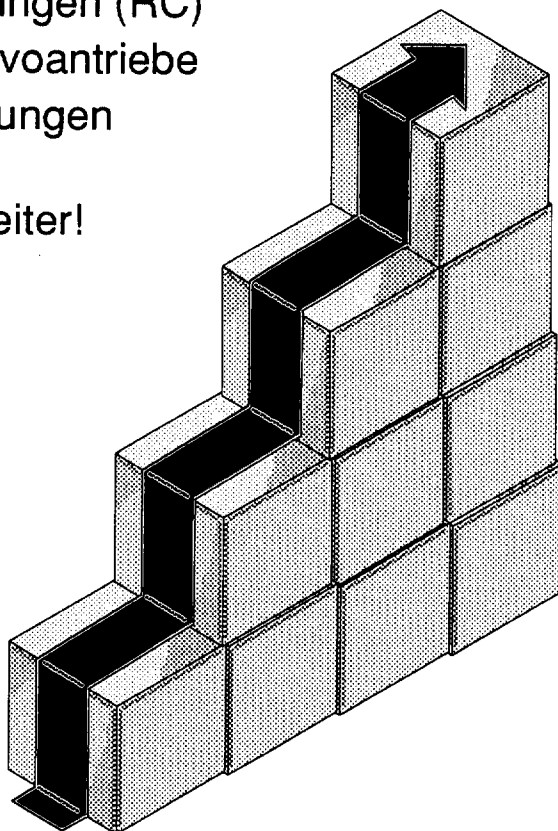
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Bosch Servo Drives for the Entire Field of Mechanical Engineering

1. Construction of the Servodyn Range of Motors SD-B.

1.1 Motors with Ferrite Magnets

Bosch servo motors of type SD-B. are part of the Bosch Servodyn drive concept for the entire field of mechanical engineering. They are operated together with inverters of series -T (A) or -TC and are designed for applications in position and velocity servo loops.

Servo motors of type SD-B. are permanent-field motors for inverter operation with electronic commutation. The permanent magnets of the rotor consist of ferrite material.

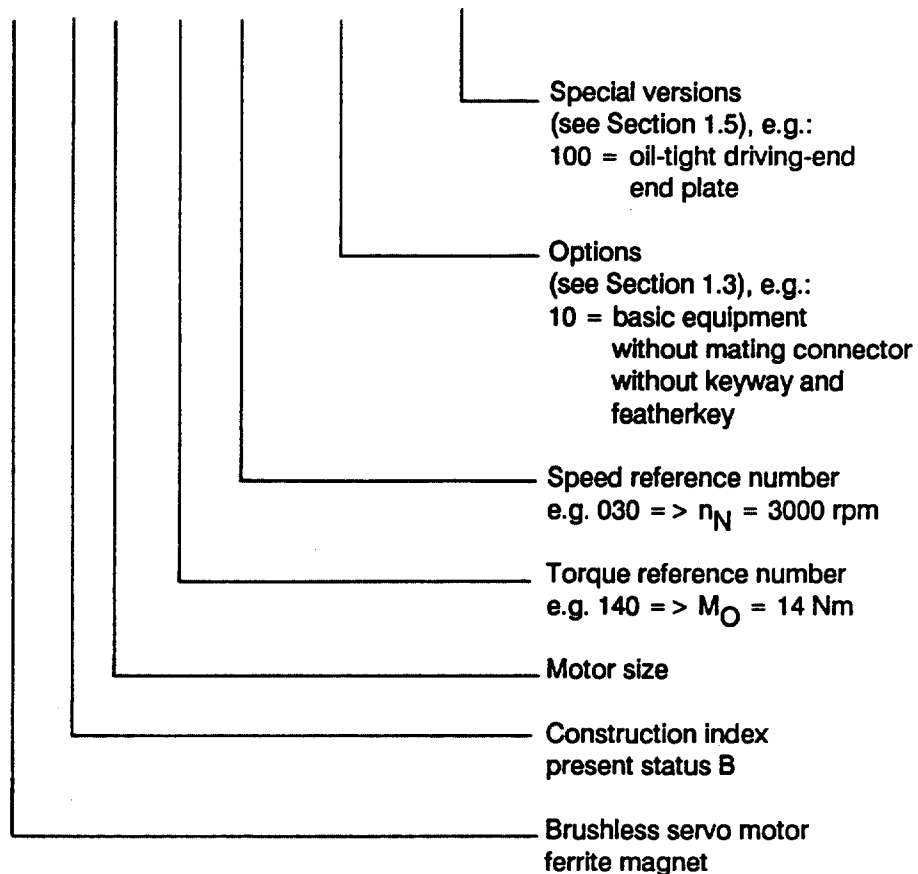
A brushless tacho and a commutation sensor are integrated for velocity feedback or rotor position detection.

Important features are as follows:

Maintenance-free operation	through the use of motors and tachos of brushless construction
Constant torque	throughout the range of the speed-torque characteristic
High resistance against demagnetization	admissible peak torque equals 3 times the rated torque
Large overload capacity	through advantageous heat dissipation; the total power loss is created in the stator winding, which has a low thermal resistance with respect to the motor surface.
Good synchronization	through special magnet configuration and precise current regulation in all three phases.
High protection standard	due to completely sealed construction.

1.2 Type Designation

SD- **B** **3** .140 .030 - **1** **0** . **1** **0** **0**



1.3 Options

Option Code Table

Code	Basic equipment without mating connector without keyway and featherkey	Disk brake*	Shaft with keyway and featherkey	Vibr. quality R	2nd shaft end**
10	x				
04	x	x			
00			x		
04		x	x		
30	x			x	
34	x	x		x	
20			x	x	
24		x	x	x	
50	x				x
54	x	x			x
40			x		x
44		x	x		x
70	x			x	x
74	x	x		x	x
60			x	x	x
64		x	x	x	x

x Possible combinations

* Installation by the manufacturer

** Preparation for the fitting of a measuring system and 2nd shaft end are mutually exclusive

The possible combinations in the code table are produced by the following options:

Code

10 Basic equipment without mating connector without keyway and featherkey

Mating connectors of various versions must be ordered separately (see information in Section 1.4).

The basic equipment includes:

- Tacho, brushless version
- Temperature monitoring, evaluation in the inverter
- Protection Standard IP 54
- Design B 5
- Shaft without keyway and featherkey
- Vibration quality level N
- Centering for measuring system attachment at the non-driving end bearing housing
- Tacho socket, socket for power and brake connection (separate brake socket on motor size B6 and B5.380.030)

Code

- 00 Shaft with keyway and featherkey**
- Driving-end shaft extension with featherkey and keyway in accordance with DIN 6885 for keyed torque transmission (dimensions, see Section 4.1).
Other equipment as for basic equipment.
- Shaft connections with featherkey, spline and multiple-spline connections are suitable for less stringent requirements.
The shaft-to-hub connection is subject to multi-directional tension under load, resulting from torsion, radial and axial forces and flexural torque. Continuous loading with alternating torques (peak stresses at the force flux transitions) changes the fit characteristic, and rotationally asymmetrical misalignment impairs true running.
The basic equipment with shaft without keyway and featherkey must be used for stringent requirements.
- 04 Built-in disk brake**
- The motors can be supplied with a built-in disk brake to prevent any play of the feed axis at standstill or when the supply to the system is switched off. The permanent magnet, single surface brake, which has been specifically designed for this range of motors, works by the fail safe current principle.
The permanent magnet used creates a pull on the brake armature disk. This closes the brake when no current is flowing, and holds the axis. When a connection voltage of 24 V DC is applied, the coil through which current flows builds up an opposing field which cancels the effect of the permanent magnet and opens the brake or keeps it open (technical data, see Section 2.2).
- CAUTION**

The disk brake is not a working brake and may be operated only when the axis is stationary.
The disk brake must be inspected after 1000 EMERGENCY-STOP braking operations.
- When the brake is open there is no residual torque; when the brake is closed the axis is held without any play. The low overall length of the disk brake permits installation in the driving-end end plate without motor extension.
- 20 Vibrational quality level R**
- The motor remains below the limit values specified by DIN ISO 2373 for vibrational quality level R.
- 40 Second shaft end**
- Shaft end at non-driving end with hexagonal head (spanner size 13) for spanner or handwheel.
The maximum torque is 50 Nm for all motors. (See dimensioned drawing, Section 4.3).

1.4 Mating Connectors

The following equipment is required for electrical connection of the motors:

- A motor plug (power plug)
- A tacho plug
- A brake plug, for sizes B6 and B5.380.030 only:

See the dimensioned drawings in Section 4.1 for space requirement.

Motor connectors

Tacho connectors

Brake connectors

Motor type	Order No.	
	Plastic connector (complete) with aluminium securing ring Right-angled	Straight
SD-B3... SD-B4... SD-B5.250.015 SD-B5.250.020 SD-B5.380.012	093/914039	093/914637
SD-B5.250.030 SD-B5.380.020	093/914038	-
SD-B5.380.030 SD-B6..	93/914037	-
All motor types	093/914036	093/14636
SD-B5.380.030 SD-B6...	093/914034	-

Note

The plastic protective caps which are fitted captive to the motor connectors must remain on the motor and must be screwed on if the motors are returned, in order to avoid transport damage to the sockets.

1.5 Special Versions

Code

- | | | |
|-----|---|--|
| 004 | Built-in encoder
ROD 426.014 | 2500 pulses/rev. (See Section 2.5 for technical data) |
| 100 | Oil-tight bearing at
driving end | <p>If required, the motors can be supplied with a special shaft sealing ring at the driving end. At least half of the shaft sealing ring must run in oil.</p> <p>Motors with oil-tight driving-end end plate may also be mounted vertically with the flange pointing upwards (type IM V3).
Vertical attachment with the flange pointing downwards (type IM V1) is permitted only if lubrication and heat dissipation of the sealing points are guaranteed by an appropriate oil level or splash lubrication.</p> |

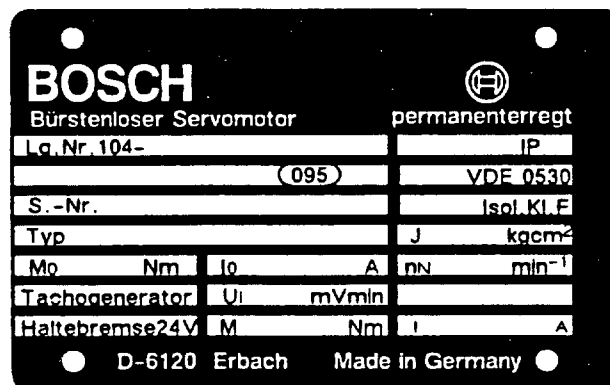
1.6 Special Accessories
(not including installation)

Preparation for fitting of incremental encoder (ROD 426.014)

The set comprises the following: housing, adaptor flange, coupling, socket, plug coupling, various small parts (see dimensioned drawing Section 4.2).

	Stock number With plug connection	Stock number w/o plug connection
Motor size SD-B3	104-912561	104-913850
Motor size SD-B4	104-912562	104-913851
Motor size SD-B5	104-912563	104-913852
Motor size SD-B6	104-913425	104-913853

1.7 Type Label



Please always specify the stock number (Lg. Nr.), the "S-Nr." and the motor type in all inquiries and for servicing.

