

MRD-S

ELECTRICAL MINIATURE ROTARY ACTUATOR



Dear Customer,

Congratulations on choosing a SCHUNK product. By choosing SCHUNK, you have opted for the highest precision, top quality and best service.

You are going to increase the process reliability of your production and achieve best machining results – to the customer's complete satisfaction.

SCHUNK products are inspiring.

Our detailed assembly and operation manual will support you.

Do you have further questions? You may contact us at any time – even after purchase. You can reach us directly at the mentioned addresses in the last chapter of these instructions.

Kindest Regards,

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1 Safety

1.1 Symbol Key



You will find this symbol wherever **hazards for persons** are possible.



You will find this symbol wherever **damage to the product** are possible.



This symbol indicates **important information** on the product or its handling.

1.2 Appropriate Use

The MRD-S miniature rotary actuator is designed for the limited purpose of transmitting rotative movements. The driving power is directly transmitted without mechanical transmission elements. The rotary actuator is particularly suited to applications for which high dynamics are demanded.

1.3 General information

The purpose of this manual is to furnish such information as is necessary to enable skilled personnel to perform repair and maintenance work to the MRD-S 04/08/12 miniature rotary actuators independently.




To ensure safe operation, you must comply with the instructions contained in the following:

- Technical data for MRD-S 04/08/12 miniature rotary actuators according to the motor data sheet and the overview of our product range
- Documentation for the drive controller in use (DOK-ECODR3-XXX....)
- Assembly instructions for the system in which the miniature rotary actuator is to be operated
- We assume no liability for operation of the motors with control modules of other manufacturers without express approval. Indramat control modules are standard.

1.4 Safety Notes

1. There are potential risks associated with the unit, for example if:
 - the MRD-S is improperly used, installed or serviced.
 - the MRD-S is used other than for the intended purpose.
 - the EC Machine Directive, the accident prevention regulations, the VDE guidelines or the safety and installation instructions are not observed.

2. Installation, initial start-up and maintenance of the MRD-S miniature rotary actuator may only be performed by skilled personnel and supported by following the instructions in this manual.

3. The MRD-S miniature rotary actuator is equipped with protective devices for your safety. Nevertheless, this actuator may constitute a hazard if operated by insufficiently trained personnel or used for a purpose other than its intended purpose.
4.  The secondary parts integrated into the miniature rotary actuator are high-power permanent magnets! People wearing medical devices, such as pacemakers and hearing aids can be injured as a result. Electronic assemblies, memory media, precision mechanical elements and other magnetically interactive objects can be damaged.
5. No work on the actuators and the controls may, under any circumstances, be performed unless the machine is in the stop state. Ensure that no part of the device is electrically energized.
6.  Placement of measuring cables next to electrical power cables should be avoided.
7.  To ensure a good seal, the seal on the rotary table should be replaced every 5 million cycles.
Note that the use of the unit under extreme environmental conditions (e.g. casting dust or abrasive dust) can significantly reduce the life of the seals.
11.326Observer the maintenance instructions (see Chapter 11.3, page 29).
8. Before assembly, disassembly or maintenance work is started, the MRD-S miniature rotary actuator must be in a cooled-down state.

1.5 Protection against hazardous movements

Hazardous movements may occur where the drives are incorrectly actuated. The drives are monitored in such a way that, to a very great extent, malfunction can be excluded. However, owing to the risk of injury, for reasons of personal protection and in light of the risk of property damage, the user should not rely completely on such monitoring. Until such time as the integrated controls come into operation, improper actuator movements must be expected.

Improper actuations may be caused by:

- Cabling and wiring errors
- Defective components
- Software bugs
- Handling errors
- Removal of safety devices
- Signal transmitter and transducer errors
- Entry of wrong parameters before initial start-up

1.6 Environmental and operating conditions

For trouble-free operation, certain environmental and operation conditions must be obeyed.

- (1) The modules of type IP54 were tested according to DIN EN 60529 (IEC 529/VDE 047 T1) with water.
- (2) To guarantee personal safety, the drive controllers must be operated with isolating transformers (circuit recommendation included).
- (3) Ambient temperature: 10°C (50°F) to 40°C (104°F)
- (4) Permissible medium: Filtered compressed air (10µm), dry, lubricated or non lubricated
- (5) The actuator must be protected against:
 - strong irradiation and heat
 - pollution by chips and dust
 - aggressive gas
 - vibration
 - shock
 - humidity
 - oily and acidic environment

If the components are to be used in difficult ambient conditions (e.g. honing oil or other aggressive media), please contact us!

1.7 Modifications to the torque motor actuator

Modifications to the MRD-S miniature rotary actuator and/or assembly of additional, non-genuine parts may impair the operational safety of the actuator. This applies in particular with respect to work or manipulation performed on safety-related parts.

If modifications to the MRD-S miniature rotary actuator are effected, SCHUNK disclaims any warranty therefor.

2 Warranty

The warranty period is 24 months from the date of delivery when utilized as intended in single-shift operations and in compliance with the specified maintenance and lubrication intervals and the defined environmental and operating conditions (see chapter 1.5).

Parts that come into contact with the workpiece and wearing parts are not covered by the warranty. See also our General Terms and Conditions in this regard.

The unit is considered defective when the basic rotary function is inoperable.

3 Scope of Delivery

The scope of delivery comprises

- Miniature Rotary Actuator Type MRD-S, depending on the version ordered.

4 Technical Data

Type	MRD-S 04	MRD-S 08	MRD-S 12
Overall size in mm (width x height x depth)	60 x 104 x 68	60 x 124 x 68	60 x 144 x 68
Nominal torque	0,4 Nm	0,8 Nm	1,2 Nm
Maximum torque	1,2 Nm	2,4 Nm	3,6 Nm
Maximum revolutions per minute (rpm)	600 rev/min	600 rev/min	600 rev/min
Acceleration up to	3897 rev/s ²	6160 rev/s ²	7539 rev/s ²
Repeat accuracy	± 0,001°	± 0,001°	± 0,001°
Angle of rotation	infinite	infinite	infinite
Workloads up to	1 kg	2 kg	3 kg
Weight	1,2 kg	1,5 kg	1,8 kg

Table 1: Miniature Rotary Actuator

Please consult our catalogue for further technical details. The last version is valid in each case (in accordance with Chapter 2.3 General Terms and Conditions)

Example of traversing time

	MRD-S 04	MRD-S 08	MRD-S 12
additional torque of inertia	200 kg/m ²	200 kg/m ²	200 kg/m ²
angle of rotation	180°, 100% ED (duty ratio)	180°, 100% ED (duty ratio)	180°, 100% ED (duty ratio)
cycle time	126 ms	120 ms	110 ms

5 Product description

5.1 Sizes



Figure 1: Sizes 04, 08 and 12 (from left to right)

Gearless electric rotary actuators based on so-called torque motors with lead-throughs for pneumatic hoses and electric cables.

