

Operating and Assembly Instructions

Incremental Encoder FG 40



**Read the Operating and Assembly Instructions prior to assembly, starting installation and handling!
Keep for future reference!**

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UL certificates can be requested from us.

An overview of our UL devices can be found at the following link:

<https://iq.ulprospector.com/info>

UL File Number: E351535

Type	UL model No.
FG 40 (solid shaft)	FG 40 K-XXXX
	FG 40 K-XXXX-S
	FG 40 KK-XXXX
	FG 40 L-XXXX
	FG 40 L-XXXX-S
	FG 40 LL-XXXX
FGH 40 (hollowshaft)	FGH 40 K-XXXX
	FGHJ 40 K-XXXX
	FGH 40 K-XXXX-S
	FGH 40 KK-XXXX
	FGHJ 40 KK-XXXX
	FGH 40 L-XXXX
	FGHJ 40 L-XXXX
	FGH 40 LL-XXXX
	FGHJ 40 LL-XXXX

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1 General

1.1 Information about the Operating and Assembly instructions

These Operating and Assembly Instructions provide important instructions for working with the device. They must be carefully read prior to starting all tasks, and the instructions contained herein must be followed.

In addition, applicable local regulations for the prevention of industrial accidents and general safety regulations must be complied with.

1.2 Scope of delivery

Incremental Encoder FG 40, Operating and Assembly Instructions.

1.3 Explanation of symbols

Warnings are indicated by symbols in these Operating and Assembly Instructions. The warnings are introduced by signal words that express the scope of the hazard.

The warnings must be strictly heeded; you must act prudently to prevent accidents, personal injury, and property damage.

**WARNING!**

Indicates a possibly dangerous situation that can result in death or serious injury if it is not avoided.

**CAUTION!**

Indicates a possibly dangerous situation that can result in minor injury if it is not avoided.

**CAUTION!**

Indicates a possibly dangerous situation that can result in material damage if it is not avoided.

**NOTES!**

Indicates useful tips and recommendations as well as information for efficient and trouble-free operation.

**NOTES!**

Do not use a hammer or similar tool when installing the device due to the risk of damage occurring to the bearings or coupling!

**DANGER!****Life-threatening danger due to electric shock!**

Indicates a life-threatening situation due to electric shock. If the safety instructions are not complied with there is danger of serious injury or death. The work that must be executed should only be performed by a qualified electrician.

1.4 Disclaimer

All information and instructions in these Operating and Assembly Instructions have been provided under due consideration of applicable guidelines, as well as our many years of experience.

The manufacturer assumes no liability for damages due to:

- Failure to follow the instructions in the Operating and Assembly Instructions
- Non-intended use
- Deployment of untrained personnel
- Opening of the device or conversions of the device

In all other aspects the obligations agreed in the delivery contract as well as the delivery conditions of the manufacturer apply.

1.5 Copyright



NOTES!

Content information, text, drawings, graphics, and other representations are protected by copyright and are subject to commercial property rights.

It is strictly forbidden to make copies of any kind or by any means for any purpose other than in conjunction with using the device without the prior written agreement of the manufacturer. Any copyright infringements will be prosecuted.

1.6 Guarantee terms

The guarantee terms are provided in the manufacturer's terms and conditions.

1.7 Customer service

For technical information personnel is available that can be contacted by telephone, fax or email. See manufacturer's address on page 2.

2 Safety



DANGER!

This section provides an overview of all the important safety aspects that ensure protection of personnel, as well as safe and trouble-free device operation.

If these safety instructions are not complied with significant hazard can occur.

2.1 Responsibility of the owner

The device is used in commercial applications. Consequently the owner of the device is subject to the legal occupational safety obligations and subject to the safety, accident prevention and environmental protection regulations that are applicable for the device's area of implementation.

2.2 Intended use

The device has been designed and constructed exclusively for the intended use described here.

Series FG 40 Incremental Encoders are used for measurement of rotations, for instance of electrical and mechanical drives and shafts.

Claims of any type due to damage arising from non-intended use are excluded; the owner bears sole responsibility for non-intended use.

For UL and CSA:

For the use in NFPA 79 applications only.

2.3 Improper use

Do not use the device in potentially explosive areas.

The device must not be subjected to mechanical loads in addition to its own weight and unavoidable vibration and shock loads that arise during normal operations.

Examples for non-permitted mechanical loads (incomplete list):

- Fastening transport or lifting tackle to the device, for example a crane hook to lift a motor.
- Fastening packaging components to the device, for example ratchet straps, tarpaulins etc.
- Using the device as a step, for example by people to climb onto a motor.

2.4 Personnel

Installation and commissioning as well as disassembly routines must be carried out by skilled technical staff only.

2.5 Personal protective equipment

Wear personal protective equipment such as safety shoes and safety clothing to minimise risks to health and safety when carrying out work such as installation, disassembly or commissioning. Adhere to all applicable statutory regulations as well as the rules and standards determined by the owner.

2.6 Special dangers

Residual risks that have been determined based on a risk assessment are cited below.

2.6.1 Electrical current



DANGER!

Life-threatening danger due to electrical shock!

There is an imminent life-threatening hazard if live parts are touched. Damage to insulation or to specific components can pose a life-threatening hazard.

Therefore:

Immediately switch off the device and have it repaired if there is damage to the insulation of the power supply.

De-energize the electrical equipment and ensure that all components are connected for all tasks on the electrical equipment.

Keep moisture away from live parts. Moisture can cause short circuits.

2.6.2 Rotating shafts / Hot surfaces



WARNING!

Danger of injury due to rotating shafts and hot surfaces!

Touching rotating shafts can cause serious injuries.

Therefore:

Do not reach into moving parts/shafts or handle moving parts/shafts during operation.

Close to protect from injury all access openings in flanges with the corresponding plug screw, and provided you exposed rotating components with protective covers.

Do not open covers during operation. Prior to opening the covers ensure that all parts have come to a standstill.

The encoder can become hot during prolonged use.

In case of contact risk of burns is existing.

2.6.3 Safeguarding against restart



DANGER!

Life-threatening danger if restarted without authorization!

When correcting faults there is danger of the power supply being switched on without authorization.

This poses a life-threatening hazard for persons in the danger zone.

Therefore:

Prior to starting work, switch off the system and safeguard it from being switched on again.

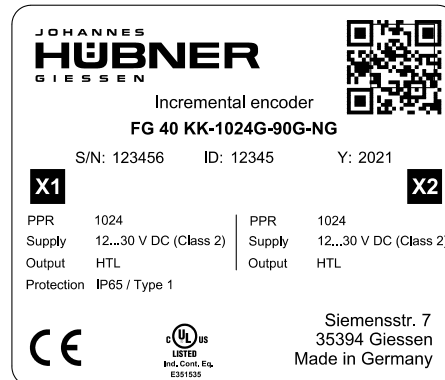
3 Technical Data

3.1 Type plates

Nameplates for different device variations are shown below



Encoder with one terminal box



Encoder with 2 terminal boxes (redundant version)



Encoder with 2 sinusoidal signals



Encoder with round plug (not UL-listed)

The nameplate and UKCA label are located on the side of the housing and contain the following information:

Englisch	Deutsch
Manufacturer, address	Hersteller, Anschrift
Type: Incremental Encoder, Year of manufacture	Typ: Inkrementaler Drehgeber, Baujahr
CE mark	CE-Kennzeichnung
Serial number (S/N)	Seriennummer (S/N)
Pulse rate	Impulszahl
Degree of protection	Schutzart
Supply voltage	Versorgungsspannung
Outputs	Ausgänge
Certification references	Zertifizierungshinweise
QR-Code	QR-Code

3.2 Electrical and mechanical data

3.2.1 For pulse rates (square wave pulses)

Pulse rates	Value
Standard pulse rates	500, 600, 1000, 1024, 1200, 2000, 2048, 2400, 2500
Special pulse rates	4000, 4096, 4800, 5000, 8192, 10000, 12000, 16000, 16384, 20000, 25000, 40000, 50000 (further pulse rates according to customers specification)
Connection data	
Supply voltage	12 V ... 30 V DC For UL and CSA Class 2 supplied
No load-current	approx. 50 mA at 24 V
Outputs	Current limited, short-circuit proof push-pull line driver with integrated impedance adaptation for 30 to 140 Ω lines.
Pulse height (HTL)	approx. as supply voltage, output saturation voltage < 0.4 V at I_L 30 mA
Output current	max. 150 mA at 24 V (observe derating)
Internal resistance	75 Ω bei 24 V
Slew rate	200 V / μ s with C_L 100 pF
Duty cycle	1 : 1 \pm 3 % for standard pulse rates 1 : 1 \pm 5 % for special pulse rates up to 25000 pulses
Square wave displacement 0°, 90°	90° \pm 3 % for standard pulse rates 90° \pm 5 % or special pulse rates up to 25000 pulses
Max. frequency	200 kHz, Higher max. frequency on request
Special output voltage 5V (TTL)	
Pulse height	5V, RS422-compatible (TIA/EIA-Standard)
Supply voltage	12 ... 30 V DC (optional: 5 V DC) For UL and CSA Class 2 supplied

3.2.2 Output signals Sine / Cosine

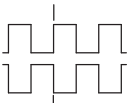
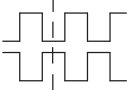
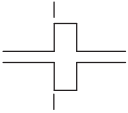
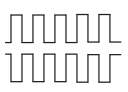
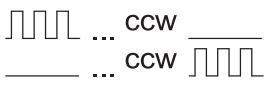
Pulse rates	Value
Standard pulse rates	500, 600, 1000, 1024, 1200, 2000, 2048, 2400, 2500
Connection data	
Supply voltage	5 V ... 30 V DC For UL and CSA Class 2 supplied
No load-current	Approx. 120 mA at 5 V, approx. 50 mA at 24 V
Max. frequency	200 kHz, higher max. frequency on request
Output signals	2 sinusoidal signals A and B each with inverted signals Reference pulse with inverted signal Signal amplitude 1 V pp / $R_L = 120 \Omega$ Error signal and inverted signal Signal amplitude 5V
Resolution	1024 signal periodes

Duty cycle	$1 \pm 0,1$
Phase shift A, B	$90^\circ \pm 1^\circ$

Protection class acc. to DIN EN 60529	Sealing	Permissible speed	Rotor moment of inertia	Breakaway torque
IP65	Standard	$\leq 6000 \text{ min}^{-1}$	510 gcm ²	6 Ncm
IP66	with labyrinth seal	$\leq 6000 \text{ min}^{-1}$	580 gcm ²	6 Ncm
IP66/IP67	with axial shaft seal	$\leq 4000 \text{ min}^{-1}$	510 gcm ²	8 Ncm
IP66/IP67	with radial shaft seal (for special applications, e.g. wet areas in rolling mills)	$\leq 3000 \text{ min}^{-1}$	510 gcm ²	9 Ncm
(UL and CSA Type 1)				

Encoder temperature ranges

Standard	0°C... + 70°C		
Special temperature ranges	-25°C... + 85°C -40°C... + 85°C -5°C... + 100°C	For UL/CSA max. +70°C	
Vibration resistance	DIN EN 60068-2-6 / IEC 68-2-6 (10 ... 2000 Hz)		20 g (=200 m/s ²)
Shock resistance	DIN EN 60068-2-27 / IEC 68-2-27 (6 ms)		150 g (=1500 m/s ²)
Max. encoder shaft load	F _{a, max.} (axial) = 100 N F _{r, max.} (radial) = 120 N		
Shaft dimensions	11j6 x 30 mm (standard) 14j6 x 30 mm (optional)		
Weight	Type AK Type K Type KK	approx. 2,8 kg approx. 3,1 kg approx. 3,6 kg	

Signal outputs	
Basic version Basic channel 0° (A) and pulse channel 90° (B) Internal system diagnostics with error output (ERROR) Each with inverted signals	$\begin{matrix} 0^\circ \\ \overline{0^\circ} \end{matrix}$  $\begin{matrix} 90^\circ \\ \overline{90^\circ} \end{matrix}$ 
Option N Reference pulse (N) mechanically defined; one square-wave pulse per revolution; with inverted signal	$\begin{matrix} N \\ \overline{N} \end{matrix}$ 
Option 2F Twice as many pulses as basic channel by combining the 0° and 90° channels	$\begin{matrix} 2F \\ \overline{2F} \end{matrix}$ 
Option B Rapid direction of rotation detection at each edge of the 0° and 90° channels Can be combined with Option F	$\begin{matrix} B \\ \overline{B} \end{matrix}$ $\begin{matrix} \text{CW} \curvearrowright \text{CCW} \curvearrowleft \\ \text{CW} \curvearrowleft \text{CCW} \curvearrowright \end{matrix}$
Option B2 Rapid direction of rotation detection at each edge of the 0° and 90° channels; additional standstill recognition	$\begin{matrix} B2 \\ \overline{B2} \end{matrix}$ $\begin{matrix} \text{CW} \curvearrowright \text{CCW} \curvearrowleft \dots \text{STOP} \\ \text{CW} \curvearrowleft \text{CCW} \curvearrowright \dots \text{STOP} \end{matrix}$
Option B3 Rotation-dependent output signals. This option supports counter cards with separate UP/DOWN pulse inputs. Basic channel signals are issued at option output 1 when rotation is clockwise and at option output 2 when rotation is counterclockwise.	$\begin{matrix} O1 \\ O2 \end{matrix}$ $\begin{matrix} \text{CW} \dots \text{CCW} \\ \text{CW} \dots \text{CCW} \end{matrix}$ 
Option S Electronic overspeed switch with two independently programmable switching points	See separate Operating and Assembly Instructions EGS® 40
Fiber optic option As an alternative to conventional signal transmissions via copper cables encoder signals can also be transmitted via fiberoptic cables.	Max. frequency 100 kHz

The signal sequence 0°, 90° applies for clockwise rotation seen from the drive shaft direction. To obtain the same signal sequence for counter clockwise rotation the clamp 0°, 90° has to be connected see connection diagram.