For your notes:

2. Technical Data

2.1 Motor Data

Max. ambient temperature	$\theta_U = 0^\circ$ to 40°C
Protection standard	IP 54 in accordance with DIN 40050/40053 with mated connector and prescribed cable diameter, except driving-end shaft gland.
Construction	Basic type of construction IM B5 in accordance with DIN IEC 34-7, can also be used as IM V1 and IM V3. In the case of IM V3, no fluid may remain in the flange end plate. IM V1 is permitted only conditionally in the case of oil-tight driving-end end plate.
Flange	Flange in accordance with IEC 72-2 / DIN 42948
Ball bearings	Locating bearing at driving end (flange end). Minimum service life 20 000 h
Shaft extension	Cylindrical shaft extension in accordance with DIN 748 without featherkey and keyway. Version with keyway and featherkey, see options, Section 1.3. Shaft extension with thread for connecting and disconnecting drive elements.
Vibration quality level	Vibration quality levels "N" and "R" in accordance with DIN ISO 2373. Basic version with vibration quality level "N" (in the case of shaft with keyway and featherkey, the motors are balanced with featherkey).
Noise rating	Max. 64 dB (A) at a distance of 1.0 m
Insulating material class	F in accordance with VDE 0530
Cooling	By thermal radiation and natural convection. Installation must ensure adequate heat dissipation. High surface temperatures may occur on the motor. A touch guard must be provided if necessary.
Thermal motor protection	NTC thermostat integrated in the winding with evaluation in the related servo module. Temperature range - 10°C to $+145^\circ \text{C}$.
Tacho and commutation sensor	Brushless version, integrated in the non-driving end of the motor. The commutation sensor controls commutation of the phase currents in the connected inverter.
Disk brake	Permanent-magnet brake operating on the basis of the fail-safe principle, backlash-free. See options, Section 1.3.

2.2 Performance Data

	Symbol	Unit	SD-B3				SD-B4				
			031. 030-	050. 030-	068. 030-	095. 030-	070. 030-	092. 020-	140. 020-	140. 030-	180. 020-
Torque at standstill $n_o = 200 \text{ rpm}; \Delta t_w (30s) = 105 \text{ K}$	M_o	Nm	3.1	5.0	6.8	9.5	7.0	9.2	14.0	14.0	18.0
Nominal speed	n_N	rpm	3000	3000	3000	3000	3000	2000	2000	3000	2000
Current at standstill at M_o $n_o = 200 \text{ rpm}; \Delta t_w = 105 \text{ K}$	I_o	A	3.25	5.3	6.3	8.8	7.5	6.0	9.8	13.0	11.7
Peak current at $t_{amb.} = 20^\circ\text{C}$	I_{max}	A	13.0	21.2	25.2	35.2	30.0	18.0	34.3	45.5	35.1
Torque constant $t_{amb.} = 40^\circ\text{C}; \Delta t_w = 105 \text{ K}$	K_T	Nm/A	0.96	0.94	1.08	1.08	0.93	1.53	1.43	1.08	1.54
Voltage constant $t_{amb.} = 40^\circ\text{C}; \Delta t_w = 105 \text{ K}$	K_E	$\frac{\text{V}/1000}{\text{rpm}}$	130	131	134	148	137	200	206	150	197
Winding resistance $t_w = 20^\circ\text{C}$	R_{2ph}	Ohm	6.7	2.58	1.7	1.8	1.86	3.7	1.88	0.92	1.46
Winding inductance	L_{2ph}	mH	40.0	18.0	12.9	11.2	18.7	32.9	20.6	8.48	15.0
Elec. time const. $t_w = 20^\circ\text{C}$	T_{el}	ms	6.0	6.98	7.6	6.2	10.1	8.9	11.0	9.24	10.3
Mech. time const. $t_w = 20^\circ\text{C}$	T_{mech}	ms	12.1	9.3	5.4	5.2	13.3	7.4	7.7	6.9	5.8
Thermal time constant $t_w = 20^\circ\text{C}$	T_{therm}	min	70	85	110	75	120	100	130	130	120
Max. theoretical acceler.	α_{max}	rad/s^2	17700	19500	18580	16190	9880			9900	
Rotor inertia incl. tacho	J	kgm^2	1.55×10^{-3}	2.90×10^{-3}	4.37×10^{-3}	4.37×10^{-3}	5.88×10^{-3}	5.88×10^{-3}	11.56×10^{-3}	11.56×10^{-3}	11.56×10^{-3}
Dimension	Flange	sw	mm				mm				
	Shaft	d _{xl}	mm				mm				
	Length	L	310	392	470	470	366	366	484	484	484
Mass, not incl. disk brake	m	kg	13	18.3	25	25	23	23	37.8	37.8	37.8

Tacho

EMF at $t_{amb.} = 20^\circ\text{C}$	$U_i = 2.7 \text{ V}/1000 \text{ rpm} \pm 5 \%$
min. terminating resistance	$R_{min} = 20 \text{ kOhm}$
Voltage ripple	$< 1.5 \%$

Disk brake

Holding torque (trans.)	M_{BR}	Nm	4.0	9.5
Connection voltage	U_{BR}	V	$24 \pm 5 \%$	$24 \pm 5 \%$
Nominal current	I_{BR}	A	0.64	0.74
Inertia	J_{BR}	kgm^2	0.11×10^{-3}	0.36×10^{-3}
Mass	m_{BR}	kg	0.6	1.1

t_w = winding temperature $t_{amb.}$ = ambient temperature

	Symbol	Unit	SD-B5						SD-B6			
			250. 015-	250. 020-	250. 030-	380. 012-	380. 020-	380. 030-	480. 020-	720. 020-	960. 010-	960. 015-
Torque at standstill $n_o = 200 \text{ rpm}; \Delta t_w (30s) = 105 \text{ K}$	M_o	Nm	25	25	25	38	38	38	48	72	96	96
Nominal speed	n_N	rpm	1500	2000	3000	1200	2000	3000	2000	2000	1000	1500
Current at standstill at M_o $n_o = 200 \text{ rpm}; \Delta t_w = 105 \text{ K}$	I_o	A	12.9	17.2	22.5	15.4	23.7	35.0	32.4	48.6	30.9	45.5
Peak current at $t_{amb.} = 20^\circ\text{C}$	I_{max}	A	38.7	51.6	67.5	46.2	71.1	122.5	129.6	194.4	108.1	159.2
Torque constant $t_{amb.} = 40^\circ\text{C}; \Delta t_w = 105 \text{ K}$	K_T	Nm/A	1.94	1.46	1.11	2.46	1.60	1.09	1.48	1.48	3.12	2.05
Voltage constant $t_{amb.} = 40^\circ\text{C}; \Delta t_w = 105 \text{ K}$	K_E	$\frac{\text{V}/1000}{\text{rpm}}$	291	225	131	355	186	126	187	189	244	287
Winding resistance $t_w = 20^\circ\text{C}$	R_{2ph}	Ohm	1.26	0.75	0.28	1.13	0.49	0.15	0.32	0.19	0.44	0.23
Winding inductance	L_{2ph}	mH	26.8	15.0	5.3	25.9	12.1	2.9	6.7	5.26	13.5	5.3
Elec. time const. $t_w = 20^\circ\text{C}$	T_{el}	ms	21.32	19.95	18.8	22.98	25.46	19.5	20.94	27.68	30.68	23.3
Mech. time const. $t_w = 20^\circ\text{C}$	T_{mech}	ms	5.9	6.1	5.1	5.1	6.5	4.3	16.3	13.8	15.6	10.6
Thermal time constant $t_w = 20^\circ\text{C}$	T_{therm}	min	320	260	140	220	180	90			300	220
Max. theoretical accler.	α_{max}	rad/s ²	6150	6080	1735	7460	6080	1755	2590	2590	2790	2770
Rotor inertia incl. tacho	J	kgm ²	25.36 $\times 10^{-3}$	25.36 $\times 10^{-3}$	25.36 $\times 10^{-3}$	37.6 $\times 10^{-3}$	37.6 $\times 10^{-3}$	37.6 $\times 10^{-3}$	135 $\times 10^{-3}$	194 $\times 10^{-3}$	258 $\times 10^{-3}$	258 $\times 10^{-3}$
Dimension	Flange	sw	116 <input checked="" type="checkbox"/>						142 <input checked="" type="checkbox"/>			
	Shaft	dxi	ø 19x40						ø 24x50			
	Length	L	489	489	489	590	590	590	555	635	745	
Mass, not incl. disk brake	m	kg	58.6	58.6	58.6	80	80	80	115	157	190	190

Tacho

EMF at $t_{amb.} = 20^\circ\text{C}$	$U_i = 2.7 \text{ V}/1000 \text{ rpm} \pm 5 \%$
min. terminating resistance	$R_{min} = 20 \text{ kOhm}$
Voltage ripple	$< 1.5 \%$

Disk brake

Holding torque (trans.)	M_{BR}	Nm	36	80
Connection voltage	U_{BR}	V	$24 \pm 5 \%$	$24 \pm 5 \%$
Nominal current	I_{BR}	A	1.36	1.8
Inertia	J_{BR}	kgm ²	3.18×10^{-3}	18.75×10^{-3}
Mass	m_{BR}	kg	3.5	9.0

t_w = winding temperature $t_{amb.}$ = ambient temperature

2.3 Recommended Motor-Module Combinations

The motor-module combinations listed below are recommended, i.e. favorable assignments which do, however, represent but a few of many possible variations.

The combination must always be based upon a matched motor current and module current, allowing for system-related conditions such as simultaneity factors, intermittent periodic duty and changes in operating mode resulting from individual design (see Handbook NO. 10 or No. 11).