5.2 Overview of types

The miniature rotary actuator are identified via their type and size:

MRD-S	04	IPxx	ED
MRD-S = Miniature Rotary Actuator	Nominal torque in Nm 04 = approx. 0.4 Nm 08 = approx. 0.8 Nm 12 = approx. 1.2 Nm	IP40 = Protection class IP40 (Standard) IP54 = Protection class IP54	with electric Feed-Through

Continuous improvement of our products is always our objective, and for this reason it is important that you always quote the SCHUNK GmbH & Co.KG material and serial number when making inquiries and placing orders for spare parts.

5.3 Functional Principle

5.3.1 Function - general description

The miniature rotary actuators are powered by a gearless drive. Such a direct drive dispenses completely with mechanical transmission; as a consequence, the inaccuracies associated with them are eliminated.

This gearless drive is a 3-phase brushless synchronous motor, which is permanently magnet-excited. The geometrics of these motors are specially designed for the transmission of high power and high torques.

5.3.2 Function of gearless drive

The function of the gearless drive is illustrated in Figure 2. The stator (1) consists of a 3-phase Cu coil. A 3-phase magnetic field is generated within the coil by means of the drive controller. There are permanent magnets on the rotor (2) forcing the rotor to follow the external magnetic field of the stator. In the event of a rotary motion of the magnetic field of the stator, the rotor will rotate in synchronisation with this field.

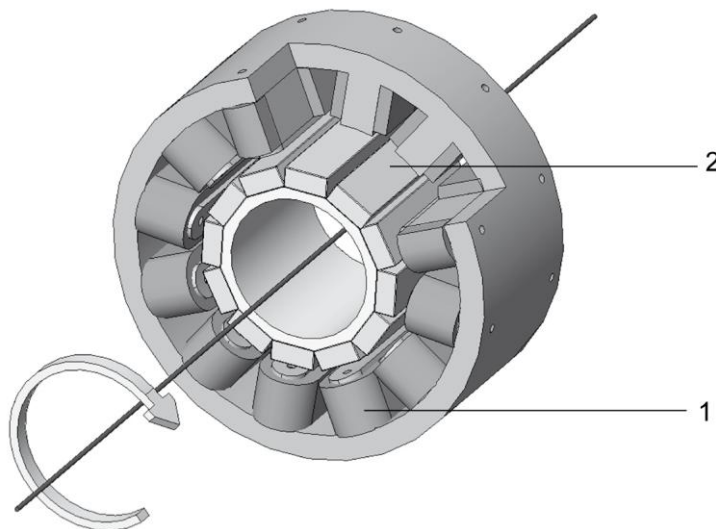


Figure 2: Function of the Gearless Drive (torque motor)

5.3.3 Special feature of the gearless drive

In the area of handling technology, it is necessary to perform motion tasks very rapidly and at a high degree of precision. A typical task consists of picking up a tool at a certain angle and feeding it in the correct positional arrangement to subsequent processing. Since this process has to be performed very rapidly, it is necessary for the torque motor actuator to be able to go from standstill to a pre-defined position in a very brief period of time. For this reason, the torque motor actuator is equipped with a great number of pole pairs to allow for high torque at even the lowest revolution speeds.

5.3.4 Advantages

- High acceleration
- Superior precision
- High rigidity
- Free from play
- Low friction
- Long life
- High dynamics
- Low space requirements

6 Transport and storage

6.1 Transport

The MRD-S 04/08/12 miniature rotary actuators are precision drive devices. For transport, the packaging must be such that it protects the drive from all external adverse effects (such as mechanical impact and humidity).

Size	MRD-S 04	MRD-S 08	MRD-S 12
Height	104 mm	124 mm	144 mm
Width	60 mm	60 mm	60 mm
Depth	68 mm	68 mm	68 mm
Mass	approx. 1,2 kg	approx. 1,5 kg	approx. 1,8 kg

Table 2: Dimensions of miniature rotary units

6.2 storage

The storage environment should be clean and dry. Ambient temperature should be 15 °C (59 °F) to 40 °C (104 °F). Exposure to atmospheric moisture is not permitted!

7 Installation and connection of the MRD-S

7.1 Preparation for installation

7.1.1 Safety instructions prior to use



Danger to life from strong magnetic force!

The secondary parts integrated into the MRD-S are highpower permanent magnets. They can ruin medical devices, such as pacemakers and hearing aids.

- Always keep a safe minimum distance to the secondary part, if you are a pacemaker or hearing aid wearer.



Danger to life from electric shock!

Touching live parts can cause electrocution.

- Only qualified electricians, complying with electro-technical regulations, may perform works on the electrical equipment and systems.

7.1.2 Preparatory measures

- Remove any transportation locks, which may still be present
- Installation and assembly are to be carried out by skilled personnel only
- Ensure that the machine is de-energized both pneumatically and electrically
- Do not perform any works on the drives unless the machine is at a standstill
- Before any start-up, ensure that the miniature rotary actuator is properly mounted (high acceleration and forces may be generated)
- Ensure that the movement zone of the miniature rotary actuator is free of any obstruction
- Check the safety features to ensure that protection is sufficient. (software limit stops, limit switches, reference switches and so on)



Note the technical data to be found in the brochure MRD-S 04/08/12 - Overview of our product range!

- Observe the manufacturer's instructions for the drive control unit.
- Check all of the warnings, error messages, etc. from the drive control unit
- If unusual noises are detected, investigate the cause
- Investigate any unusually large rises in temperature
- If possible, avoid placement of measuring cables next to electrical power cables

7.2 Main Components

The miniature rotary actuator is designed to be used both vertically as well as horizontally in performing positioning tasks within the field of automation.

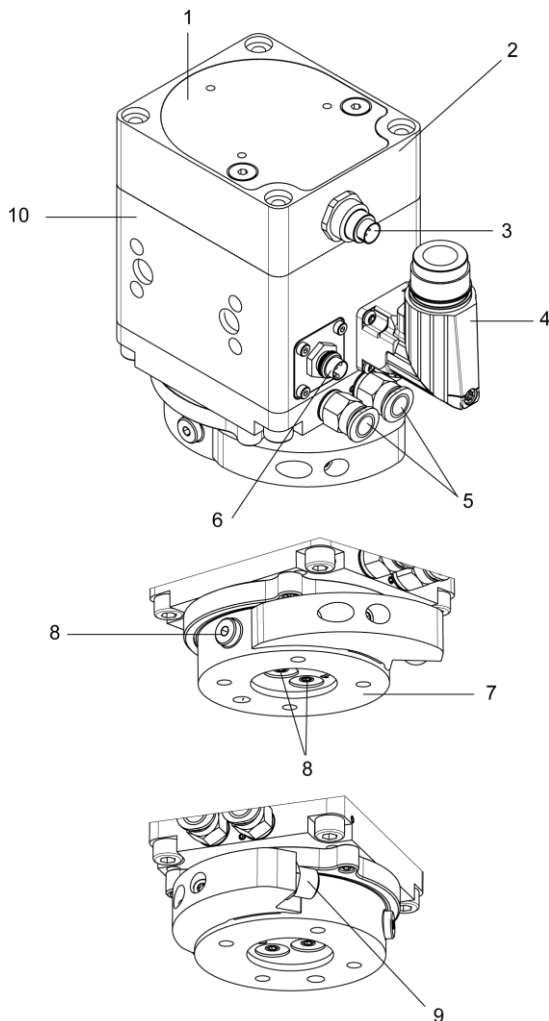


Figure 3: MRD-S 04 miniature rotary actuator

Item	Description
1	Flange mounting surface with centring rings
2	Incremental optical rotary encoder with reference mark
3	Connection for rotary encoder
4	Motor plug
5	2 x input for pneumatic rotary lead-through
6	Input for electric rotary lead-through
7	Rotary table with centring rings for mounting grippers or customized parts
8	2 x output for pneumatic rotary lead-through The actuators have two connection facilities. As default factory setting the outputs are closed and must be opened as required.
9	Output for electric rotary lead-through
10	Double-sided flanging surfaces with centring rings (front and back side)

