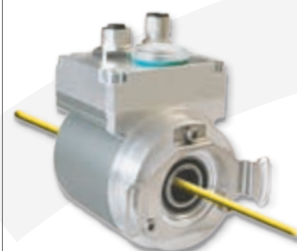
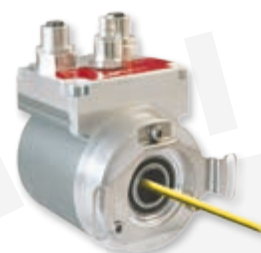


TR-Electronic Absolute Rotary Encoder Product Information C__58



















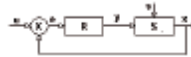



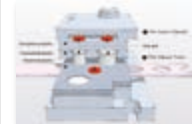
TR-Electronic – Your Partner in Automation

TR-Electronic can look back on more than 25 years of success, and is represented worldwide with an export share of more than 40 %. The core business comprises the development and manufacture of industrial angular and position measuring technology, as well as compact drive technology with integrated position control and measurement. The company is divided into three Business Units (BU) and is thus well positioned for further growth in the future.

Products in the **Rotary Encoder Business Unit** with optical or magnetic scanning precisely acquire position in steel production, wind power plants, cranes and ships as well as in explosion-proof versions in painting lines. Miniature versions ensure the correct position in medical technology. SIL 3 approved absolute rotary encoders ensure the necessary safety.

In the **Linear Encoders Business Unit** magnetostrictive position sensors position injection molding machines, for example, or are directly integrated into hydraulic cylinders. Cascadable distance measurement sensors position parting units. With their high precision, glass scales on machine tools ensure precise position. Laser sensors based on phase difference measuring techniques position aisle stackers in warehousing and materials handling technology.

In the **Drives Business Unit** angle sensors are combined with compact drives: no external electronics are required, position, speed and torque controllers, power electronics and absolute rotary encoders are compactly integrated into the drive and thus bring intelligence directly to the drive shaft via the field bus. Compact drives are used for diverse applications in the printing and packaging industry and on palletizers.

					
 electronic			 systems		
Rotary Encoder	Linear Encoder	Drives	Components	Engineering	Unidor
 Incremental Encoder  Absolute Encoder  Draw Wire Encoder	 Magnetostriction  Glass scale  TOF laser  Barcode Positioning	 Actuator  Positioning Drive  Processing Drive	 I/O Module  Controls  Industrial-PC	<p>Automation Solutions</p>  <p>Retrofit</p> 	<p>Punching and forming Measurement and control systems</p>  <p>Sensors</p>  <p>Process monitoring tools</p> 

The portfolio is supplemented by the affiliated **TRsystems** with customized controls, industrial PCs, hydraulic controls as well as control units and sensors for punching and forming.

An essential factor for the success of **TR-Electronic** are the now more than **300 employees** who actively help to shape the product portfolio with innovations and successfully implement customer projects. Through its commitment to the regional colleges, TR-Electronic supports the high quality training of young employees and thus guarantees the highest level of innovation and quality at its Trossingen location.

A high degree of vertical integration allows customer-specific requirements to be responded to very quickly. The constantly new requirements on the mechanical design of sensors, on innovative new operating interfaces and new plug connectors result in a rapidly increasing product diversity. With **TR-Electronic** you have a partner who can fulfil these requirements.



Have you thought of everything? Just four steps to the individual rotary encoder.

Contents

Possible applications – Industry solutions

4/5

1st step



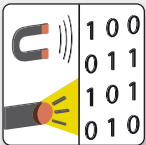
Which type of shaft do you need?

Mechanics

58 mm housing – As universal standard	6
Overview – Shaft types	7
Shaft types – Solid shaft (construction, mounting options)	8/9
Shaft types – Hollow shaft (distortion lock)	10/11
Shaft types – Blind shaft (distortion lock)	12–14
Shaft types – Integrated coupling	15
Shaft load – Shaft protection	16
Wire-actuated encoder – With rotary encoder	17

Mechanics

2nd step



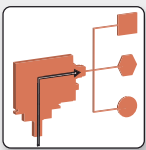
Which type of scanning should you consider?

Measuring technology

Scanning – Optical and magnetic	18
Mode of operation – Single- / multi-turn	19

Measuring technology

3rd step



Which type of signal transmission do you require?

Interfaces

Overview – Wide variety of interfaces	20
Direct interfaces – Special bits, scaling parameters	21
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Direct interfaces – Analog; Cam group	23
Field bus interfaces – PROFIBUS, CANopen, DeviceNET	24
Industrial-Ethernet interfaces – PROFINET, Ethernet/IP, EtherCat, sercos III	25

Interfaces

4th step



Which connection do you need?

Optional parameters

Connection technology – Direct interfaces	26
Connection technology – Bus system, installation space comparison of 58 vs. 65	27
Ambient conditions – Temperature, imperviousness, Seal-Pack	28
Housing options – Stainless steel, extruded aluminium and explosion-proof housings	29

Optional parameters



For better orientation

Icons at the top left/right of each page symbolize the relevant chapters in the brochure.

General information

Addresses – Sales, Germany and International

30/31

TR-Electronic – The right solution for all industries

Storage and logistics

Particularly in the area of modern warehouse setups, such as shelf-stacking devices, transfer belts and crane systems, a powerful, decentralized measuring and control system for simple project processing and quick configuration makes all the difference.

- Shelf-stacking devices, transfer belts and crane systems
- Efficient, decentralized measurement and control technology
- Driverless transport systems, industrial trucks
- Moving pallets into and out of storage



Packaging industry

Flexible automation solutions according to our customers' wishes are the intelligent basis for successful machine concepts within the packaging industry. High processing speeds enable fast turnaround times and large quantities.

Absolute measuring systems save time-consuming reference travel, while highly integrated, intelligent sensor technology reduces space requirements and relieves higher level controls. We can provide solutions which were previously not possible, particularly for high-precision applications.

- Stainless steel variants for medical technology and the food sector
- Positioning and speed monitoring



Metalworking

The world of presses and punches has long been TR-Electronic's special field. We develop the products from the outset so that they can withstand the high stresses of shocks and vibrations.

- Absorber modules eliminate the strongest vibrations
- Especially for harsh environments (high temperature ranges)
- Level monitoring in cooling circuits, hydraulics etc.



Woodworking

Intelligent, decentralized control concepts, efficient sensors with local signal processing and components which operate reliably despite strong temperature fluctuations are the basis for automation solutions in the woodworking industry. The intelligent equipping and networking of transfer machines, machining centers and assembly cells is our speciality, especially when you require a platform for your own special machine philosophy or special function!

- Alignment of sawing and jointing units
- EX rotary encoders for hazardous, dusty areas
- Planers and belt sanders, conveyor/process belts etc.



Printing technology and paper processing

Fast signal processing for printing machines enables high register accuracy and decentralized compact drives automate setting processes. Rotary encoders with stainless steel housings can resist even aggressive media such as groundwood pulp in paper machines. Small absolute encoders measure movements in restricted installation spaces.

- _ Paper transfer between printer and punch
- _ Monitoring of roll changers and roll paper
- _ Measurement of the printing ink level
- _ Speed monitoring in the pressure cylinder



Event technology

TR-Electronic absolute encoders offer safety for all requirement classes in event technology. From certified safety rotary encoders with SIL 3 / PLe or wire-actuated encoders, we offer the right solution for your customized safety concept.

- _ Control for stage curtains, stage sets, rolling floors
- _ Lighting supports/racks (movement up and down)
- _ integrated Safety for revolving platform (rotation, vertical, horizontal)
- _ Position determination for motorized and manual drives



Renewable energies

Intelligent tracking of photovoltaic systems improves efficiency and accelerates amortization. High-resolution rotary encoders enable exact positioning and reliably align your system with the sun, even after a number of years.

Photovoltaics

- _ Elevation and azimuth control of heliostats
- _ Angular position control of parabolic trough systems

Wind energy

- _ Pitch and azimuth positioning
- _ Speed monitoring of rotor and generator shaft



Plastics processing

Diverse measuring tasks in plastics processing machinery and systems require fast signal processing and high precision. For example for function monitoring or belt speeds in hammer mills, fine grinding mills or washing systems.

- _ Position measurement of profile cutting machines
- _ Pressure monitoring in injection cylinders
- _ Monitoring of rotational movements of various applications in materials handling technology and robotics
- _ Early warning of material feeding





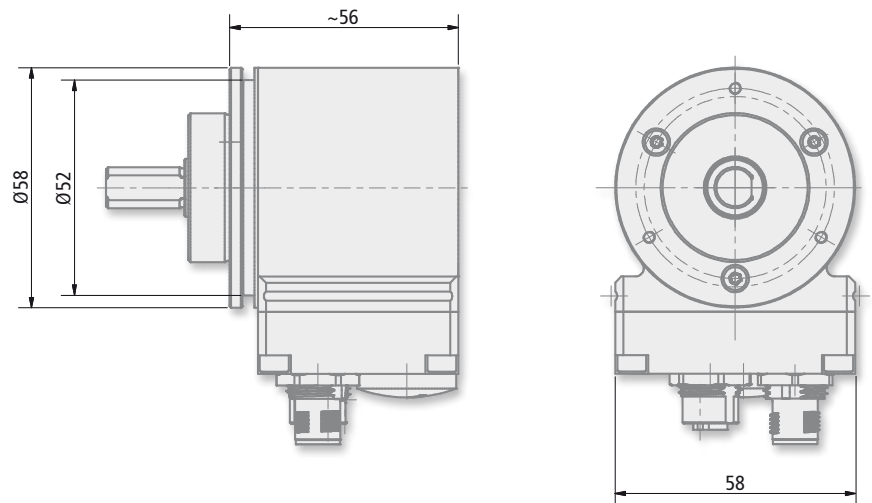
The 58 mm housing for standard industrial applications

Size 58 mm has become established as a widespread industry standard for absolute and incremental rotary encoders. What is considered special by other suppliers is standard with TR-Electronic. The absolute rotary encoders in the 58 mm series have a modular design. They therefore enable the requirements of your application to be met especially well, usually without the need for special developments.

- + Industry standard size 58 mm
- + Cost-optimized thanks to different resolution ranges
- + Lots of interfaces
- + Compatible with a multitude of control systems
- + Shaft and mounting variants
- + Same mechanics with different interfaces
- + Compact connector technology – for series machines
- + For individual projects, as can be programmed by the user
- + For customized connection technology
- + Partially with UL approval

Example of CEV 58 M-CO

- CANopen
- Connection via 2 × M12 connectors
- 8,192 steps/revolution
- 4,096 revolutions
- Flange with centering collar 36 mm shaft 10 mm with surface
- Protection class IP 65



*others on request



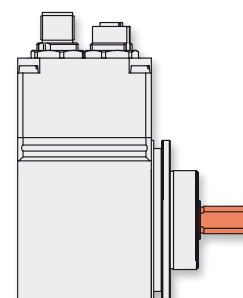
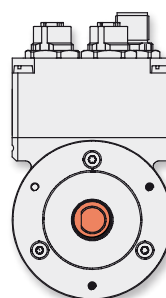
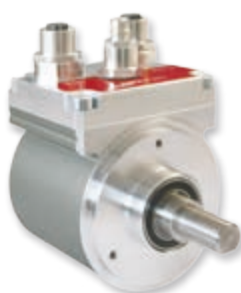
Complete mechanical concept

The 58 mm series of compact rotary encoders has been systematically developed for the different mounting variants. A suitable device is thus available for any installation situation - functions which are required for a machine with solid shaft can easily be provided for another machine with continuous hollow shaft. For solid shaft rotary encoders we can supply couplings to match the mechanics of your application.

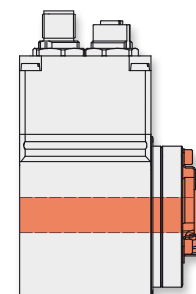
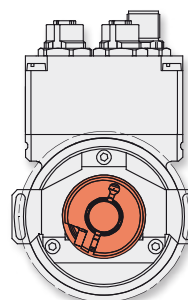
The diversity of mechanical solutions expands your scope for innovative designs. You will find the wide variety of mounting options in the following overview of mounting variants. Not all possible combinations can be shown, but we are confident that we can offer a solution for your individual mounting situation.