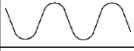
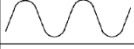
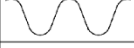





Signal outputs for output signals sine / cosine

Basic channel 0° (A) and pulse channel 90° (B).

Reference pulse (N) mechanically defined; one square-wave pulse per revolution; with inverted signal

Each with inverted signal.

Internal system diagnostics with error output (ERROR).

A+		Ausgang A+	Output A+
A-		Ausgang A-Invers	Output A-Inverse
B+		Ausgang B+	Output B+
B-		Ausgang B-Invers	Output B-Inverse
N+		Ausgang Nullimpuls	Output Reference
N-		Ausgang Nullimpuls Invers	Output Reference Inverse
ERR		Fehlerausgang (Low aktiv)	Error Output (Low aktiv)
$\overline{\text{ERR}}$		Fehlerausgang (High aktiv)	Error Output (High aktiv)

3.3 Type code

3.3.1 For pulse rates (square wave pulses)

	FG	40	K	1024	G	90G	NG	2F	S
Incremental encoder									
Series									
connections, radial design									
K: Terminal box									
R: Burndy®-plug									
C: Connection cable									
L: Fiber optic connection									
S: 15-pole EMC industrial plug									
KK: 2 terminal boxes, i.e. redundant version or with option S									
further combined connections available									
connections, axial design									
AK: Terminal box									
AR: Burndy®-plug									
AC: Connection cable									
Pulses per revolution									
Basic signal output									
Basic channel 0° (A)									
Pulse channel 90° (B)									
Each with inverted signals									
NG: Option reference pulse with inverted signal									
N2: Reference pulse, mechanically fixed with LED check (red) for display of reference pulse									
2F: Option 2F									
B: Option B									
B2: Option B2									
B3: Option B3									
S: Option S									
Options see pages before									

3.3.2 For output signals Sine / Cosine

	FG	40	K	1024	S	N
Incremental encoder						
Series						
connections, radial design						
K: Terminal box						
R: Burndy®-plug						
C: Connection cable						
L: Fiber optic connection						
S: 15-pole EMC industrial plug						
KK: 2 terminal boxes, i.e. redundant version						
Resolution						
1024 signal periods per revolution						
Output signals						
2 sinusoidal signals A and B each with inverted signals						
NG: Option reference pulse with inverted signal						

4 Transport, packaging and storage

4.1 Safety instructions for transport

**CAUTION!****Material damage caused by improper transport!**

Observe the symbols and information on the packaging:

- Do not throw - risk of breakage
- Keep dry
- Do not expose to heat above 40 °C or direct sunlight.

4.2 Incoming goods inspection

Check delivery immediately upon receipt for completeness and possible transport damage.

Inform the forwarder directly on receipt of the goods about existing transport damages (prepare pictures for evidence).

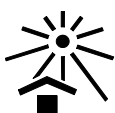
4.3 Packaging / disposal

The packaging is not taken back and must be disposed of in accordance with the respective statutory regulations and local guidelines.

4.4 Storage of packages (devices)

**Keep dry**

Keep packages dry and free from dust; protect from moisture.

**Protect against heat**

Protect packages from heat above 40 °C and direct sunlight.

If you intend to store the device for a longer period of time (> 6 months) we recommend you use protective packaging (with desiccant).

**NOTES!**

Turn the shaft of the device every 6 month to prevent the bearing grease solidifying!

5 Mounting and commissioning

5.1 Safety instructions

Personnel

Installation and commissioning must be carried out by skilled technical staff only.



NOTES!

Observe the safety instructions contained in **Chapter 2** when installing or working on the device!

5.2 Technical information



NOTES!

Do not use a hammer or similar tool when installing the device due to the risk of damage occurring to the bearings or coupling!

Ambient temperature

The max. permissible ambient temperature depends on the speed and degree of protection of the device, the signal frequency, the length of the signal cable and the place of installation (please refer to Chapter 3.2).

Degree of protection

To fulfil degree of protection requirements the diameter of the connection cable must correspond to that of the cable gland (please refer to Chapter 11 dimension drawings)!

Deep groove ball bearings

FG incremental encoders are fitted with maintenance-free, greased "for-life" deep groove bearings. Bearings must be changed by the manufacturer only. Opening the encoder renders the guarantee null and void.

Screw retention

We recommend using Loctite® 243 threadlocker (medium strength) on all fastening screws to prevent loosening.

5.3 Required tools

- Spanners: 10 mm, 22 mm, 24 mm
- Allen keys: 2 mm, 3 mm
- Flat-blade screwdrivers:
- Assembly grease
- Loctite® 243 (medium strength threadlocker)

5.4 Mounting preparations

1. Ensure all accessories are available (please refer to Chapter 11 Dimension drawings).



NOTES!

Fastening screws and earth cable are not included in the range of supply.

2. Preparing the place of attachment: Clean the (motor) shaft, centering, bolting surfaces and fastening threads; check for damage. Repair any damage!

5.5 Mounting B5 type (flange) incremental encoders



NOTES!

For a mounting example please refer to dimension drawing HM 09 M 57 263a (Chapter 11.1).

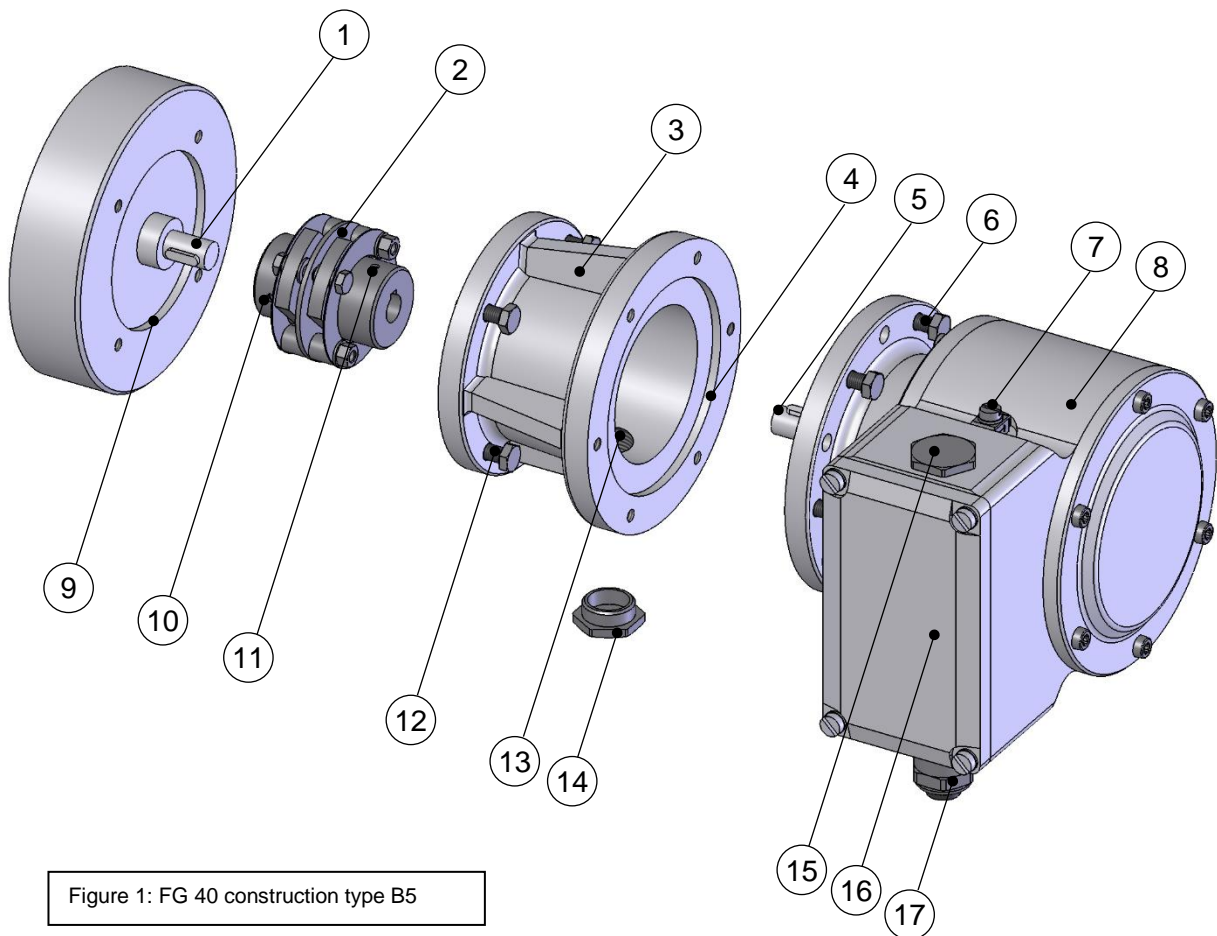


Figure 1: FG 40 construction type B5

1. Lightly grease the (motor) shaft (1) and centering (9).
2. Fit coupling (2) onto (motor) shaft.

**NOTES!**

You must be able to mount the coupling without force. Ream out the bores of used couplings, if necessary!

3. Secure the coupling hub on the (motor) shaft with a grub screw or cheese head screw (10) (depending on the coupling type).
4. Fasten the intermediate flange (3) to the motor using the fastening screws (12).

**NOTES!**

If possible, fit the intermediate flange in a manner that ensures the screwed sealing plug (14) points downwards!

5. Lightly grease the encoder shaft (5) and centering (4).
6. Fit the encoder (8) into both the centering (4) and coupling hub at the same time.

**NOTES!**

You must be able to mount the coupling without force. Ream out the bores of used couplings, if necessary!

**NOTES!**

If possible, fit the device in a manner that ensures the cable gland points downwards
Exchange the position of the cable gland (16) and the blanking plug (15), if necessary.

7. Secure the encoder with 4-6 screws (6) evenly distributed around the circumference of the flange.
8. Remove the sealing plug (14) from the access bore (13) to the coupling.
9. Secure the coupling hub on the encoder shaft with a grub screw or cheese head screw (11) (depending on the coupling type).

**NOTES!**

To carry out this task, it may be necessary to turn the (motor) shaft to the correct position.

10. Replace the sealing plug (14) to seal the access bore to the coupling.

5.6 Mounting B35 type (flange and foot) incremental encoders



NOTES!

B35 type encoders can be attached by means of a flange (B5, please refer to Chapter 5.5) **or** foot (B3):

For a mounting example please refer to dimension drawing HM 09 M 102 240a (Chapter 11.2).

