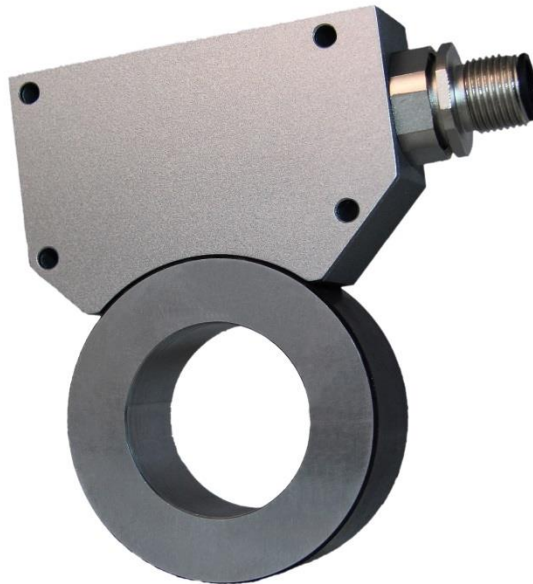


# Operation Manual

## SERIES *EMAX-RO*

Rotative Magnetic Absolute Encoder



- Magnetic Single-turn Absolute Encoder
- Bearing-less encoder for rotative applications
- Distance monitoring by LED
- High resolution, 16000 steps per turn
- Additional incremental signals for highly dynamic drives
- Diverse interfaces available:  
Standard: SSI or CANopen  
On request: RS422, RS422 (addressable), RS232, CAN BASIC ELGO  
In preparation: BISS-C

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## 2 General, Safety, Transport and Storage

### 2.1 Information Operating Manual

This manual contains important information regarding the handling of the device. For your own safety and operational safety, please observe all safety warnings and instructions.




Precondition for safe operation is the compliance with the specified safety and handling instructions. Moreover, the existing local accident prevention regulations and the general safety rules at the site of operation have to be observed.

Please read the operating manual carefully before starting to work with the device! It is part of the product and should be kept close to the device and accessible for the staff at any time. The illustrations in the manual are for better demonstration of the facts. They are not necessarily to scale and can slightly differ from the actual design.


### 2.2 Explanation of Symbols

Special notes in this manual are characterized by symbols. The notes are introduced by signal words which express the magnitude of danger. Please follow this advice and act carefully in order to avoid accidents, damage, and injuries.


#### Warning notes:

	<b>DANGER!</b> This symbol in connection with the signal word "Danger" indicates an immediate danger for the life and health of persons. Failure to heed these instructions can result in serious damage to health and even fatal injury.
	<b>WARNING!</b> This symbol in connection with the word „Warning“ means a possibly impending danger for the life and health of persons. Failure to heed these instructions can result in serious damage to health and even fatal injury.
	<b>CAUTION!</b> This symbol in connection with the signal word "Caution" indicates a possibly dangerous situation. Failure to heed these instructions can lead to minor injuries or damage of property.



#### Special safety instructions:

	<b>DANGER!</b> This symbol in connection with the signal word "Danger" indicates an immediate danger for the life and health of persons due to voltage. Failure to heed these instructions can result in serious damage to health and even fatal injury. The operations may only be carried out by a professional electrician.
---	---

#### Tips and recommendations:

	<b>NOTE!</b> ... points out useful tips and recommendations as well as information for an efficient and trouble-free operation.
---	--

#### Reference marks:

-  Marks a reference to another chapter of this manual.
-  Marks a reference to another chapter of another document.

## 2.3 Statement of Warranties

The statement of warranties is enclosed separately in the sales documents.

**Guarantee:**

The producer guarantees the functional capability of the process engineering and the selected parameters. The period of warranty is one year and begins with the date of delivery.

## 2.4 Demounting and Disposal

Unless acceptance and disposal of returned goods are agreed upon, demount the device considering the safety instructions of this manual and dispose it with respect to the environment.

**Before demounting**, disconnect the power supply and secure against re-start. Then disconnect the supply lines physically and discharge remaining energy. Remove operational supplies and other material.

**Disposal:**

Recycle the decomposed elements: Metal components in scrap metal, Electronic components in electronic scrap, Recycle plastic components. Dispose the remaining components according to their material consistence



**CAUTION!**

Wrong disposal causes environmental damages!  
Electronic scrap, electronic components, lubricants and other auxiliary materials are subject to special refuse and can only be disposed by authorized specialists!

Local authorities and waste management facilities provide information about environmentally sound disposal.

**Sicherheit**



**CAUTION!**

Please read the operating manual carefully, before using the device! Observe the installation instructions! Only start up the device if you have understood the operating manual. The operating company is obliged to take appropriate safety measure.

The initial operation may only be performed by qualified and trained staff.  
Selection and installation of the devices as well as their embedding into the controlling system require qualified knowledge of the applicable laws and normative requirements on the part of the machine manufacturer.

## 2.5 General Causes of Risk

This chapter gives an overview of all important safety aspects to guarantee an optimal protection of employees and a safe and trouble-free operation.

Non-observance of the instructions mentioned in this operating manual can result in hazardous situations.

## 2.6 Personal Protective Equipment

Employees have to wear protective clothing during the installation of the device to minimize danger of health.

**Therefore:**

Change into protective clothing before performing the works and wear them throughout the process.

Additionally observe the labels regarding protective clothing in the operating area.

**Protective clothing:**

	<p><b>PROTECTIVE CLOTHING</b> ... is close-fitting working clothing with light tear strength, tight sleeves and without distant parts. It serves preliminarily for protection against being gripped by flexible machine parts. Do not wear rings, necklaces or other jewelry.</p>
	<p><b>PROTECTIVE GLOVES</b> ... for protecting the hands against abrasion, wear and other injury of the skin.</p>
	<p><b>PROTECTIVE HELMET</b> ... for protection against injuries of the head.</p>

## 2.7 Conventional Use

The ELGO-device is only conceived for the conventional use described in this manual.  
The EMAX-RO - ELGO- length measuring system only serves to measure lengths.