Shaft types – overview

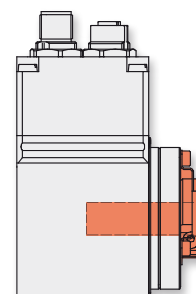
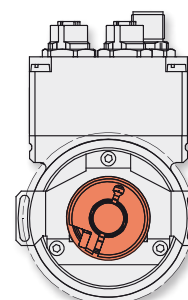
Solid shaft



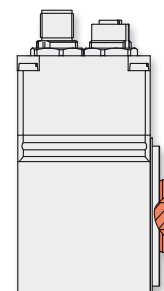
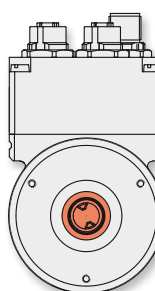
Hollow shaft
(Continuous hollow shaft)



Blind shaft



Integrated coupling



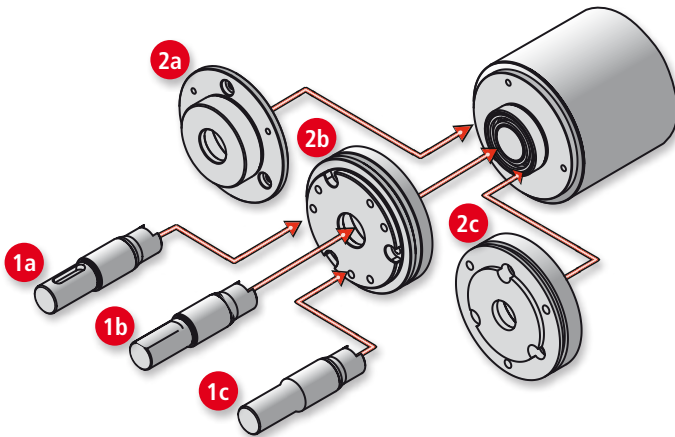


Construction of the solid shaft

Rotating part

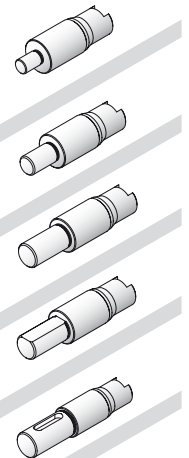
Shaft type – solid shaft variant:

- 1 a) with groove
- 1 b) with surface
- 1 c) smooth



Standard shaft diameter / shaft length

Diameter	Shaft length
Ø 6 mm	10 mm
Ø 8 mm	19.5 mm
Ø 10 mm	19.5 mm
Ø 12 mm	24 mm (also surface)
Ø 12 mm with groove	24 mm



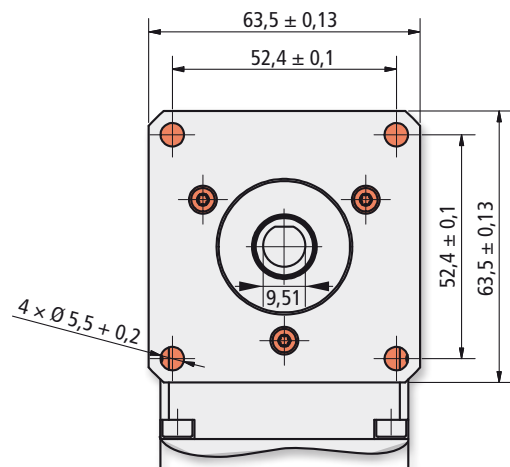
Stationary part – fixing with flange

- 2 a) Clamping flange with 36 mm centering collar
- 2 b) Synchronous flange with 50 mm centering collar
- 2 c) Customized example flange with 45 mm centering collar

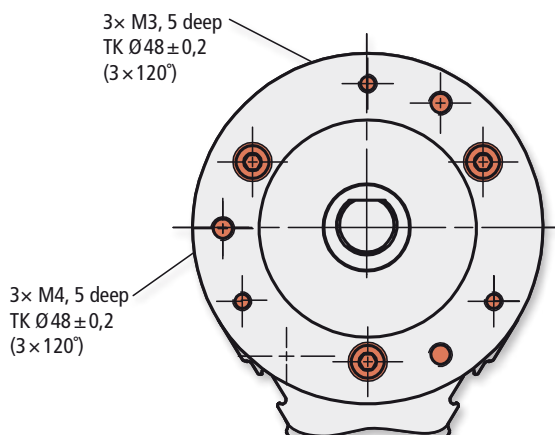
! Further shaft geometry options

- + Square (combined with groove)
- + Different shaft diameters and lengths

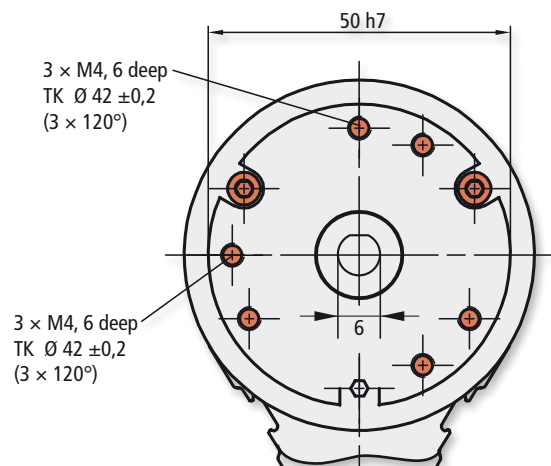
Standard drilling pattern for US market – standard shaft Ø 3/8" Flange (US) SQRT 3/8" Centering collar 1.25"



Standard drilling pattern with clamping flange ZB3610FL Standard shaft Ø 10 with surface with 36 mm centering collar



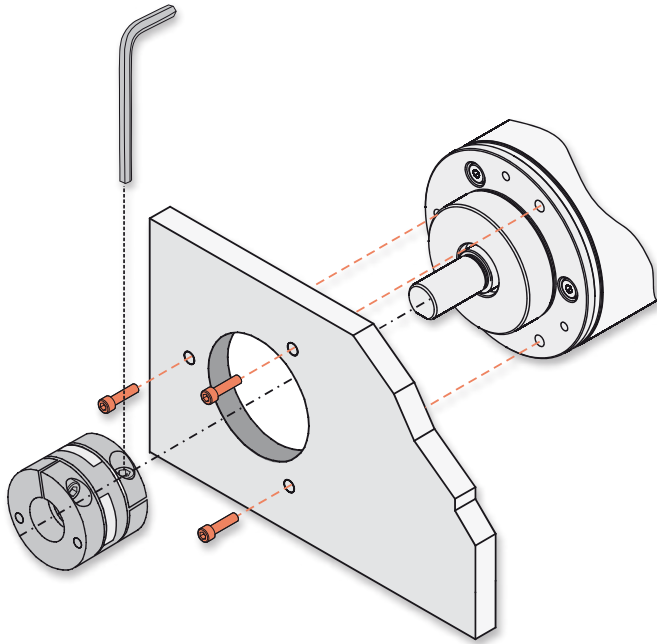
Standard drilling pattern with synchronous flange ZB506GL Standard shaft Ø 6 smooth with 50 mm centering collar



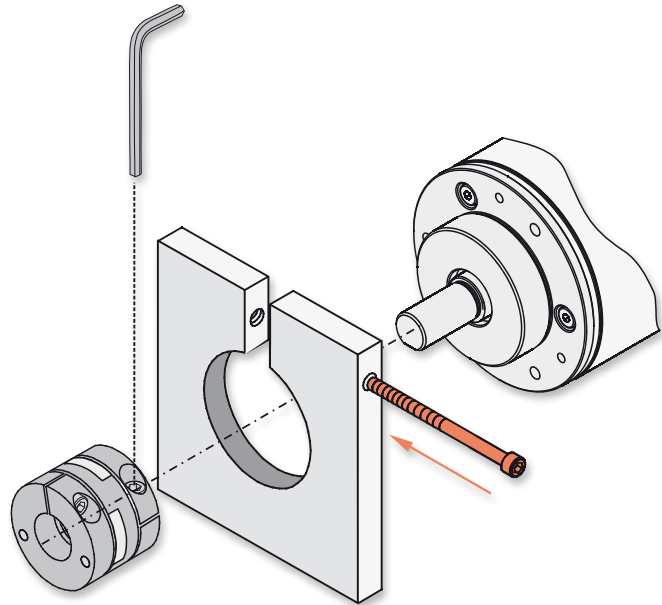


Mounting options

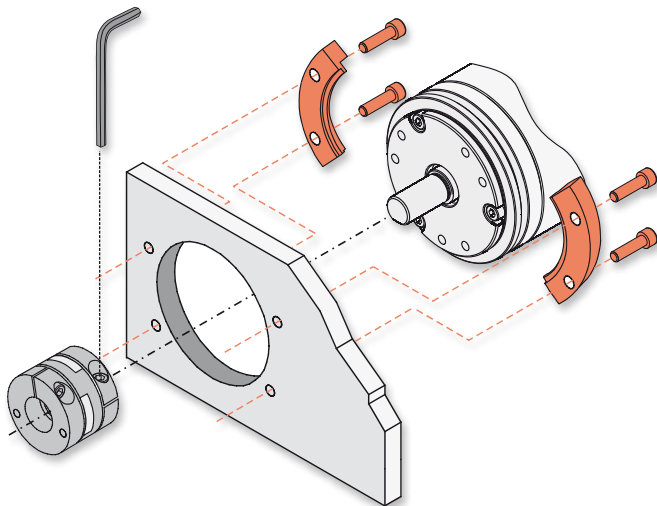
a) with flange



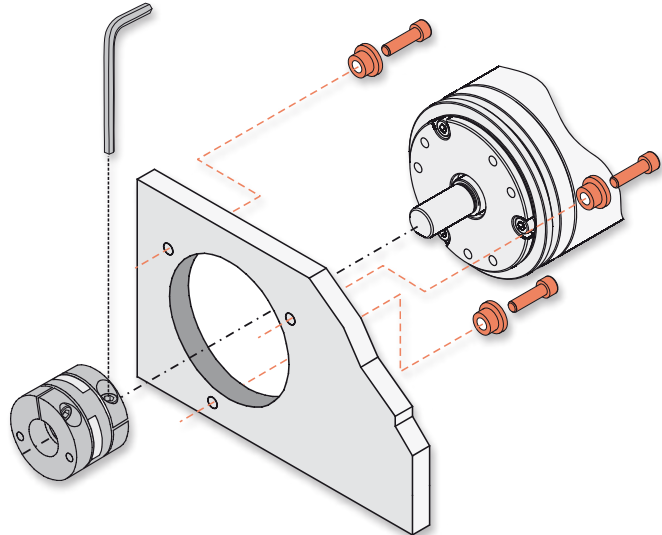
b) with clamping flange



c) with clamping shoes



d) with servo clamp mounting





Distortion lock

Distortion lock ...	Synchronization of the shaft with the aid of ...
- Pin / Groove	- Clamping ring
- Torque support	- Groove / spring in the shaft
	- V-groove
	- Axial screw

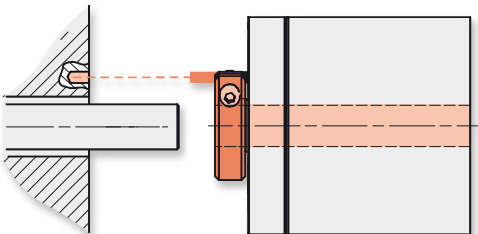


Fixing type

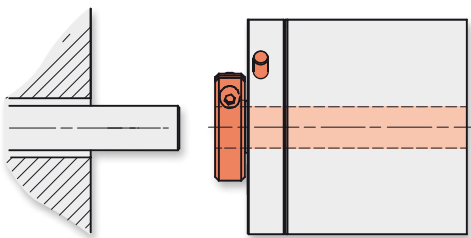
The rotary encoders in series C__58 are secured against rotation either by a torque support comprising spring plate or a pin/groove combination. In the latter case a suitable pin is included in the scope of supply. In conjunction with the different driver options, the C__58 adapts optimally to a wide variety of installation situations.

