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Translation of the original operating manual

ELGO ELECTRONIC

Operating Manual

SERIE *RMIX2*

Magnetic length and angle measuring system with 25 µm resolution

- Direct, contactless and wear-free measurement
- Suitable for linear, radial and rotative applications (e.g. length, angle or speed measurement)
- Measuring length theoretically unlimited
- Resolution of 25 µm at 4 edge triggering
- Standard diameters for accessorial magnet rings: 72 mm, 38 mm or 19.75 mm (others on request)
- The distance between sensor and magnetic tape resp. magnet ring can vary between 0.1 and 0.6 mm
- Insensitive to dirt, dust and water (IP67)

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1 Contents

2 List of Figures

3 List of Tables

4 General, Safety, Transport and Storage

4.1 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.

4.2 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:

	DANGER! 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.
	WARNING! 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.
	CAUTION! 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:

	DANGER! 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:

	NOTE! …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.

4.3 Statement of Warranties

The producer guarantees the functional capability of the process engineering and the selected parameters.

4.4 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.

Safety

	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.

4.5 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.

4.6 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:

	PROTECTIVE CLOTHING … 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 jewellery.
	PROTECTIVE GLOVES …for protecting the hands against abrasion, wear and other injury of the skin.
	PROTECTIVE HELMET …for protection against injuries of the head.

4.7 Conventional Use

The ELGO-device is only conceived for the conventional use described in this manual.
The RMIX2 measuring system only serves to measure lengths and angles.

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:

- Remodelling, 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.

4.8 Safety Instructions for Transport, Unpacking and Loading

CAUTION!
Transport the package (box, palette etc.) professionally.
Do not throw, hit or fold it.

4.9 Handling of Packaging Material

Notes for proper disposal: ☞4.4

4.10 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.

4.11 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 (☞6) needs to be observed
- Relative humidity (☞6) must not be exceeded
- Inspect packages regularly if stored for an extensive period of time (>3 months)

5 Product Features

Figure 1: RMIX2 with magnet ring

Figure 2: RMIX2 with magnetic tape

- For linear, radial and rotative measurements
- Direct contactless measurement
- Excellent price / performance ratio
- High resolution of 0.025 mm at 4 edge triggering
  (0.1 mm at 1 edge triggering)
- Repeat accuracy ± 0.1 mm
- High protection class IP67
- The distance between senor and magnetic tape/magnetic ring can vary between 0.1 … 0.6 mm
- Measuring lengths theoretically unlimited
- Very robust against pollution
- Magnetic rings 72 mm, 38 mm und 19,75 mm available (other on request)
- Index pulse 4 mm - periodical
- Integration of Hall sensors and interpolation as single-chip

5.1 Functional principle

The basis of the magnetic incremental encoders consists of a scanning technology, which scans the north and south poles on the coded magnetic tape and produces a single sine/cosine wave for each pole.

The complete sine/cosine signal process is interpolated electronically. Depending on refinement of the interpolation, together with the pole distance of the magnetic tape, the resolution of the measuring system is determined. The pole pitch of the magnetic tape MB20.20 and the suitable MR magnet rings is 2.0 mm. Special evaluation electronics are used to process the sinusoidal signal. It generates rectangular output signals from the signal information of the magnetized tape or ring, which are compatible with conventional rotary encoders or optical linear measuring systems.