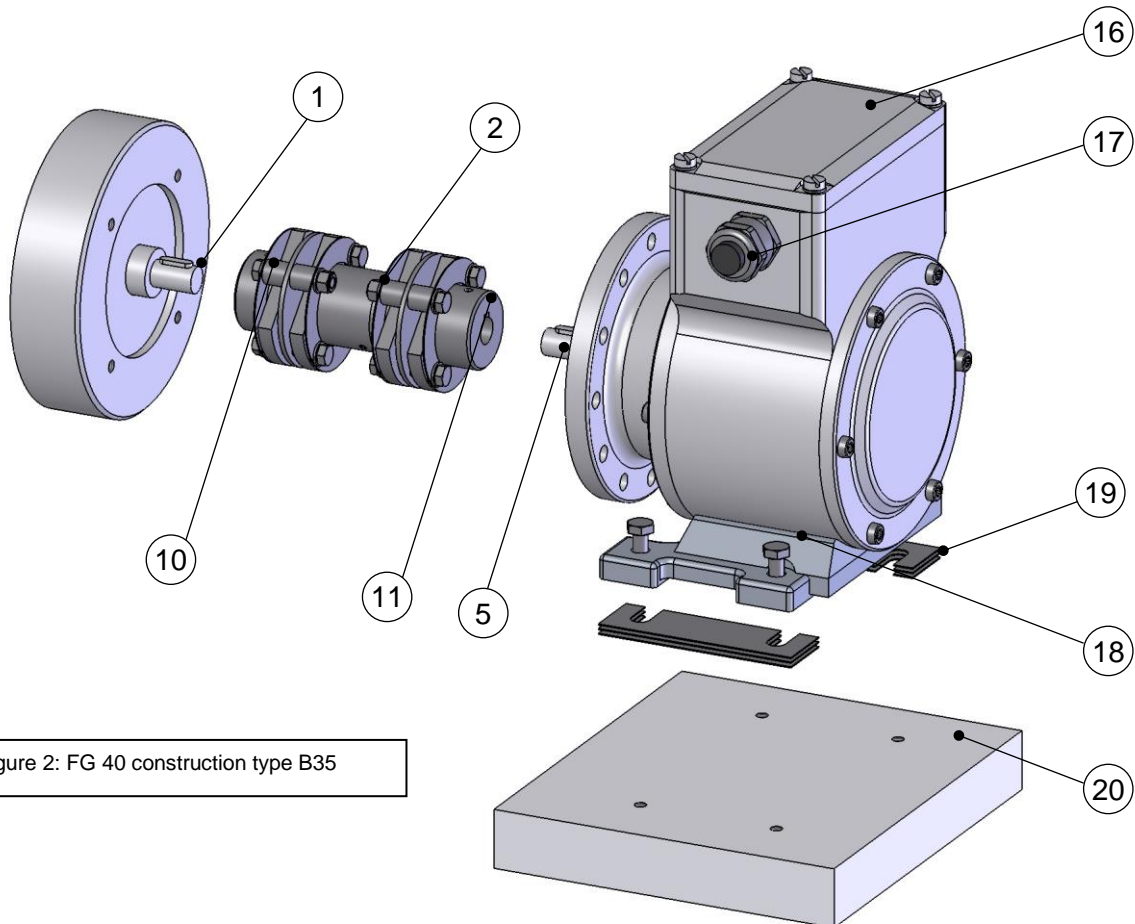


Figure 2: FG 40 construction type B35

1. Lightly grease the (motor) shaft (1).
2. Fit coupling (2) onto (motor) shaft.



NOTES!

You must be able to mount the coupling without force. Ream out the bores of used couplings, if necessary!



NOTES!

We recommend our zero-backlash, torsion-resistant **double-joint coupling HKD5** to attach B35 type encoders. Please refer to the catalogue Torsion Resistant Couplings for Encoders.

3. Secure the coupling hub on the (motor) shaft with a grub screw or cheese head screw (10) (depending on the coupling type).

- Align the encoder shaft (5) to the (motor) shaft and insert into the coupling hub.



NOTES!

Use shims (19) to achieve the correct vertical alignment to the base plate (20).

Observe information in Chapter 5.7 about mounting errors and max. permissible mounting tolerances!

- Fasten encoder foot with 4 M6 hexagon head screws (18).
- Secure the coupling hub on the encoder shaft with the grub screw or cheese head screw (11) (depending on the coupling type).

5.7 Mounting tolerances for construction type B5 and B35



NOTES!

Angle misalignment and parallel displacement between the (motor) shaft and the encoder shaft are mounting errors and should be kept as small as possible.

Mounting errors

- Cause radial forces to act on the encoder shaft.
- Reduce the service life of the bearings and the coupling.
- Degrade the quality of the signals (harmonic content).

Mounting tolerances for our zero-backlash, torsion-resistant couplings HK5 and HKD5:

Coupling	Axial offset	Angular error	Parallel offset
HK 5	$\pm 1 \text{ mm}$	0.5°	-
HKD 5	$\pm 1.5 \text{ mm}$	0.5°	0.5 mm

5.8 Attaching additional devices



NOTES!

Encoders in construction type B5/B14 have a second shaft end with integrated coupling half (1) and a B 14 flange (2) on the non-drive end onto which it is possible to fit an additional device with a B5 flange, for example an incremental encoder, absolute shaft encoder or an overspeed switch. A second coupling half with elastomer ring (5, Figure 4), which is available as an accessory, is required to fit an additional device. Installation example see dimension drawing HM 09 M 102 245 (Chapter 11.5). This design option makes it possible to combine up to four devices.

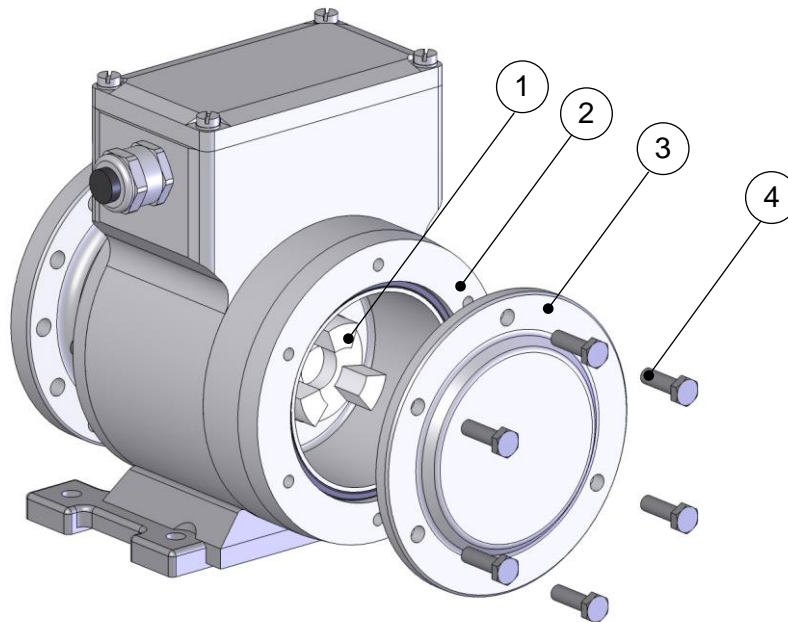


Figure 3:

When supplied ex works the second shaft end is protected by a cover plate (3) secured with 6x M6x20 hexagon head screws (4).



CAUTION!

Do not remove the housing cover secured with Torx screws! These devices are not equipped with a second shaft end.

1. Loosen the hexagon head screws (4).



NOTES!

The fastening screws (4) can be used later to secure the additional device (7).

2. Remove the cover plate (3).



NOTES!

Ensure no liquids or dirt are allowed ingress into the device when the cover plate is removed.

Mount the cover again, if you experience installation delays.



WARNING!

If no second device is added ensure the cover plate is fitted to protect and cover the second shaft end.

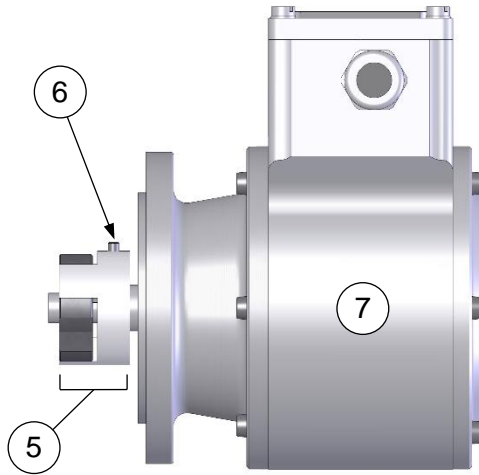


Figure 4:

3. Slide on the coupling half (5) with elastomer ring up to the collar of the shaft of the additional device (7), and secure by tightening the grub screw (6).



NOTES!

The correct distance between both coupling halves has now been set.

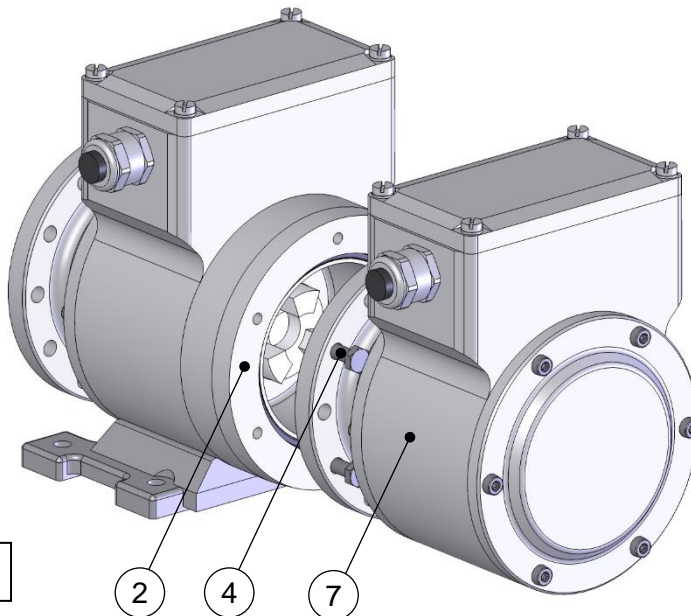


Figure 5:

4. Mount the attachment (7) to the B 14 flange (2) of the rotary encoder.
5. Fix the attachment (7) with 6 x hex bolts M6 x 20 – 8.8. For this step the mounting screws (4) of the cover can be used.

5.9 Electrical connection and start up



NOTES!

You must observe applicable EMC guidelines when routing cables!



NOTES for UL and CSA!

Do only use copper cables!

5.9.1 Preparing cables

1. Strip cable insulation.
2. Crimp wire-end ferrules.

5.9.2 Electrical connection

1. Open the terminal box cover (16, Fig.1).



CAUTION!

Do not allow moisture to enter the terminal box when the cover is open!

2. Remove the cap of the cable gland (17, Fig. 1).
3. Feed the cable into the terminal box trough the cable gland.

NOTES!

The signal cable shielding can be connected directly to the housing via the EMC cable gland. A coil spring integrated in the cable gland ensures all-round contact is made with the bare cable shielding to ensure a good shield connection. This type of shield connection should be preferred.



Alternatively, if equipotential bonding currents are anticipated it is possible to connect the cable shielding to a shield terminal in the terminal box. A capacitor between the shield terminal and the encoder housing prevents the flow of equalizing current.

To achieve an effective shielding the cable shield must also be connected in the electrical cabinet.

4. Tighten the cable gland and blanking plugs using a spanner.



NOTES!

Prior to delivery cable glands and blanking plugs are tightened finger tight only. To ensure that the terminal box is reliably sealed tighten all cable glands and blanking plugs before starting up for the first time.

5. Use a spanner to tighten the cable gland until the cable is securely clamped and properly sealed.

**NOTES!**

Prevent lateral pulling forces acting on the cable and plugs so as not to impair the degree of protection of the cable gland.

6. Connect the supply voltage and signal cable (please refer to the connection diagrams, Chapter 11).

**CAUTION!**

Do not apply supply voltage to the signal outputs, as this will destroy the device!

7. Applicable to alternative shield connection only: fit cable lug to cable shield and connect to the shield terminal (please refer to the connection diagrams, Chapter 12).

**NOTES!**

To achieve a good shielding effect the cable shield be kept as short as possible.

8. Close the terminal box cover.

**NOTES!**

Before closing the terminal box cover check and if necessary clean both seal surfaces and the gasket.

**CAUTION!**

Ensure when closing the terminal box cover that no cable becomes jammed.

9. Secure earth cable to earth terminal (7).

6 Dismantling

6.1 Safety instructions

Personnel

Dismantling must be carried out by skilled technical staff only.