Examples with hollow shaft

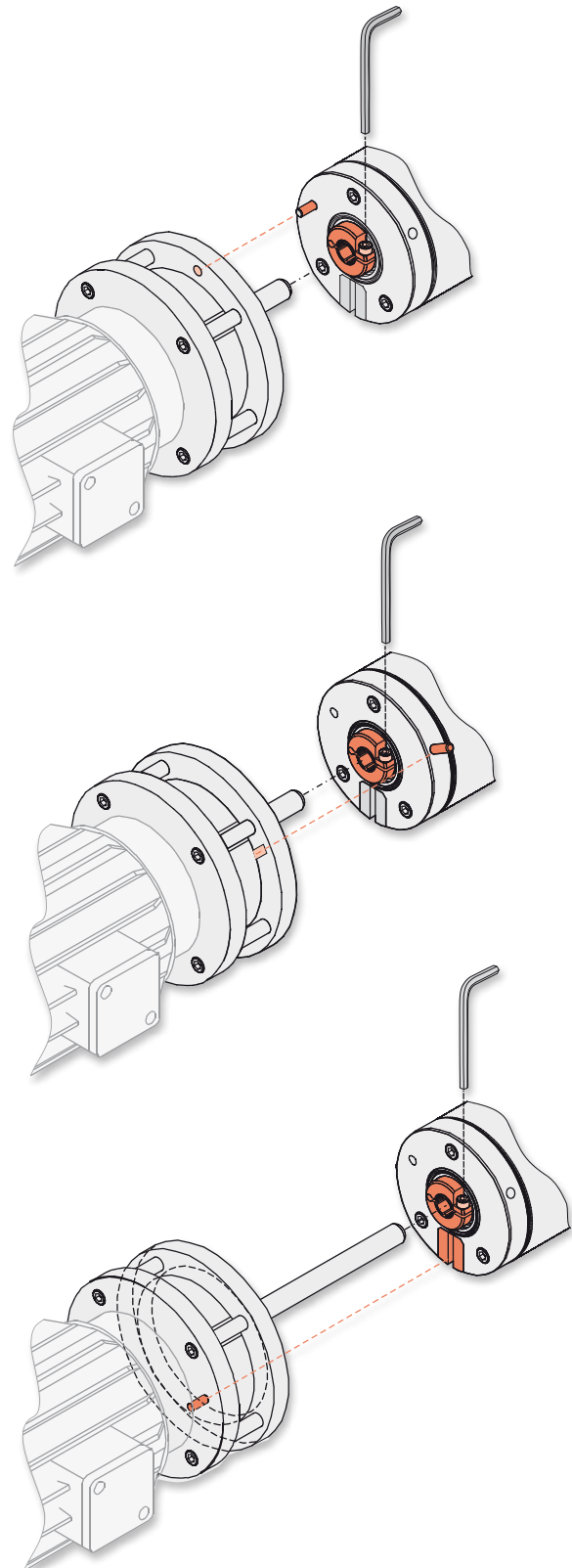
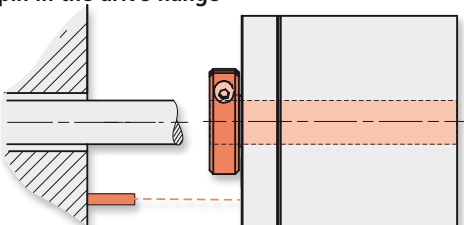
Pin/groove axial with clamping ring on the flange side



Pin/groove radial with clamping ring on the flange side

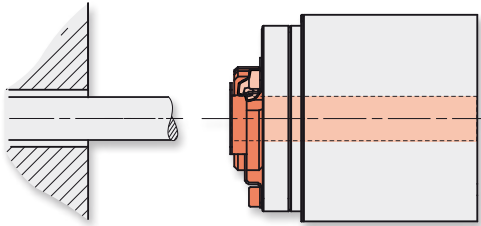


Pin/groove axial with clamping ring on the flange side, pin in the drive flange

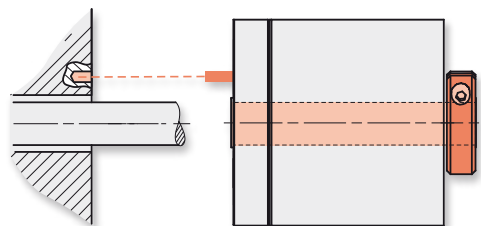




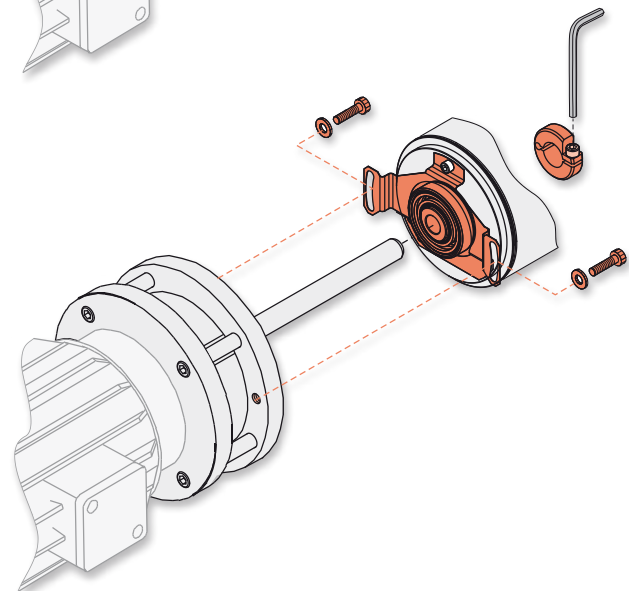
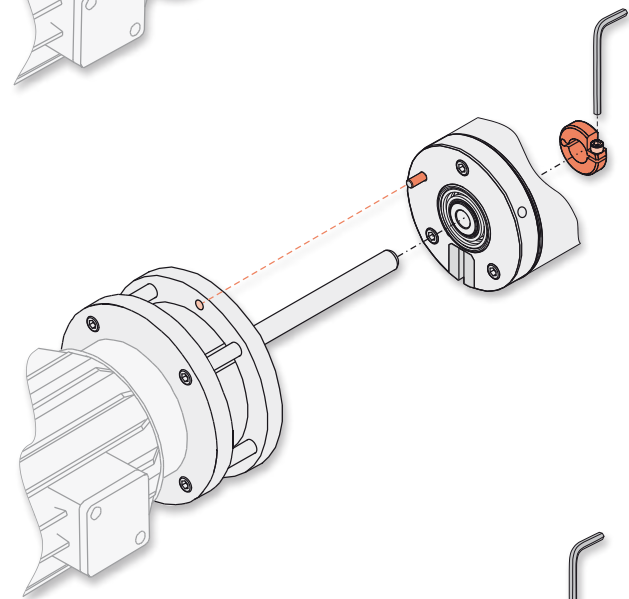
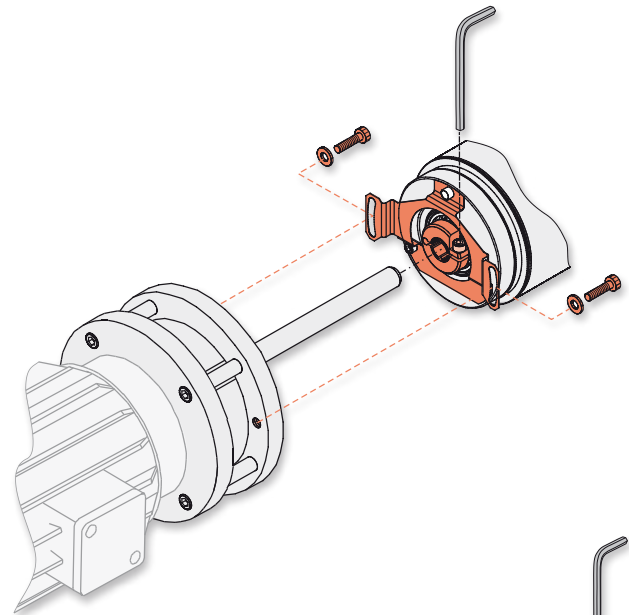
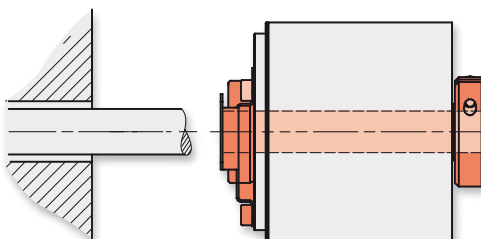
Torque support with clamping ring on the flange side



Pin/groove axial with clamping ring on the cover side



Torque support with clamping ring on the cover side

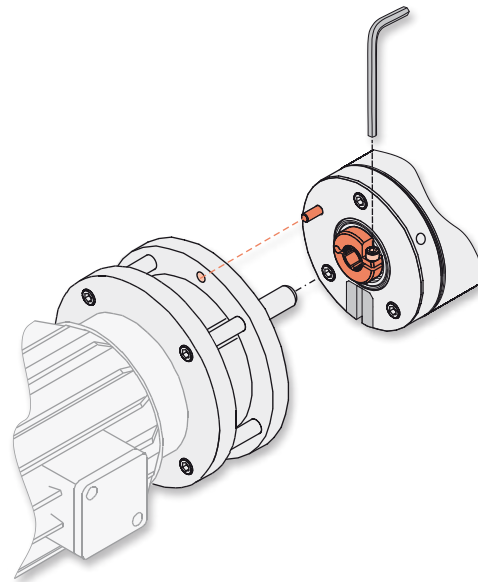
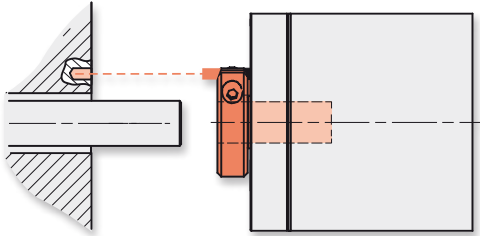




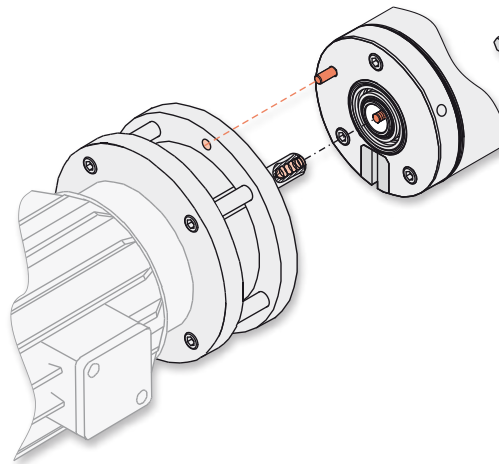
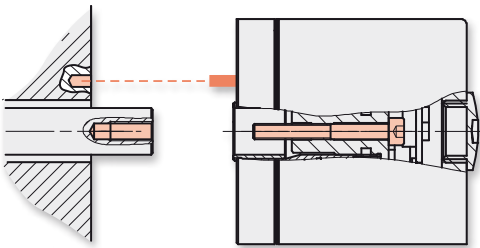
Distortion lock

Examples with blind shaft

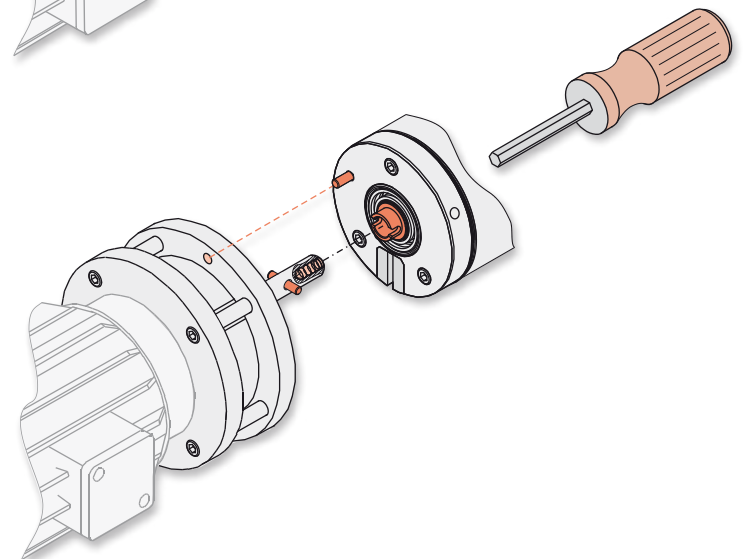
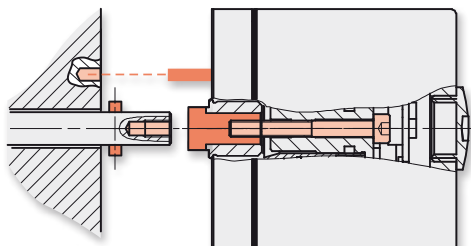
Pin/groove axial with clamping ring