### CAUTION!

Danger through non-conventional use!

Non-intended use and non-observance of this operating manual can lead to dangerous situations.

Therefore:

- Only use the device as described
- Strictly follow the instructions of this manual

Avoid in particular:

- Remodeling, refitting or changing of the construction or single components with the intention to alter the functionality or scope of the device.

Claims resulting from damages due to non-conventional use are not possible.  
Only the operator is liable for damages caused by non-conventional use.

## 2.8 Safety Instructions for Transport, Unpacking and Loading



### CAUTION!

Transport the package (box, palette etc.) professionally.

Do not throw, hit or fold it.

## 2.9 Handling of Packaging Material

Notes for proper disposal: ↗ 2.4.

## 2.10 Inspection of Transport

Check the delivery immediately after the receipt for completeness and transport damage.

In case of externally recognizable transport damages:

- Do not accept the delivery or only accept under reserve.
- Note the extent of damages on the transportation documents or delivery note.
- File complaint immediately.



### NOTE!

Claim any damage immediately after recognizing it. The claims for damage must be filed in the lawful reclaim periods.

## 2.11 Storage

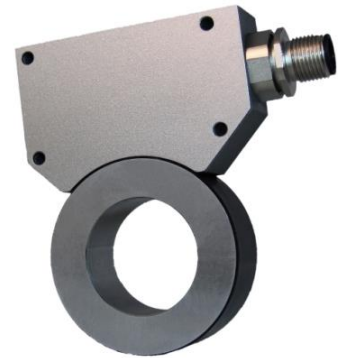
Store the device only under the following conditions:

- Do not store outside
- Keep dry and dust-free
- Do not expose to aggressive media
- Protect from direct sun light
- Avoid mechanical shocks
- Storage temperature (↗ 4 Technical Data) needs to be observed
- Relative humidity (↗ 4 Technical Data) must not be exceeded
- Inspect packages regularly if stored for an extensive period of time (>3 months)

### 3 Product Features

The angle measuring system EMAX-RO is a combination of a sensor and a magnetic ring. The magnetic ring is mounted directly to an engine shaft or an axle (see mounting suggestions § 5.3). This ensures a quick and easy installation. EMAX-RO is especially suited for measuring rotative angles.

The sensor head with high protection class is resistant against any kind of dust and dirt and works completely without wear. Furthermore, the rotative measuring system EMAX-RO has the advantage of absolute measurement and therefore belongs in the category of single turn encoders.



**Important features:**

- Rotative angle measuring system
- Resolution of 16000 measuring steps over 360° (other resolutions on request)
- Absolute measurement
- Different interfaces are available

**Absolute:**

- Standardly: SSI or CANopen DS406;
- On request: RS422, addressable RS422, RS232, CAN BASIC ELGO
- In preparation: BISS-C

**Incremental:**

- 90° phase shifted square-wave signals TTL or HTL
- Sine/cosine signal 1Vss
- Direct measurement on engine shaft or axle possible

#### 3.1 Functional principle

A Hall sensor and a magneto-resistive impedance measuring bridge are guided over a two-track magnetic tape with a fine-interpolation trace and an absolute track. Together with the sensor line the absolute track provides an absolute value and the fine-interpolation trace provides together with the interpolation electronic the measuring systems high resolution. The figure shows two magnetic traces, with North Pole and South Pole magnetization. The fine interpolation trace encloses alternately north and South Pole traces with a distance of 5 mm, these are scanned with resistance bridges and provide a resolution of 16000 steps per turn. The absolute value provides the sensor line with 16 single Hall sensors. These sensors are scanning the code sections of the north and south poles. The absolute value on the magnetic ring repeats once per revolution.

For easier illustration were the tracks of the magnetic ring shown as a tape

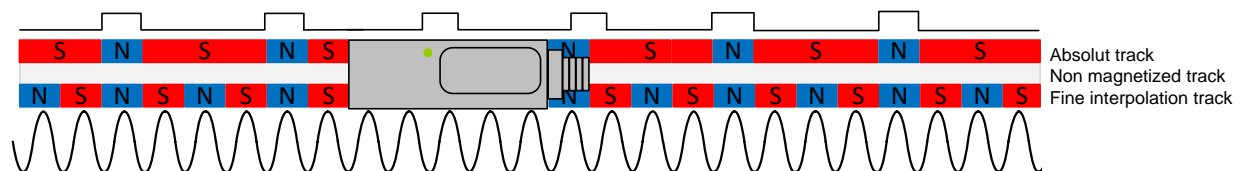


Figure 1: Functional principle

## 4 Technical Data

### 4.1 Identification

The type label serves for the identification of the unit. It is located on the housing of the sensor and gives the exact type designation (=order reference, see chapter type designation with the corresponding part number. Furthermore, the type label contains a unique, traceable device number. When corresponding with ELGO always indicate this data.