WARNING!

Observe the safety instructions contained in **Chapter 2** when inspecting or working on the device!



NOTES!

Do not use a hammer or similar tool when installing the device due to the risk of damage occurring to the bearings or coupling!

6.2 Dismantling the encoder

Remove all electrical cables from the device before dismantling. To dismantling the encoder follow the instructions given in Chapters 5.5 and 5.6 or 5.8 in the reverse order.

7 Faults

7.1 Faults table

Faults	Possible cause	Remedy
Moisture in the terminal box	Soiled terminal box gasket or seal surfaces	Clean terminal box gasket and seal surfaces
	Damaged terminal box gasket	Replace terminal box gasket
	Cable gland/blanking plug not tightened	Tighten cable gland/blanking plug
	Unsuitable cable for cable gland	Use suitable cable and cable glands
No output signals	Supply voltage not connected	Connect supply voltage
	Connection cable reversed	Wire correctly
Output signals subject to interference	Unsuitable cable	Use data cable with conductors arranged as twisted pairs and common shield
	Cable shield not connected	Connect cable shield at both ends
	Cable routing not EMC compliant	Observe applicable EMC guidelines when routing cables
Signal interruptions	Signal end stage overloaded	Check pin assignment; observe connection diagram
		Do not assign unused outputs
	Outputs short-circuited	Do not connect outputs with supply voltage or GND

Contact Hübner-Service (page 2) if none of the remedies listed above provides a solution!

8 Inspections

8.1 Safety instructions



WARNING!

Skilled technical staff only are permitted to inspect the device and its installation.
Observe the safety instructions contained in **Chapter 2** when inspecting or working on the device!

8.2 Maintenance information

The device is maintenance-free. However, to guarantee optimum fault-free operations we recommend that you carry out the following inspections.

8.3 Inspection schedule

Interval	Inspections
Yearly	Inspect the coupling for damage and ensure it is free of play
	Ensure the fastening screws are properly tightened
	Ensure cable connections and connection terminals are securely seated
Following approx 16 000 ... 20 000 hours of operation / higher levels of continuous load	Check deep groove ball bearings are running smoothly and listen for running noises

9 Disposal

9.1 Disposal procedure

The manufacturer is not obliged to take back the device.

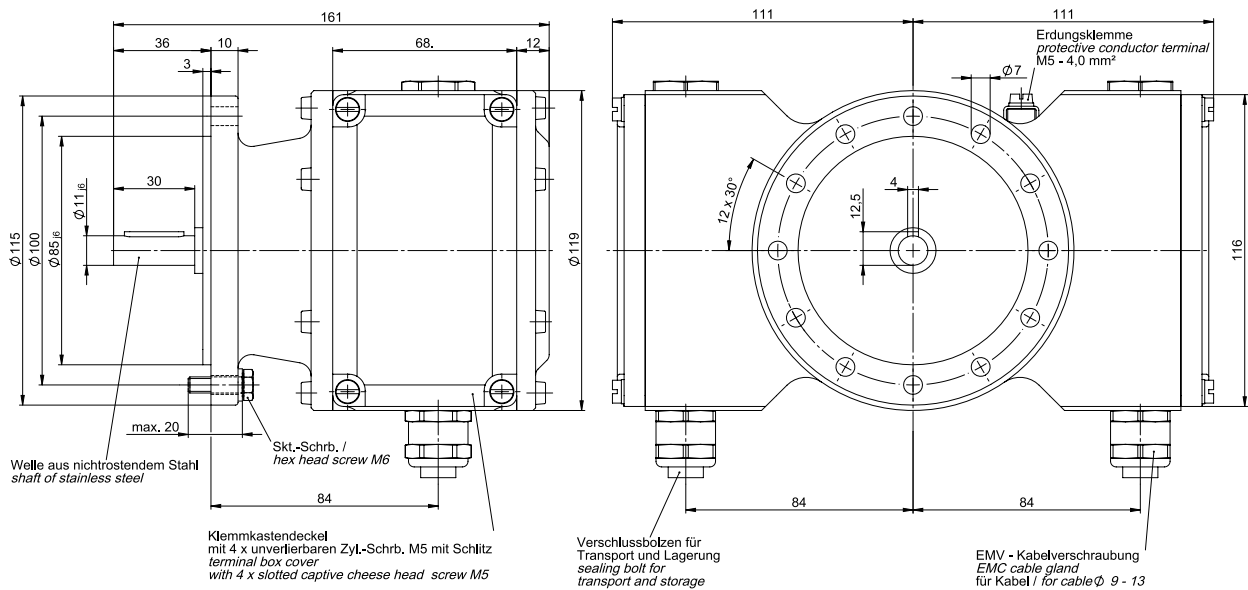
The device is classed as electronic equipment and subject to the WEEE Directive; observe local, country-specific laws when disposing of the device.

For information on environmentally sound disposal please contact your local authority or a specialist disposal company.

10 Replacement parts

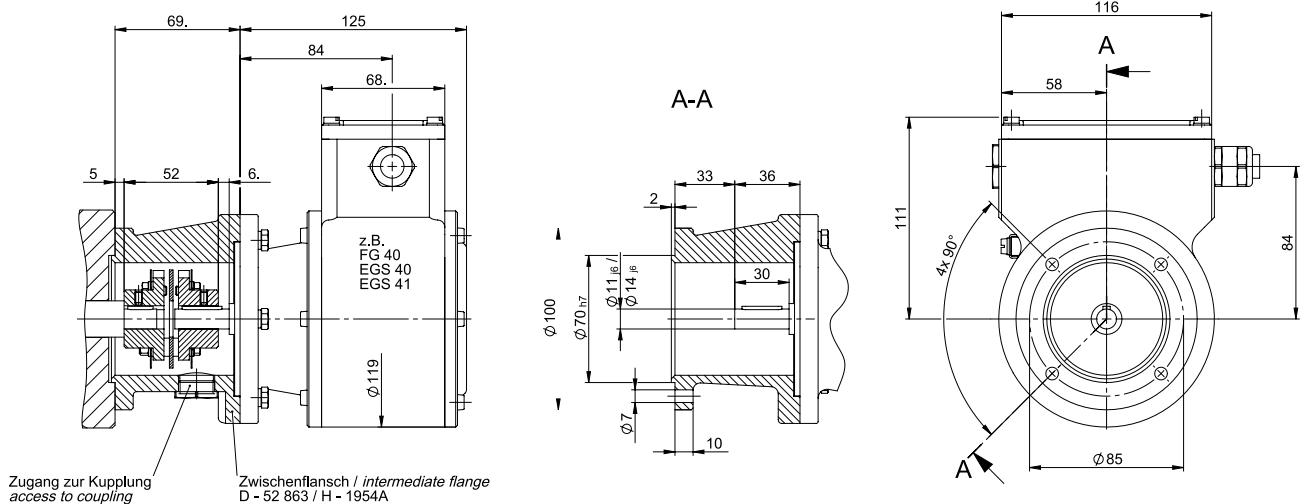
The replacement parts listed below can be obtained via the service address on page 2.

Replacement parts	Comment
Cover	Cover for the 2nd shaft end or for the hollow shaft bore (gAS)
Cable gland	M 20 x 1.5
Terminal box cover	Including flat seal and screws
Feather key	Specify shaft dimensions or feather key dimension
Programming cable and software	
Screw plug	For closing the access to the coupling

**FG 40 KK**

Redundant version

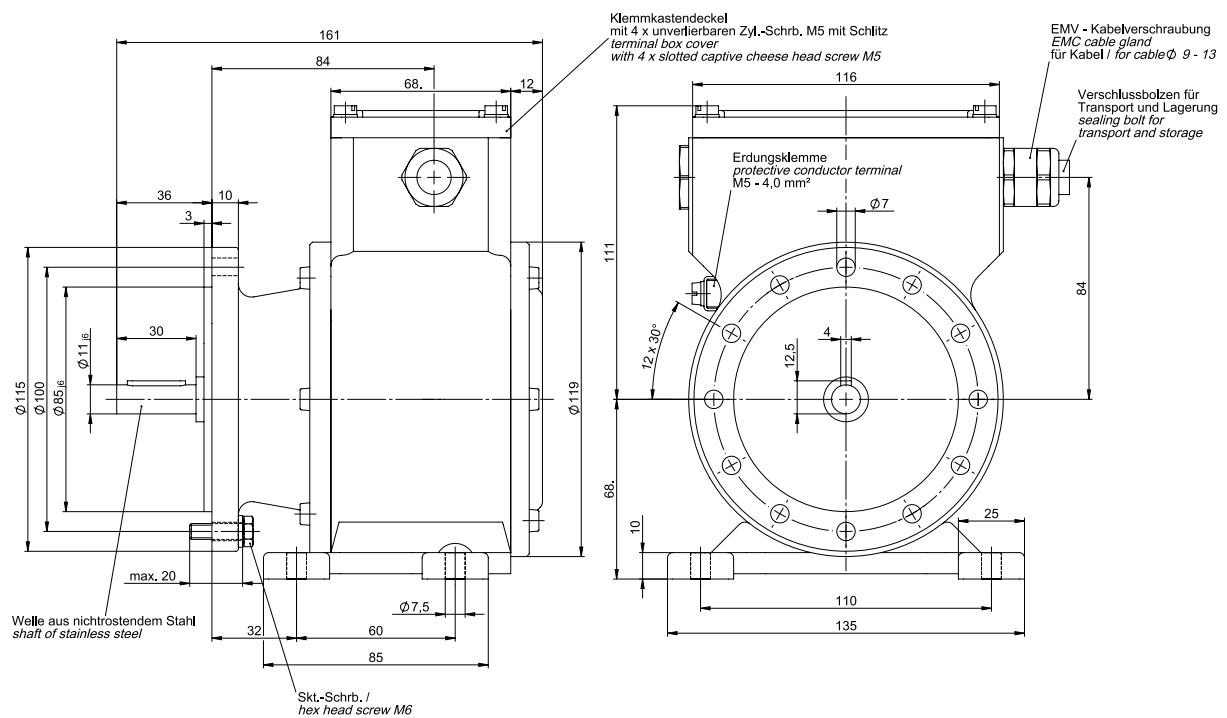
HM 08 M 57 223a

**FG 40 K**

Mounting example for construction type B5 with flange and coupling HK 522

HM 09 M 57 263a

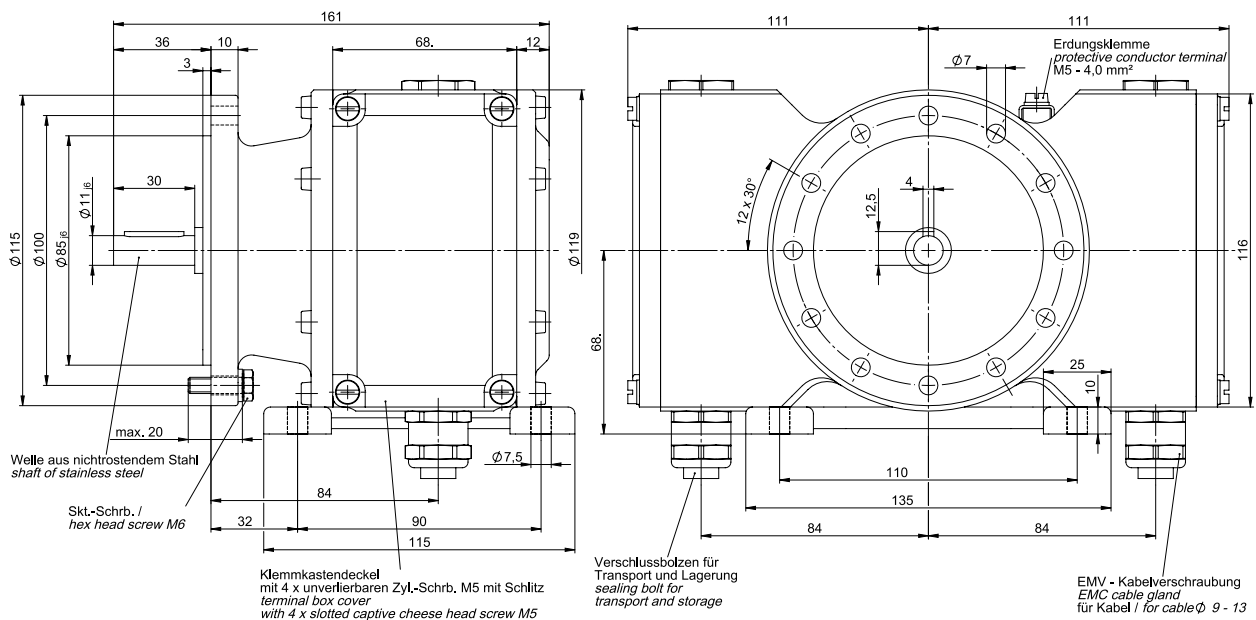
11.2 Construction type B35 (flange and foot)