Pin/groove axial with axial screw

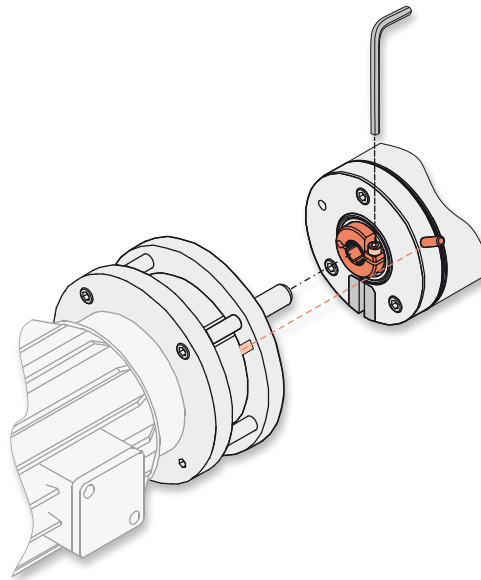
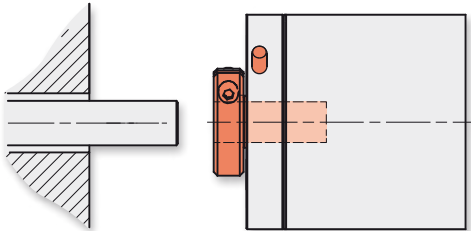


Pin/groove axial with V-groove and axial screw

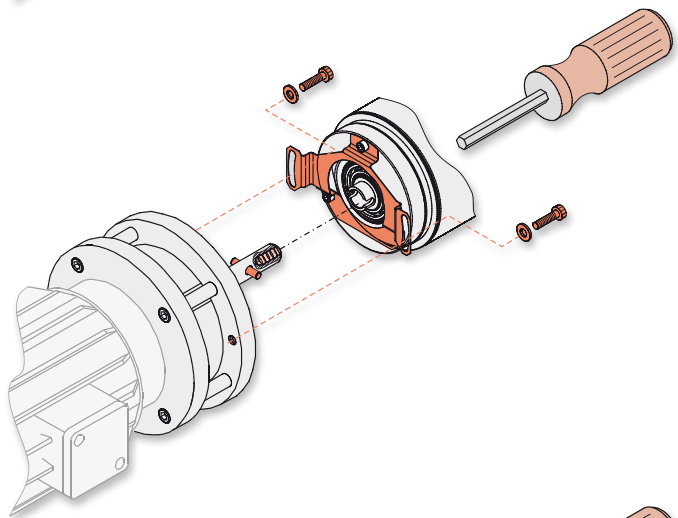
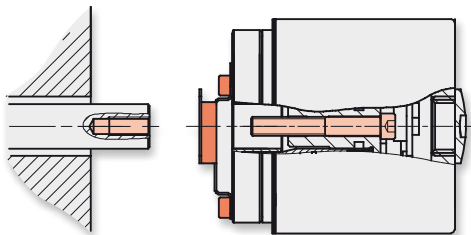




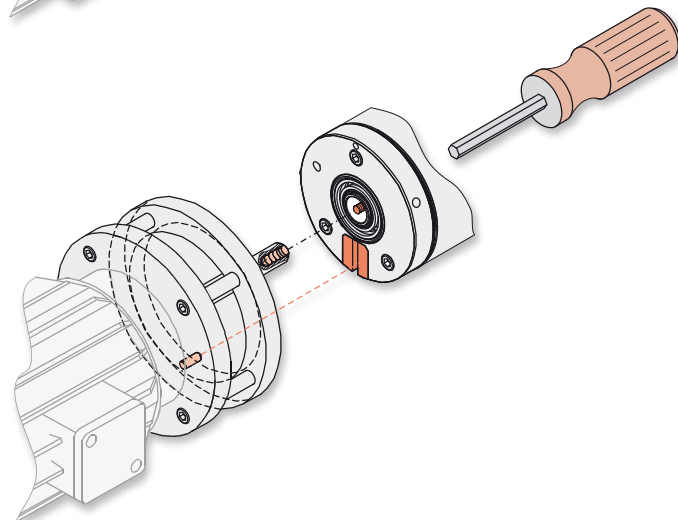
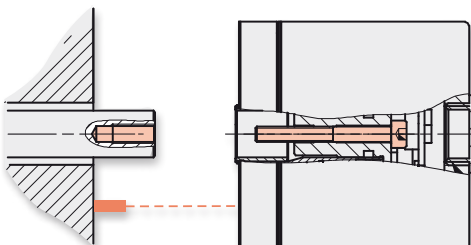
Pin/groove radial with clamping ring



Torque support with V-groove and axial screw



Pin/groove axial with axial screw, pin on customer side

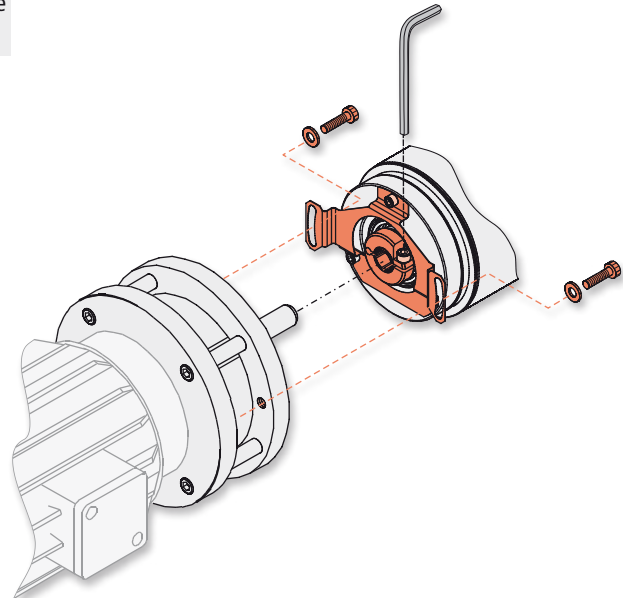
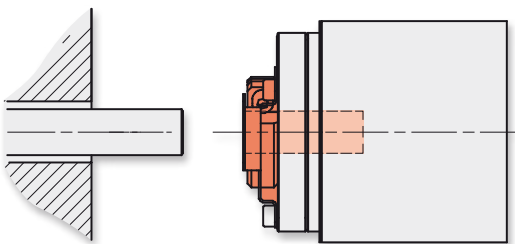




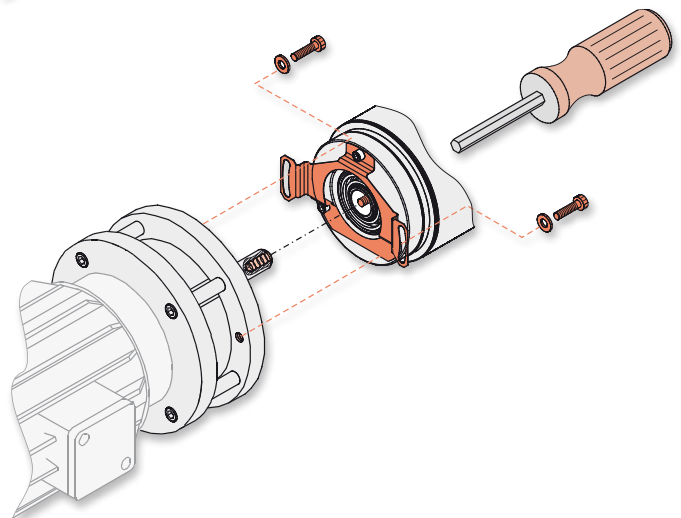
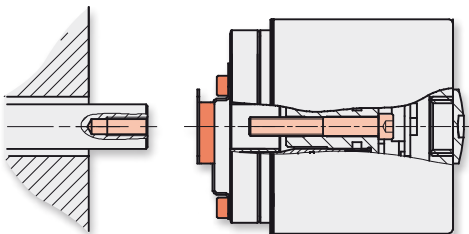
Further mounting options

- + Pin / groove axial with clamping ring, pin on customer side
- + Pin / groove radial with axial screw
- + Pin / groove axial with V-groove and axial screw, pin on customer side
- + Pin / groove radial with V-groove and axial screw

Torque support with clamping ring



Torque support with axial screw



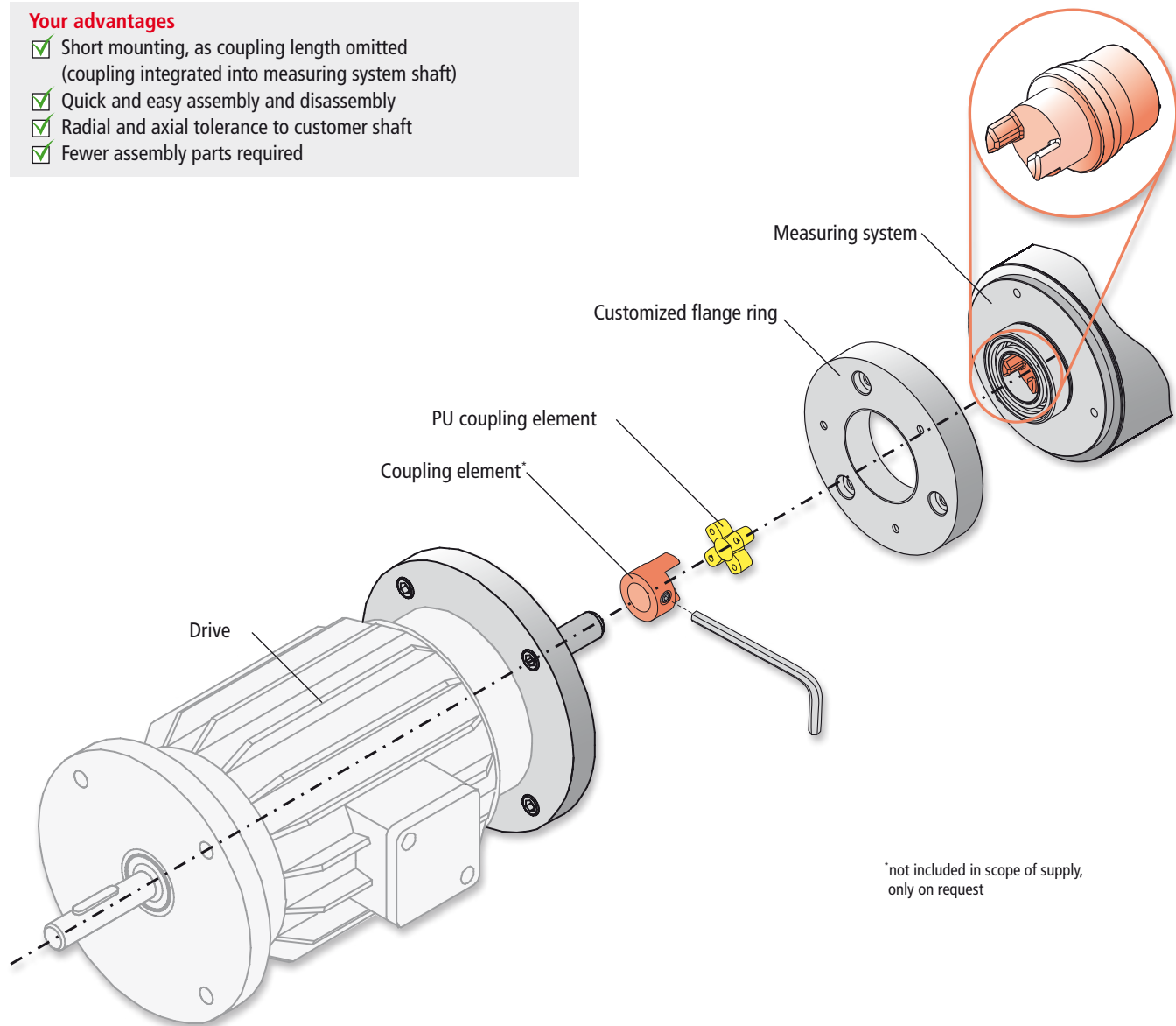


Absolute encoder with integrated coupling

Measuring systems with integrated coupling are stand-alone devices and cannot be produced by modifying a standard device with shaft.

Your advantages

- ✓ Short mounting, as coupling length omitted (coupling integrated into measuring system shaft)
- ✓ Quick and easy assembly and disassembly
- ✓ Radial and axial tolerance to customer shaft
- ✓ Fewer assembly parts required



*not included in scope of supply,
only on request



Bearing module (bearing/protection modules)

Bearing module 58 serves as collar bearing for our 58 mm encoders, to absorb increased bearing load.