### 4.2 Dimensions of Sensor

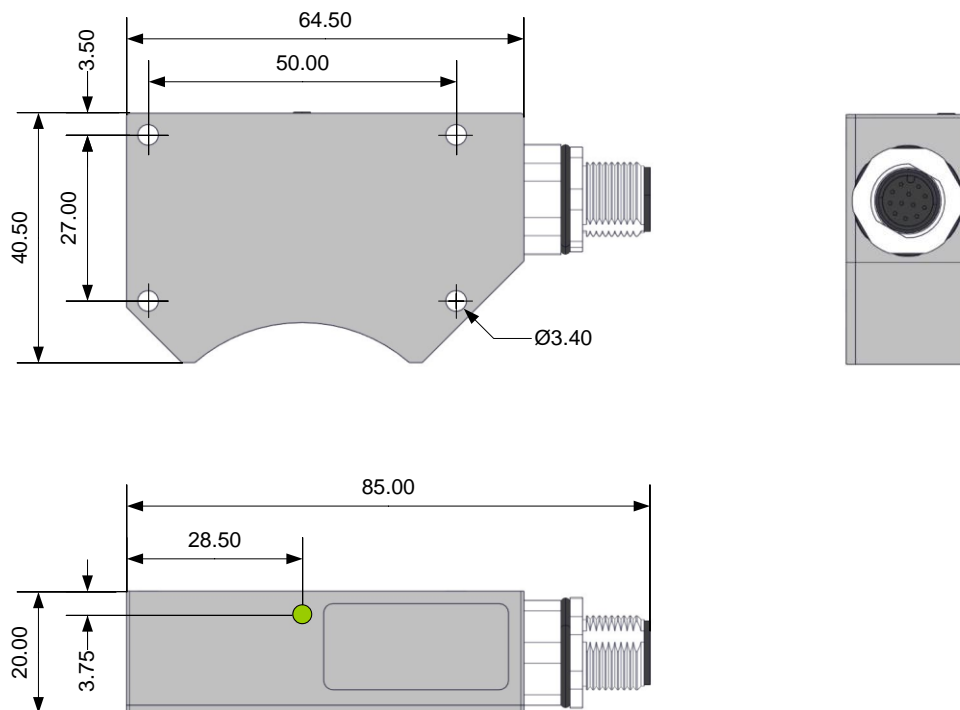


Figure 2: Sensor dimensions



### 4.3 Dimensions of Magnetic Ring

#### 4.3.1 Dimensions of Magnetic Ring without Protection Ring

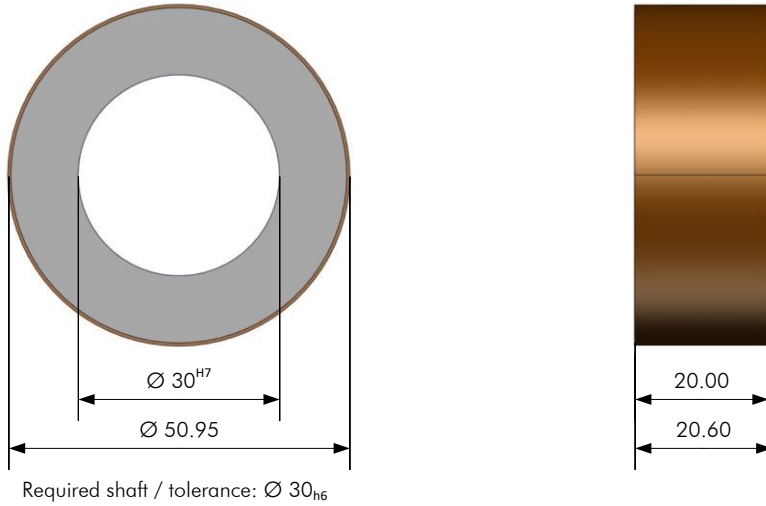


Figure 3: Magnetic ring dimensions (without protection ring)

Usage up to maximum 1000 rpm

#### 4.3.2 Dimensions of Magnetic Ring with Protection Ring

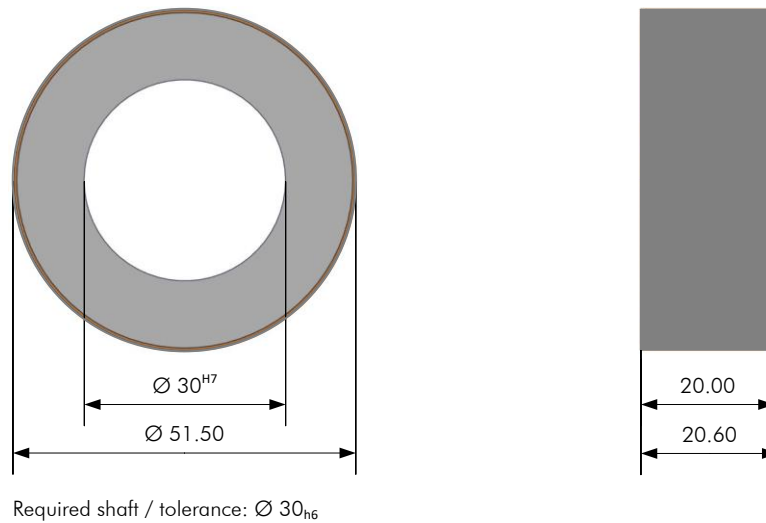


Figure 4: Magnetic ring dimensions (with protection ring)

Usage up to maximum 20000 rpm

#### 4.4 Technical Data Sensor

##### **EMAX-RO (standard version)**

###### **Mechanical Data**

Measuring principle	Absolute
Repeat accuracy	+/- 1 Increment
System accuracy in $\mu\text{m}$ at 20 °C	+/- (150 + 20 x L) / + / - 0.35° (type designation 010) +/- (50 + 20 x L) / + / - 0.16° (type designation F10) L = length in meter
Sensor distance to magnetic ring	max.1.0 mm without protection ring, max.0.45 mm with protection ring
Basic pole pitch	5 mm
Sensor housing material	Aluminium
Sensor housing dimensions	L x B x H = 64.5 x 40.5 x 20 mm
Required magnetic ring	MRR-00-050-030-20-0032 (without protection ring) MRR-00-051-030-20-0032 (with protection ring)
Max. measuring range	360°
Connection	Circular male plug 12-pin M12 outboard
Weight	ca. 90 g Cable (Accessory): ca. 60 g per meter
Sensor cable	5 m standard length accessory (other on request)

###### **Electrical Data**

Power supply	10 ... 30 VDC
Ripple	< 5 %
Current consumption	max. 150 mA
Interfaces	SSI or CANopen (DS406) / on request: CAN BASIC ELGO (CNO), RS422, addressable RS422, RS232 / in preparation: BISS-C
Resolution	16000 steps per turn
Max. speed	20000 rpm (dependent on interface) <ul style="list-style-type: none"> <li>▪ 0 to 1000 rpm without protecting ring</li> <li>▪ 1000 to 20000 rpm with protecting ring</li> </ul>
Cable length	max. 30 m (dependent on interface)