7.3 Assembly



Danger of crushing!

- Do not perform any works on the drives unless the machine is at a standstill.
- Ensure that the machine is de-energized both pneumatically and electrically.

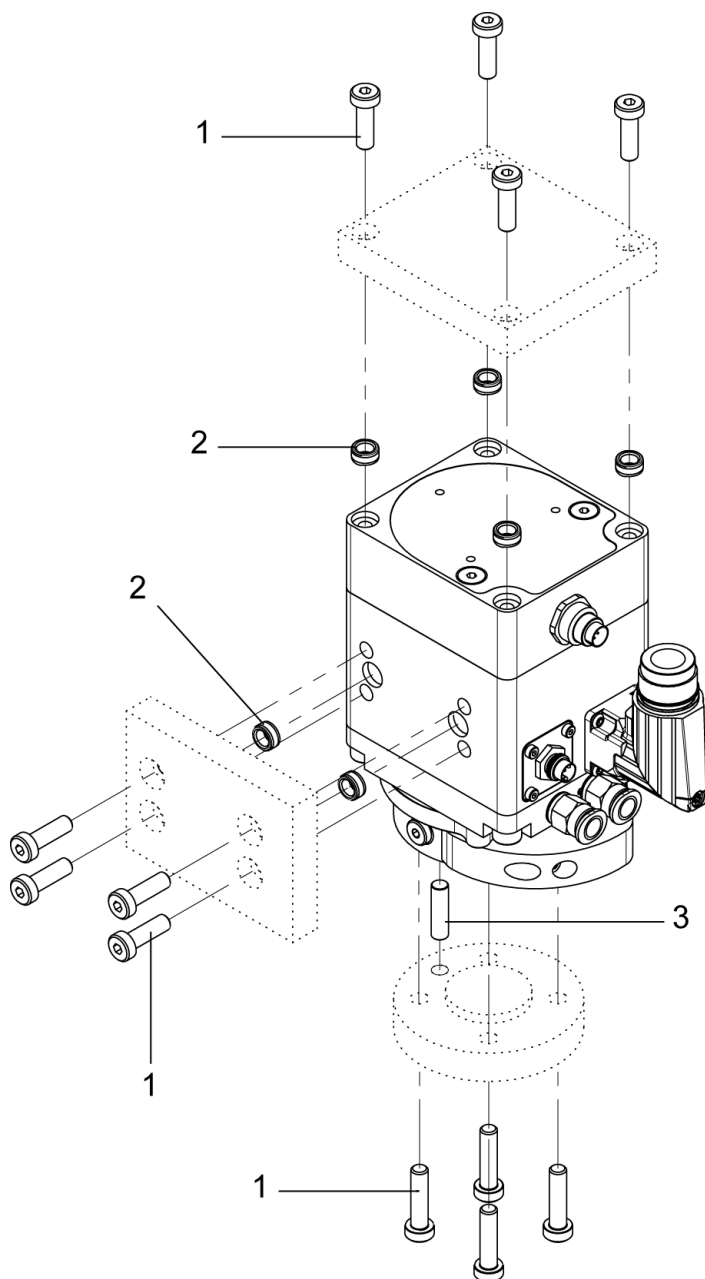



Figure 4: Assembly - miniature rotary actuator

The miniature rotary actuator offer several mounting surfaces for linear axes, gripper or customized parts. Mounting is performed via adapter plates.

Use the following screws and centre sleeves:

Item	Description
1	Mounting screws M5 DIN 912 (Tightening torque: 5.9 Nm)
2	centre sleeves $\varnothing 8$ (part-No. 335 917)

Table 3: Details of Figure 4

 CAUTION

- Mind length of screw!
- Maximum screw-in depth 9 mm

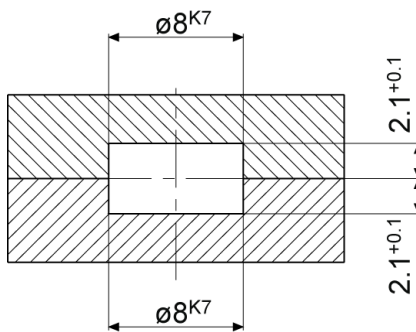


Figure 5: Dimensions for location of centering bush

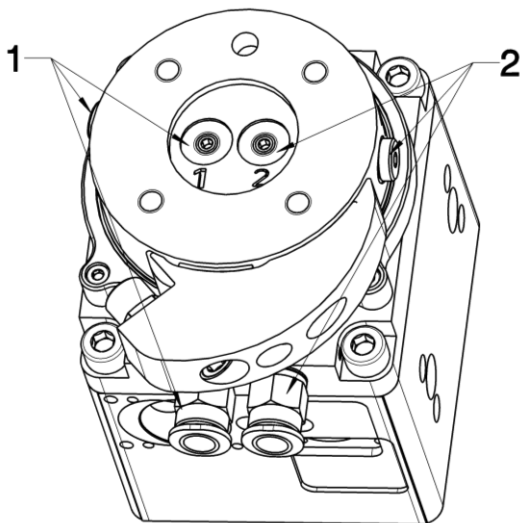


Figure 6: Ansicht Drehteller

Item	Description
1	pneumatic connection 1
2	pneumatic connection 2

Table 4: Details of Figure 6

7.4 Compressed air supply rotary feed-through

The compressed air used must be filtered (10 μm), dry, oiled or unoled.
 (Standard for quality of the compressed air according to ISO 8573-1: **6 4 4**)