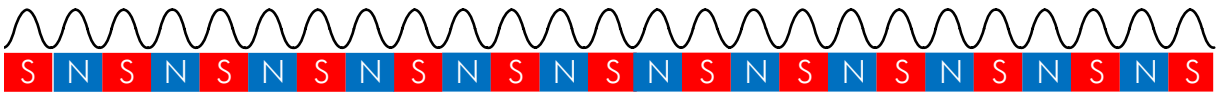
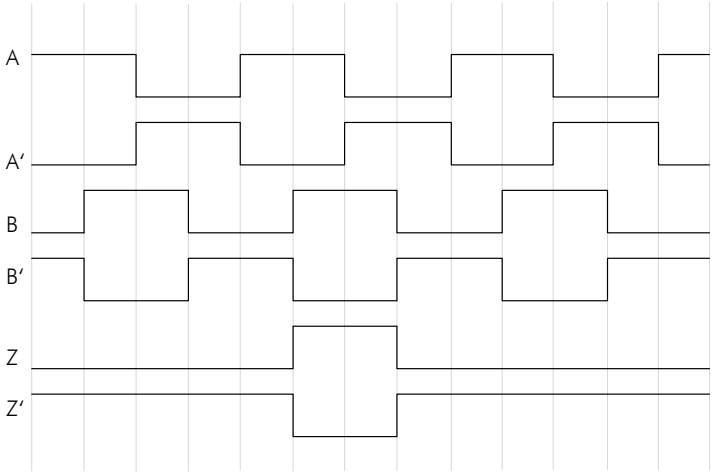


Figure 3: Magnetic Tape coding

5.2 Pulse Diagram



Channels A and B are phase-shifted by 90°.

The index pulse is output periodically every 4 mm.

Figure 4: Pulse diagram

6 Technical Data

6.1 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 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.

6.2 Dimensions Sensor

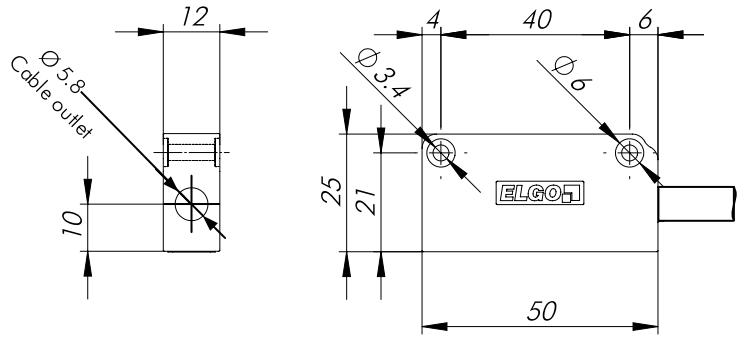


Figure 5: Dimensions Sensor

6.3 Technical Data Sensor

RMIX2 (Standard version)	
Mechanical Data	
Measuring principle	incremental
Measuring methods	linear, radial, rotative
Repeat accuracy	± 0.1 mm
System accuracy in µm at 20° C	± (25 + 20 x L) L = measuring length in meters
Distance sensor - magnetic tape	max. 0.6 mm
Basic pole pitch	2 mm
Sensor housing material	ABS plastic
Sensor housing dimensions	L x W x H = 50 x 12 x 25 mm
Required magnetic tape (linear)	MB20-20-10-1-R (☞ 10.1 Accessories)
Available magnet rings (rotative)	MR2030, MR3860 and MR72114 (☞ 10.1 Accessories)
Maximum measuring length	theoretically unlimited
Connection	open cable ends
Sensor cable	1.5 m standard cable length (others on request) drag chain suitable
Weight	approx. 40 g without cable
Electrical Data	
Power supply voltage	10 … 30 VDC / 5 VDC
Residual ripple	10 … 30 V < 10 % +/- (5 V +/- 25 mV)
Current consumption	10 … 30 VDC: max. 150 mA 5 VDC: max. 200 mA
Output signals	A, A´, B, B´, Z, Z´
Output level	TTL or HTL (depending on order information)
Resolution	0.1 mm resp. 0.025 mm (4 edge triggering)
Index pulse	4 mm periodically
Output frequency per channel	max. 200 kHz / channel A or B
Operating speed	max. 20 m/s (linear) max. 300.000 rpm / number of pole pairs (rotative)
Environmental Conditions	
Storage temperature	−25 … +85 °C
Operation temperature	−10 … +70 °C (−25 … +85 °C on request)
Protection class	IP67