###### **Ambient Conditions**


Storage temperature	-25... +85 °C
Operation temperature	-10... +70 °C (-25... +85 °C) on request
Humidity	max. 95 %, not condensing
Protection class	IP50 (standard), IP65 (option V); higher protection class on request

#### 4.5 Technical Data Magnetic Ring


###### **Mechanical Data**



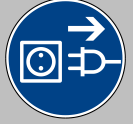


Outer $\varnothing$	50.95 mm without protection ring 51.50 mm with protection ring
Inside $\varnothing$	30 <sup>H7</sup> (required shaft: 30 <sub>h6</sub> )
Width	20.6 mm
Number of Poles / P	32
Basic pole pitch	5 mm
Material	Martensitic stainless steel (magnetic, hardenable), material 1.4021 (X20Cr13)
Weight	ca. 190 g


## 5 Installation and First Start-Up

	<p><b>CAUTION</b> Please read the operating manual carefully before using the device! Strictly observe the Installation instructions! In case of damage caused by failure to observe this operating manual, the warranty expires.</p> <p>ELGO is not liable for any secondary damage and for damage to persons, property or assets.</p> <p>The operator is obliged to take and to realize appropriate safety measures.</p> <p>The first start-up may only be performed by staff that has been trained and authorized by the operator.</p>
---	---

### 5.1 Operating Area

	<p><b>WARNING!</b> Do not use the device in explosive or corrosive environments! The device must not be installed close to sources of strong inductive or capacitive interference or strong electrostatic fields!</p>
--	---

	<p><b>CAUTION!</b> The electrical connections must be made by suitably qualified personnel in accordance with local regulations.</p>
	<p>The device may be designed for switchboard mounting. During work on the switchboard, all components must be de-energized if there is a danger of touching the energized parts! (protection against contacts)</p>
	<p>Wiring works may only be performed in the de-energized state!</p>
	<p>Thin cable strands have to be equipped with end sleeves! Before switching on the device, connections and plug connectors have to be checked!</p>
	<p>The device must be mounted in a way that it is protected against harmful environmental influences such as splashing water, solvents, vibration, shock and severe pollution and the operating temperature must not be exceeded.</p>

	<p><b>WARNING!</b> Influence of external magnets</p> <p>External magnetic fields must not exceed 64 mT (640 Oe; 52 kA/m) on the surface of the magnetic ring as this could damage or destroy the code on the tape.</p>
---	--

## 5.2 Installing of the Sensor Head

### 5.2.1 Installing Tolerances



**Note!**

Distance between magnetic ring and active sensor area of the measuring system is between 0.50 mm and 1.00 mm without protection ring, and max. 0.45 mm with protection ring. Observe the given tolerances when installing the system! Outside this area, proper functioning of the device cannot be guaranteed!

Install sensor with M3 screws, see Chapter "Dimensions of Sensor and Magnetic ring"

Table 1 Installing Tolerances

Tolerances	
Ride height Sensor/Magnetic Ring	0.5 mm ... max. 1.0 mm without protection ring, resp. max. 0.45 mm with protection ring
Roll/Pitch	The max. distance of 1 mm must not be exceeded With protection ring the max. distance of 0.45 mm must not be exceeded
Lateral offset	+/- 1 mm

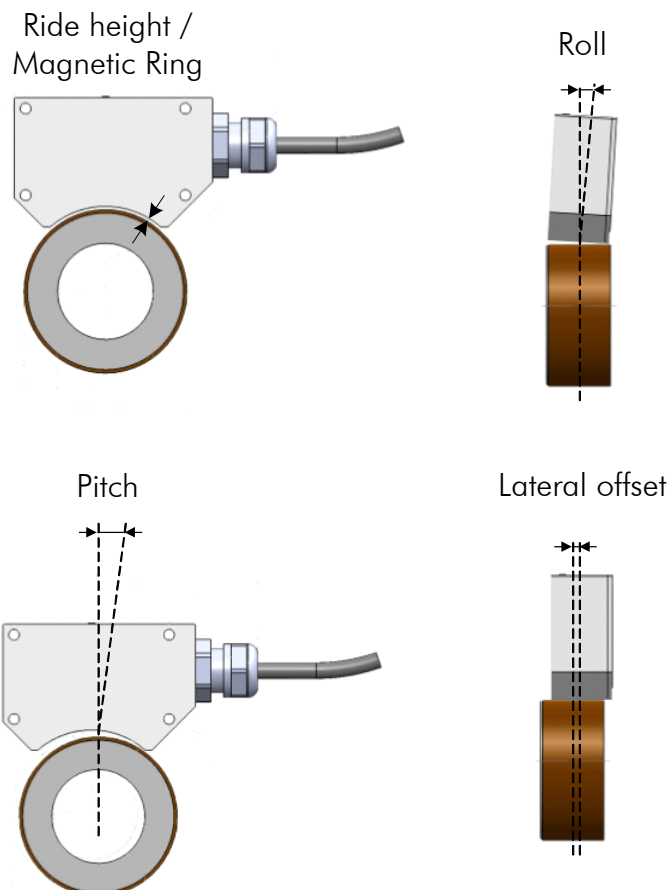


Figure 5: Installation tolerances of the sensor

### 5.2.2 Mounting direction of EMAX-RO Sensor to Magnetic Ring

Sensor and magnetic ring have to be mounted to the same direction (direction of arrow). The direction arrows indicate the positive direction.