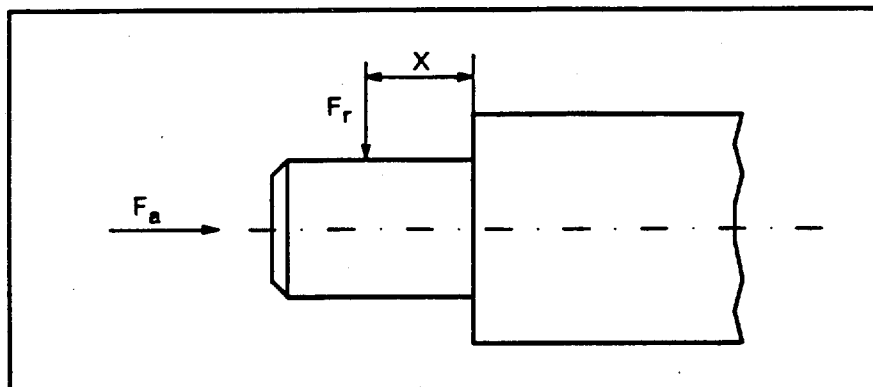
- = Module peak current
- = Module peak current, reduced
- A = Module with torque reduction to ≤ 90 %
(see Handbook No. 10)

Ferrite motors		Servodyn-T(A) Servo modules SM ... -T(A)						Servodyn-TC Servo modules SM ... -TC			
Type	I_0 [A]*	5/10	10/20	17/35	25/50	35/70	50/100	5/10	10/20	15/30	25/50
SD-B3.031.030	3.25	●						●			
SD-B3.050.030	5.3	●	●					●	●		
SD-B3.068.030	6.3		●						●		
SD-B3.095.030	8.8		●						●	●	
SD-B4.070.030	7.5		●						●	●	
SD-B4.092.020	6.0		•						●A	●	
SD-B4.140.020	9.8		●	•					●	●	
SD-B4.140.030	13.0			●						●	
SD-B4.180.020	11.7			●						●	
SD-B5.250.015	12.9			●						●	
SD-B5.250.020	17.2			●	●						●
SD-B5.250.030	22.5				●	•					●
SD-B5.380.012	15.4			●	•					●	●A
SD-B5.380.020	23.7				●	●					●
SD-B5.380.030	35.0					●	●				
SD-B6.480.020	32.4					●	●				
SD-B6.720.020	48.6						●				
SD-B6.960.010	30.9					●	●				
SD-B6.960.015	45.5						●				

* I_0 = Current at standstill, see Section 2.2 for further data

2.3 Mechanical Load on Motor Shaft

Admissible axial forces F_a and radial forces F_r acting on the motor shaft:

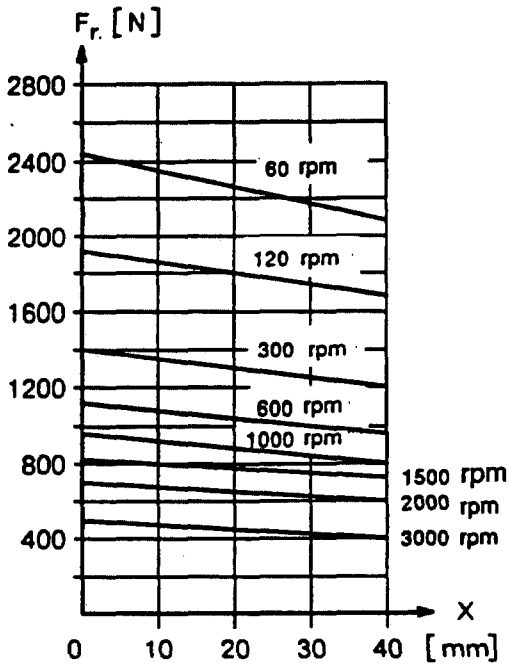


Axial load

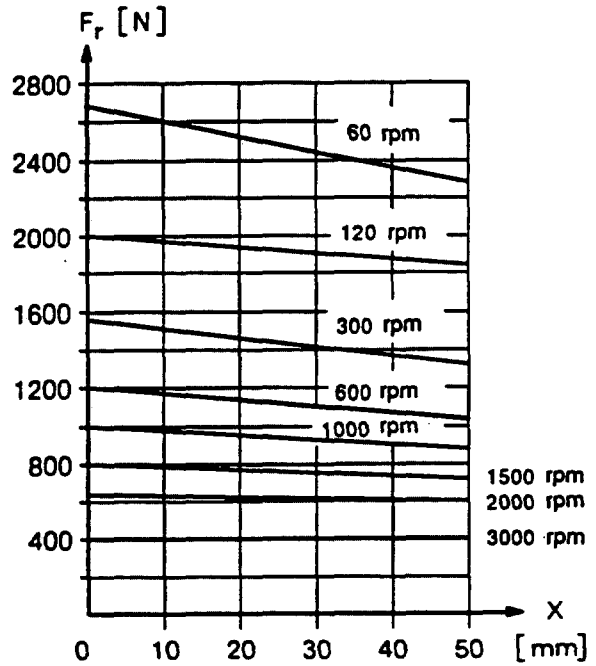
Motor size	Constr.	Admissible axial forces F_a [N]
SD-B3	IM B5	200
	IM V3	110
	IM V1	240
SD-B4	IM B5	200
	IM V3	60
	IM V1	280
SD-B5	IM B5	400
	IM V3	120
	IM V1	600
SD-B6	IM B5	900
	IM V3	100
	IM V1	1400

Fixed bearing at the driving end prevents temperature-related expansion at the driving side.

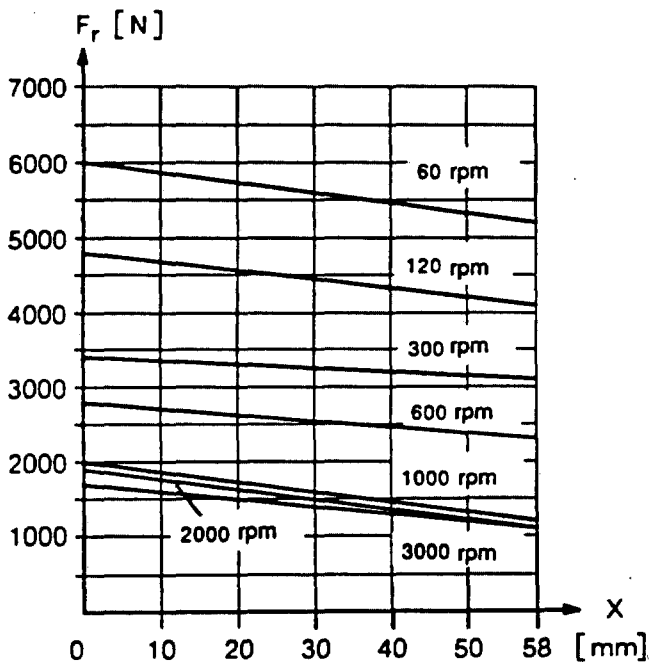
SD-B3



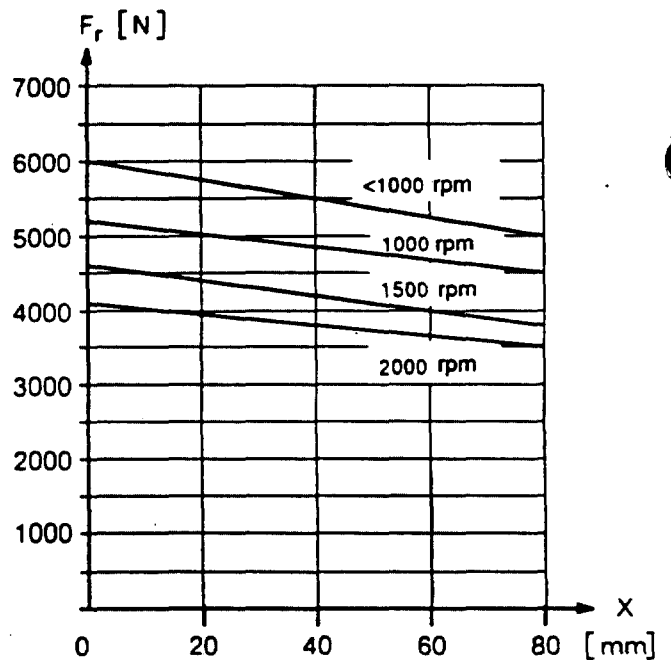
SD-B4



SD-B5



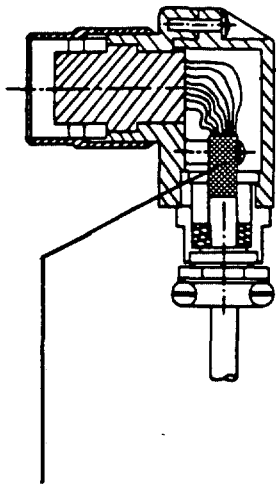
SD-B6



2.5 Data Incremental Encoder Type ROD 426.014 (Manufactured by: Dr.J.Heidenhain)

Standard pulse count	Optionally 100/360/500/1000/1250/1500/ 2000/2500/3600
Max. speed	12,000 rpm
Working temperature range	- 30 °C to + 100 °C
Storage temperature range	- 40 °C to + 110 °C
Light source	Miniature lamp 5 V/0.6 W
Power supply	Circuitry and light sources + 5 V/± 5 % typ. 170 mA, max. 220 mA (zero load)
Output signals	TTL compatible
Signal sequence	Rectangular pulse sequences U_{a1} and U_{a2} and the inverted signals $\overline{U_{a1}}$ and $\overline{U_{a2}}$. U_{a2} lags behind U_{a1} during clockwise rotation Reference signal U_{a0} Inverted pulse $\overline{U_{a0}}$ (1 pulse per revolution)
Switching times	≤ 0.2 μs Time delay of signal U_{a0} with respect to signals U_{a1} and U_{a2} ≤ 50 ns
Scanning frequency	0 to 300 kHz
Max. output load	$I_{High} \leq 20 \text{ mA}$ $I_{Low} \leq 20 \text{ mA}$ $C_{Load} \leq 1000 \text{ pF}$
Short circuit protection	For short periods (≤ 3 sec) all outputs against 0 V, 1 output continuously at an ambient temperature ≤ 25 °C
Admissible mechanical load on shaft	Axial 10 N Radial 20 N
Protection standard	IP 64 in acc. with DIN 40050 or IEC 529
Inertia of the rotor	$0.0145 \times 10^{-4} \text{ kgm}^2$
Max. cable length	Cable to associated electronics max. 50 m with differential signal receiver at the input of the associated electronics, which must not affect the value for the supply voltage to the ROD 426

2.6 Connection Cable Incremental Encoder ROD 426.014
(Encoder and extension with Bosch encoder cable)



Screen braiding

Pin	Signal	Cross-section (mm ²)	Connector (socket) assignment on encoder side	Bosch encoder cable (if used)
1	Ua1	0.14	Brown	White/yellow
2	$\overline{Ua1}$	0.14	Green	Green
3	Ua2	0.14	Grey	Grey
4	$\overline{Ua2}$	0.14	Pink	Pink
5	+ 5 V el.	0.14	Blue	Brown
6	Uaø	0.14	Red	White
7	$\overline{Uaø}$	0.14	Black	White/grey
8			Violet	Violet
9	+ 5 V lamp	0.5	Brown	Red
10	0 V el.	0.14	White	Black
11	Screen (connection, see below)		White/brown	
12	0 V lamp	0.5	White	Blue

Screen connection
(encoder side and module side)

After stripping the insulation from the cable, push the screen braiding which has been shortened to a length of approx. 1 cm back over the cable insulation and connect it to the plug housing by clamping it beneath the strain-relief facility. A connection must also be made between screen and PIN 11.

CAUTION

Screen connections not connected to encoder lines may lead to unpredictable behavior of the drives.

Ensure perfect screen connections in order to avert danger.

3. Interface Conditions

3.1 Information on Installation

Adequate heat dissipation by thermal radiation and natural convection must be ensured.

CAUTION

**High surface temperatures may occur on the motor.
A touch guard must be provided if necessary.**

The minimum cable cross-sectional areas must be observed in the cable glands in order to maintain the **protection standard**.

No fluid may remain at the flange end plate on servo motors for vertical installation (**Type IM V3**).