6.4 Technical Data Magnetic Tape

The magnetic tape (see ☞ 10.1 Accessories) consists of two components:

- The actual magnetic tape which carries the position information
- A mechanical stainless steel back iron

Magnetic tape MB20-20-10-1-R	
Encoding	incremental, single-track system
Pole pitch	2 mm
Operation temperature processed	−20 °C … +65 °C (−20 … +80 °C when using without adhesive tape, option „B“ or „D“)
Storage temperature unprocessed	Short-term: −10 °C … +60 °C Medium-term: 0 °C … +40 °C Long-term: +18 °C (−20 … +80 °C when using without adhesive tape, option „B“ or „D“)
Gluing temperature	+18 °C … +30 °C
Relative humidity	max. 95 %, non-condensing
Accuracy at 20° C in µm	±(25 + 20 x L) L = measuring length in meters
Material carrier tape	Precision strip 1.4310 / X10CrNi 18-8 (EN 10088-3)
Double-faced adhesive tape	3M-9088 (observe processing notes), others on request
Dimensions	→ without adhesive tape: 10 mm (± 0.1) x 1.35 mm (± 0.11) → with adhesive tape (excl. carrier): 10 mm (± 0.1) x 1.56 mm (± 0.13) → with adhesive tape (incl. carrier): 10 mm (± 0.1) x 1.63 mm (± 0.14)
Length expansion coefficient	$\alpha \approx 16 \times 10^{-6}$ 1/K
Thermal length expansion	$\Delta L[m] = L[m] \times \alpha[1/K] \times \Delta\vartheta[K]$ (L = tape length in meters, $\Delta\vartheta$ = relative temperature change)
Bending radius	min. 150 mm (min. 50 mm when using without adhesive tape, option „B“ or „D“)
Available lengths	32 m (up to 70 m on request)
Weight magnetic tape	ca. 62 g/m (including magnetic tape + cover foil)
Imprint on tape	ELGO standard, printing color black, character height >= 5 mm
Influence of other magnets	Other magnetic fields must not exceed 64 mT (640 Oe; 52 kA/m) at the surface of the magnetic tape, as this could damage or destroy the encoding of the magnetic tape.
Protection class	Carrier tape stainless steel

6.5 Technical Data Magnet Rings

For radial resp. rotative measurements, three types of standard magnet rings (☞ 10.1 Accessories) are available:

RMIX2 MR Series			
System accuracy at 20°C	< ± 1 %		
Total error	< 0.15 ° (standard) / < 0.007 ° (special applications)		
Material	Hard ferrite 8/22 according to DIN 17410, sintered isotrop		
Recommended adhesive	Loctite AA 326 adhesive and pre-treatment with Loctite 7649 activator		
Pole length	2 mm		
RMIX2	MR2030	MR3860	MR72114
Outer ∅ in mm	19,75 (– 0,05)	38 (– 0,1)	72 (± 0.05)
Inside ∅ in mm	14,7 (+0.2/- 0.15)	30 (± 0.5)	54 (± 0.8)
Width in mm	4,1 (+ 0.05)	6,5 (± 0.05)	7 (± 0.1)
Number of poles (P)	30	60	114
Max. pulse/U = IF x P	6000	12000	22800
Interpolation factor (IF)	200		

7 Installation and First Start-Up

CAUTION

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.

ELGO is not liable for any secondary damage and for damage to persons, property or assets.

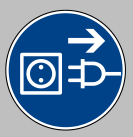
The operator is obliged to take appropriate safety measures.

The first start-up may only be performed by staff that has been trained and authorized by the operator.

7.1 Operating Area

WARNING!

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!



CAUTION!

The electrical connections must be made by suitably qualified personnel in accordance with local regulations.

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)

Wiring works may only be performed in the de-energized state!

Thin cable strands have to be equipped with end sleeves!

Before switching on the device, connections and plug connectors have to be checked!

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.