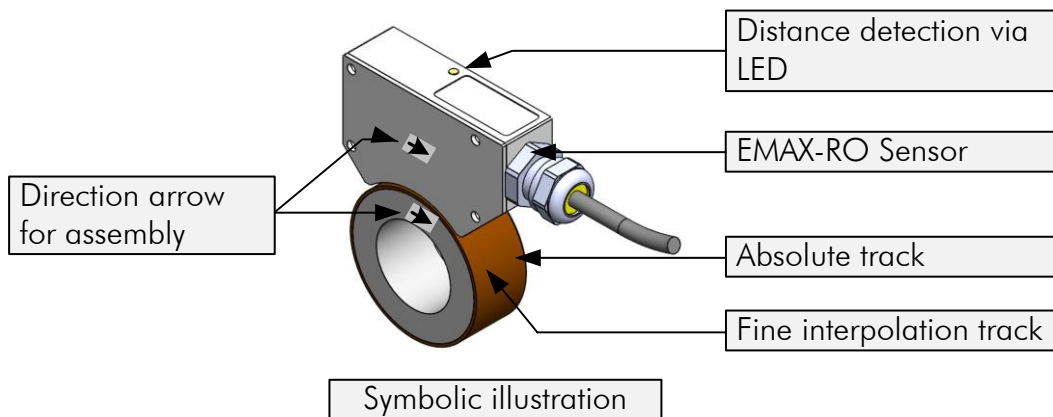


Figure 6: Mounting direction of EMAX-RO Sensor to Magnetic Ring

### 5.2.3 Offset

After the installation of the magnetic tape and the measuring system (EMAX-RO) a value is transmitted by the interface. Because this value does not conform to the machine zero point, an offset should be deposited at the controller side.



**NOTE!**

The offset should be arranged at any change from measurement system (sensor head) or magnetic ring.

### 5.2.4 Activation of the device

The device starts automatically after operation voltage application. Depending on the interface may be additional steps required to activate the EMAX-RO.

### 5.3 Magnetic Ring mounting suggestions

The magnetic ring may be mounted in various ways on a shaft. The examples will below show non-binding proposals how the magnetic ring can be installed.

#### 5.3.1 Example for adhesive mounting:

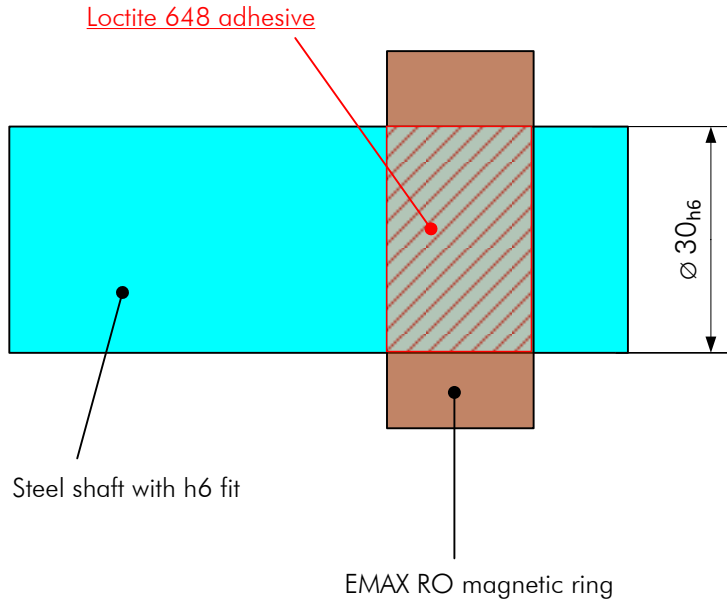


Figure 7: Magnetic ring: example for adhesive mounting

#### 5.3.2 Example for screw mounting

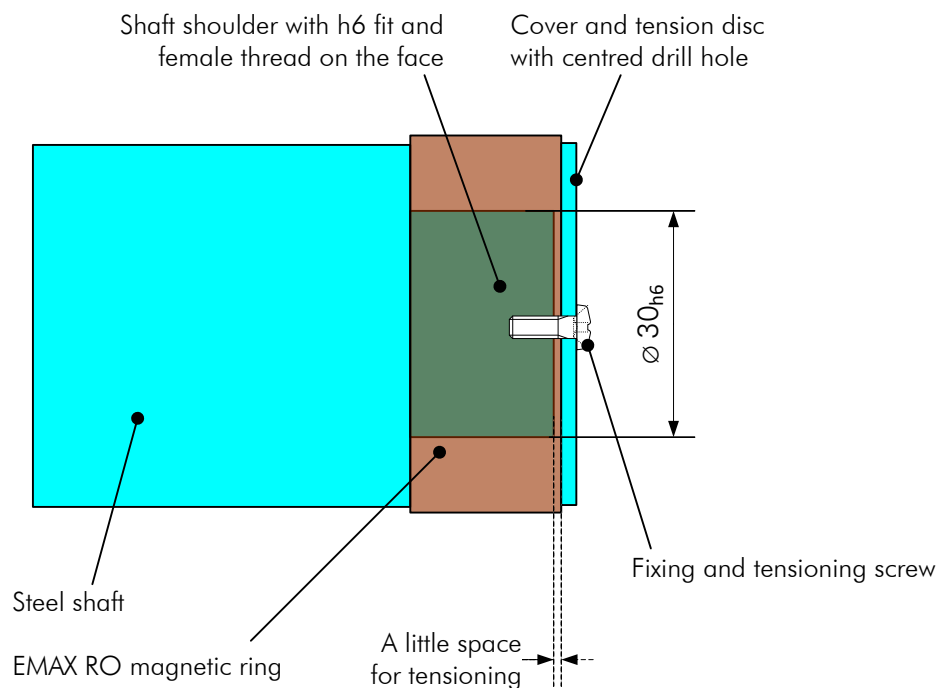


Figure 8: Magnetic ring: example for screw mounting

## 6 Interfaces and Assignment

### 6.1 Pin Assignment

Table 2 Pin Assignment SSI / optionally with incremental signals

The colours are valid with the DKA signal cable which is available as accessories.