Drive elements such as belt pulleys, clutch disks and gear wheels etc. may be fitted and removed only with a suitable **mounting and extraction device**. Use the thread on the shaft extension.

CAUTION

Never hammer or knock the shaft extension since this would damage the ball bearings and rotor.

Motors with **keyway and featherkey** are balanced with featherkey.

Servo motors prepared for **encoder attachment** may not be operated with attached coupling/clutch and without attached encoder.

Servo motors with **oil-tight driving-end end plate** must run at least half in oil. They may not be operated dry. If this is not guaranteed, the shaft sealing ring must be removed. It cannot be reused.

Servo motors Type SD-B. may **not be dismantled**.

One exception to this rule is replacing the tacho board in accordance with Section 3.3 and replacing the connection sockets. All other installation work must be carried out at the Bosch works.

3.2 Electrical Connection

Before initial operation of the servo motors, check the motor-module combination using the type label (see Section 2.3).

Note If a module which is not approved is connected, this will restrict operation and may cause damage to the motor.

3.2.1 Motor connection

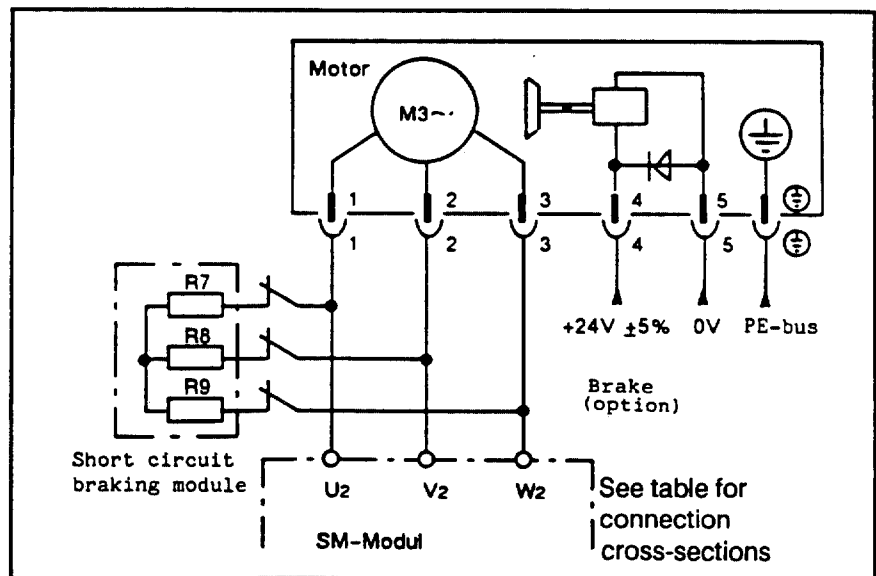
CAUTION

Always disconnect the power supply before carrying out any connection or installation work. Owing to permanent magnet excitation, the motor and tacho terminals are live when the rotor is driven.

The brushless servo motors are connected at terminals U2, V2, W2 of the associated servo modules. On the motors themselves the connection is made by plug connectors.

SD-B3, B4, B5
without SD-B5.380.030

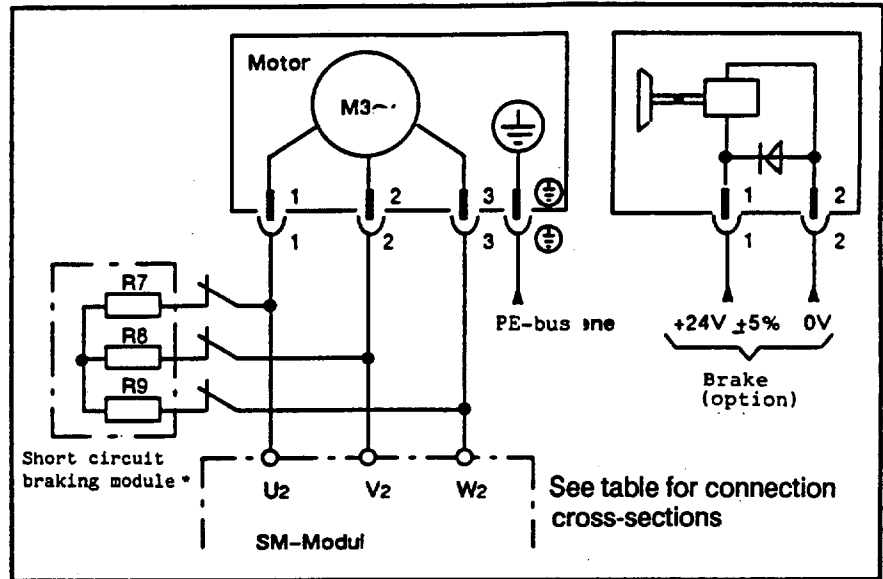
**PIN 6 (motor star point)
must not be grounded!**



* Short circuit braking for E.STOP. See Section 3.2.2 for connection.

**SD-B6 and
SD-B5.380.030**

**! PIN 4 (motor star point)
! must not be grounded!**



* Short circuit braking for E.STOP. See Section 3.2.2 for connection.

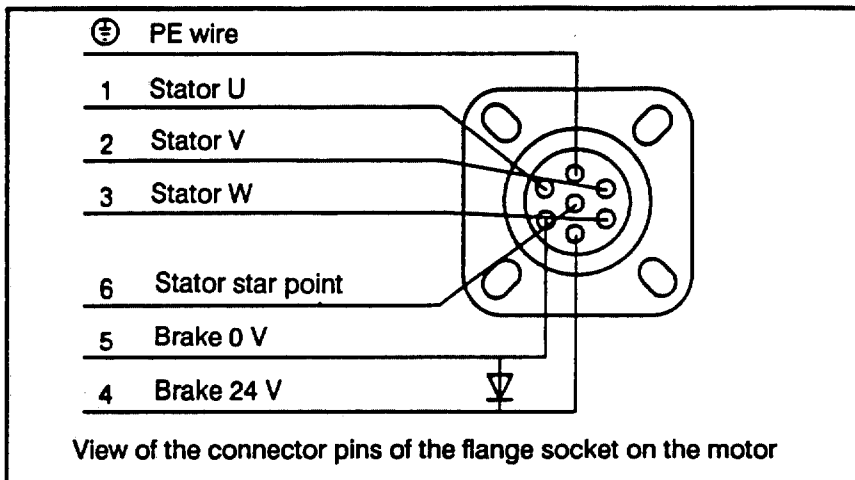
Connection cross-sections

(in accordance with EN 60204, Part 1, Tables BI and BII for normal applications in cable duct at an ambient temperature of 45 °C

Motor	Connection cross-section in the mating connector [mm ²]
SD-B3	1.5
SD-B4	1.5
SD-B5.250.015	2.5
SD-B5.250.020	2.5
SD-B5.250.030	6.0
SD-B5.380.012	2.5
SD-B5.380.020	6.0
SD-B5.380.030	10.0
SD-B6.480.020	10.0
SD-B6.720.020	16.0
SD-B6.960.010	10.0
SD-B6.960.015	16.0

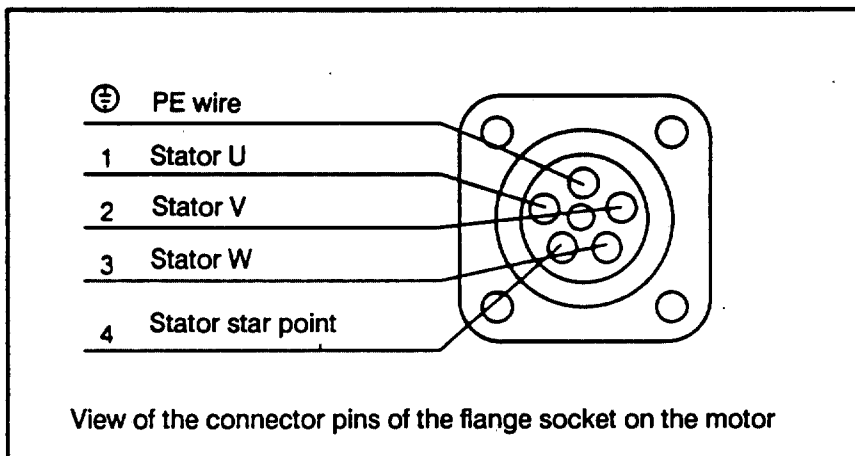
Socket for power connection and disk brake SD-B3, B4, B5

**PIN 6 (motor star point)
must not be connected!**

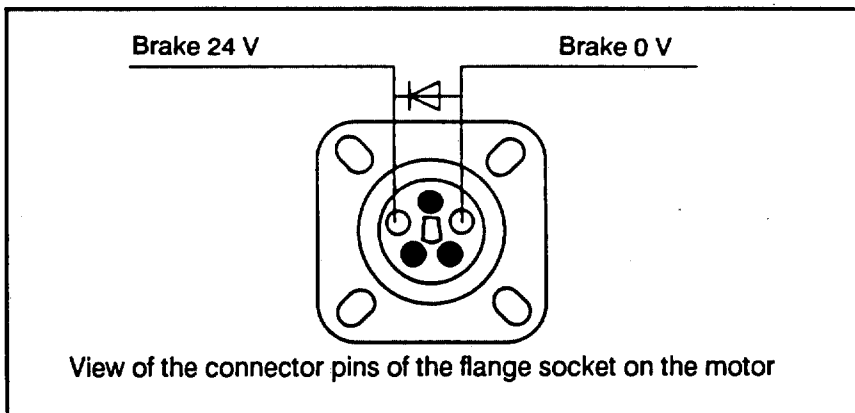


Socket for power connection SD-B6 and SD-B5.380.030

**PIN 4 (motor star point)
must not be connected!**



Socket for disk brake SD-B6 and SD-B5.380.030



3.2.2 Short circuit braking

In order to prevent coasting of the feed axes in an EMERGENCY-STOP, the feed motors can be braked by shorting the motor windings via braking resistors.

The short circuit braking resistors are rated such that the motors stop with maximum current in the shortest possible time.