FG 40 K

With radial terminal box

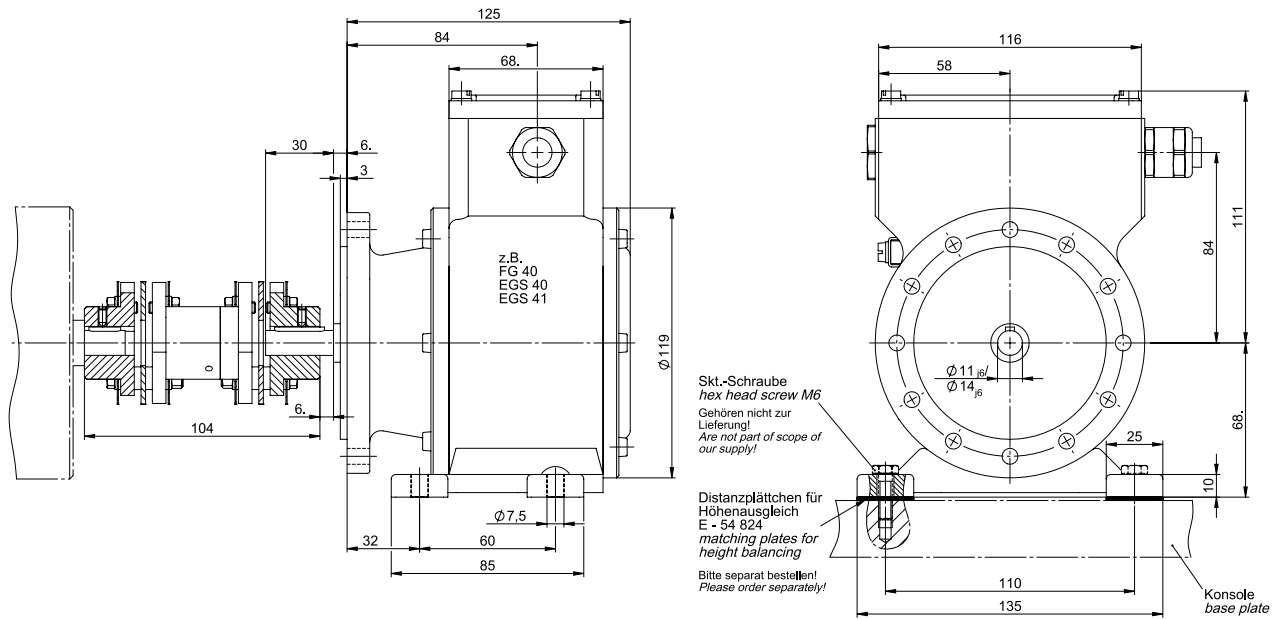
HM 08 M 57 222a



FG 40 KK

Redundant version

HM 08 M 57 224a

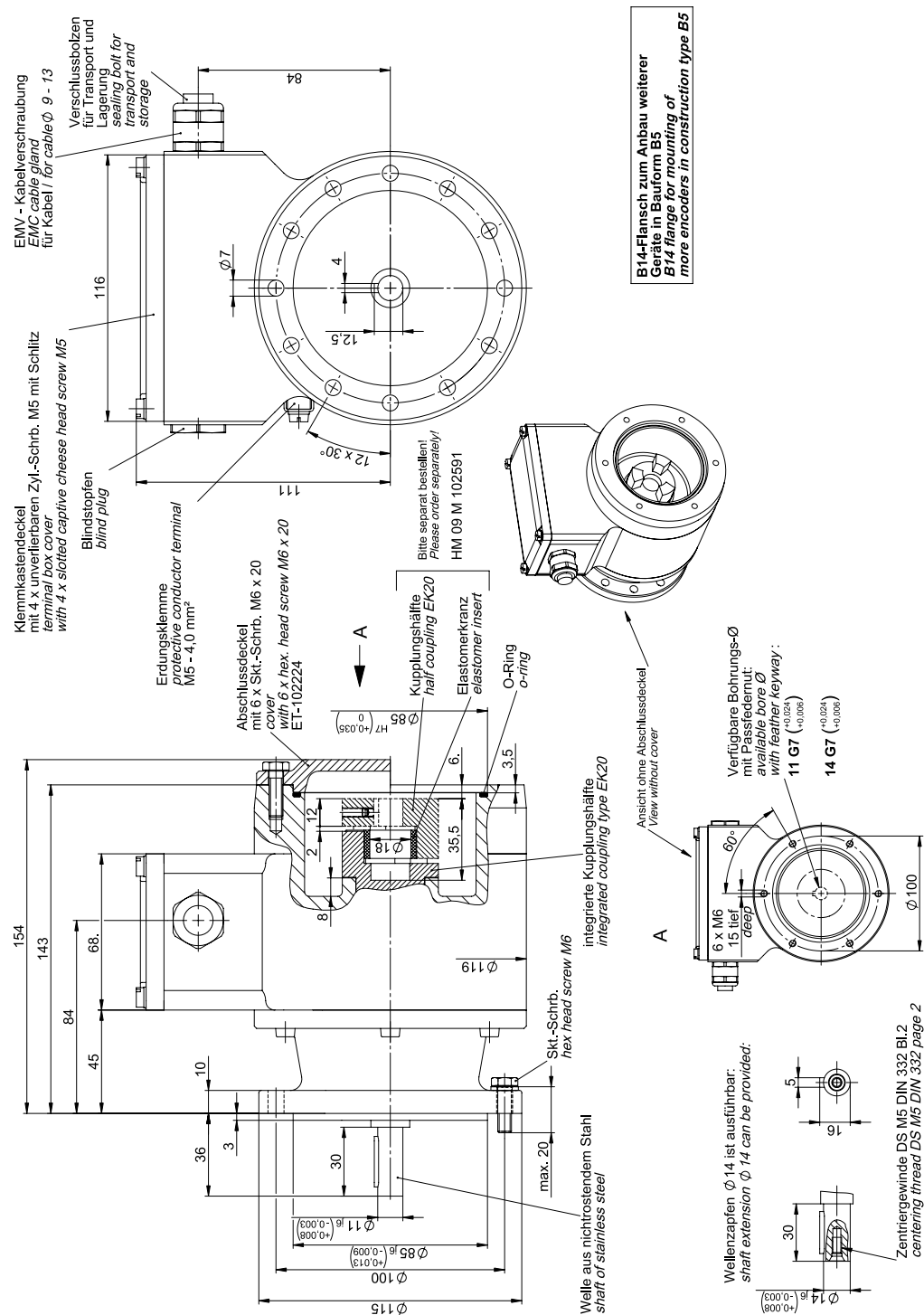


FG 40 K

**Mounting example for construction type B35
With coupling HKD 522**

HM 09 M 102 240a

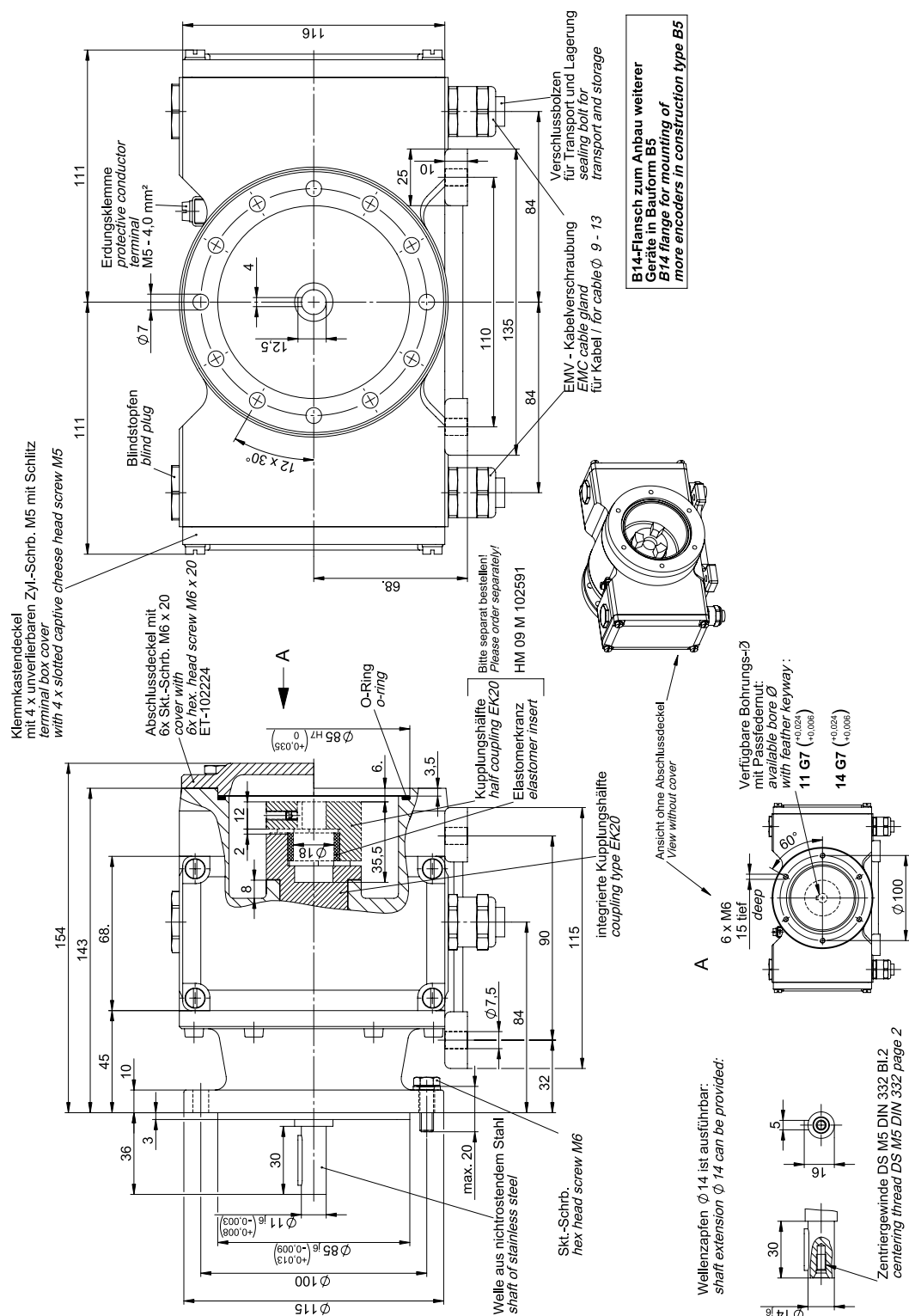
11.3 Construction type B5/B14 (flange with 2 shaft ends)



FG 40 K

Construction type B5/B14
(flange with 2 shaft ends)

HM 09 M 102 541

**FG 40 KK**

redundant version

HM 09 M 102 549

B14-Flansch zum Anbau weiterer Geräte in Bauform B5
more encoders in construction type B5

Klemmkastendeckel
mit 4 x unverbaubaren Zyl.-Schrub. M5 mit Schlitz
terminal box cover
with 4 x slotted captive cheese head screw M5

Verschlussbolz für Transport u Lagerung
sealing bolt for transport and storage

Blindstopfen
blind plug

Erdungsklemme
protective conductor terminal
M5 - 4,0 mm²

Abschlussdeckel
cover
mit 6 x Skt-Schrb. M6 x 20
ET-102224

Kupplungshälfte
half coupling EK20

Elastomerkranz
elastomer insert

O-Ring
o-ring

integrierte Kupplungshälfte
integrated coupling type EK20

Skt-Schrb.
hex head screw M6

Welle aus nichtrostendem Stahl
shaft of stainless steel

Wellenzapfen Ø 14 ist austauschbar.
shaft extension Ø 14 can be provided:

Zentriergewinde DS M5 DIN 332 Bl.2
centring thread DS M5 DIN 332 page 2

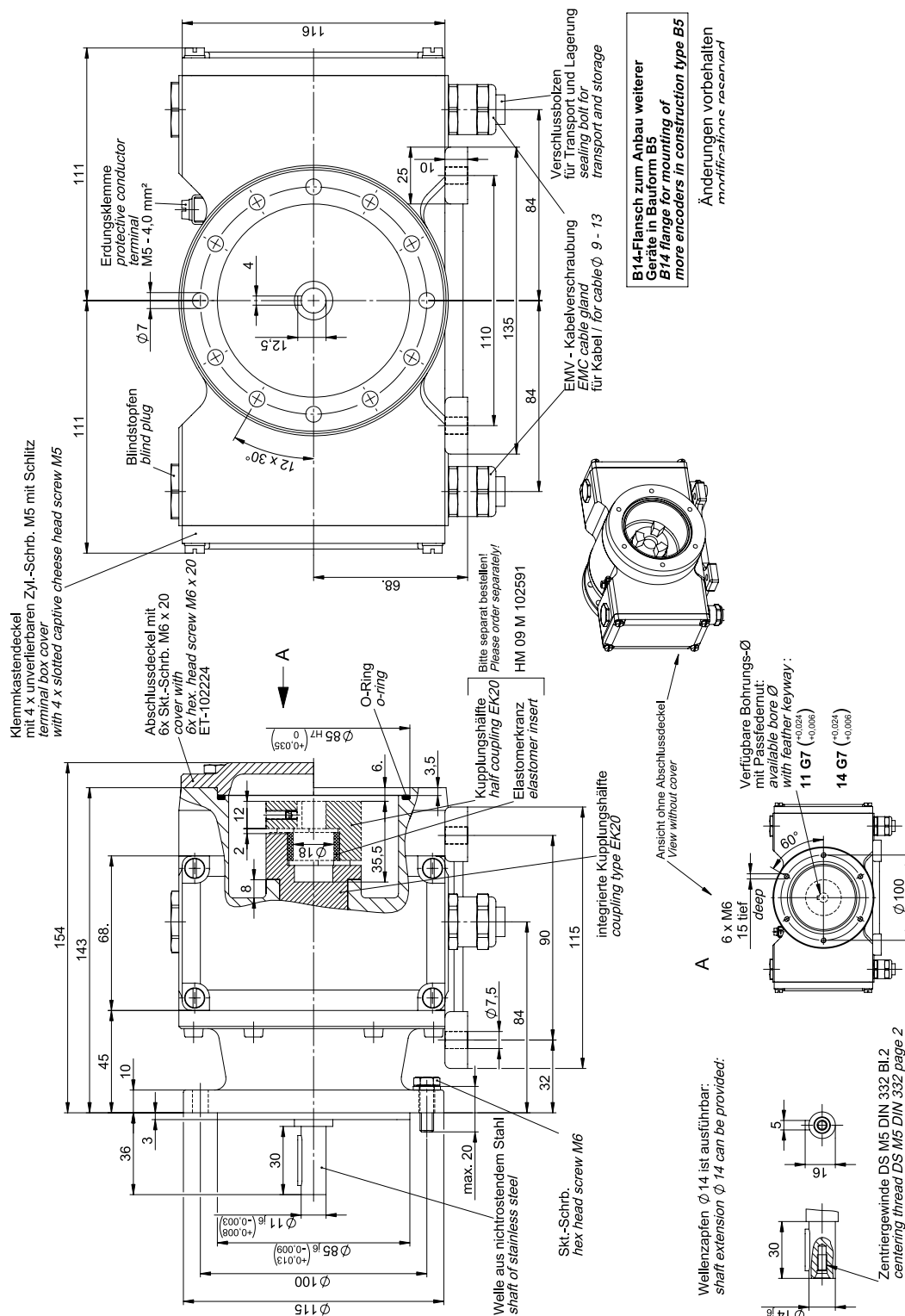
Verfügbare Bohrungs-Ø mit Passbohrung mit Federkerbwinkel:
available bore Ø with feather keyway:
11 GT (+0,024 / +0,006)
14 GT (+0,024 / +0,006)

Ansicht ohne Abschlussdeckel
View without cover

Bitte separat bestellen!
Please order separately!
HM 09 M 102591

EMV - Kabelverschraubung
EMC cable gland
für Kabel / for cable Ø 9 - 13

HM 09 M 102 280



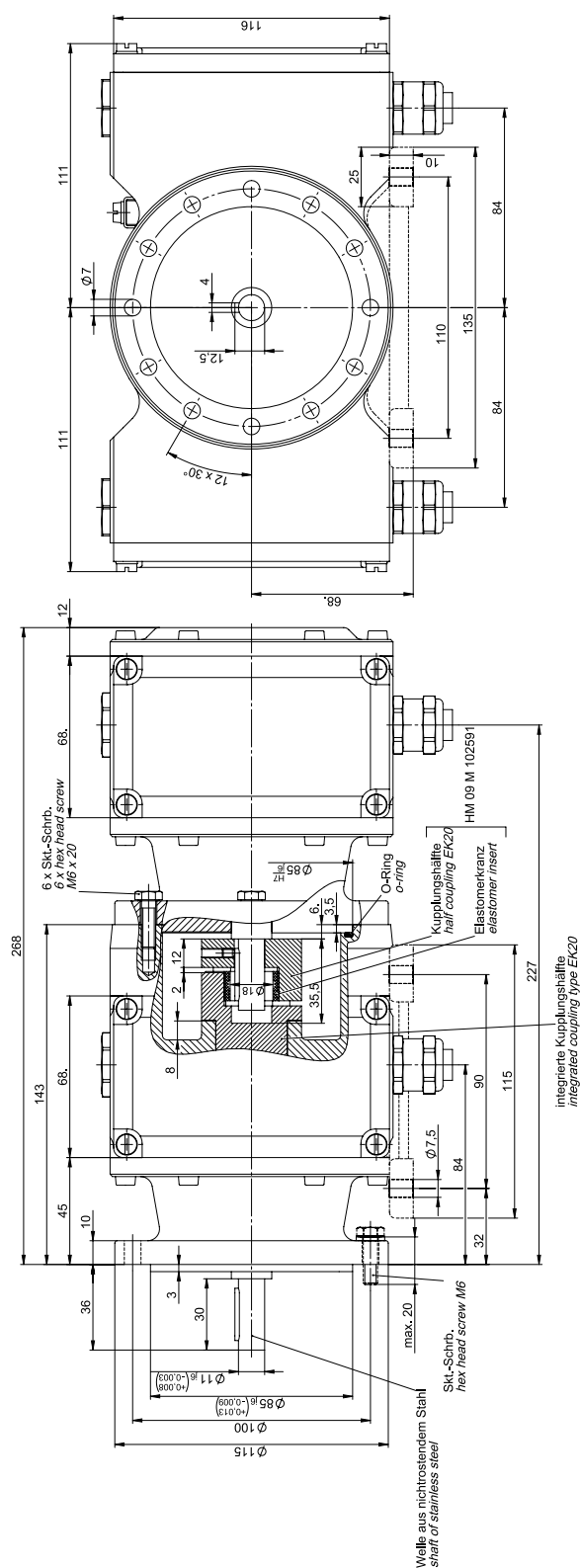
B14-Flansch zum Anbau weiterer Geräte in Bauform B5
more encoders in construction type B5

Änderungen vorbehalten
modifications reserved

FG 40 KK

redundant version

HM 09 M 101 548

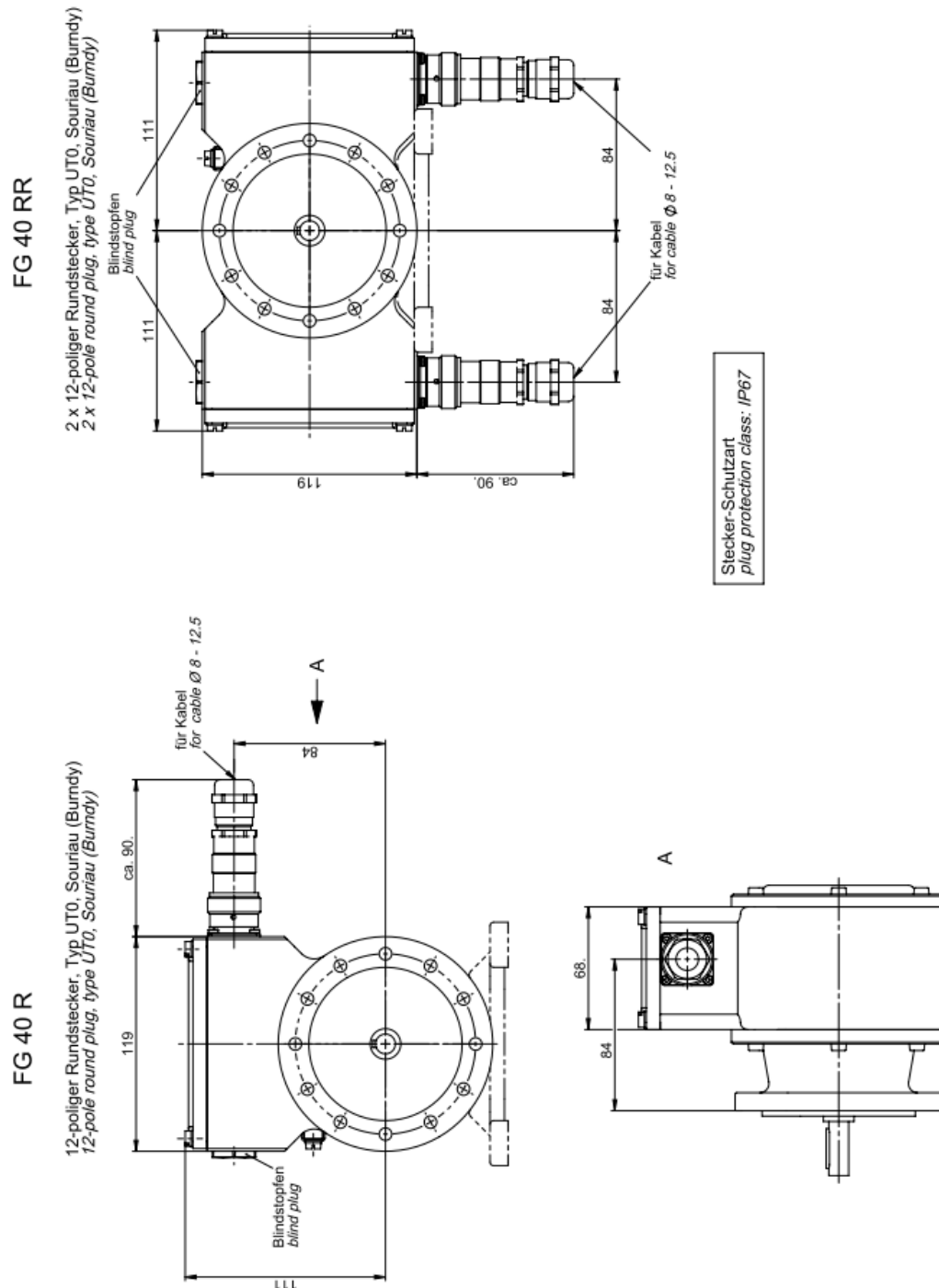


FG 40 KK

FG 40 KK with coupled unit

HM 09 M 102 627

11.6 Additional dimension drawings – electrical socket design



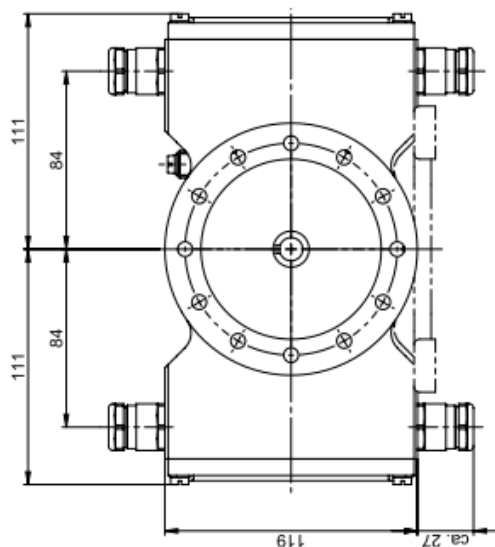
FG 40 R/RR

**additional dimension drawing
electrical socket design FG 40 R/RR**

HM 09 M 102 270

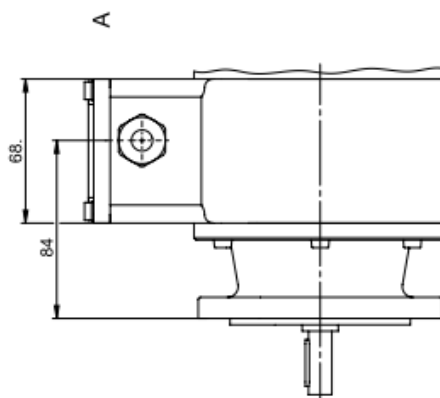
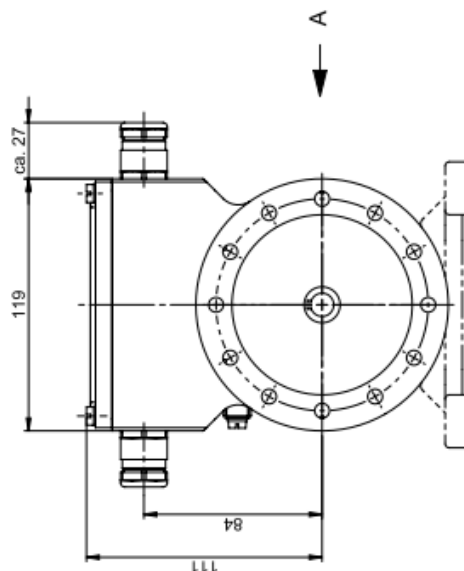
FG 40 LL