7.5 Interfaces

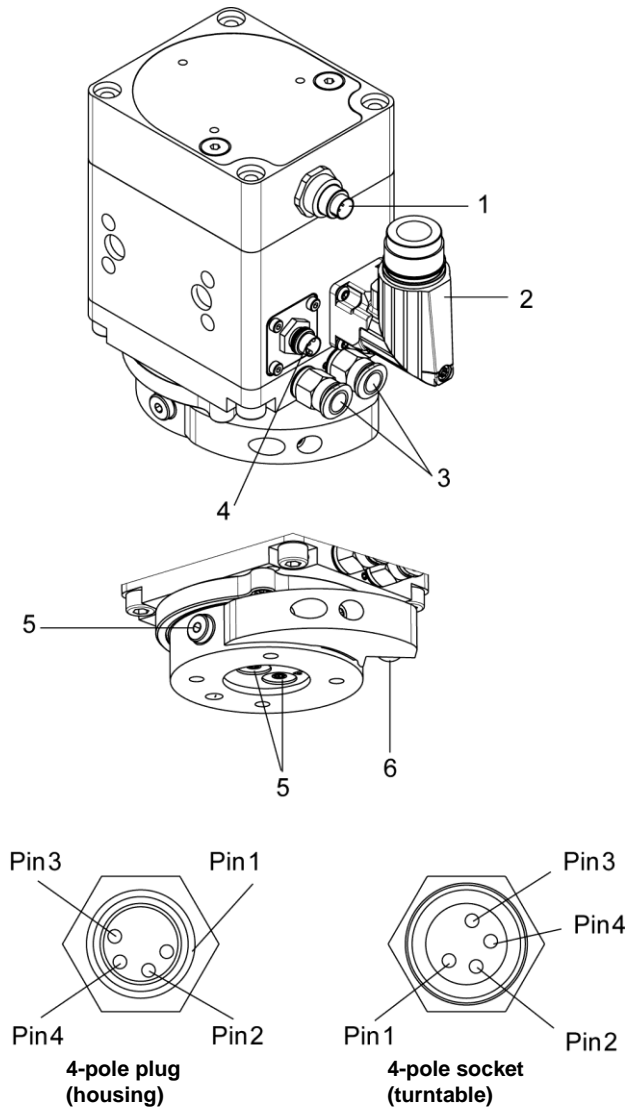


Figure 7: electric and pneumatic interfaces

Item	Description	Notes
1	8-pole sensing system connector to 15-pole D-SUB plug	see Table 6 page 16 and Figure 8 page 17
2	Electrical power cable, 6-pole	see Table 7 page 16 and Figure 9 page 17
3	Input pneumatic rotary lead-through	hose connection \varnothing 4 mm and max. 8 bar
4	Input electric rotary lead-through	M8 4-pole plug (housing)
5	Output* pneumatic rotary lead-through	hose connection \varnothing 4 mm and max. 8 bar
6	Output electric rotary lead-through	M8 4-pole socket (turntable)
Pin1	+ (brown)	
Pin2	\bar{Q} (white)	
Pin3	- (blue)	
Pin4	Q (black)	

Table 5: Details of Figure 7

* The drives have two connection facilities. As default factory setting the outputs are closed and must be opened as required.

8-pole sensing system connector to 15-pole D-SUB plug

15-pole D-Sub plug	8-pole Round pin plug
Pin 1 = N.C.	
Pin 2 = N.C.	
Pin 3 = Ref+	Pin 5
Pin 4 = Ref-	Pin 6
Pin 5 = B (COS-)	Pin 4
Pin 6 = B (COS+)	Pin 3
Pin 7 = A (SIN+)	Pin 1
Pin 8 = A (SIN-)	Pin 2
Pin 9 = N.C.	
Pin 10 = GND (0 V)	Pin 7
Pin 11 = N.C.	
Pin 12 = Ucc	Pin 8
Pin 13 = N.C.	
Pin 14 = N.C.	
Pin 15 = N.C.	

Table 6: Connections for Pos. 1 of Figure 7

Connection to power cable

Electrical power cable, 6-pole
Pin 1 = U
Pin 2 = V
Pin 3 = W
Pin 4 = N.C.
Pin 5,6 = temperature sensor
Pin PE = grounding (motor) ⊕