Cable Plug 12 pol M12x1	PIN-Nr.	Function
	1 (white)	0 V/GND
	2 (brown)	10 ... 30 VDC
	3 (green)	CLK+
	4 (yellow)	CLK-
	5 (grey)	DATA+
	6 (pink)	DATA-
	7 (blue)	COS+ or B+
	8 (red)	COS- or B-
	9 (black)	SIN+ or A+
	10 (violet)	SIN- or A-
	11 NC	NC
	12 NC	NC

Table 3 Pin Assignment CA0 / optionally with incremental signals

The colours are valid with the DKA signal cable which is available as accessories.

Cable Plug 12 pol M12x1	PIN-Nr.	Function
	1 (white)	0 V/GND
	2 (brown)	10 ... 30 VDC
	3 (green)	CAN-LOW
	4 (yellow)	CAN-HIGH
	5 (grey)	NC
	6 (pink)	NC
	7 (blue)	COS+ or B+
	8 (red)	COS- or B-
	9 (black)	SIN+ or A+
	10 (violet)	SIN- or A-
	11 NC	NC
	12 NC	NC

## 6.2 Interfaces

The following chapters give detailed information about the connections and interfaces.

### 6.2.1 Interface SSI (option SB0 and SG0)

If the clock is not interrupted for the time  $T_m - T/2$  (output of further 25 periods), the shift register clocks once again the same data value (error recognition in evaluation).

Some encoders contain a **Power Failure Bit (PFB)**:

With EMAX-RO the PFB is always „LOW“.

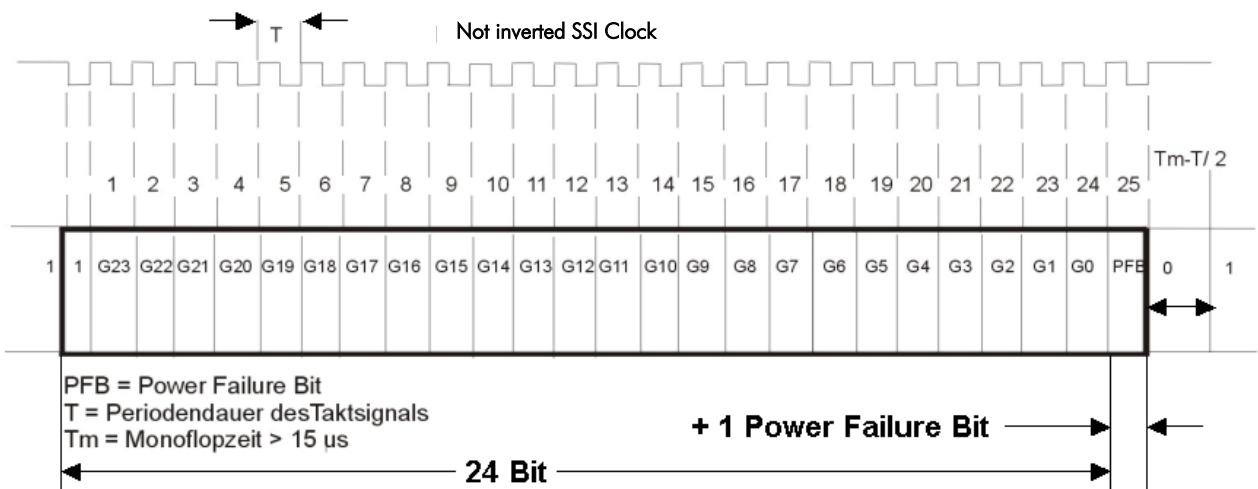


Figure 9 SSI Interface

### 6.2.2 Interface CANopen (option CA0)

As standard the EMAX-RO measuring system is equipped with a CANopen standard interface DS406, when ordering option CA0.

The following identifiers are given:

CAN - Identifier  
(4 Byte telegram)  
180 (16) = Identifier  
First 4 bytes = Position  
Baud rate = 250 KB / s

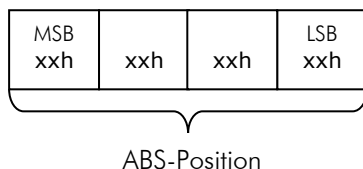


Figure 10: CAN Interface



### 6.2.3 Incremental Signal TTL / HTL

As an option, there are two 90 ° phase shifted rectangle signals (compatible to rotary encoders) with HTL or TTL output level (push-pull, push / pull).

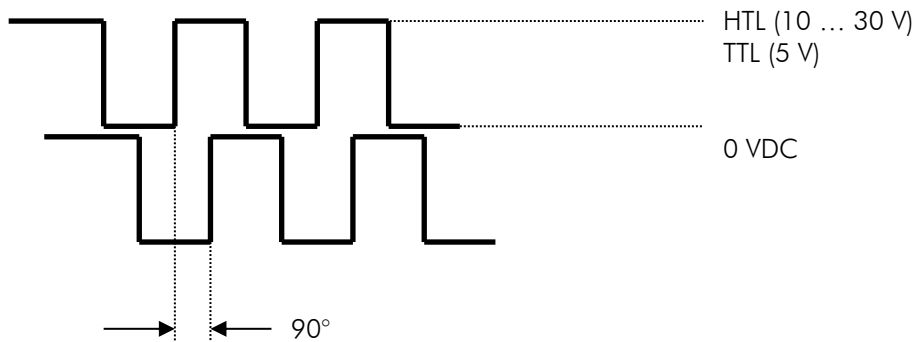


Figure 11: A / B - Incremental Signal TTL / HTL

### 6.2.4 Sine-Cosine Incremental Signal (Option SC50)

Sine-Cosine signals with 1 V<sub>ss</sub> are available as an option (push-pull output stage, short-circuit proof)