7.2 Installation of Magnet Rings

The magnetic ring can be mounted on the axle or shaft either as a thermal fit or by bonding.

7.2.1 Recommended Adhesive

For bonding the magnetic ring to the shaft, we recommend the use of Loctite AA 326 adhesive with pre-treatment by Loctite 7649 activator.

7.3 Installation of the Magnetic Tape

NOTE: External Magnetic Fields

The magnetic tape must not be influenced by external magnetic fields!
The magnetic tape must not come into direct contact with other magnetic fields (e.g. permanent magnets, magnetic clamps, electromagnets, magnetic stands)! This may cause irreparable damage, which will compromise the measuring accuracy or even the functioning.

7.3.1 The Magnetic Tape MB20-20-10-1-R

In the standard case, the magnetic tape is delivered as described
It is installed by gluing it to the respective mounting surface.

The magnetic tape consists of 2 pre-assembled components (see Figure 6: Components of the magnetic tape:

- A magnetized, flexible plastic tape (Pos. 3), which is connected with a magnetically conductive steel tape as inference band (Pos. 4) and is supplied with an adhesive tape (Pos. 5).
- A magnetized permeable cover tape (Pos. 1), which serves for the mechanical protection of the plastic tape (not required for the measurement) and is supplied with an adhesive tape (Pos. 2).

Therefore a divergent tape structure and scope of delivery is also possible.
The cover tape is also available separately

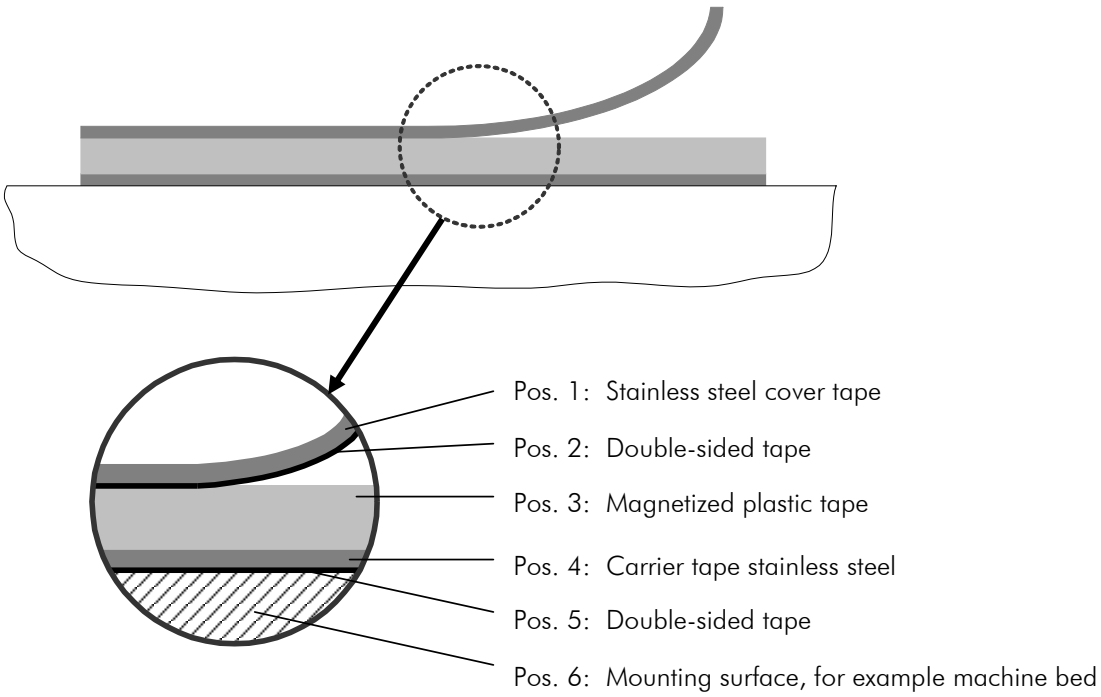


Figure 6: Components of the magnetic tape

7.3.2 Handling

In order to avoid tension in the tape, it must not be stretched, compressed or twisted. It should be stored with the magnetized plastic tape to the outside. The minimum bending radius is 150 mm.