4 x Kabelverschraubung für Kabel-Ø 8,5 - 11
mit Verschlussbolzen für Transport und Lagerung
4 x cable gland for cable Ø 8.5 - 11
with sealing bolt for transport and storage



FG 40 L

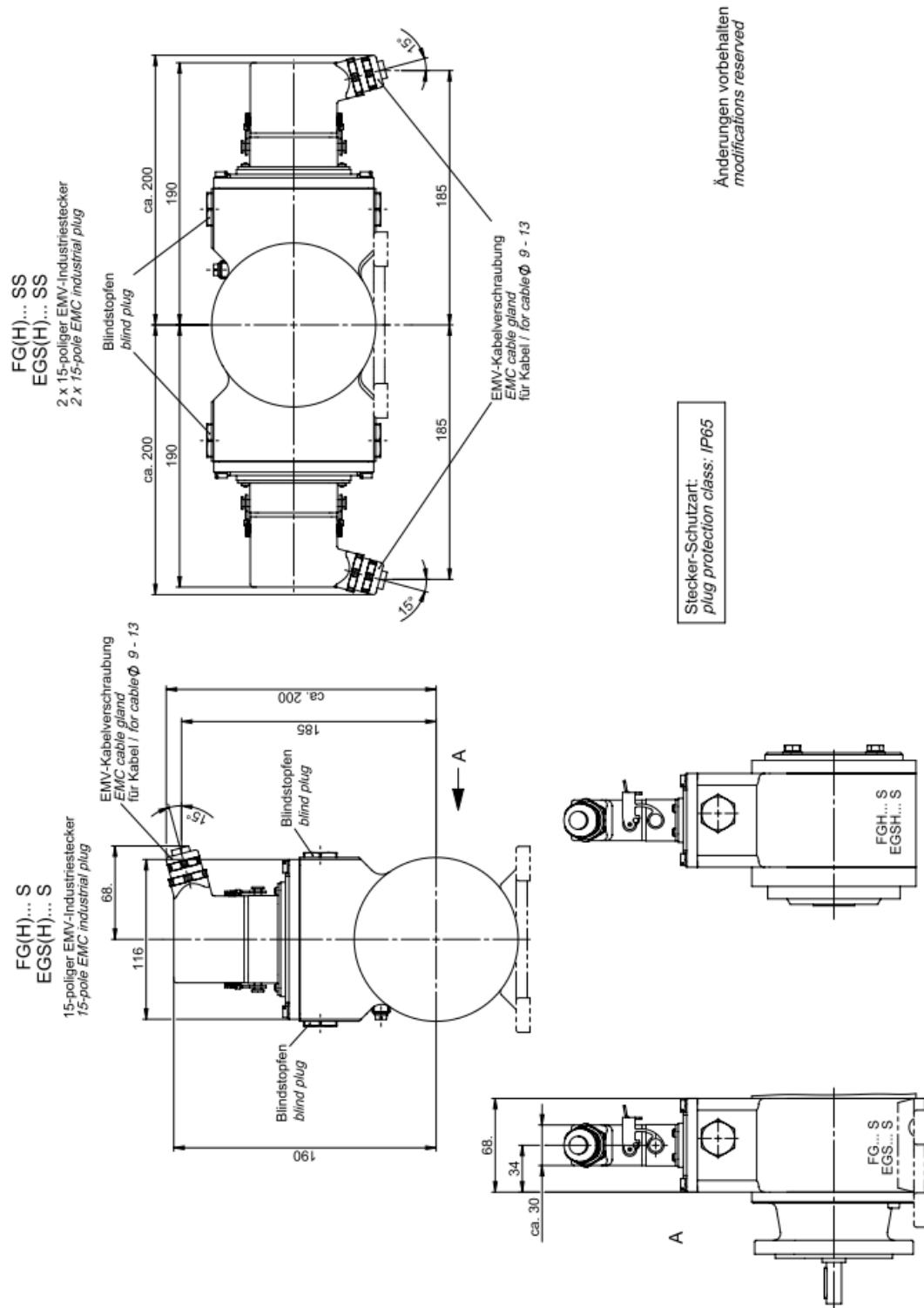
2 x Kabelverschraubung für Kabel-Ø 8,5 - 11
mit Verschlussbolzen für Transport und Lagerung
2 x cable gland for cable Ø 8.5 - 11
with sealing bolt for transport and storage



FG 40 L/LL

additional dimension drawing
electrical socket design FG 40 L/LL

HM 09 M 103063



FG 40 S/SS

additional dimension drawing

electric connection implementation FG 40 S/SS

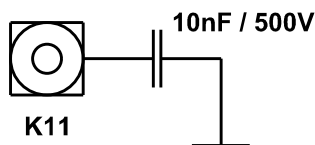
HM 12 M 105755

15 pole EMC

12 Connection diagrams

Shielding:

The shield of the signal cable can be connected directly to the housing of the encoder by the cable gland. Alternatively the shield of the signal cable can be connected to K11 via a capacitor (10nF / 500V) to the housing of the encoder.

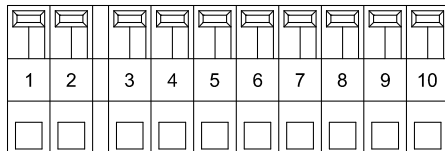


Klemmkasten Terminal box		Anschlussplan Connection diagram PN109-400		
1	0V		GND	GND
2	12...30V		Versorgungsspannung	Power Supply
3	0°		Inkr. Ausgang 0°	Incr. Output 0°
4	0°		Inkr. Ausgang 0° Invers	Incr. Output 0° Inverse
5	90°		Inkr. Ausgang 90°	Incr. Output 90°
6	90°		Inkr. Ausgang 90° Invers	Incr. Output 90° Inverse
7	N		Nullimpuls	Reference
8	N		Nullimpuls Invers	Reference Inverse
9	ERR		Fehlerausgang (Low aktiv)	Error Output (Low active)
10	ERR		Fehlerausgang (High aktiv)	Error Output (High active)

FG 40

Standard

Terminal box

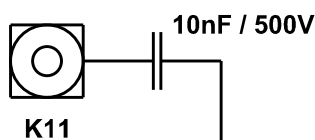


10 pole printed circuit spring terminal block type Phoenix ZFKDS

Connection data:

wire section
0,2-1,5 [mm²]

Alternative Shielding



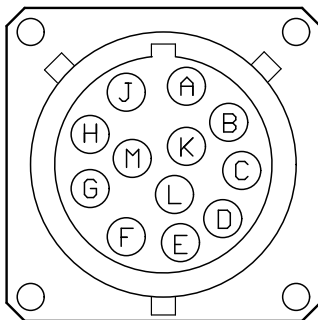
Klemmkasten Terminal box		Anschlussplan Connection diagram PN109-401		
1	0V		GND	GND
2	12...30V		Versorgungsspannung	Power Supply
3	0°		Inkr. Ausgang 0°	Incr. Output 0°
4	0°		Inkr. Ausgang 0° Invers	Incr. Output 0° Inverse
5	90°		Inkr. Ausgang 90°	Incr. Output 90°
6	90°		Inkr. Ausgang 90° Invers	Incr. Output 90° Inverse
7	-		nicht belegt	not connected
8	-		nicht belegt	not connected
9	ERR		Fehlerausgang (Low aktiv)	Error Output (Low active)
10	ERR		Fehlerausgang (High aktiv)	Error Output (High active)

FG 40

Standard without reference pulse

Terminal box

Socket insert view



Crimp contacts for
cross-sectional
data of wire from
0,52 up to 1,5 mm²

Shield:

The shield of the signal cable is
directly to be connected with the
socket housing.

Crimping tool: Burndy® No. MR 8 GE 5

Burndy-Stecker			Anschlussplan			PN109-410	
Burndy plug			Connection diagram			PN109-410	
1	A	0V		GND		GND	
2	B	12..30V		Versorgungsspannung		Power Supply	
3	C	0°		Inkr. Ausgang 0°		Incr. Output 0°	
4	D	0°		Inkr. Ausgang 0° Invers		Incr. Output 0° Inverse	
5	E	90°		Inkr. Ausgang 90°		Incr. Output 90°	
6	F	90°		Inkr. Ausgang 90° Invers		Incr. Output 90° Inverse	
7	G	N		Nullimpuls		Reference	
8	H	N		Nullimpuls Invers		Reference Inverse	
9	J	ERR		Fehlerausgang (Low aktiv)		Error Output (Low aktiv)	
10	K	ERR		Fehlerausgang (High aktiv)		Error Output (High aktiv)	
11	L	-		nicht belegt		not connected	
12	M	-		nicht belegt		not connected	

FG 40

Standard (not for UL/CSA)

Burndy® plug

Connection cable

6x2x0,56 twin-standard, shielded

Type: HE-2LVCC-CY AWG 20b
acc. to VDE 0881

Cross-section: 0,56 mm²
Temperature: -20 °C to + 105 °C
Outside dia: 10,1 mm

shield is connected to casing

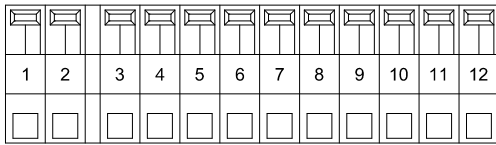
other cables- / temperature ranges
on request

Anschlusskabel			Anschlussplan			PN109-420	
Connection cable			Connection diagram			PN109-420	
1	A		schwarz	black	0V	GND	GND
2	B		rot	red	12..30V	Versorgungsspannung	Power Supply
3	C		orange	orange	0°		Inkr. Ausgang 0° Incr. Output 0°
4	D		schwarz	black	0°		Inkr. Ausgang 0° Invers Incr. Output 0° Inverse
5	E		blau	blue	90°		Inkr. Ausgang 90° Incr. Output 90°
6	F		schwarz	black	90°		Inkr. Ausgang 90° Invers Incr. Output 90° Inverse
7	G		gelb	yellow	N		Nullimpuls Reference
8	H		schwarz	black	N		Nullimpuls Invers Reference Inverse
9	J		grün	green	ERR		Fehlerausgang (Low aktiv) Error Output (Low aktiv)
10	K		schwarz	black	ERR		Fehlerausgang (High aktiv) Error Output (High aktiv)
11	L		-	-	-	nicht belegt	not connected
12	M		-	-	-	nicht belegt	not connected

FG 40

Standard (not for UL/CSA)

Connection cable



12 pole printed circuit spring terminal block type Phoenix ZFKDS

Connection data:

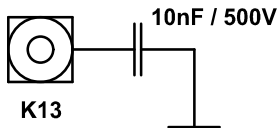
Wire section

0,2-1,5 [mm²]

Shielding:

The shield of the signal cable can be connected directly to the housing of the encoder by the cable gland. Alternatively the shield of the cable can be connected to K13 via a capacitor (10nF / 500V) to the housing of the encoder.