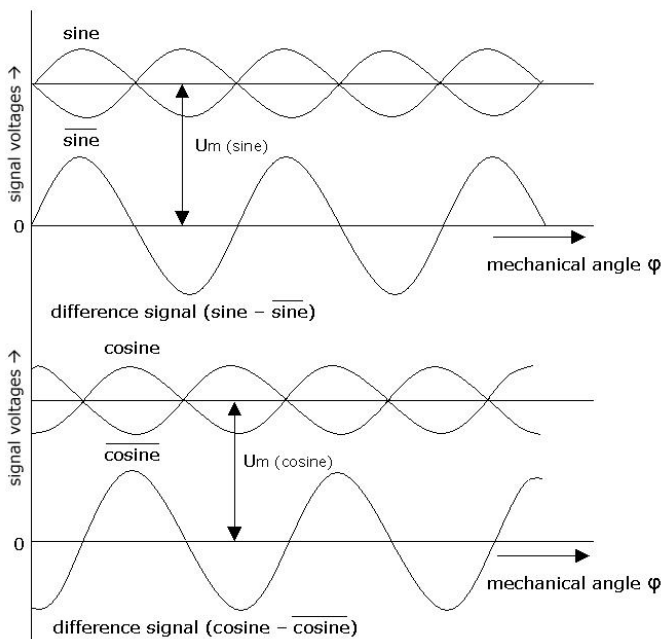


Figure 12: Sine-Cosine signals

Parameter	Description	min.	typ.	max.	unit
Medium voltage	at (sin), at (cos)	2.4	2.5	2.6	V
Amplitude	$\frac{\sin - \overline{\sin}}{\cos - \overline{\cos}}$	400	500	600	mV
proportion	$\frac{\sin - \overline{\sin}}{\cos - \overline{\cos}}$	0.9	1.0	1.1	-
Phase shift	$\varphi$	89	90	91	° degrees
Distortion factor	K	-	-	2	%

## 7 Disturbances, Maintenance, Cleaning

This chapter describes possible causes for disturbances and measures for their removal. In case of increased disturbances, please follow the measures for fault clearance in chapter 7.1.

In case of disturbances that cannot be eliminated by following the advice and the fault clearance measures given here, please contact the manufacturer (see second page).

### 7.1 Fault Clearance



**CAUTION!**

The device, the connection line and the signal cable must not be installed next to sources of interference that emit strong inductive or capacitive interference or strong electrostatic fields.

External perturbations can be avoided through suitable cable routing.



The screen of the signal output cable should only be connected to the following circuit on one side. The screens should not be grounded on both sides. Signal cables always have to be routed separately from the load power line. A safety distance of at least 0,5 m has to be kept from inductive and capacitive sources of interference such as contactors, relays, motors, switching power supplies, clocked controllers etc!

If interferences occur in spite of all the items stated above being observed, please proceed as follows:

1. Installation of RC-circuits via contactor coils of AC-contactors (e.g. 0,1  $\mu$ F / 100  $\Omega$ )
2. Installation of recovery diodes via DC-inductors
3. Installation of RC-circuits via the different motor phases (in the terminal box of the motor)
4. Do not connect protective earth and ground
5. Connect a mains filter ahead of the external power pack

### 7.2 Re-start after Fault Clearance

After the fault clearance:

1. Reset the emergency stop mechanism if necessary
2. Reset the error report at the super-ordinate system if necessary.
3. Ensure that there are no persons in the danger area.
4. Follow the instructions from chapter 5.



**WARNING!**

**Danger of injury through non-conventional fault clearance!**

Non-conventional fault clearance can lead to severe injuries and damage of property.

Therefore:

- Any work to clear the faults may only be performed by sufficiently qualified staff
- Arrange enough space before starting the works
- Make sure that the mounting area is clean and tidy. Loose components and tools are sources of accidents.

If components need to be replaced:

- Pay attention to a correct installation of the spare parts.
- Reinstall all the fixing elements properly
- Before turning on the device, ensure that all covers and safety equipment is installed correctly and functions properly

### 7.3 Maintenance

The device is maintenance-free.



**WARNING!**

Danger through non-conventional maintenance!

Non-conventional maintenance can lead to severe injuries and damage of property.

Therefore:

Maintenance works may only be completed by staff that has been authorized and trained by the operator.