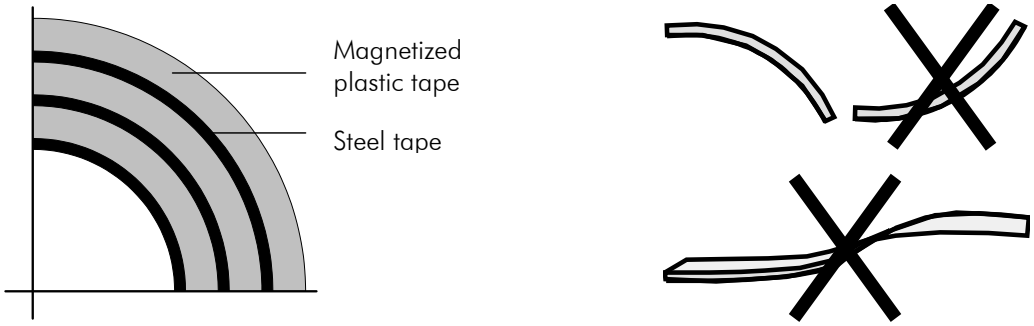


Figure 7: Handling

7.3.3 Processing hint for the gluing of magnetic tapes

Surface-Preparation: In order to guarantee optimal adhesion, all anti-adhesive contamination (e.g. oil, grease, dust, separating agents) has to be removed using solvents with residue-free evaporation. Suitable agents are ketones or alcohols. Typical solvents for cleaning the surface are a 50/50 isopropyl alcohol/water mixture or heptane. Those agents are offered by Loctite and 3M among others as surface cleaners. When using solvents, always observe the manufacturer instructions! If the surface is copper, brass etc., it should be sealed to avoid oxidation.

Contact-Pressure: The strength of the adhesion is directly dependent on the contact the adhesive can form with the surface. Therefore it is important to use as much pressure as possible when gluing the tape, possibly by using aids such as draw rolls. The optimum contact pressure is 4…5 kg/cm^2).

Gluing temperature: The optimal gluing temperature is between + 18° C and 30° C. Avoid colder sticking surfaces than + 10°C, because in this case the adhesive becomes too hard and perhaps a sufficient immediate adhesion is hardly to achieve. After proper sticking, the stability of the connection is ensured also when the temperature is below zero. The final tackiness of a sticking is from experience reached after approximately 72 hours (at + 21° C). For gluing use only the supplied adhesive tape.

7.3.4 Cutting and Gluing

Before starting the gluing process, both the magnetic and the cover tape have to be cut to the required length

Length cover tape = measuring length + sensor length + 50mm (end caps)

NOTE!
When sticking the magnetic tape pay attention to the markings on the tape and the Sensor. Improper installation does not provide the correct values. A already glued magnetic tape is destroyed after the removal, and cannot be used again. Note also the direction of counting of the measuring system

Preferably the magnetic tape should be glued close to an edge or into a groove, which should be deep enough to embed the magnetic tape and the cover tape.

When unprotected, the cover tape may peel off!

Therefore: Use tape end caps (☞ 10.1) or let the cover tape overlap the end of the magnetic tape and fix it with a screw.

The tape must be glued smoothly on the surface. The measuring accuracy decreases if the tape is not even!

Before gluing the magnetic tape and the cover tape onto the surface, they should be left lying on the mounting surface for ca. 30 minutes so that the temperature matches. This prevents strain in the tape due to thermal expansion.