A typical application is mounting of a chain disk or belt pulley.

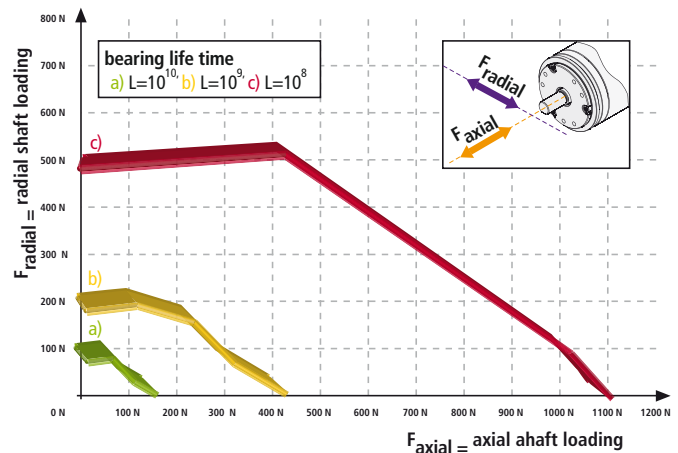
85-900-077: Ø 10 shaft

85-900-078: Ø 12 shaft

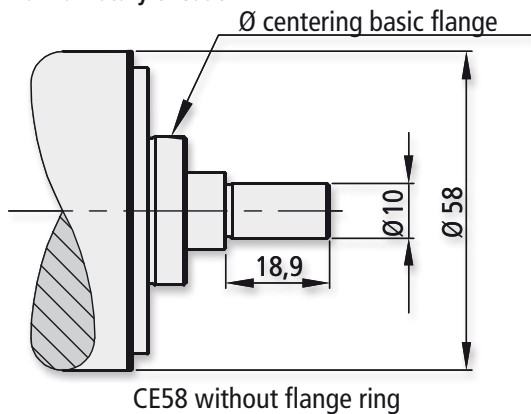
Your advantages

- ✓ Protects the shaft from strong radial and axial forces
- ✓ Increase in the general bearing life
- ✓ Fields of application: Heavy industry, rolling mills, presses
- ✓ The module is delivered ready assembled with customized encoder type or for subsequent mounting
- ✓ Suitable for extremely harsh environments

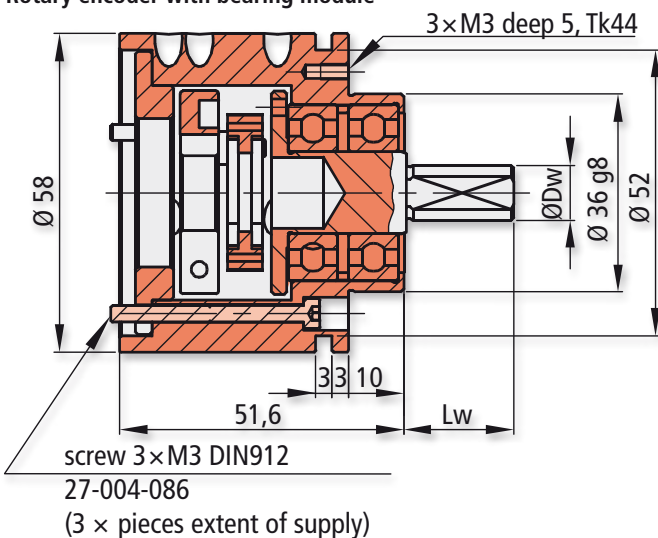
Bearing life depending on radial and axial shaft load



Normal rotary encoder



Rotary encoder with bearing module





Differentiation criteria for draw-wire boxes

SL 30

The SL 30 is designed for many years of use with a high activity rate. It is the product of many years of experience and offers a wide range of measuring lengths. The measuring cable eye is completely plastic-coated and has a (removable) ball joint for flexible cable connection. Available options include "cold grease" (-30 ... +80 °C), "bellows" at the cable outlet, single and double pulley, cable outlet on the left or right (or rotary encoder sits on the left or right of the drum in relation to the cable outlet). The spring assembly is designed for an extremely long lifetime with a high number of duty cycles. High precision: The cable lies in an endless groove, the cable drum is shifted so that the run-off point is always positioned exactly beneath the cable outlet. The housing comprises aluminium and the spring assembly cover is plastic. Internal threads enable precise assembly.

SL 30 ATEX

As SL, but approved for applications in explosive atmospheres, compatible with our AE_70.

Measurement length	Data sheet
1 m	TR-V-TI-D-0470
2 m	
5 m	TR-V-TI-D-0471
10 m	
15 m	
20 m	
25 m	
30 m	
50 m	TR-V-TI-D-0472

Measurement length	Data sheet
2 m	TR-V-TI-D-0473
10 m	TR-V-TI-D-0474
25 m	



WDS

The WDS is suitable for normal automation tasks.

Once again the cable drum moves so that the run-off point is positioned beneath the cable outlet. Cable end with a cable hook (P60, P69) or a brass cable eye (P115). The cable outlet nozzle has a simpler design in comparison to the SL. Single pulley available. The complete cable drum including spring assembly is installed in an extruded aluminium housing. Grooves on three sides enable trouble-free mounting with sliding blocks.

Measurement length	Data sheet
2.5 m	TR-V-TI-D-0475
5 m	
7.5 m	
15 m	



SL00

The SL00 is a cost-effective product for simple measuring applications with lower accuracy requirements.

In terms of precision it is compatible with our rotary encoders with magnetic scanning, but is also available with rotary encoders with optical scanning. The cable drum is narrow, so that even if it is not moved (as with the SL 30 and WDS) only small deviations occur. The cable drum uses the bearing and shaft of the installed rotary encoder. The housing is made of plastic, the cable end with eye is brass.

Measurement length	Data sheets
0.2 m	—
3 m	—



From the encoder we get the draw-wire box (V becomes W)

+ C_V58_ becomes C_W58_

+ C_V58_/C_V65_ becomes C_W58/C_W65_

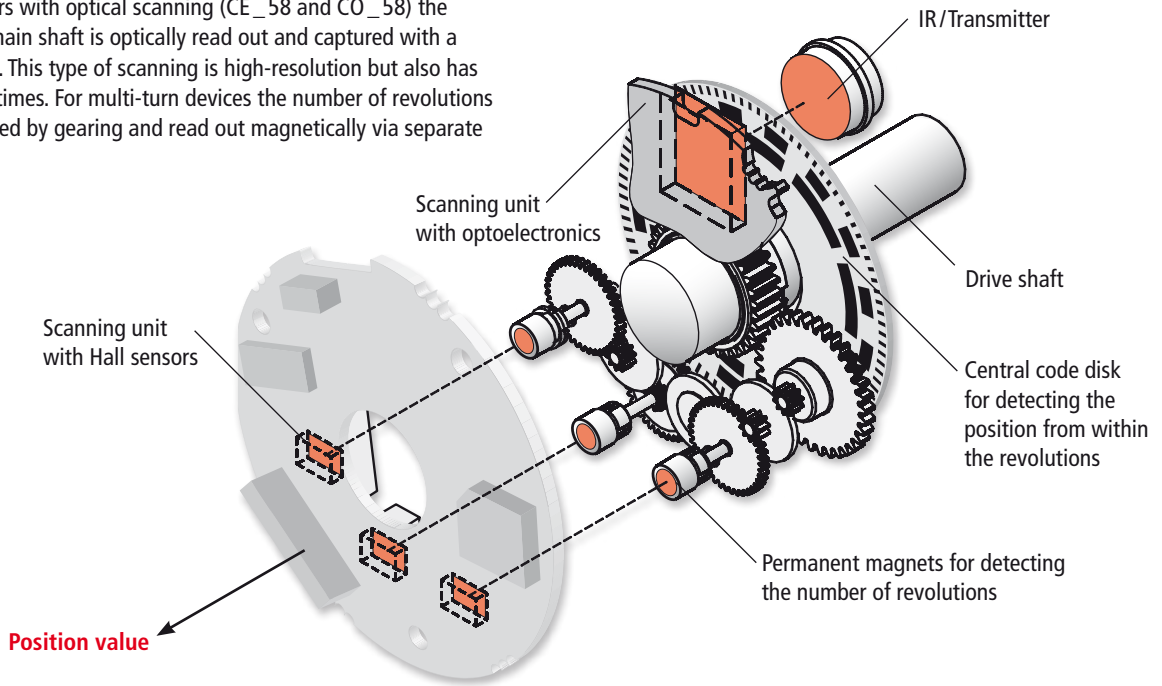
+ AEV 70_ becomes AEW 70_

+ CMV 22M becomes CMW 22M

Determination of position values

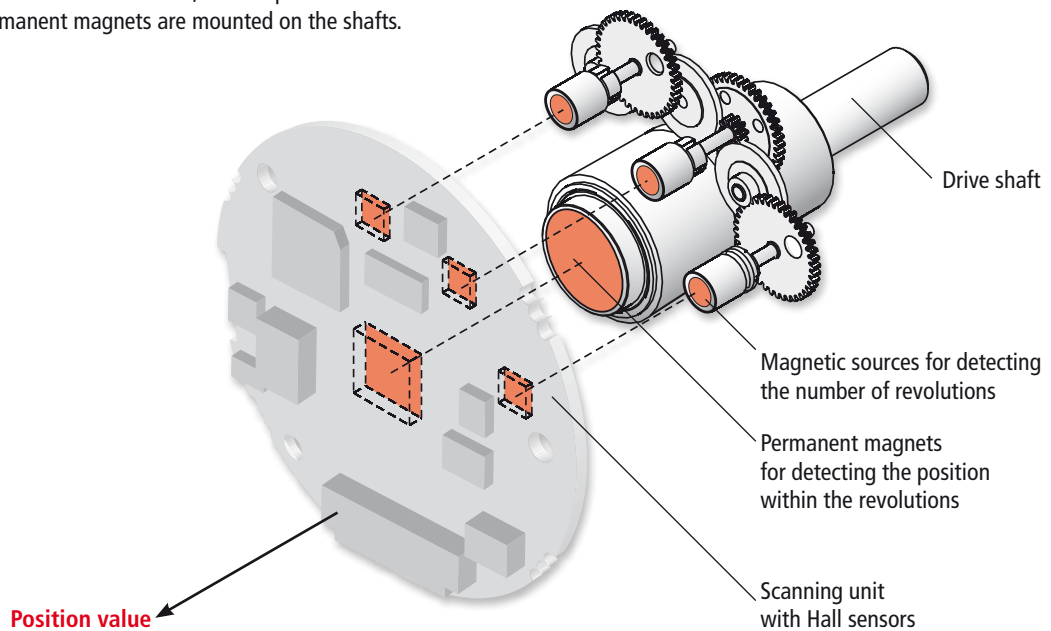
Optical scanning:

In rotary encoders with optical scanning (CE_58 and CO_58) the position of the main shaft is optically read out and captured with a coded glass disk. This type of scanning is high-resolution but also has very short cycle times. For multi-turn devices the number of revolutions is multiply reduced by gearing and read out magnetically via separate scanning.



Magnetic scanning:

In rotary encoders with magnetic scanning (CM_58) all positions (within the revolution on the main shaft and the number of revolutions on the gear shafts) are captured with magnetic position sensors. Highly integrated magnetic field sensors are used, which operate on the basis of the Hall effect. Permanent magnets are mounted on the shafts.





General

The absolute measuring system provides the current position value instantaneously. If this measuring system is run mechanically in the deactivated state, the current position is directly available as soon as

the power supply is restored. TR absolute measuring systems can be supplied as single-turn or multi-turn variants depending on the type required.

Different resolutions

Code letters in the product designation

O = Optical scanning (up to 18 bits, 262,144 steps/revolution)
E = Standard scanning (up to 15 bits, 32,768 steps/revolution)
M = Magnetic scanning (up to 11 bits, 2,048 steps/revolution)

"O" = High-resolution optical scanning

Thanks to modern Opto-Asic technology, up to 18 bits (262,144 steps) can be generated within a single revolution. This is supplemented with up to 4,096 absolute scanned revolutions. Signal processing occurs at FPGA speed. This type of scanning is always used whenever position values need to be captured very quickly and with high resolution. This type of scanning is denoted by the letter "O" in the type designation.