The technical rating of the resistors is based upon the following:

the kinetic energy of rotation $W_{rot} = 1/2 J\omega^2$ at maximum rotational speed and
load moment of inertia = motor moment of inertia

The resistors are available as resistor modules:

Motor type	Resistance R_x [Ohm]	Min. energy [Ws]	Stock No. Bosch
SD-B3.031.030	8.2	57	105/913544
SD-B3.050.030 SD-B3.068.030	5.6	261	105/913546
SD-B3.095.030	3.3	293	105/913546
SD-B4.070.030 SD-B4.092.020	5.6	261	105/913546
SD-B4.140.020 SD-B4.140.030	3.3	293	104/913545
SD-B4.180.020	5.6	261	105/913546
SD-B4.250.015			
SD-B5.250.020 SD-B5.380.012	3.3	785	105/913547
SD-B5.250.030 SD-B5.380.030	3.3	4085	Currently not available
SD-B5.380.020 SD-B6.480.020 SD-B6.720.020 SD-B6.960.010 SD-B6.960.015	1.0	4085	105/913862
$R_x (\pm 10 \%)$	Each module has 3 resistors Individual resistors as specified in the table above.		
Connection cross-section	Max. 4 mm ²		
Test voltage	2500 V AC		
Max. ambient temperature	55 °C		
Mounting	Snap-on mounting to top-hat rail 35 mm in acc.with DIN		
Protection standard	IP 20		

Short circuit braking contactors

The following short circuit braking contactors are suitable for instance:

Type	I_{th}	I
Siemens 3TH...	16 A	150 A
Klöckner-Möller DIL R	16 A	150 A
Klöckner-Möller DIL 00	20 A	200 A

3.2.3 Disk brake

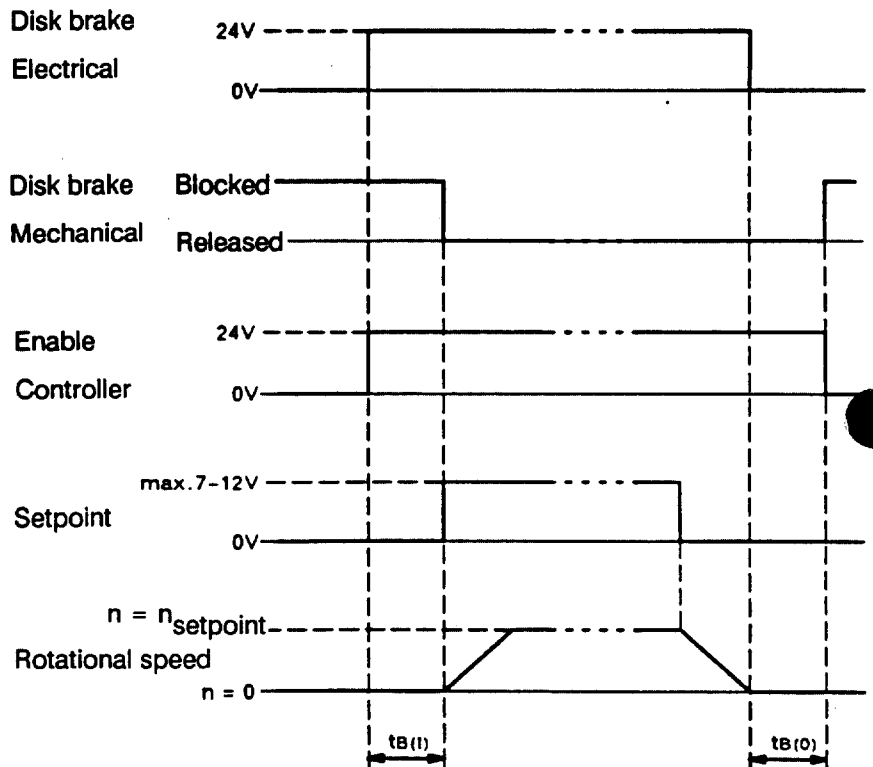
Control voltage for releasing the brake: 24 V DC \pm 5 %.
If the voltage tolerance is not observed, the disk brake cannot be released reliably.

CAUTION

The disk brake is not a working brake. It may be operated only with the axis stationary. The disk brake must be inspected after 1000 EMERGENCY-STOP braking operations.

Control

Control of the disk brake, setpoint and enabling of the servo module must thus be intermatched as a function of time as shown on the diagram below:



$t_{B(1)}$ = Switch-on time
Time between applying the DC voltage to the disk brake and completely released brake

$t_{B(0)}$ = Switch-off time
Time between switch-off of the DC voltage at the disk brake and completely blocked brake

The disk brake must be switched on and off with the servo motor stationary as shown on the diagram above. A rotational speed $n = 0$ rpm is achieved by applying a setpoint $SW1 = 0$ V, and the shaft is reliably "held" until complete release or blockage of the disk brake.

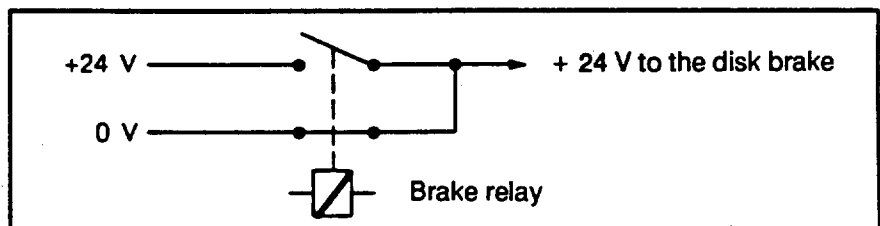
The following switch-on and switch-off times of the disk brake must be taken into consideration:

Frame size	Switch-on time $t_{B(I)}$ [ms]	Switch-off time $t_{B(O)}$ [ms]
SD-B3	15	7
SD-B4	30	13
SD-B5	100	30
SD-B6	90	40

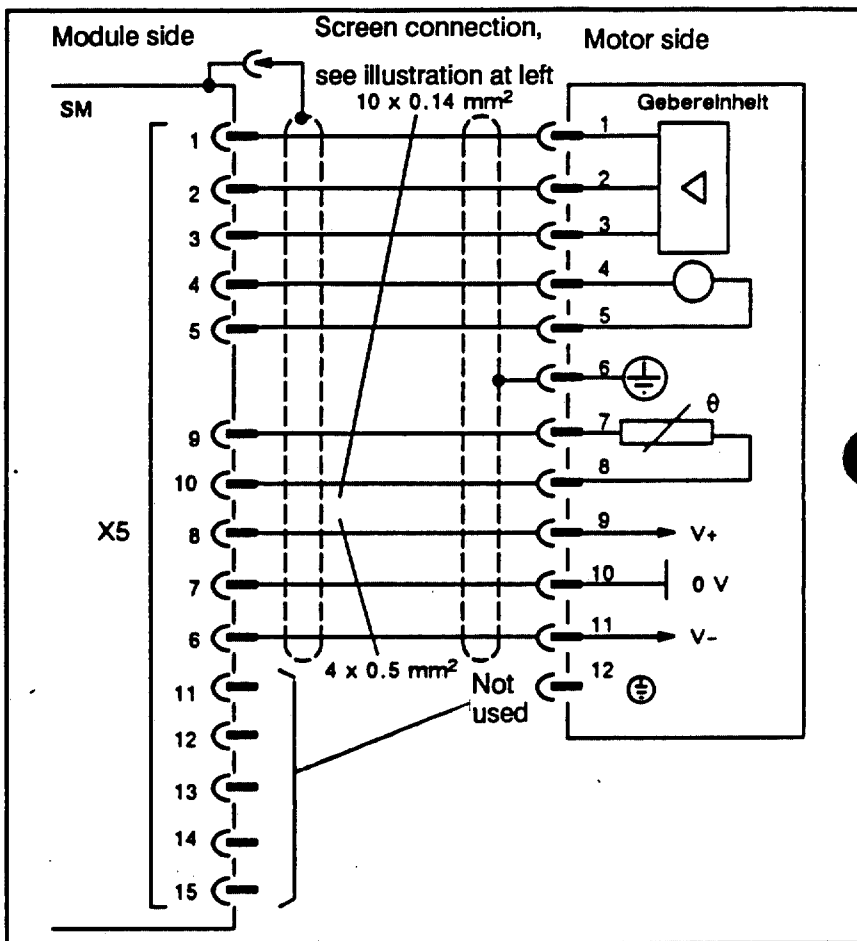
Interference

Pick-up on the 24 V supply line to the disk brake may cause a delayed response of the brake.

If such interference occurs, we recommend that the disk brake be controlled on the basis of the connection schematic below:



3.2.4 Tacho and commutation connection



Module-side assignment plug X 5	Signal	Motor plug assignment (encoder)	Color	Function - encoder unit
1	A	1	Grey-white	Rotor position encoder for commutation control
2	B	2	Violet	
3	C	3	Green	
4	Tacho	4	Yellow	Brushless DC tacho
5	N	5	Brown-white	$U = 2.7 \text{ V}/1000 \text{ rpm}$ to $n_N = 3000 \text{ rpm}$
Connect to plug housing (see above)	Screen	6	-	Screen connected to PE in the motor
9		7	Grey	Thermistor for motor temperature monitoring
10		8	White	
8	V +	9	Red	Voltage supply $\pm 15 \text{ V DC}$ for tacho and encoder
7	GND	10	Black	
6	V -	11	Blue	

* Color coding applies only to special Bosch cable

Tacho cable

The special Bosch cable or a comparable cable can be used:
Stock No.: 070 - 903499, length as required (by the meter)

Maximum admissible cable length : 100 m

Admissible bending radius:

bending once > 93 mm

bending repeatedly > 185 mm

The tacho cable 070-903499 is not suitable for trailing cable operation.

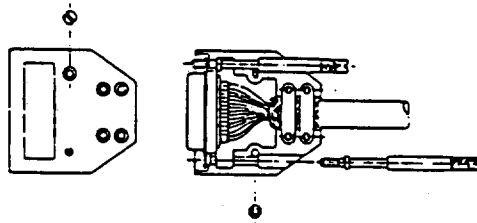
In the case of **trailing cable operation**, the mechanical load will be dependent upon the radius and length of the trailing cable and traversing speed and torsional stress, and must be coordinated with the cable manufacturer.

Further information is available from the following companies for instance:

W. L. Gore & Co. GmbH, Pleinfeld, Tel. (0 91 44) 60 10

Kabelmetal electro GmbH, Nuremberg, Tel. (09 11) 52 07-0

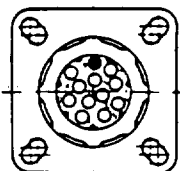
Screen connection (module side) After stripping the insulation from the cable, bend the screen braiding which has been shortened to a length of approximately 1 cm back over the cable insulation and connect it to the connector housing by clamping it beneath the strain-relief facility.



Tacho connector (motor side)

Pin 12 of the tacho connector must be sealed with the supplied **blanking plug** (as on the tacho socket).

This prevents confusion of the tacho and encoder plugs (ROD) and, thus, destruction of the encoder unit.



3.3 Replacing the Tacho Board

On Bosch servo motors type SD-B., the commutation and tacho signals are conditioned on an electronic PC board, the so-called tacho board.

Version up to 10/1987, No. 038438, with solder connection

Version as from 10/1987: No. 054300, with plug connection

The signals formed on the tacho board are monitored continually by the connected servo module so that the following fault messages may occur:

T_F tacho fault

K_F commutation fault

If a fault has occurred, check whether the cause of the fault lies in the connection cable, in the servo module or on the tacho board. In the event of a fault on the tacho board, the entire tacho board must be replaced. When replacing the tacho board, ensure that the new board is repositioned precisely owing to the fork-type light barriers.