Table 7: Connections for Pos. 2 of Figure 7

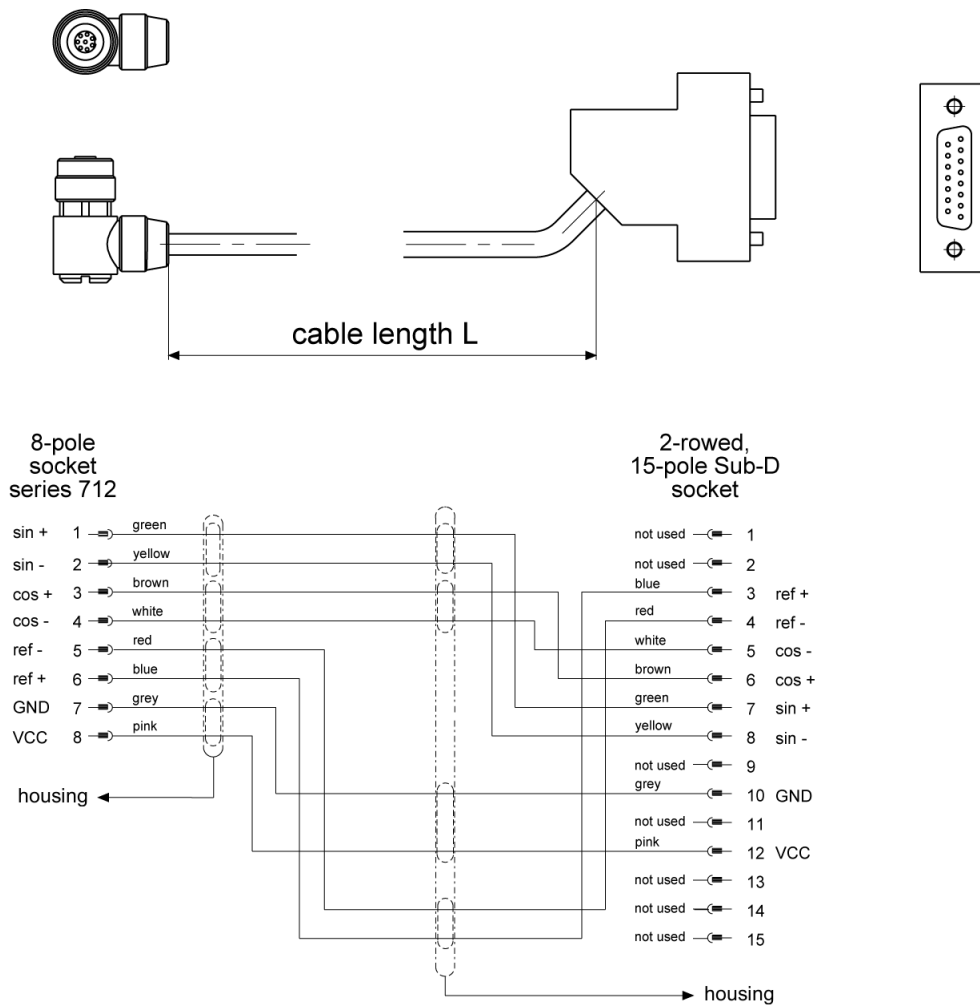


Figure 8: Sensing system cable

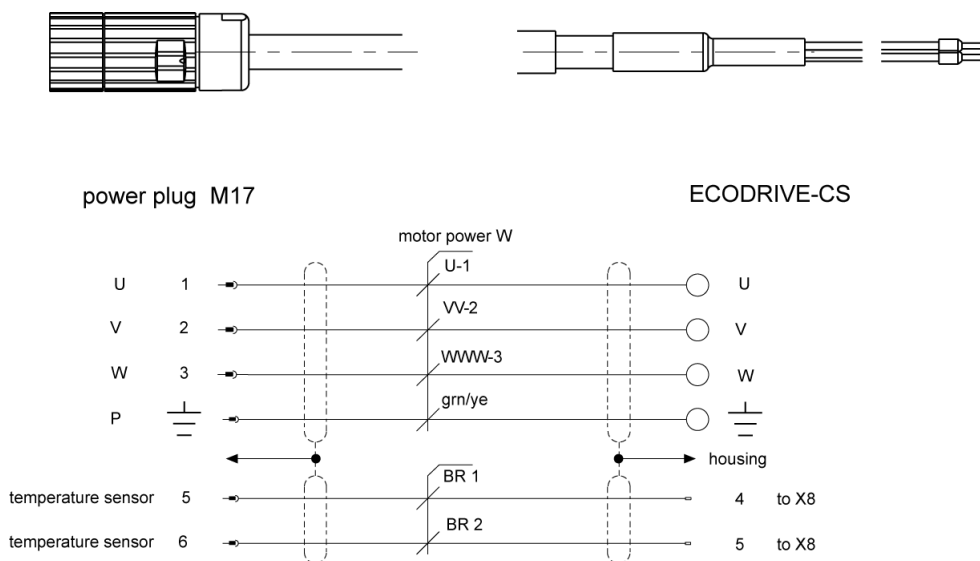


Figure 9: Electrical power cable

7.6 Connection of MRD-S to DKC Drive Controller

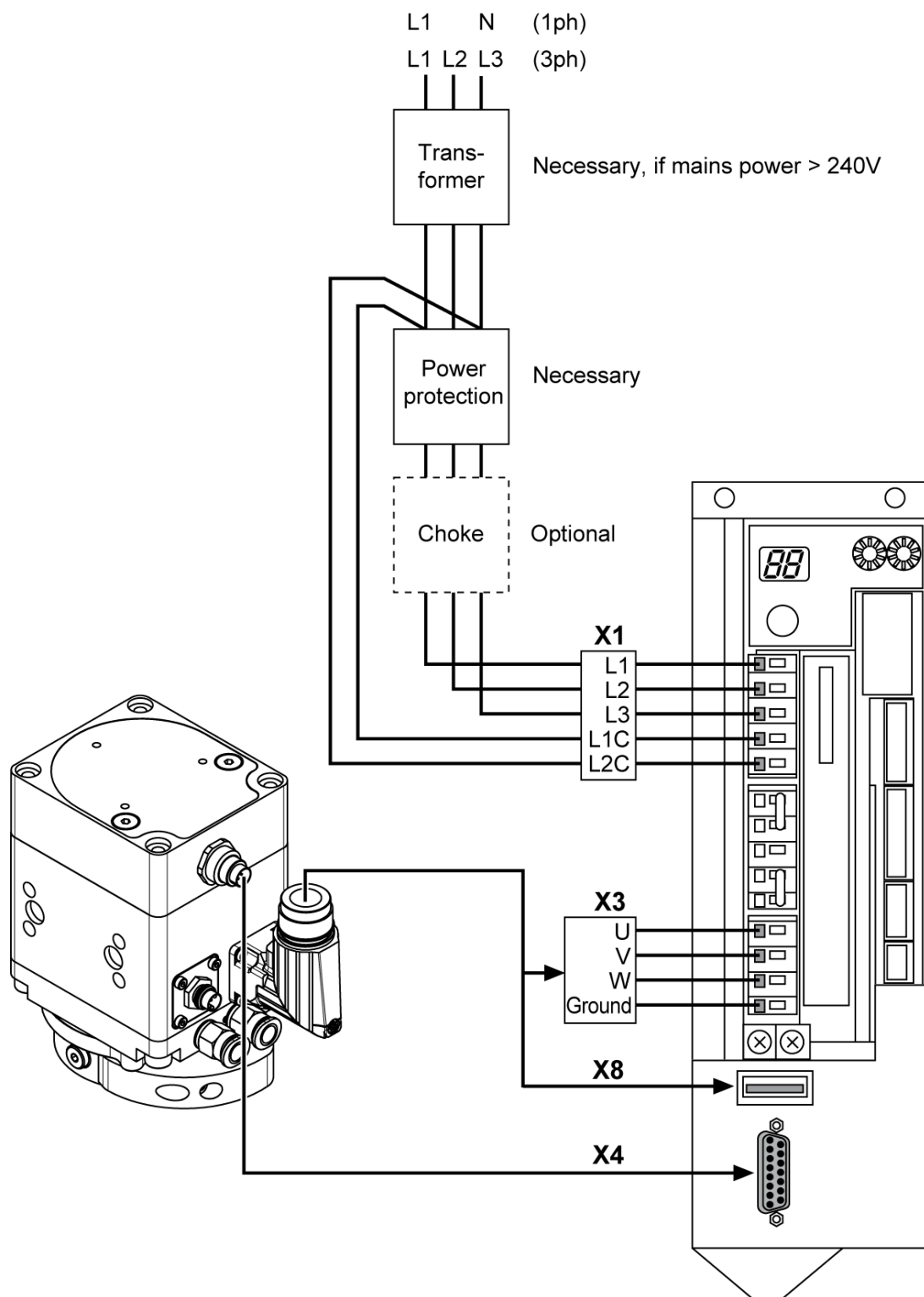


Figure 10: Connection of MRD-S miniature rotary actuator to DKC01.3-0XX Drive Controller

Item	Description																
1	MRD-S miniature rotary actuator																
2	Drive Controller (see Figure 11) <ul style="list-style-type: none"> - Basic device - Motion control communication modul 																
3	Encoder adapter SUP-E04-DKC*CS-ENCODR																
4	Electric mains, 5-pole																
5	Electrical power cable 6-pole X3 <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">Cable</td> <td style="width: 50%;">Connector</td> </tr> <tr> <td>U1</td> <td>U</td> </tr> <tr> <td>VV-2</td> <td>V</td> </tr> <tr> <td>WWW3</td> <td>W</td> </tr> <tr> <td>gn/ge</td> <td>grounding (motor) ⊕</td> </tr> </table> X8 <table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">Cable</td> <td style="width: 50%;">Connector</td> </tr> <tr> <td>BR1</td> <td>4</td> </tr> <tr> <td>BR2</td> <td>5</td> </tr> </table>	Cable	Connector	U1	U	VV-2	V	WWW3	W	gn/ge	grounding (motor) ⊕	Cable	Connector	BR1	4	BR2	5
Cable	Connector																
U1	U																
VV-2	V																
WWW3	W																
gn/ge	grounding (motor) ⊕																
Cable	Connector																
BR1	4																
BR2	5																
6	8-pole sensing system connector to 15-pole D-SUB plug (X4) Pin 1 = N.C. Pin 2 = N.C. Pin 3 = Ref+ Pin 4 = Ref- Pin 5 = B (COS-) Pin 6 = B (COS+) Pin 7 = A (SIN+) Pin 8 = A (SIN-) Pin 9 = N.C. Pin 10 = GND (0 V) Pin 11 = N.C. Pin 12 = Ucc Pin 13 = N.C. Pin 14 = N.C. Pin 15 = N.C.																