"E" = Optical scanning for standard

industrial applications

The majority of industrial applications use rotary encoders with a resolution of up to 15 bits per revolution and up to 4,096/256,000 scanned revolutions. Signal processing within the processor enables multiple evaluation functions and optimal adjustment to new requirements. Signals such as limit switches and speed monitoring can also be generated. This type of scanning is denoted by the letter "E" in the type designation.

"M" = Magnetic scanning for price-sensitive applications

Price-conscious, magnetic rotary encoders are the first choice for applications with lesser requirements on accuracy, resolution and timing. The resolution of a revolution is 11 bits and this is supplemented with 4,096 absolute scanned revolutions. There is no extended signal processing, though the resolution of this device is programmable. This type of scanning is denoted by the letter "M" in the type designation.

Optical/magnetic scanning – single-turn

This measuring system resolves one revolution (single-turn) of the drive shaft into measuring steps (e.g. 8,192). The number of measuring steps per revolution is recorded and calculated by a code disk (optical) or via the magnetic scanning. This measurement value is output via different interface modules depending on the type of interface used. After one revolution the measurement value repeats.

Optical/magnetic scanning – multi-turn

Multi-turn measuring systems record several revolutions in addition to the angular positions. An internal reduction gear is connected to the drive shaft, with which the number of revolutions is recorded. In the multi-turn measuring system the measurement value comprises

The resolution levels – optimal adaptation

Number of revolutions for single-turn version: 1

Multi-turn (O) 4,096 (optionally 256,000)

Multi-turn (E) 4,096 (optionally 256,000)

Multi-turn (M) 4,096

the angular position and the number of revolutions. The recorded measurement value is also calculated and output via different interface modules depending on the type of interface used.



Wide variety of interfaces

Different applications require different solutions

The result of almost three decades of development and production is evident. Reliability, ease of installation and a wide variety of interfaces are the result.

You benefit not only from the highest technical standard in production, but also the highest reliability of our devices. As is the norm with TR-Electronic, the C__58 also offers a wide variety of interfaces, some of which can even be combined to enable special applications. These can be specifically matched to the field and frequency of application. Which interface is ultimately used largely depends on the control

technology used.

Efficiency, safety, speed and scope of functions are the important factors. Let our sales team advise you on your own individual solution!

We offer you:

- + modular design concepts
- + everything from one source
- + a large number of possible combinations
- + adaptation of the scope of functions to the interface

"So that you can always stay connected!"





Special bits and scaling parameters (SSI, Parallel)

TR-Electronic rotary encoders in the C__58 series are mainly programmable. The following terms are used in connection with different interfaces. To see which function is actually implemented in a rotary encoder, please refer to the product description in the quotation or order confirmation.

Transferable special bits

Max. eight parallel special bits can be defined, the default setting is always 0V. Fewer parallel special bits can also be used to fulfill the requirements of customized device versions. The number of special bits depends on the selected settings and the number of clock pulses sent. These are added in the protocol after the lowest value data bit. The possible functions for the special bits are specified below. The output level for a function event can be defined by selecting active high / active low.

Overspeed

The **Overspeed** is set if the set speed (programmable: 30 – 6,000 rpm) is exceeded.

Limit switch

The switch-on and switch-off points for the four possible limit switches are set in the **Limit switch**. They are set as long as the position is at or above the switch-on point. "Rotating" limit switches can also be implemented, where the switch-on point is greater than the switch-off point.

Move up, Move down

This is a combination of directional display and standstill monitor. These are set when the position moves in the relevant direction and deleted once the position has remained unchanged for 50 ms.

The motion detection has a hysteresis for suppressing vibrations. This is one step in relation to the resolution of the central disk. After a reversal of the running direction a distance corresponding to the hysteresis must be traveled as a minimum, before a movement or direction change is indicated. The hysteresis applies equally for **Move up** and **Movement** signals.



Control of the following special bits is possible

- | | | |
|------------------|------------------|----------------|
| - Overspeed | - Static and | - Even parity, |
| - Limit switches | dynamic | error parity |
| - Move up / down | error (watchdog) | |
| - Moved up | - Movement | |

Moved up

This is set if **Move up** is set, and deleted if **Move down** is set.

Even parity, error parity

The **Parity** bit serves as control bit for error detection during data transfer. The parity represents the checksum of the bits in the SSI data word. If the SSI data word contains an odd number of ones, the **Even parity** special bit is = "1" and changes the checksum to even parity. The Parity or **Error parity** special bit must therefore always be defined last. It is calculated from all preceding bits. Therefore only a single parity special bit is possible. By selecting inverted parity we get odd parity or odd **Error parity**.

The **Error parity** corresponds to the normal parity, if no measuring system error is present. If errors are present it is inverted. This saves the additional transfer of an encoder error.

Static / Dynamic error (watchdog)

As long as the position data can be measured and transmitted error-free, the **Static error** special bit is deleted and the **Dynamic error** special bit delivers a rectangular frequency of 250 Hz. If errors are present the **Static error** is set and the Dynamic error remains at an undefined level.

Movement

This special bit is set as long as **Go up** or **Go down** is set.

Scaling parameters

The output resolution of the measuring system can be changed using the scaling parameters. The measuring system supports the gear function for rotary axes. The number of steps per revolution and the ratio of numerator revolutions / denominator revolutions may be a decimal. The position value output is calculated with a zero point correction, the counting direction set and the gear parameter entered.

Closed measuring section

The length in revolutions of the closed measuring section is any whole number in the range from 1 to 256,000. For example, for rotating applications or for decimal codes, a measuring range of the power of 2 can be unfavorable.

Powers of 2 such as 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1,024, 4,096 ... cannot be precisely matched to the application, as one is dependent on the value of the powers of two.

Procedure for linear axes

(forward and backward traversing movements)

The parameter "denominator revolutions" can be programmed as a fixed value of "1" for linear axes. The parameter "numerator revolutions" is programmed slightly higher than the required number of revolutions. This ensures that the measuring system does not generate an actual value jump (zero transition) if the travel is slightly exceeded. For the sake of simplicity the full revolution range of the measuring system can also be programmed.

Numerator / denominator

These are required if the number of steps per revolution or the ratio of numerator revolutions / denominator revolutions must be a decimal. This is referred to as a gear function. This is used for rotary axes. In contrast to the closed measuring section the transmitter programming can be adapted even more precisely to the application.



More on the topic of scaling parameters:

"Encoder Programming" (TR - E - BA - GB - 0011)



Mode of operation – SSI and Parallel

SSI

SSI interface – synchronous serial interface

This interface enables synchronous serial transfer of the measuring system position. Use of the RS422 interface for transfer allows sufficiently high transfer rates to be achieved with a cable length of max. 500 m (with 1 kHz).

The measuring system receives a clock pulse train from the data receiver (control) and responds with the current position value, which is serially transferred synchronously with the sent clock pulse.

The data signals Data+ and Data- are sent with cable transmitters (RS422). To protect against damage due to faults, potential differences or polarity reversal, the clock pulse signals Clock Pulse+ and Clock Pulse- are received with optocouplers. A parity or checksum can be added in order to detect defective transmissions.

The serial data is transferred without ground reference, as the voltage difference between two corresponding cables. The receiver only evaluates the difference between both cables, so that common mode noise on the transmission lines does not cause a distortion of the useful signal. The simplest additional measure is double read-in, where the data bits are repeated after 26 clock pulses of a train.

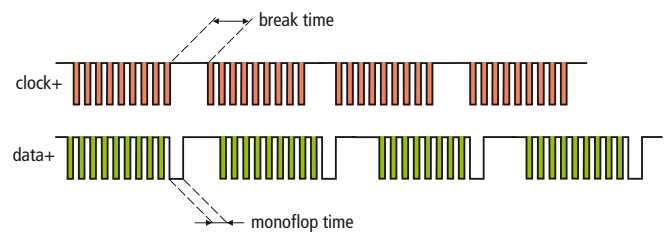
Example of transmission of special bits with 24 bit position information



SSI – programmable parameters

- + Total resolution, number of steps / revolution
- + Output code (Binary, Gray, BCD)
- + Output format (standard, fir tree, SSI + CRC, 26-bit repetition, variable number of data bits)
- + Negative values (preceding sign + value, complement on two)
- + SSI or parallel special bits (see page 23)
- + V/R (counting direction), preset (electronic adjustment)

Transfer example for Clock Pulse+ and Data+



More on SSI: CE_58 SSI User Manual
(TR - ECE - BA - DGB - 0039)

Parallel interface (exclusively for single-turn encoders)

In the parallel interface the digital position value is transmitted in parallel, i.e. there is a separate physical line for each signal bit. In addition to the pure signal lines there are also status and control lines, which (optionally, if required) activate individual additional functions in the encoder or contain their output signals.

Different codes can be used for converting the digital position value into a signal image.

The functions actually implemented in the encoder are dependent on the encoder family and the selected physical interface, among other things (number of possible lines, volume of the plug connector). Depending on the set-up, some of the functions accessible via the signal line are also programmable.

Not all functions are available with all encoder types. See programming instructions and operating manuals for the respective devices in this regard.

Parallel interfaces are now often replaced by SSI or field bus interfaces. C__58 single-turn rotary encoders with parallel interface are available for retrofits or special automation concepts. If a multi-turn device with parallel interface is required, a simple and compact solution can be achieved with a C__58 M SSI and an SSI → Parallel PU 10 signal converter.

Output of the following special bits is possible

- Overspeed
- Limit switches
- Move up / down
- Moved up
- Even parity, error parity
- Static and dynamic error (watchdog)
- Movement

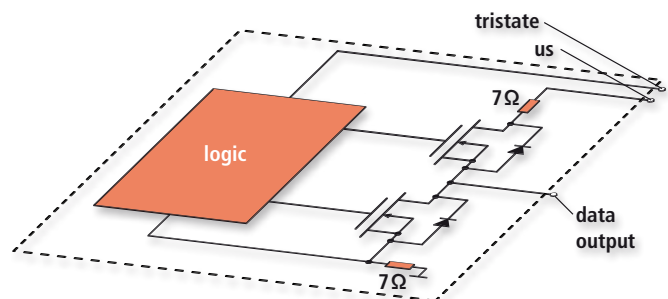
Parallel



Parallel – programmable parameters

- + Total resolution
- + Number of steps / revolution
- + Output code (Binary, Gray, BCD)
- + Output of special bits (overspeed, limit switches and many more)

Push-Pull block diagram



More on Parallel: CE_58 Parallel User Manual
(TR - ECE - BA - GB - 0054)



Mode of operation – Analog

Analog interface

The integrated 12-bit digital-analog converter features automatic range switching, which results in higher accuracy in the smaller measuring ranges.

The following output ranges are supported:

Voltage: 0 ... +5 V, 0 ... +10 V, 0 ... -10 V, -10 ... +10 V

Current: 0 ... 24 mA (freely programmable)



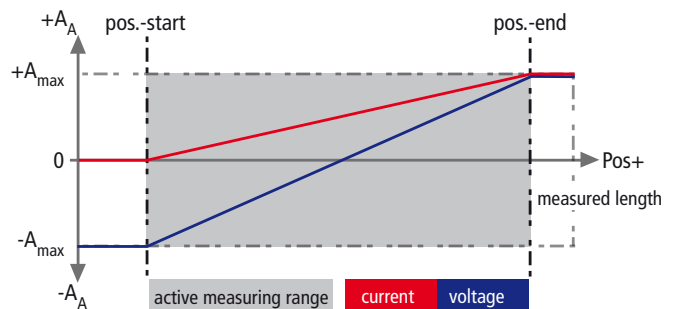
More on Analog: CE_58 Analog User Manual
(TR-ECE-BA-DGB-0041)

Analog



Analog – programmable parameters

- + Number of steps / revolution
- + Number of revolutions
- + External function input
- + Analog interface:
 - Voltage (Analog voltage operating mode)
 - Current (Analog current operating mode)



A_A = analog output variable in V or mA, with preceding sign,
 $\pm A_{\max}$ = positive/negative maximum value of the analog output variable

Mode of operation – Cam group

Cam groups are generally used in applications where actuators must be precisely controlled with fixed assignment to the machine position, e.g. in packaging machines. In mechanical groups this is achieved by connecting adjustable cam disks to the machine drive.

Save for their function, electronic cam groups do not have much in common with mechanical cam groups. Each cam track output by an electronic cam group corresponds to a mechanical cam disk. The cyclically output cam signals for controlling the actuators correspond, from a functional perspective, to the mechanical pulses of the rotating cams. The number of cam tracks, the number of cams/track, as well as the relevant switching on and off points, can be programmed individually.