Replacing tacho board 038438 by 054300

Procedure for replacing tacho board 038438 by 054300:

1. Remove the non-driving end bearing cover and any attached encoder.
2. Make a mark at the center of the fork-type light barrier A5 on the outer ring (tacho housing).
3. Mark the connection leads of board 038438 with the related numbers, desolder and remove them.
4. Undo the securing screws.
Caution: Do not undo any of the screws for the tacho housing on the rear end plate!
5. Remove the tacho board.
6. Detach the adjusting lug, if present, on the new board 054300 (see illustration).
7. Solder in the connection leads as shown on the connection table in the through-platings before the connectors. In order to do this, heat the through-plating using a soldering iron on the component side and insert the cable from the rear and solder it on firmly. Pin No. 1 has an angular soldering point.
8. Position the new board with the component side pointing inwards on the tacho housing so that the etched arrow on the soldering side is at the marked position as accurately as possible.
9. Screw the board tight in this position.
10. Check that there are no short circuits before switching on.
11. The two through holes of the 8 securing screws on the bearing cover must be sealed with Loctite 577 in order to maintain the protection standard.

Connection table

Tacho board No. 034838 (Solder connection)		Tacho board No. 054300 (Plug connection)	
Solder pin No.	Wire color	Plug X1 PIN No.	Plug X2 PIN No.
1	Yellow		4
2	Orange		6
3	Violet		7
4	Green		8
5	White 7	4	
6	White 5	2	
7	White 3	3	
8	White 1	1	
9	Blue		2
10	White + brown	5 (white)	1 (brown)
11	Black		3
12	Red		5

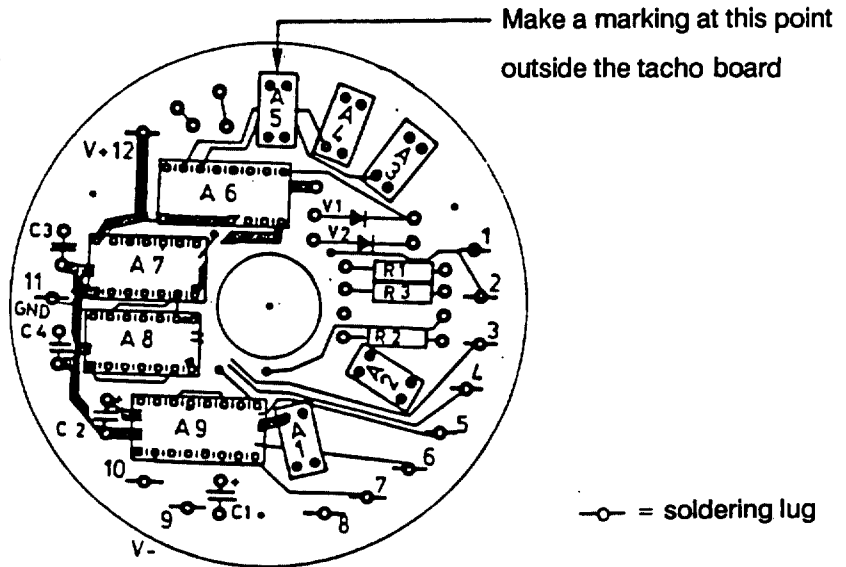
**Replacing tacho board 054300
by 054300**

Procedure for replacing the new tacho board 054300:

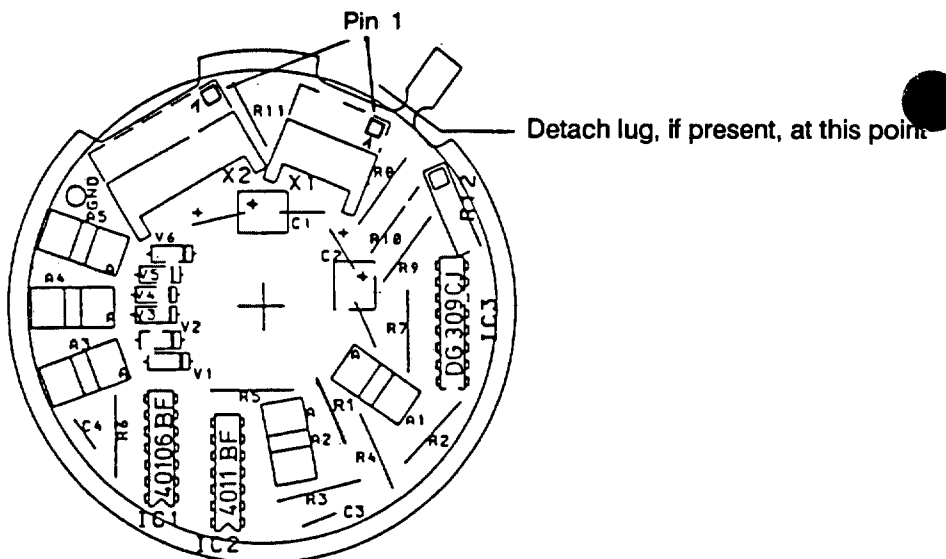
1. Remove the non-bearing cover and any attached encoder.
2. Make a mark at the center of the fork-light barrier A5 at the position of the etched arrow on the outer ring (tacho housing).
3. Undo the securing screws.
Important: Do not undo any of the screws for the tacho housing on the rear end plate!
4. Remove the tacho board.
5. Detach the connectors X1 and X2.
6. Detach the adjusting lug, if present, on the new board (see illustration).
7. Connect connectors X1 and X2.
Caution: Do not fit the mating connector twisted, so as to prevent the connector from bending up or breaking in its mount.
8. Position the new board with the component side pointing inwards on the tacho housing so that the etched arrow on the soldering side is precisely at the previously marked position.

9. Screw the board tight in this position.
10. The 2 through holes of the 8 securing screws on the bearing cover must be sealed with Loctite 577 in order to maintain the protection standard.