Alternative Shielding

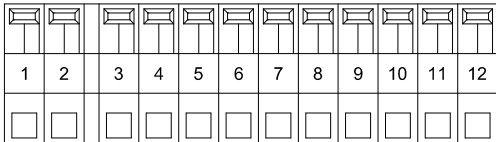


Klemmkasten <i>Terminal box</i>		Anschlussplan <i>Connection diagram</i> PN109-430		
1	0V		GND	<i>GND</i>
2	12...30V		Versorgungsspannung	<i>Power Supply</i>
3	0°		Inkr. Ausgang 0°	<i>Incr. Output 0°</i>
4	0°		Inkr. Ausgang 0° Invers	<i>Incr. Output 0° Inverse</i>
5	90°		Inkr. Ausgang 90°	<i>Incr. Output 90°</i>
6	90°		Inkr. Ausgang 90° Invers	<i>Incr. Output 90° Inverse</i>
7	N		Nullimpuls	<i>Reference</i>
8	N		Nullimpuls Invers	<i>Reference Inverse</i>
9	ERR		Fehlerausgang (Low aktiv)	<i>Error Output (Low active)</i>
10	ERR		Fehlerausgang (High aktiv)	<i>Error Output (High active)</i>
11	2F		Option 2F	<i>Option 2F</i>
12	2F		Option 2F invers	<i>Option 2F inverse</i>

FG 40

Option 2F

Terminal box



10 pole printed circuit spring terminal block type Phoenix ZFKDS

Connection data:

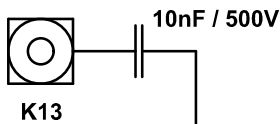
Wire section

0,2-1,5 [mm²]

Shielding:

The shield of the signal cable can be connected directly to the housing of the encoder by the cable gland. Alternatively the shield of the cable can be connected to K13 via a capacitor (10nF / 500V) to the housing of the encoder.

Alternative Shielding

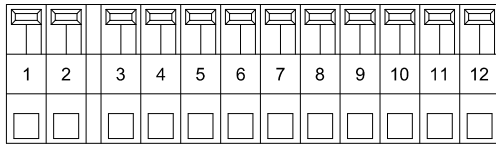


Klemmkasten <i>Terminal box</i>		Anschlussplan <i>Connection diagram</i> PN109-440		
1	0V		GND	<i>GND</i>
2	12...30V		Versorgungsspannung	<i>Power Supply</i>
3	0°		Inkr. Ausgang 0°	<i>Incr. Output 0°</i>
4	0°		Inkr. Ausgang 0° Invers	<i>Incr. Output 0° Inverse</i>
5	90°		Inkr. Ausgang 90°	<i>Incr. Output 90°</i>
6	90°		Inkr. Ausgang 90° Invers	<i>Incr. Output 90° Inverse</i>
7	N		Nullimpuls	<i>Reference</i>
8	N		Nullimpuls Invers	<i>Reference Inverse</i>
9	ERR		Fehlerausgang (Low aktiv)	<i>Error Output (Low active)</i>
10	ERR		Fehlerausgang (High aktiv)	<i>Error Output (High active)</i>
11	B		Option B	<i>Option B</i>
12	B		Option B invers	<i>Option B inverse</i>

FG 40

Option B

Terminal box

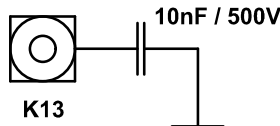


12 pole printed circuit spring terminal block type Phoenix ZFKDS

Connection data:
Wire section
0,2-1,5 [mm²]

Shielding:
The shield of the signal cable can be connected directly to the housing of the encoder by the cable gland. Alternatively the shield of the cable can be connected to K13 via a capacitor (10nF / 500V) to the housing of the encoder.

Alternative Shielding

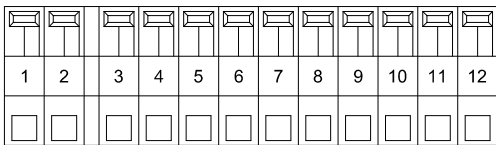


Klemmkasten <i>Terminal box</i>		Anschlussplan <i>Connection diagram</i>		PN109-450 <i>PN109-450</i>
1	0V		GND	GND
2	12...30V		Versorgungsspannung	Power Supply
3	0°		Inkr. Ausgang 0°	Incr. Output 0°
4	0°		Inkr. Ausgang 0° Invers	Incr. Output 0° Inverse
5	90°		Inkr. Ausgang 90°	Incr. Output 90°
6	90°		Inkr. Ausgang 90° Invers	Incr. Output 90° Inverse
7	N		Nullimpuls	Reference
8	N		Nullimpuls Invers	Reference Inverse
9	ERR		Fehlerrausgang (Low aktiv)	Error Output (Low active)
10	ERR		Fehlerrausgang (High aktiv)	Error Output (High active)
11	B2		Option B2	Option B2
12	B2		Option B2 invers	Option B2 inverse

FG 40

Option B2

Terminal box

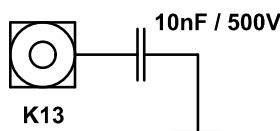


10 pole printed circuit spring terminal block type Phoenix ZFKDS

Connection data:
Wire section
0,2-1,5 [mm²]

Shielding:
The shield of the signal cable can be connected directly to the housing of the encoder by the cable gland. Alternatively the shield of the cable can be connected to K13 via a capacitor (10nF / 500V) to the housing of the encoder.

Alternative Shielding

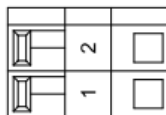


Klemmkasten <i>Terminal box</i>		Anschlussplan <i>Connection diagram</i>		PN109-460 <i>PN109-460</i>
1	0V		GND	GND
2	12...30V		Versorgungsspannung	Power Supply
3	0°		Inkr. Ausgang 0°	Incr. Output 0°
4	0°		Inkr. Ausgang 0° Invers	Incr. Output 0° Inverse
5	90°		Inkr. Ausgang 90°	Incr. Output 90°
6	90°		Inkr. Ausgang 90° Invers	Incr. Output 90° Inverse
7	N		Nullimpuls	Reference
8	N		Nullimpuls Invers	Reference Inverse
9	ERR		Fehlerrausgang (Low aktiv)	Error Output (Low active)
10	ERR		Fehlerrausgang (High aktiv)	Error Output (High active)
11	B3		Option B3	Option B3
12	B3		Option B3 invers	Option B3 inverse

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Option B3

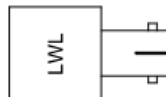
Terminal box



2 pol. Print-Zugfederklemme Typ Phoenix ZFKDS
2 pole printed circuit spring terminal block type Phoenix ZFKDS

Anschlussdaten:
Aderquerschnitt
0,2-1,5 [mm²]

Connection data:
wire section
0,2-1,5 [mm²]



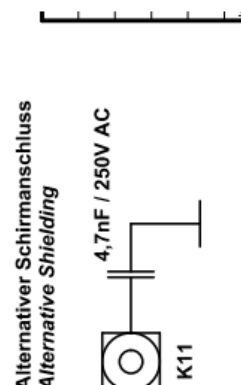
Anschlussdaten:
ST-Steckverbinder
1 Glasfaser 50/125µm
oder
1 Glasfaser 62.5/125µm

Connection data:
ST connector
1 Fibre optic cable 50/125µm
or
1 Fibre optic cable 62.5/125µm

Klemmkasten Terminal box	Anschlussplan Connection diagram	PN109-470 PN109-470
1	12...30V DC	Power Supply
2	0V	GND
3	LWL	Fibre Optic Cable

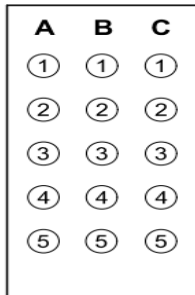
Schirmung:
Der Schirm der Signalleitung kann über die Kabelverschraubung direkt mit dem Gehäuse verbunden werden.
Alternativ kann der Kabelschirm an K11 über einen Kondensator (4,7nF / 250V AC) mit dem Gebergehäuse verbunden werden.

Shielding:
The shield of the signal cable can be connected directly to the housing of the encoder by the cable gland.
Alternatively the shield of the signal cable can be connected to K11 via a capacitor (4,7nF / 250V AC) to the housing of the encoder.



Ansicht auf Steckdoseneinsatz

Socket insert view



Anschlussdaten:

Crimpkontakte für Drahtquerschnitte
0,75-1,0 [mm²]

Connection data:

Crimp contacts for cross-Sectional data of wire
0,75-1,0 [mm²]

Schirmung:

Der Schirm der Signalleitung muss über
die Kabelverschraubung direkt mit dem
Gehäuse verbunden werden.

Shielding:

The shield of the signal cable has to be
connected directly to the housing of the
encoder by the cable gland.

EMV-Industriestecker EMC industrial plug		Anschlussplan Connection diagram		PN109-415 PN109-415
C5	0V		GND	GND
A5	12...30V		Versorgungsspannung	Power Supply
A1	0°		Inkr. Ausgang 0°	Incr. Output 0°
A2	0°		Inkr. Ausgang 0° Invers	Incr. Output 0° Inverse
A3	90°		Inkr. Ausgang 90°	Incr. Output 90°
A4	90°		Inkr. Ausgang 90° Invers	Incr. Output 90° Inverse
B3*	N		Nullimpuls	Reference
B4*	N		Nullimpuls Invers	Reference Inverse
B5	ERR		Fehlerausgang (Low aktiv)	Error Output (Low active)
C3	ERR		Fehlerausgang (High aktiv)	Error Output (High active)
C1*	2F		Option 2F	Option 2F
C2*	2F		Option 2F Invers	Option 2F Inverse
C1*	B		Option B	Option B
C2*	B		Option B Invers	Option B Inverse
C1*	B2		Rechtslauf	clock wise
C2*	B2		Linkslauf	counter clock wise

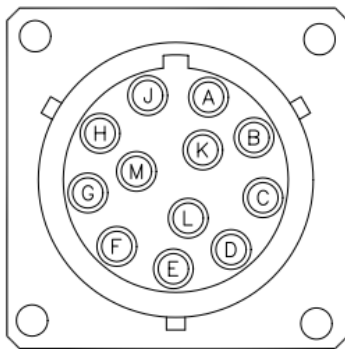
* optional je nach Ausführung
depending on options

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connection scheme PN 109-415 (nicht für UL/CSA)

EMC industrial plug

Ansicht auf Steckdoseneinsatz View on device connector



	M	
	H	
	A	
	B	
	C	
	D	
	E	
	F	

—c +12V...+30VDC Versorgungsspannung
Supply voltage

—c GND

—o Schaltausgang 1
Switching output 1

—o Schaltausgang 2
Switching output 2

—o Systemüberwachung
System check

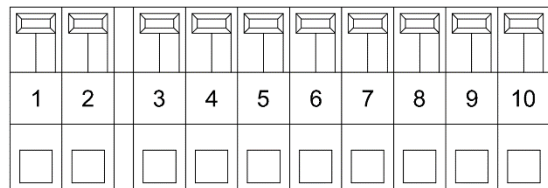
Crimpkontakte für Drahtquerschnitte 0,52 bis 1,5 mm

Crimping tool: Burndy No. MR 8 GE 5

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connection scheme 649 Option S(nicht für UL/CSA)

Burndy plug



10 pol. Print-Zugfederklemme Typ Phoenix ZFKDS

10 pole printed circuit spring terminal block type Phoenix ZFKDS

Anschlussdaten:

Aderquerschnitt

0,2-1,5 [mm²]

Connection data:

wire section

0.2-1.5 [mm²]

Klemmkasten Terminal box		Anschlussplan Connection diagram PN148-400b		
1	0V		GND	GND
2	5...30V DC		Versorgungsspannung	Power Supply
3	A+		Ausgang A+	Output A+
4	A-		Ausgang A-Invers	Output A-Inverse
5	B+		Ausgang B+	Output B+
6	B-		Ausgang B-Invers	Output B-Inverse
7	N		Nullimpuls	Reference
8	N̄		Nullimpuls Invers	Reference Inverse
9	ERR		Fehlerausgang (Low aktiv)	Error Output (Low active)
10	ERR̄		Fehlerausgang (High aktiv)	Error Output (High active)

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connection sheme 148 400b

Sine /cosine output