Table 8: Details of Figure 10

8 Start up

8.1 Safety instructions prior to commissioning



Danger to life from electric shock!

Touching live parts can cause electrocution.

- Only qualified electricians, complying with electro-technical regulations, may perform works on the electrical equipment and systems.

- Before any start-up, ensure that the torque motor actuator is properly mounted (high acceleration and forces may be generated)
- Ensure that the movement zone of the torque motor actuator is free of any obstruction
- Check the safety features to ensure that protection is sufficient (software limit stops, limit switches, reference switches and so on)
- Observe the manufacturer's instructions for the drive control unit

8.2 Required Components

- Encoder evaluation SUP-E04-DKC*CS-ENCODR
- Firmware Version WA-ECO DR3-MGP-01V14-MS

8.3 Initial start-up

The **motor file** contains all motor-related settings of the controller. This file must be loaded. It includes a subset of all controller parameters, except the interface parameters.

The motion control communication interface is configured with default values. These values must be adapted to the field bus interface of the higher-ranking control by the user.

8.4 Replacement of a controller

The previously created **parameter backup** file will be completely loaded to the controller. This backup file contains all parameters required for operation, including the interface parameters and any parameter set that may already be present.

8.5 Backup of the controller data set

After start-up or changes to the data set of the controller it is advisable to save this data set with DrivTop (backup).

8.6 Changing the motor type

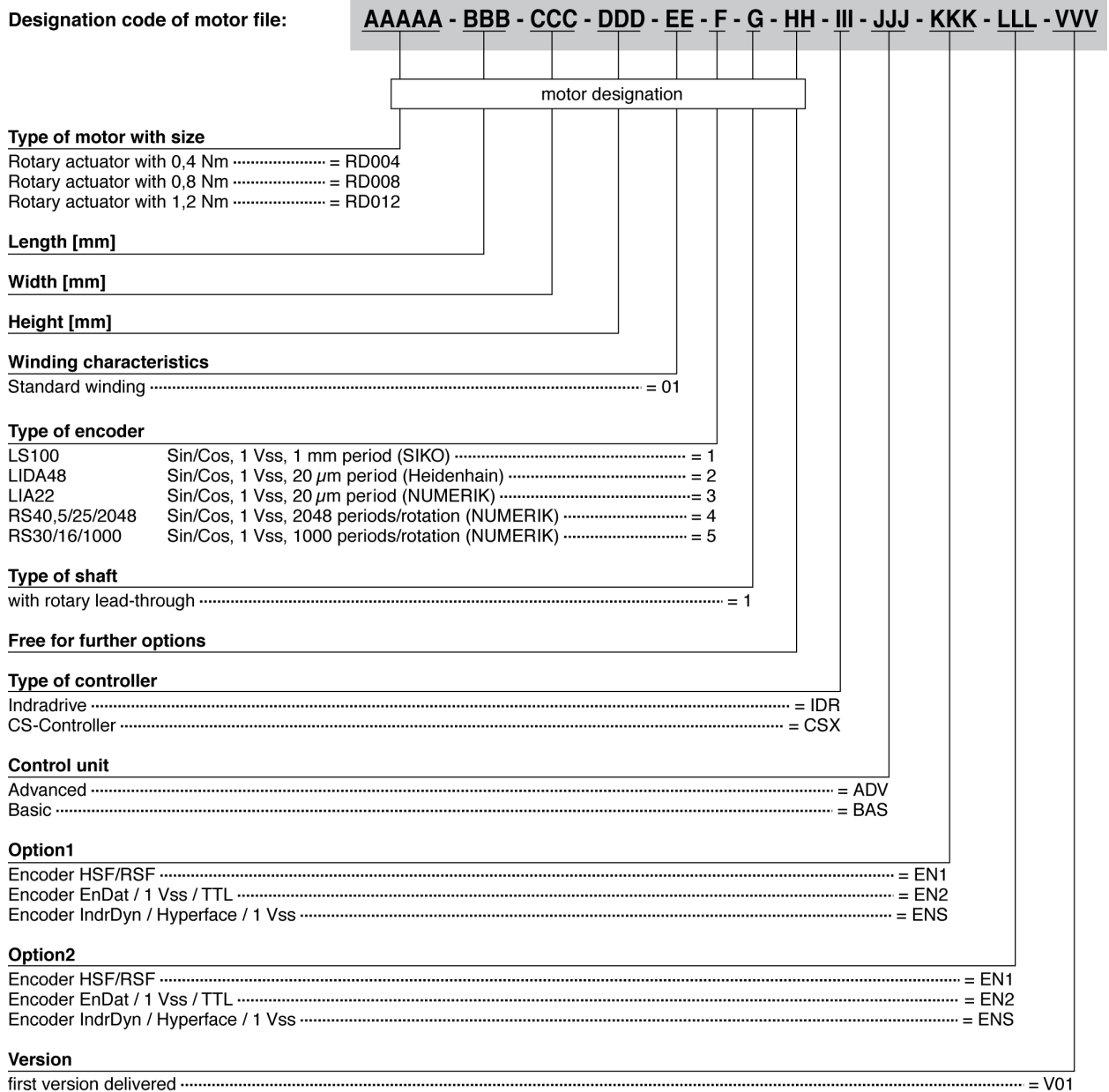
8.6.1 Assignment: motion control communication interface

Where the motor type is being changed, the corresponding motor file must be loaded.

Interface	End device	Basic device	motion control communication interface
Parallel / Analog	DKC 01.3-0xx	DKC (01.3-0XX)	none
SERCOS	DKC 02.3-0XX	DKC (02.3-0XX)	none
Profibus	DKC 03.3-0XX	DKC (10.3-0XX)	ECM (01.1 - PB01 –NN)
CANopen	DKC 05.3-0XX	DKC (10.3-0XX)	ECM (01.1 - CN01 – NN)
DeviceNet	DKC 06.3-0XX	DKC (10.3-0XX)	ECM (01.1 - DN01 – NN) or ECM (01.1 - DN02 –NN)
Analog	DKC 11.3-0XX	DKC (11.3-0XX)	none

Table 9: Assignment: motion control communication interface-end device-basic device- motion control communication modul

8.6.2 Motor parameters



Note:

The first part of the designation code of the motor parameters corresponds to the motor designation. Parts of the designation with are not needed may be replaced by X. These motor parameters apply for motors having varying X references.