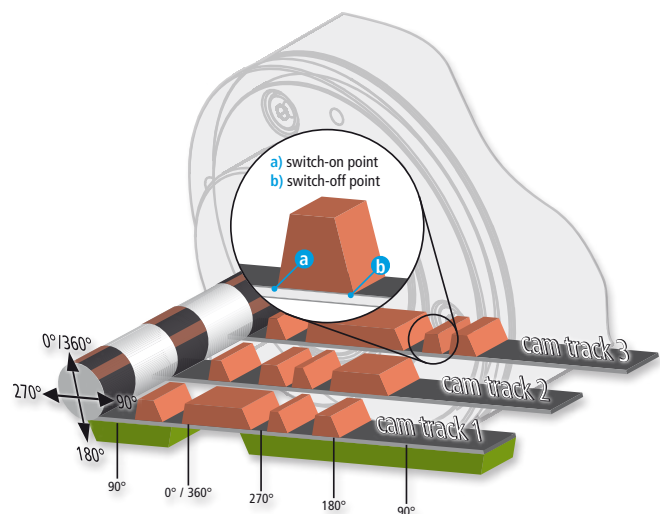


CE_58 special variants with cam group

- Parallel interface with 32 tracks and 4 cams each
- CANopen interface with 8 tracks and 1 cam each
- SSI interface with 4 tracks and 1 cam each

Customer-specific modifications such as

- ✓ dynamic cams (compensation of dead times)
- ✓ displacement of cams
- ✓ overlapping / circumferential cams
- ✓ output to different interfaces
- ✓ teach-in function
- ✓ zero offset and much more



Normal cams, max. 32 cam tracks with 8 cams each

Circumferential cams



Mode of operation

PROFIBUS – Process Field Bus

PROFIBUS is a continuous, open, digital communication system with a broad range of applications, particularly in manufacturing and process automation. PROFIBUS communication is based on the international standards IEC 61158 and IEC 61784. The application and engineering aspects are defined in the PROFIBUS User Organization guidelines. These serve to fulfil the user requirements for a manufacturer independent and open system where the communication between devices from different manufacturers is guaranteed without modification of the devices.

The PROFIBUS User Organisation has implemented a special profile for encoders. The profile describes the connection of rotary, angular and linear encoders with single turn or multi turn resolution to the DP. Two device classes define the basic and additional functions, e.g. scaling, alarm management and diagnosis.

In addition to device classes 1 and 2 defined in the profile, the measuring systems also support additional TR-specific functions.



PROFIBUS – benefits and advantages

- + DP communication protocol (cyclical data exchange, station, module and channel specific diagnosis)
- + Connection variants (cable gland or plug connector)
- + up to 1,200 m cable length

Programmable parameters

- + Total resolution
- + Number of steps/revolution (standard or extended)
- + PUO encoder profile parameters (counting direction switching, scaling function etc.)
- + Output code (Binary, Gray, capped Gray),
- + TR-specific functions (gear, speed output)

CANopen

The CANopen field bus was developed by the CiA and has been standardized as European standard EN 50325 since the end of 2002. CANopen uses layer 1 and 2 of the CAN standard originally developed for use in cars (ISO 11898-2) as a transmission technology. These are extended in automation technology by the recommendations of the CiA Industrial Association in respect of plug assignment, transmission rates and applications.

CiA has developed the CAL standard (CAN Application Layer) for the application layer. The CANopen communication profile was developed first of all together with "building instructions" for device profiles, in which the common denominator of all device profiles is defined with the structure of the object directory and the general coding conventions.

The CANopen communication profile (documented in CiA DS 301) regulates how devices exchange data with each other.



CANopen – programmable parameters

- + Counting direction, scaling function, preset adjustment
- + Total measuring length in steps
- + Revolutions, numerator / denominator
- + Speed resolution
- + Layer Setting Services (LSS) = Node ID and baud rate
- + Maximum 8 cams

A distinction is made between real time data (e.g. position value) and parameter data (e.g. counting direction). CANopen assigns appropriate communication elements to these data types, which are completely different in character.

DeviceNet

DeviceNet was developed by Rockwell Automation and the ODVA as an open field bus standard, based on the CAN protocol and is standardized in the European standard EN 50325-4. Specification and maintenance of the DeviceNet standard is regulated by the ODVA. DeviceNet, along with ControlNet and EtherNet/IP, belongs to the family of CIP-based networks. The CIP (Common Industrial Protocol) forms a common application layer for these 3 industrial networks.

DeviceNet, ControlNet and Ethernet/IP are therefore well matched to one another and present the user with a graduated communication system for the physical layer (Ethernet/IP), cell layer (ControlNet) and field layer (DeviceNet).

DeviceNet is an object-oriented bus system and operates according to the resource-saving producer - consumer (publish-subscribe) principle. Simple I/O messages have virtually no overheads and often do not need a send request.

The terminals can send data event or time controlled, without additional interim storage. The periphery indicates its requirement for data re-



DeviceNET – programmable parameters

- + Direction of rotation
- + Output code (Binary / Gray)
- + Measurement length in steps
- + Measurement length in revolutions, only multi-turn measuring system
- + Preset adjustment via the bus
- + Preset value 1 / 2
- + 7 Special outputs

ceipt as a "consumer" and sends its data as a "producer". Each device can be both a data consumer and a data producer, and a producer can operate any number of consumers.



Mode of operation

PROFINET – Process Field Network

PROFINET is the innovative open standard for Industrial Ethernet and satisfies all requirements of automation technology. A publicly accessible specification was also introduced, which was published by the IEC (IEC/PAS 62411) in 2005 and has been part of the IEC 61158 and IEC 61784 standards since 2003. PROFINET is supported by "PROFIBUS International" and the "INTERBUS Club".

PROFINET has a modular concept, so that the user can select the functionality himself. PROFINET CBA and PROFINET IO are available. These essentially differ because of the type of data exchange, in order to fulfil the speed requirements.

Different performance levels are defined. In PROFINET data which is not time-critical, such as e.g. parameter data, configuration data and connection information, is transferred via the standard data channels based on TCP/UDP and IP. This means that the automation level can also be connected to other networks.

For the transmission of time-critical process data PROFINET distinguishes between three real-time classes (RT Class 1 to 3), which differ in their performance.



PROFINET – benefits and advantages

- + IO communication protocol (cyclic/acyclic data exchange of record data = read/write services)
- + Exact synchronization of all nodes
- + Up to 100 m cable length (between two nodes)
- + Real-time classes (RT Class) 1 to 3

Programmable parameters

- + Total resolution
- + Number of steps/revolution (standard or extended)
- + Profinet IO – device, addressing (name assignment → MAC occurs when the network is initialized)
- + Profinet IO – parameters (counting direction switching, scaling function, preset adjustment)

EtherNet/IP

EtherNet/IP was developed by Rockwell Automation and the ODVA as an open field bus standard, based on the Ethernet Industrial Protocol and is standardized in the international standards IEC 61158: Type 2 and IEC 61784-1: CP 2/2 Type 2.

The ODVA is responsible for the specification and maintenance of the EtherNet/IP standard. Like ControlNet and DeviceNet, it belongs to the family of CIP (Common Industrial Protocol)-based networks.

DeviceNet, ControlNet and EtherNet/IP are therefore well coordinated and provide the user with a graduated communication system for the control level (EtherNet/IP), cell level (ControlNet) and field level (DeviceNet).



EtherNet/IP – programmable parameters

- + Total resolution (≤ 25 bits, ≤ 36 bits)
- + Number of steps/revolution (standard, extended)
- + Number of revolutions (standard, extended)
- + EtherNet/IP parameters = scaling, counting direction, preset value

EtherNet/IP is an object-oriented bus system and operates according to the producer/consumer principle.

EtherCAT – Ethernet for Control and Automation Technology

EtherCAT is a real-time Ethernet technology and is particularly suitable for communication between control systems and peripheral devices such as e.g. I/O systems, drives, sensors and actuators.

EtherCAT was developed in 2003 and is available as an open standard. The "EtherCAT Technology Group" (ETG) user association was established for the further development of this technology.

EtherCAT is a publicly accessible specification, which was published by the IEC (IEC/Pas 62407) in 2005.

It is part of ISO 15745-4. This part was integrated into the forthcoming new editions of the international field bus standards IEC 61158 (Protocols and Services), IEC 61784-2 (Communication Profiles) and IEC 61800-7 (Drive Profiles and Communication).



EtherCAT – programmable parameters

- + Counting direction, scaling function, preset adjustment
- + Total measuring length in steps
- + Numerator/denominator revolutions
- + Speed resolution
- + Layer Setting Services (LSS) = Node ID and baud rate

sercos III*

Sercos3 is the third generation of the sercos interface series according to IEC/EN 61491 and based upon Ethernet standard IEEE 802.3 and has been submitted to the IEC (International Electric/Electrotechnical Commission) for global standardization, thus becoming part of the international standards IEC 61800-7, IEC 61784 and IEC 61158.

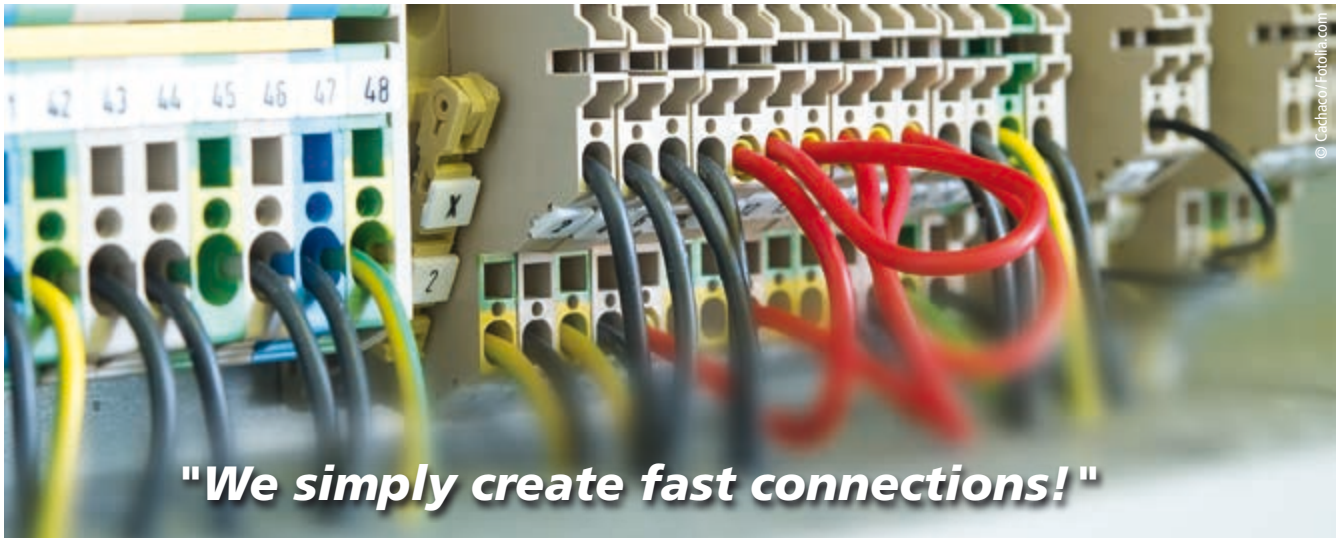
The vision of a real-time, non-proprietary communication solution permeates the world of industrial automation. Different types of automation devices have to be network-enabled in an easy and consistent way: sercos III is an open and IEC-compliant universal bus for Ethernet-based real-time communication.



sercos III – new functions and advantages

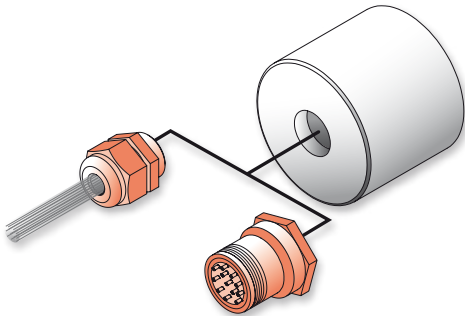
- + New and extended device profiles
- + High bandwidth with small cycle time
- + Innovative synchronization process
- + Direct slave-to-slave traffic and hot-plugging
- + High availability = through hardware redundancy