**Tacho board No. 38438
with solder connection**

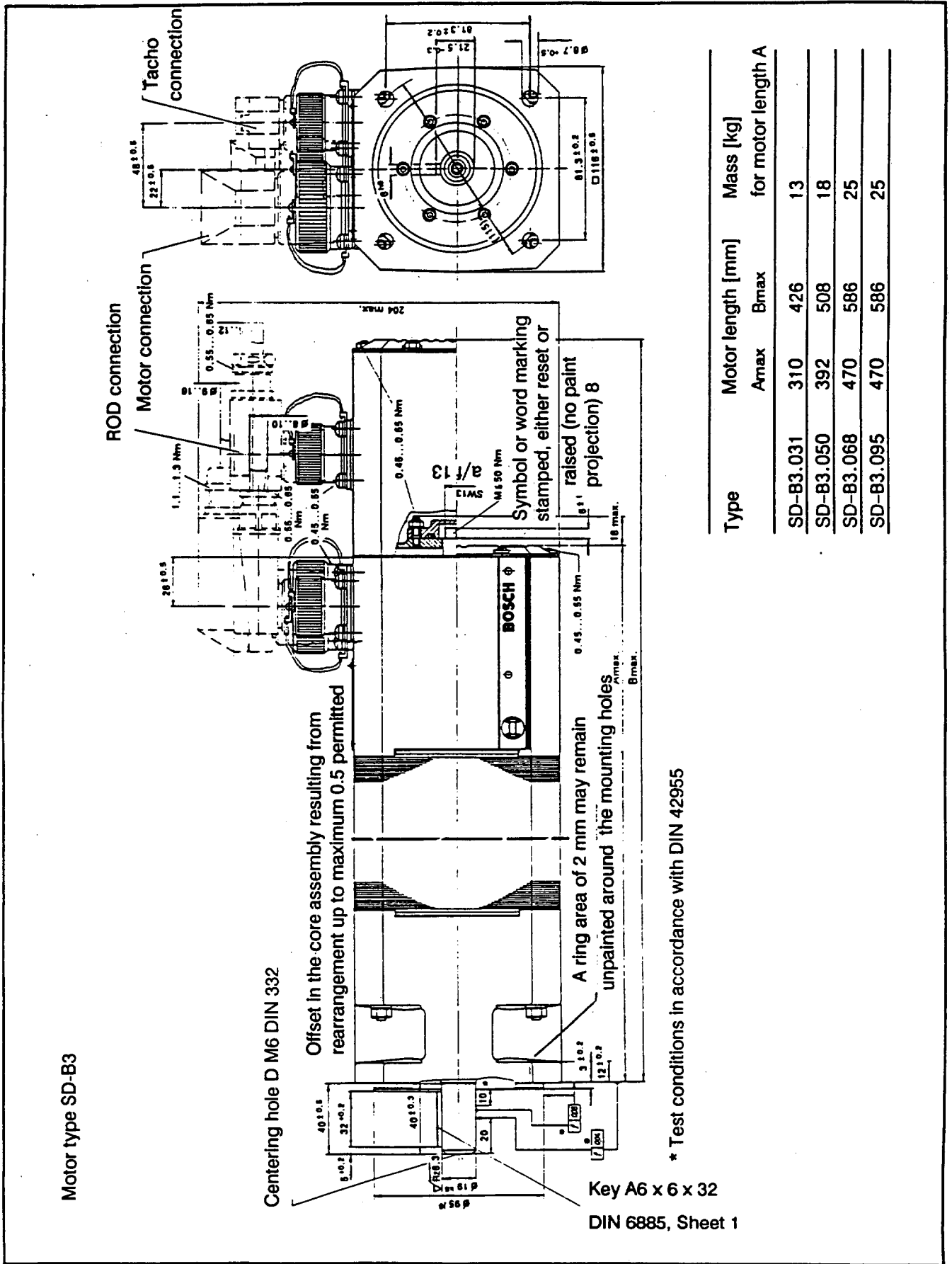


**Tacho board No. 054300
with plug connection (new)**



4. Dimensioned Drawings

4.1 Dimensioned Drawings Servo Motors Type SD-B.



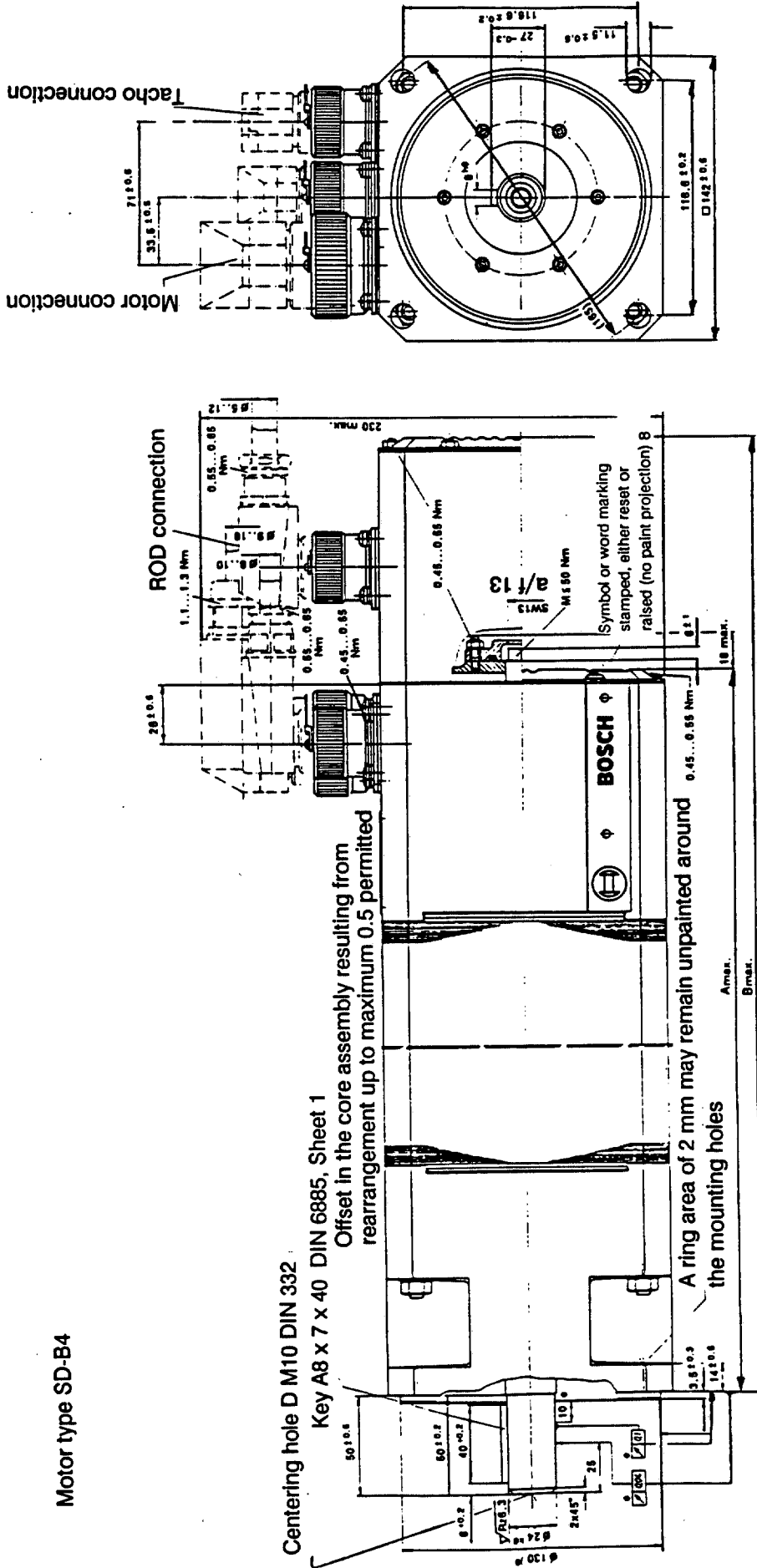
Type	Motor length [mm]		Mass [kg] for motor length A
	A _{max}	B _{max}	
SD-B3.031	310	426	13
SD-B3.050	392	508	18
SD-B3.068	470	586	25
SD-B3.095	470	586	25

Motor type SD-B4

Centering hole D M10 DIN 332

Key A8 x 7 x 40 DIN 6885, Sheet 1

Offset in the core assembly resulting from rearrangement up to maximum 0.5 permitted



A ring area of 2 mm may remain unpainted around the mounting holes

* Test conditions in accordance with DIN 42955

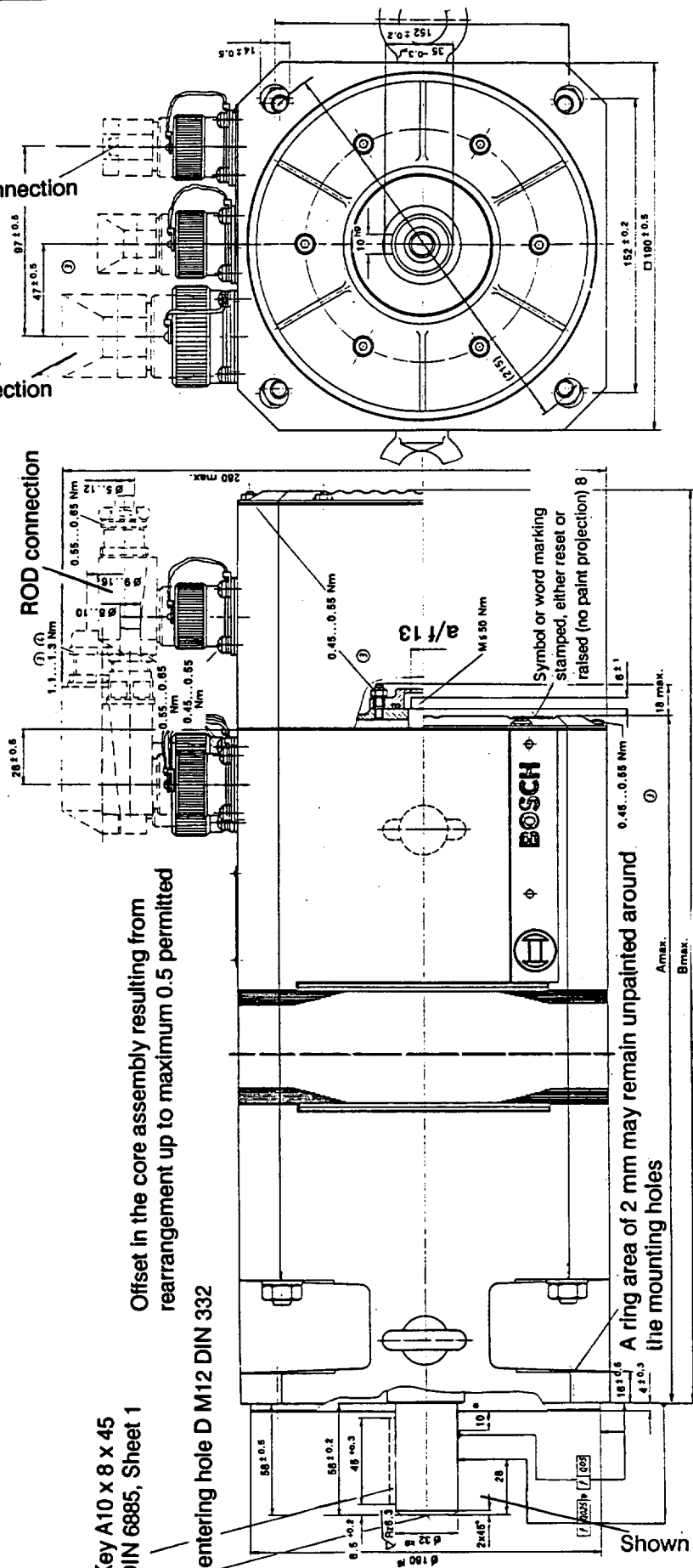
Type	Motor length [mm]		Mass [kg] for motor length A
	A _{max}	B _{max}	
SD-B4.070	362	478	23
SD-B4.092	362	478	23
SD-B4.140	480	596	38
SD-B4.180	480	596	38

Motor type SD-B5

Key A10 x 8 x 45
DIN 6885, Sheet 1

Offset in the core assembly resulting from
rearrangement up to maximum 0.5 permitted

Centering hole D M12 DIN 332

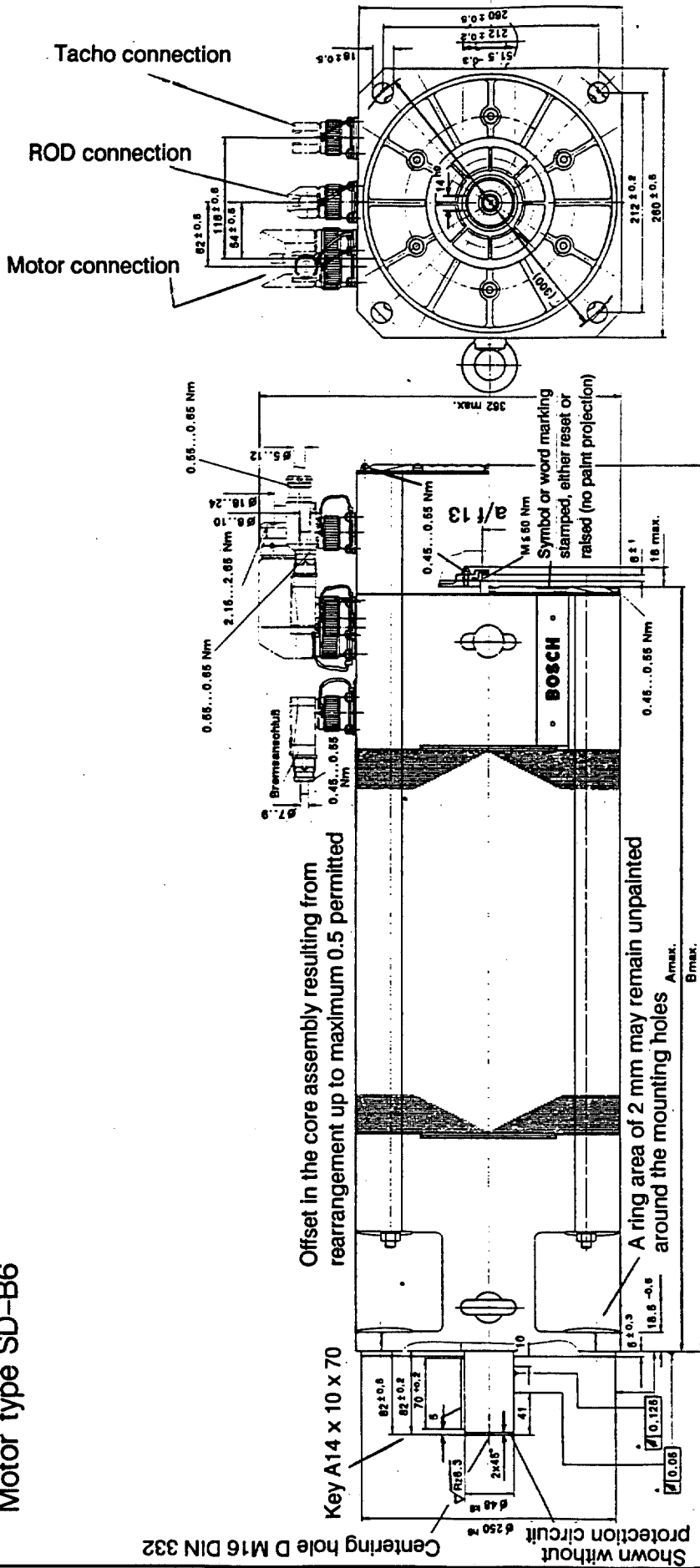


Shown without protection circuit

* Test conditions in accordance with DIN 42955

Type	Motor length [mm]		Mass [kg] for motor length A
	A _{max}	B _{max}	
SD-B5.250	484	600	60
SD-B5.380	585	701	80