Examples for the designation of the motor parameter file:

RD004-104-055-065-01-4-1-XX-CSX-V01.par : RDS04 for CS-Controller
 RD008-124-055-065-01-4-1-XX-IDR-ADV-EN2-EN1-V01.par : RDS08 for Indradrive ADVANCED controller with encoder option EN2-EN1

Figure 11: Determination of the file names for motor parameters

8.6.3 Loading the parameter file

In order to load the parameter file *.PAR you need the following components:

- Software Indramat DRIVE TOP from version 16V02, or higher
- Parameter file *.PAR out of a former backup file or the enclosed motor parameter files
- Programming cable for CS and Indra-Drive



Some parameters cannot correctly be set until other parameters have attained a certain value. As a result, the parameter file has to be loaded **twice**. Between the first and second download a phase adjustment is required, as only the latter will cause the evaluation of loaded parameters via the controller.

Load the selected parameter file as follows:

- Connect the drive to the drive controller.
- Use the programming cable to connect the PC to the DKC drive controller.
- Switch on the drive controller.
- Start DRIVE TOP in the online mode on your PC.
- Use the right mouse button to change to the parameterizing mode “Parametriermodus” (see Figure 12).

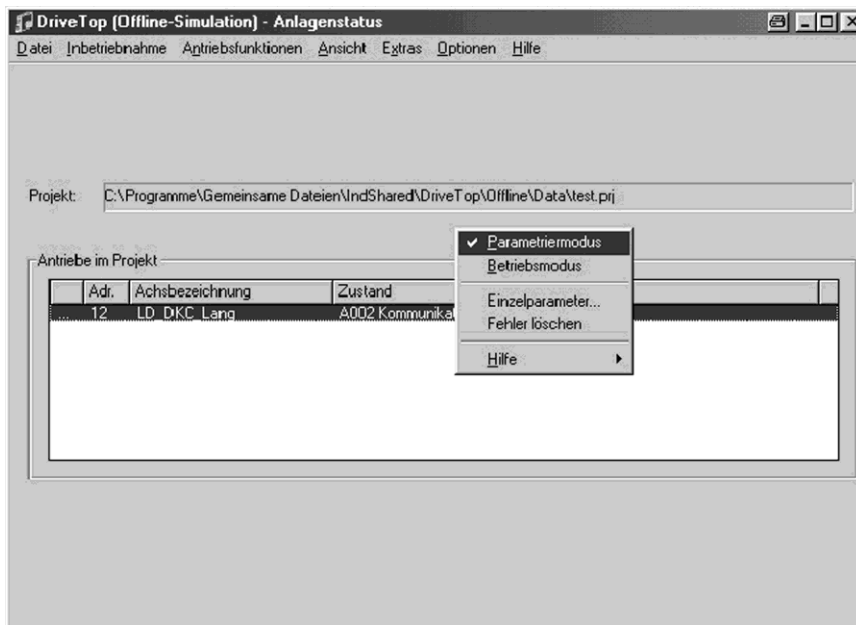


Figure 12: Selecting the parameterizing mode “Parametriermodus”

- To select the backup file, click the menu item **Datei** (“file”) and choose **Laden** (“load”) (see Figure 13 page 24)

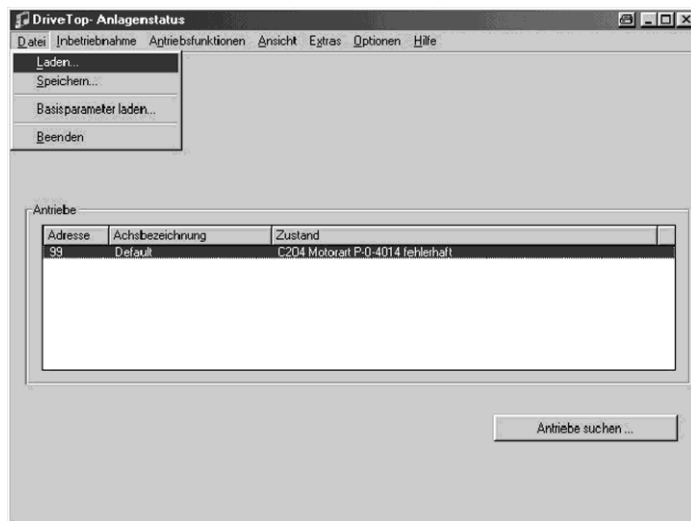


Figure 13: Selecting the backup file

- Click the menu item **Ändern** (“change”) to select another backup file.
- Click **OK** to start the download (see Figure 14). A status bar reflects the progress of the parameter download (see Figure 15)



Figure 14: Selecting the backup file / starting the download

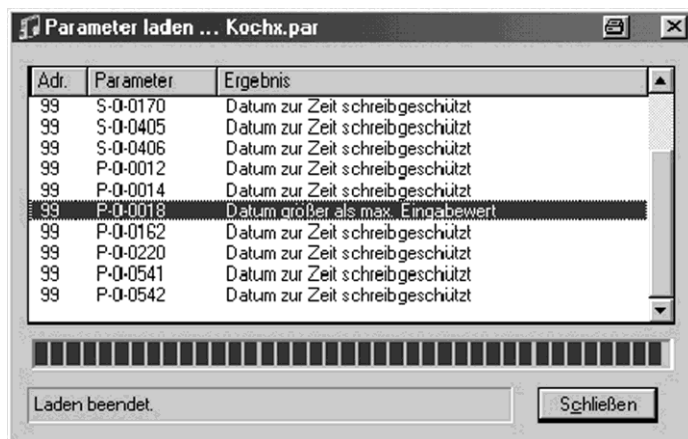


Figure 15: downloading the parameters

- When the download is completed, go first to “Betriebsmodus” (operation mode) and then back to the parameterizing mode (“Parametriermodus”). Load the parameter file now a second time.

8.6.4 Fine adjustment and programming

After loading the parameter file the drive is ready to use and fine adjustment of the drive controller as well as programming can be undertaken.

Please refer to:

- Notes on DKC-LD controller adjustment
- Functional description: ECODRIVE CS (DOK-ECODR3-MGP-01VRS**-FK01-DE-P)

8.6.5 Notes on control loop adjustment

For the motor-controller-combination a configuration CD is supplied containing the primal basic settings. In order to achieve a maximum of dynamics it is necessary to manually adjust the control loop settings to your needs (e.g. the torque moment of inertia). For more information, refer to the manuals of the drive units.



CAUTION

Do not perform “Urladen” (original load) with MRD-S, as this will delete all motor parameters. In the event original load “Urladen” cannot be avoided, the motor parameters will have to be reloaded with DRIVE TOP.

Do not run “Automatische Regelkreiseinstellung” (automatic control loop adjustment) from the DRIVE TOP configuration software. This will cause the calculation for the MRD-S to be performed incorrectly, which may cause significant damage.