* under preparation

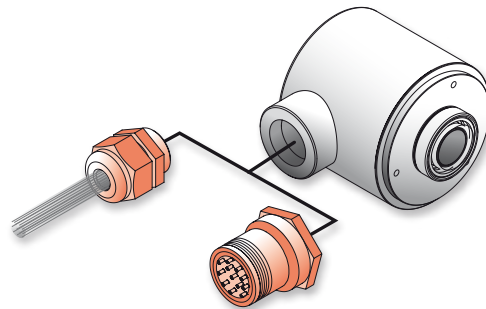


Direct interfaces (SSI, Parallel, Analog)

Axial outgoing feeder (rear)



Radial outgoing feeder (on side of housing)



Cable outlet with cable

1. Outgoing feeder with cable
 - a) radial
 - b) axial
2. Cable selection
 - a) Standard cable
 - b) According to customer specification
3. Type of cable (end finishing)
 - a) Ready-made cable with plug (individual lengths)



b) Bare end without plug



c) According to customer specification (length, stripped cable)



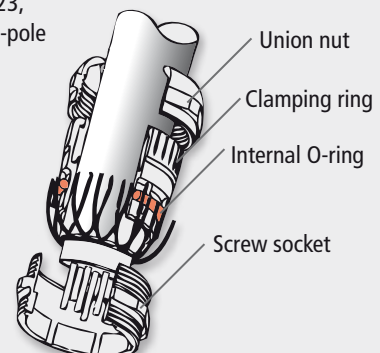
Plug

1. Plug selection
 - a) M 23 plug (standard)
 - b) M 12 plug (optional)
 - c) Combination multi-pin plug (only with cable)
 - d) Special plug connector (only with cable)
2. Plug assignment
 - a) 12-pole (standard)
 - b) 17-pole (optional)
 - c) At customer request



Example configuration of a standard plug for SSI

- M23,
- 12-pole





Bus system

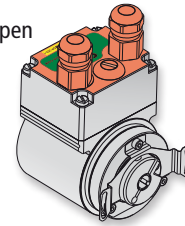
1.) Side cover for cable (CE_58, CO_58)



CANopen



Example of CEV 58 with CANopen



2.) Radial connector outlet (CE_58, CO_58)



2 × M12 + 1 × M8

CANopen

a) TR standard:

- 2 × M12
- 2 × M12 + 1 × M8

b) CiA-compliant

- 2 × M12 + 1 × M8

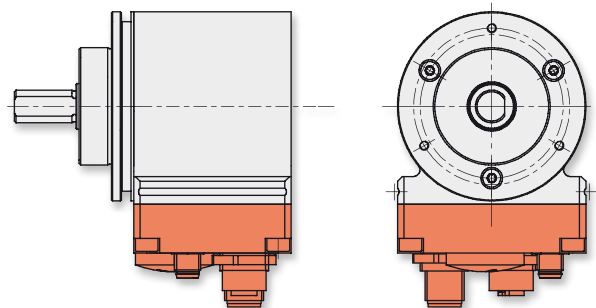


2 × M12, 1 × M8

EtherCAT

2 × M12 + 1 × M8

Example of CEV 58 with PROFIBUS



3.) Axial connector outlet (CM_58, CE_58, CO_58)



2 × M12 + 1 × M8

CANopen

TR standard:

- 2 × M12
- 2 × M12 + 1 × M8



3 × M12

EtherCAT

3 × M12

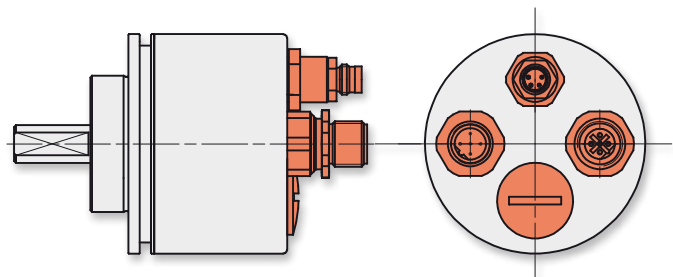


3 × M12

SERCOS[®]
the automation bus

3 × M12

Example of CEV 58 with PROFIBUS



*under preparation

Room for even more functions – in 65 mm housing

- + Convenient connection of field bus cables
- + Large clamping range for cable glands
- + Optimal adaptation thanks to extensive selection of plug connectors
- + Incremental signal for converter and field bus for control from one encoder
- + Decentralized control of machine parts by cam group in encoder
- + Rare interfaces feasible



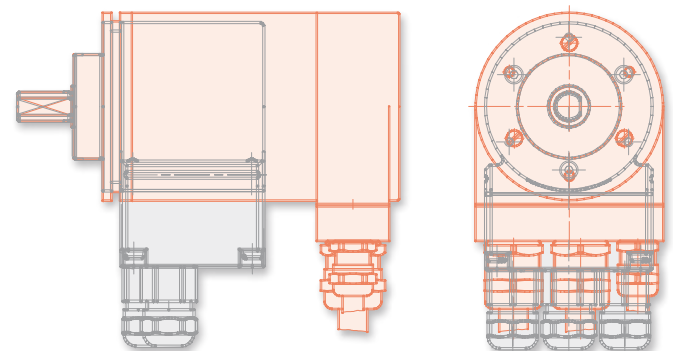
A host of special functions in 65 mm housing

In special engineering applications, it has been proven that the use of cable from a roll to connect field devices saves costs. The cables are cut to size and connected during installation. Minimal cable bends and generous terminal equipment considerably facilitate on-site connection of C_V65.

Installation space comparison

58 mm housing

65 mm housing





Temperature

Storage temperature

The storage temperature range for the components is the temperature range in which the components can be permanently stored. No voltage should be present at the device and the device should ideally be stored in the original packaging.

Failure to adhere to the minimum or maximum storage temperature can cause damage to the components.

Storage up to a maximum air humidity of 98 % (non-condensing) should be guaranteed.



Storage temperature

from -30 °C to +85 °C

Operating temperature

The operating temperature denotes the optimum temperature range for the operation of electronic, electromechanical or mechanical systems or units or their individual components.

If the operating temperature is exceeded lower efficiencies generally result, or there is a risk of destruction of the system or device.

The temperature ranges specified below may be selected. In a larger housing a heating element may be installed, in order to better protect the device from freezing temperatures.



Operating temperature

Optional
Standard

from -20 °C to +60 °C
from 0 °C to +85 °C

Imperviousness – definition via IP protection class

The protection class indicates the suitability of electrical equipment for different environmental conditions, and the level of protection for people against potential hazards during its use. Further information on imperviousness can be found in our brochure "Rotary encoders with encapsulated electronics" (TR-V-PR-GB-0003).

General purpose

In many applications electrical and electronic devices must operate safely in harsh environmental conditions for many years. The penetration of foreign bodies / dust and water must be prevented. The devices are

supplied with protection class IP 65 as standard. It is protected against the ingress of dust (protection against foreign bodies) and against jet-water from all directions. The "Seal Pack" option is available for more demanding applications.



Standard protection class

Highly impervious option

Relative air humidity
(DIN EN 60068-3-4)

solid- (IP65), hollow- (IP54) shaft
see Seal Pack with IP 67
98 %, non-condensing

"Seal Pack" – an option for high-resolution absolute encoders in 58 mm housing

The optional "Seal Pack" package has an additionally sealed housing cover. It combines coordinated measures for absolute rotary encoders, in order to guarantee the following characteristics:

- + Imperviousness to temporary immersion (IP 67, testing according to DIN EN 60529)
- + Hermetically sealed against the penetration of moisture due to temperature variations in a moist environment (testing according to DIN EN 60068-2-30)
- + Special imperviousness to the ingress of penetrating oils such as honing oil.

The "Seal Pack" is available as an option for absolute rotary encoders from TR-Electronic in the standard industrial size of 58 mm for solid shaft and blind shaft.

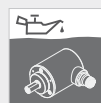
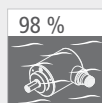


Without any problem – 672 h salt spray test

Our rotary encoders are salt spray-tested in accordance with EN-DIN 60068-2-52 (severity 1) and are therefore suitable for special onshore and offshore applications. Provided with an additional paint coat they can withstand extreme environmental conditions, whilst ensuring full functionality and a polished appearance.



Be absolutely certain!



The bearing for blind shaft and solid shaft rotary encoders is provided with an additional seal. The plug connectors are always internally encapsulated after assembly. Liquids which penetrate the plug connector due to inadequate connection can thus not penetrate the encoder and damage it. The housing cover is additionally sealed to give greater imperviousness. The test standard of IP 54 or IP 65 is thus increased to IP 67 (clean water at 20 °C).

The housing of rotary encoders with the **Seal Pack** option is air-tight. This means that no moist air or water is sucked in, even in the event of temperature and compressed air fluctuations. These systems are therefore fully tropicalized. Devices with **Seal Pack** are no more than 7 mm longer, with otherwise identical external and mounting dimensions.



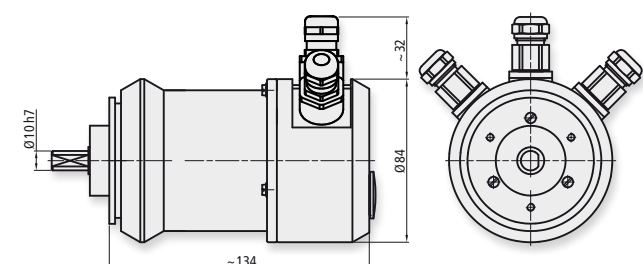
Housings for neutral and aggressive environments

With us you are safely equipped for all eventualities. The devices can also be provided with enhanced robustness.

For example, a stainless steel housing can be used for aggressive environments or food applications. The extruded aluminium housing

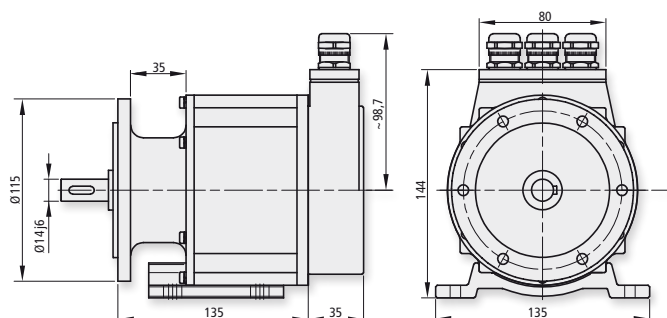
offers exceptional protection against vibrations and high temperature fluctuations. Appropriately equipped rotary encoders can also operate safely in explosive atmospheres up to Zone 1/21 or 2/22, guaranteeing maximum safety.

Housing options



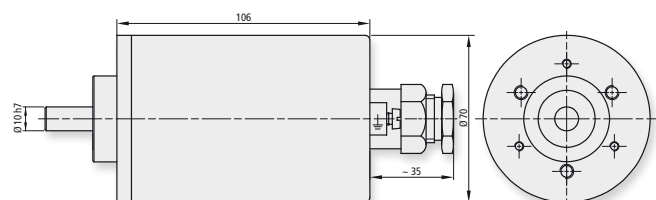
CEV84 – in aggressive environments in stainless steel housing

Rotary encoders in the C__58 series installed in a stainless steel housing for aggressive environments. Additional sealing elements protect the rotary encoder from external influences. All interfaces can be combined with this housing, and seal and connector body materials are selected according to environmental conditions. Applications e.g. in the paper industry (groundwood pulp) can be implemented problem-free with this housing.



CEV115 – protection against mechanical and climatic influences

Rotary encoders in the C__58 series installed in an extruded aluminium housing for protection against external mechanical influences. Additional bearings, larger shaft diameter and the large mounting flange forgive even extremely high shaft loads or misuse as a climbing aid. Integration of a heating element or provision for external water recoling are possible in this installation space. This makes this housing the optimal solution in heavy machinery construction such as rolling mills, for example.



AEV70 – potentially explosive atmospheres in aluminium housing

Rotary encoders in the C__58 series installed in a protective housing for use in potentially explosive zones in accordance with CE Atex (CE Ex II 2G Ex db II CT6 and CE Ex II 2D Ex tb II CT80°C). This provides protection up to Zone 1/21 (device group II, category 2). They are therefore protected from gas in Zone 1 and from dust in Zone 21 (including Zone 2/22) for the occasional occurrence of an explosive atmosphere. The selection of available interfaces is mainly determined by the availability of approved sensor cables.



More on the AEV70: Brochure on Explosion-proof Rotary Encoders (TR-V-PR-GB-0005)



SIL3, PL_e





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