### 7.4 Cleaning

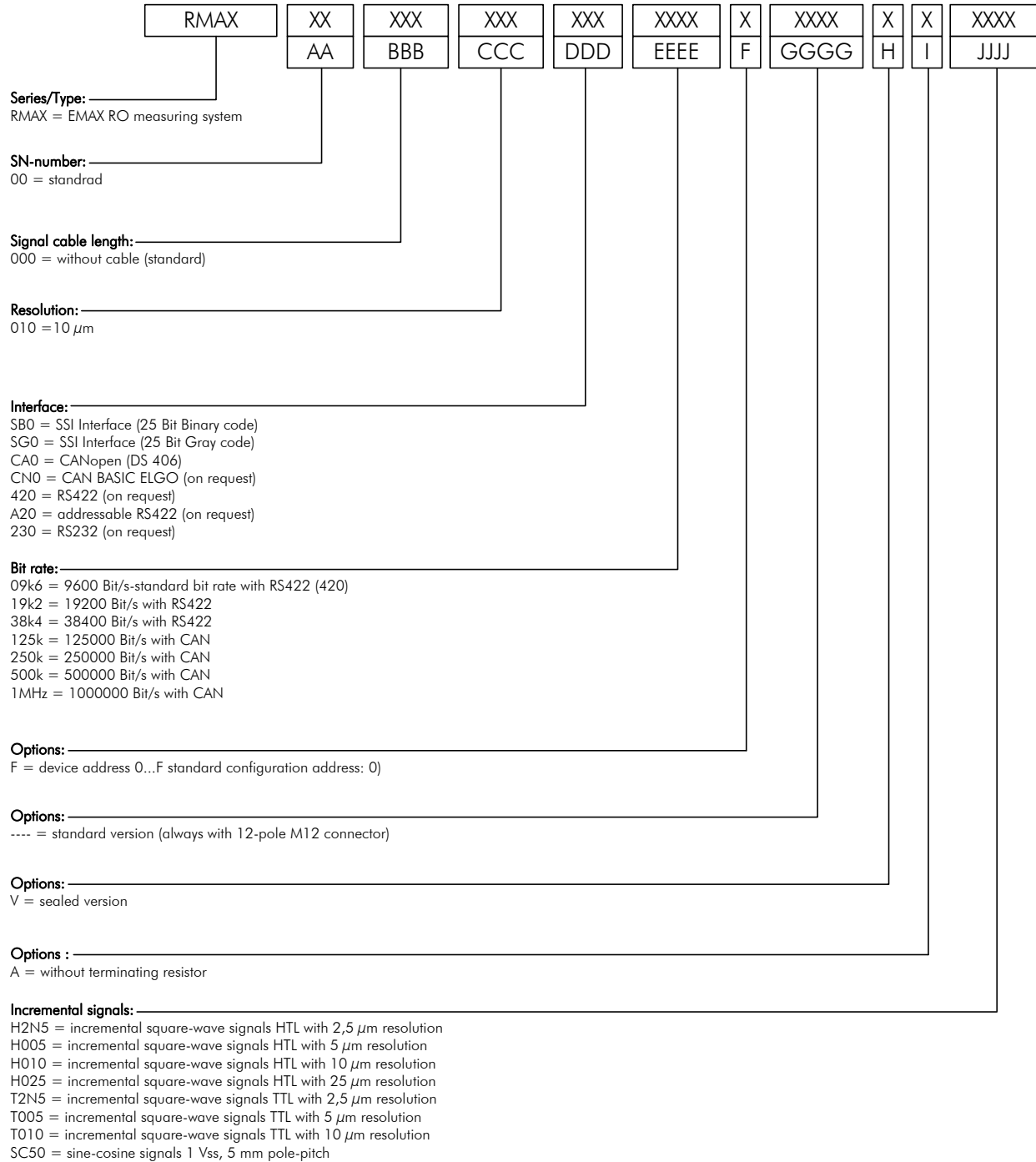


**WARNING!**

The device can only be cleaned with a damp cloth, do not use aggressive cleanser!

## 8 Type Designation

### 8.1 Type Designation EMAX-RO



\*Refers to the absolute position and not on the optional incremental position

Figure 13: Type designation EMAX-RO

## 8.2 Accessories

Table 4 Accessories

Order Designation	Description
MRR-00-050-030-20-0032	Magnetic ring without protection ring (max. 1000 rpm)
MRR-00-051-030-20-0032	Magnetic ring with protection ring (max. 20000 rpm)
DKA-00-RCF0-050-XXXX-12-T-D-S	EMAX-RO connection cable with (female)12-pin M12 connector, 05.0 = cable length 5.0 m, customer sided with an open cable end, 12-wire, twisted pair, drag chain suitable, screen available

## 8.3 Type Designation Magnetic Ring

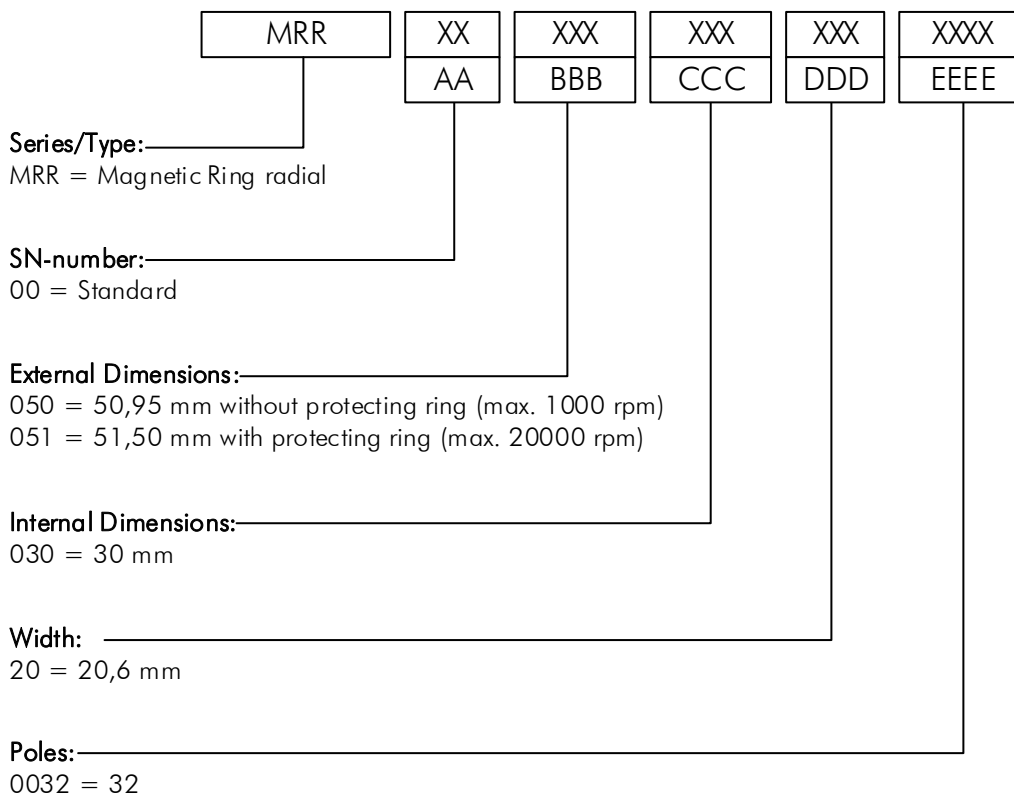


Figure 14: Type designation of Magnetic Ring



**NOTE**

When ordering, please use the here described ordering code (Type Designation). Options that are not required are filled in with „-“.

Notes:

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