Motor type SD-B6

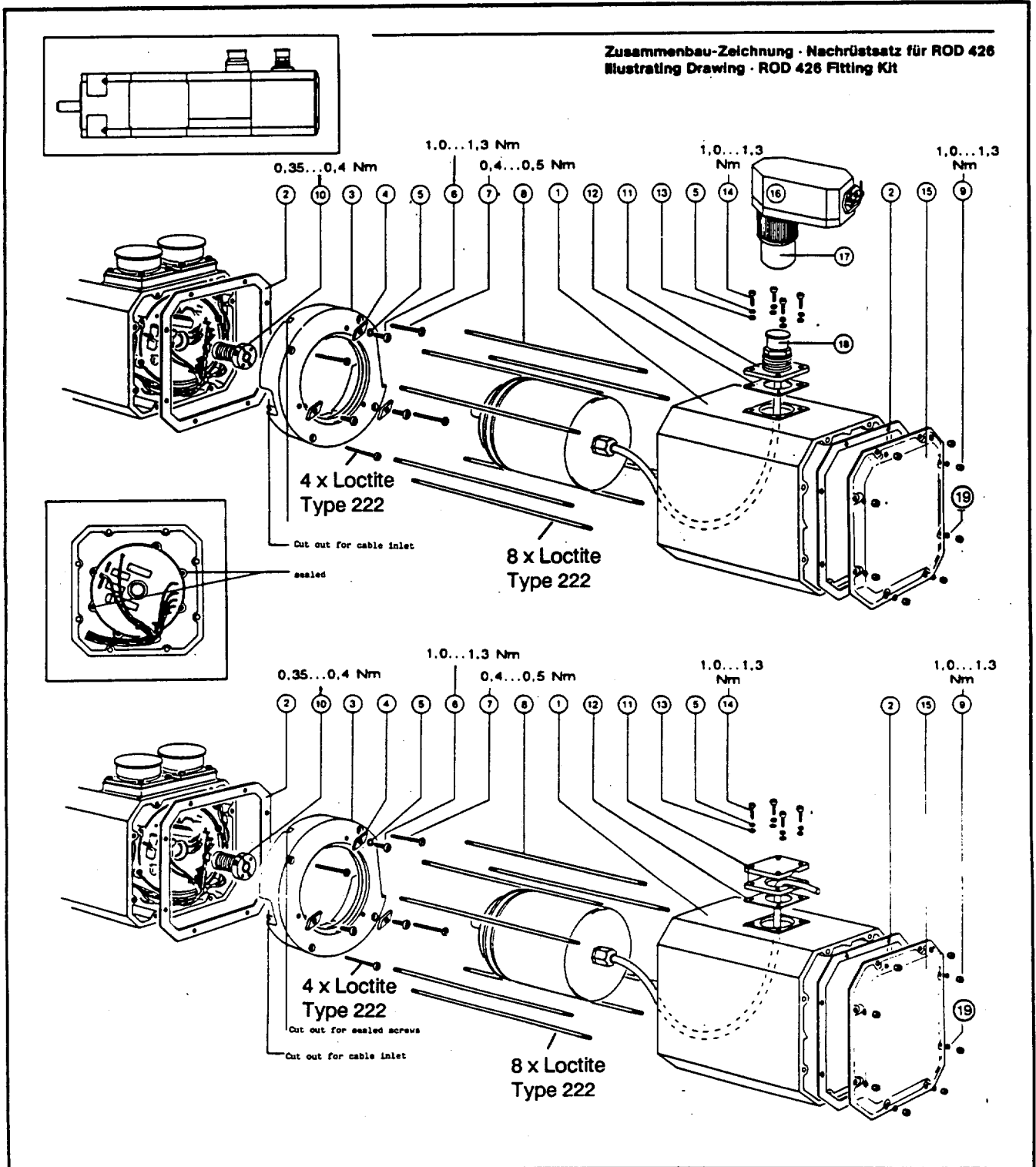


Type	Motor length [mm]		Mass [kg] for motor length A
	Amax	Bmax	
SD-B6.480	551	667	115
SD-B6.720	631	747	157
SD-B6.960	741	857	190

* Test conditions in accordance with DIN 42955

4.2 Dimensioned Drawing/Assembly Drawing for Encoder Attachment

ROD 426.014 fitting kit (cf. Section 1.5)



Item designations of the
 assembly drawings

M4

Item No.	Designation	Item No.	Designation
1	Intermediate housing	11	Socket
2	Seal	12	Seal
3	Intermediate ring	13	Plain washer
4	Clamping jaw	14	Raised cheese-head screw
5	Spring washer	15	Bearing cap
6	Raised cheese-head screw M4	16	Plug-in connector
7	Raised cheese-head screw M3	17	Contact socket
8	Stud bolt M4	18	Contact pin
9	Hexagon nut M4	19	Sealing washer
10	Coupling (spare part Stock No.: 913 224)		

The following tools are required for assembly:

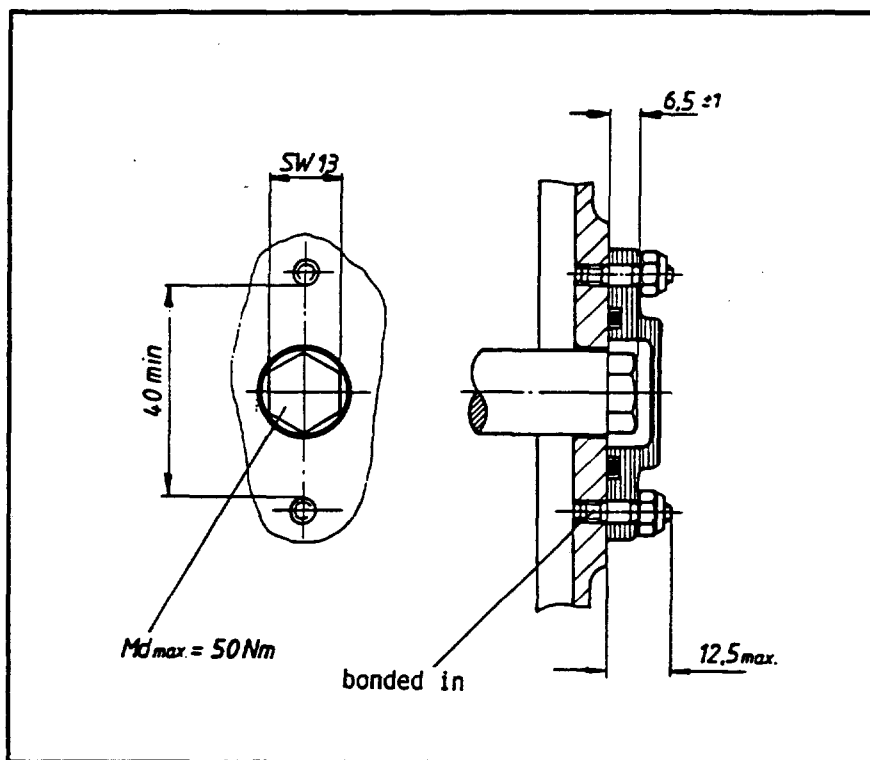
- 1.5 mm hexagon spanner, extra-long, stock No. 915345
- 2.5 mm hexagon spanner, Stock No. 915346

Assembly instructions
ROD 426 fitting kit
(with connector system)

1. Remove the bearing cap (15) and seal (2) on the motor.
2. Fully insert the coupling (10) into the locating hole on the rotor. Tighten the axial fillister-head screw with internal hexagon to a torque of 0.9 ... 1 Nm.
3. Remove screws on the tacho board which are not locked with lacquer (4 ea., 90°-offset).
4. Fit the intermediate ring (3) and secure it with the raised cheese-head screws (7). Seal screws with Loctite 222.
Caution: Do not crush the wires.
5. Insert the ROD encoder into the intermediate ring (3) and coupling (10) (the coupling must not mechanically contact the encoder housing). Secure the encoder with the raised cheese-head screw (6), spring washer (5) and clamping jaw (4) (3 x 120°-offset).
6. Clamp the clamping ring of the coupling (10) onto the encoder shaft using a hexagon wrench (0.35 = 0.40 Nm).
7. Secure the stud bolts (8) on the motor housing.
8. Fit the seal (2) and intermediate housing (1) onto the stud bolts (8).
Caution: Do not crush the wires.
9. Solder the contact sockets to the encoder cable.
10. Remove the cover on the intermediate housing (1) and insert the encoder cable through the intermediate housing and seal (12).
11. Engage the contact pins into the socket (11) on the basis of the recommended pin assignment.
12. Secure with the socket with 4 x raised cheese-head screws (14), spring washers (5) and plain washers (13). The required installation position can be checked by plugging in the mating connector.
13. After setting the reference mark by turning the encoder, fit the sealing ring (2) and bearing cover (15).
Secure bearing covers made of sheet metal with 2 sealing washers (19), and bearing covers made of aluminium with 1 sealing washer (19) and hexagon nuts (9) and seal with Loctite 222.

Also see our publication
 P.-No. 3736 with connection system
 P.-No. 3795 without connection
 system

4.3 Dimensioned Drawing - 2nd Shaft End



For your notes:

5. Spare Parts

5.1 Connection Systems (Souriau) - Stock Numbers for Spares Orders

Motor type	SD-B3...4	SD-B5	SD-B5.250.030 and B5.380.020	SD-B6 and SD-B5 380.030
Power connector (mating connector, see Section 1.4)				
Description	Motor SD-B3...4	Motor SD-B5	SD-B5.250.030 and B5.380.020	Motor SD-B6 and SD-B5.380.030
Socket	8PM.Q3-7P.015A Stock No. 9154045	8PM.Q3-7P.015A Stock No. 914045	8PM.Q3-7AP.022A Stock No. 914041	8PM.Q4-5P.012A Stock No. 914040
Contact pin (disk brake) with connection 0.75 mm ²	2x 8291-1435 Stock No. 914029	2 x 8291-1435 Stock No. 914029		
Contact pin with connection 1.5 mm ²	4 x 8291-1433 Stock No. 914031			
Contact pin with connection 2.5 mm ²	1 x 8291-1431 Stock No. 914030	5 x 8291-1431 Stock No. 914030		
Contact pin with connection 6 mm ²			7 x 8291-1683 Stock No. 914028	
Contact pin with connection 16 mm ²				5 x 8291-1451 Stock No. 914027
Reducing bush for disk brake			2 x 8291-1692 Stock No. 914046	
Tacho socket motor for all frame sizes (mating connector, see Section 1.4)				
Socket	8PM.Q2.12P.008A Stock No. 914043			
Contact pin with connection 0.25 mm ²	10 x 8291-1297 Stock No. 914033			
Contact pin with connection 1 mm ²	1 x 8291-1295 Stock No. 914032			
Brake socket for SD-B6 and B5.380.030 only (mating connector, see Section 1.4)				
Socket	8PM.Q2.5P.010A Stock No. 914044			
Contact pin with connection 0.75 mm ²	2 x 8291-1435 Stock No. 914029			
ROD encoder socket fitting kit				
Socket parts set consisting of: - Socket - Contact pins 1.5 mm ²	8PM.Q2-12AP014 Stock No. 914042			
Mating connector: - Connector coupling - Contact sockets	8PM.V2-12AS007 Stock No. 914035			

Motor type	Tacho and ROD	Brake	SD-B3...5	SD-B5.250.030 SD-B6.380.020	SD-B6 and SD-B5.380.030
Dismantling Tools for Connections and Contacts					
For contact ø 1.6 mm	Stock No.914050				
For contact ø 2.4 mm		Stock No.914051			
For contact ø 3.6 mm				Stock No.914115	
For contact ø 5.0 mm					Stock No.914052
Socket spanner to dismantle connectors	Stock No.914048		Stock No.914047		Stock No.914049

CAUTION

Seal the securing screws with Loctite 577 when replacing the connection sockets (protection standard)!

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