9 Troubleshooting

- When errors of the electrics occur, the M1 display will be flashing.
- The error must be read out and the appropriate error description, cause and remedy must be ascertained from the DOK-ECODR3-MPG-01VRS-WA01-DE documentation.
- In the event of mechanical errors, the drive will have to be replaced. Repair can only be carried out by SCHUNK.

10 Decommissioning

De-energize the system (electrically as well as pneumatically).
The miniature rotary actuator is now decommissioned.

11 Maintenance and Care



- Ensure that the MRD-S is de-energized both pneumatically and electrically.
- Do not perform any works on the drives unless the MRD-S is at a standstill.

11.1 Cleaning

The modules comply with the requirements of protection class IP54.
Remove any dirt from the miniature rotary actuator at specific intervals (e.g. with a lint-free cloth and white spirit).

11.2 General maintenance

The miniature rotary actuator is maintenance-free, provided the following points are observed:

- Clean workshop atmosphere / normal environmental and operation conditions (see chapter 1.6 page 6)
- No splash water
- No dust from friction or processing

11.3 Maintenance of rotary feed-through for IP54 version

11.3.1 Servicing intervals

The sealing kit of the rotary lead-through is a wear part. Depending on ambient and operational conditions it must be replaced in the event of leakage.

To ensure a good seal, the seal on the rotary table should be replaced.

Type	MRD-S 04	MRD-S 08	MRD-S 12
Maintenance intervals (million cycles)	5	5	5

Please note that the use of the unit under extreme environmental conditions (e.g. casting dust or abrasive dust) can significantly reduce the life of the seals (and also the maintenance interval).

11.3.2 Replacing the seal



- Ensure that the MRD-S is de-energized both pneumatically and electrically.
- Do not perform any works on the drives unless the MRD-S is at a standstill.

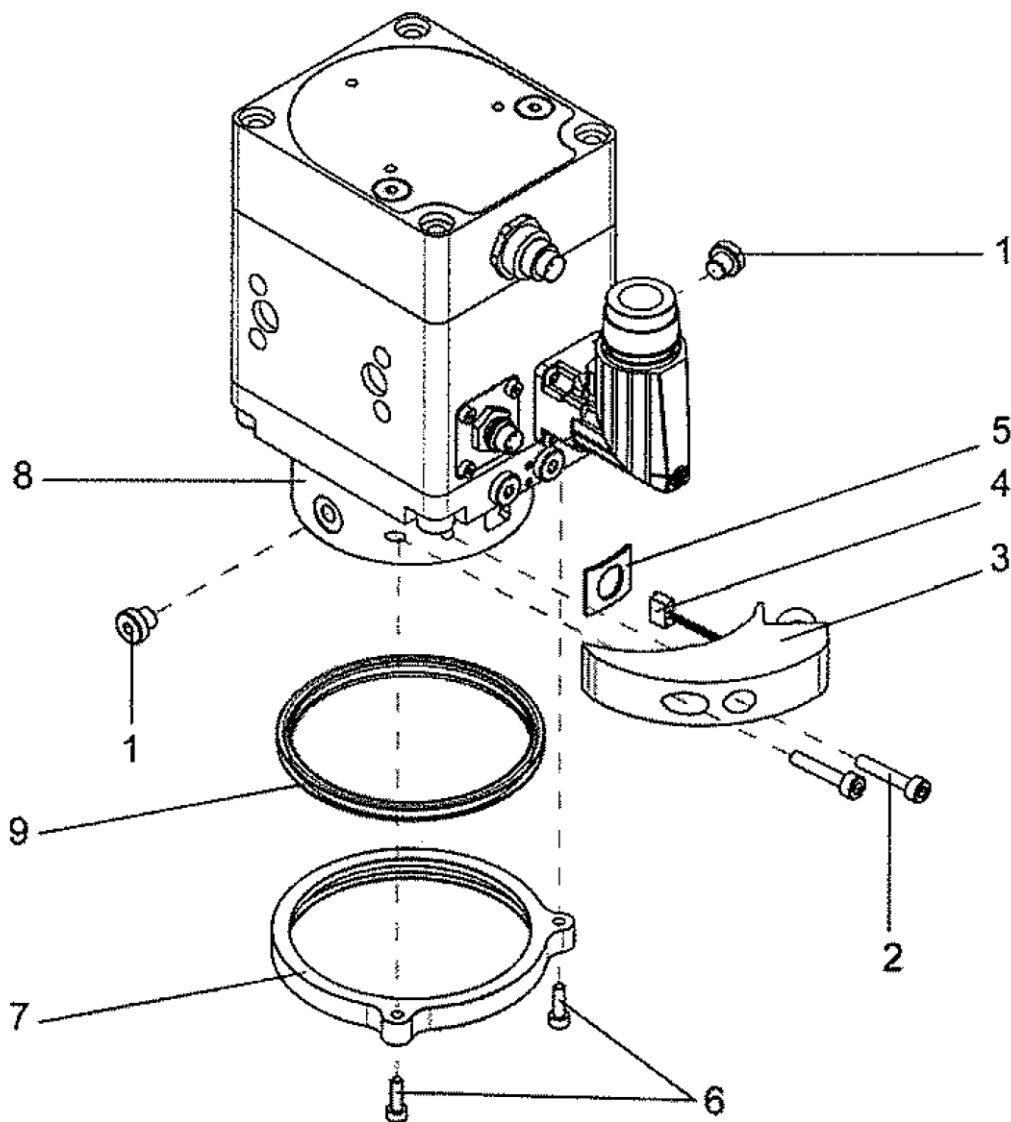


Figure 16: Replacing seal for rotary feed-through

Item	Description	Item	Description
1	Plug and/or fitting	6	Screws
2	Screws	7	Seal ring
3	Mount for rotary feed-through connector	8	Rotary table
4	Interface connector	9	Seal
5	Seal		

Table 10: Details of Figure 16

Removing the seal

(For item. no. see Figure 16)

- (1) Remove the plug and/or fitting (item 1) on the rotary table (item 8).
- (2) Loosen and remove the screws (item 2) from the mount for the rotary feed-through connector (item 3).
- (3) Carefully pull out the mount for the rotary feed-through connector (item 3).
- (4) Carefully disconnect the interface connector (item 4) and remove the entire mount for the rotary feed-through connector (item 3).
- (5) Remove the seal (item 5).
- (6) Unscrew the screws (item 6) from the seal ring (item 7) and remove the seal ring (item 7) from the rotary table (item 8).
- (7) Remove the seal (item 9) from the seal ring (item 7).

Installing the seal

(For item. no. see Figure 16)

- (1) Press a new seal (item 9) into the seal ring (item 7).
- (2) Lightly oil the edge of the seal for mounting.
- (3) Carefully position the seal ring (item 7) over the rotary table (item 8) and screw it tight with the screws (item 6).
- (4) Mount the seal (item 5).
- (5) Plug in the interface connector (item 4) in the correct position.
- (6) Mount the rotary feed-through connector (item 3).
- (7) Tighten the screws (item 2).
- (8) Insert the plug and/or fitting (item 1).

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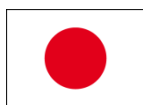
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