Mounting steps:

1. Thoroughly clean the surface (☞ 7.3.3)
2. Acclimatization: let magnetic tape and cover tape adjust their temperature
3. Remove the protection foil from the magnetic tape
4. Glue magnetic tape under great pressure
5. Thoroughly clean surface of magnetic tape
6. Remove the protection foil from the cover tape
7. Glue the cover tape under great pressure
8. Safeguard the ends of the cover tape against peeling off (e.g. by using end caps ☞ 10.1)

7.3.1 Resistance against Chemical Influence

Table 1: Resistance against Chemical Influence

Show no or little effect in constant contact after 2-5 years:			
formic acid	glycerol 93°C	linseed oil	soy beans oil
cotton seed oil	N-hexane	lactic acid	
formaldehyde 40%	Iso octane	petroleum	
Show weak to moderate effects in constant contact after approximately 1 year:			
acetone	gasoline	acetic acid 30%	oleic acid
acetylene	steam	acetic acid, pure acetic acid	sea water
ammonia	acetic acid 20%	isopropyl ether	stearic acid 70°C, anhydrous
kerosene			
Have strong effects when contacting permanently after 1-5 months:			
benzene	nitric acid 70%	turpentine	toluene
lacquer solvent	nitric acid, red, vitriolic	carbon tetrachloride	tetrahydrofuran
trichloroethylene	nitrobenzene	hydrochloric acid 37%, 93°C	xylene

7.4 Mounting the Sensor

To mount the sensor head, use 2 x M3 screws of adequate length (see sensor dimensions ☞ 6.2).

During installation, the specified mounting tolerances must also be observed:

7.4.1 Mounting Tolerances

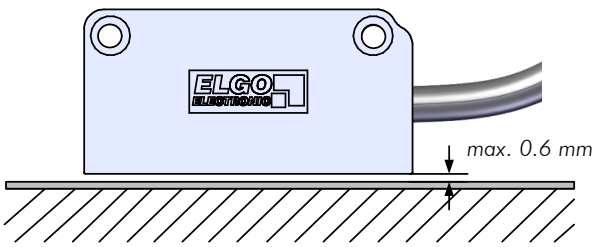
NOTE!

The specified tolerances apply equally to mounting with magnetic tape and magnet rings.
For detailed information about sensor alignment to magnet rings refer to section ☞ 7.4.2.

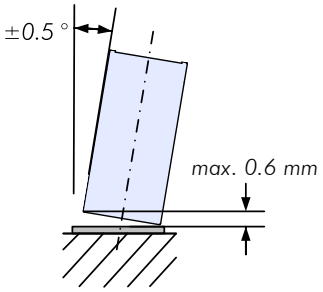
Table 2: Mounting tolerances

Tolerances	
Magnetic tape (☞ 10.1 Accessories)	MB20-20-10-1-R
Magnet rings (☞ 10.1 Accessories)	MR2030, MR3860 or MR72114
Sensor distance to tape / ring	0.1 mm … max. 0.6 mm
Pitch and Roll	the maximum reading distance must not be exceeded at any position
Yaw	± 0.5°
Lateral offset	± 0.5 mm

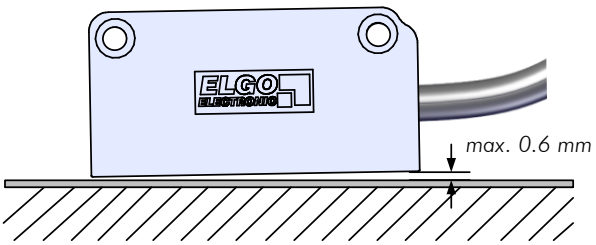
Sensor distance



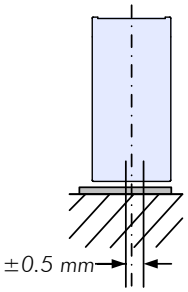
Roll



Pitch



Lateral offset



Yaw

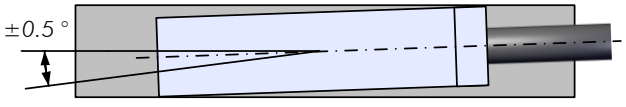


Figure 8: Tolerances

7.4.2 Alignment of RMIX2 with a Magnet Ring

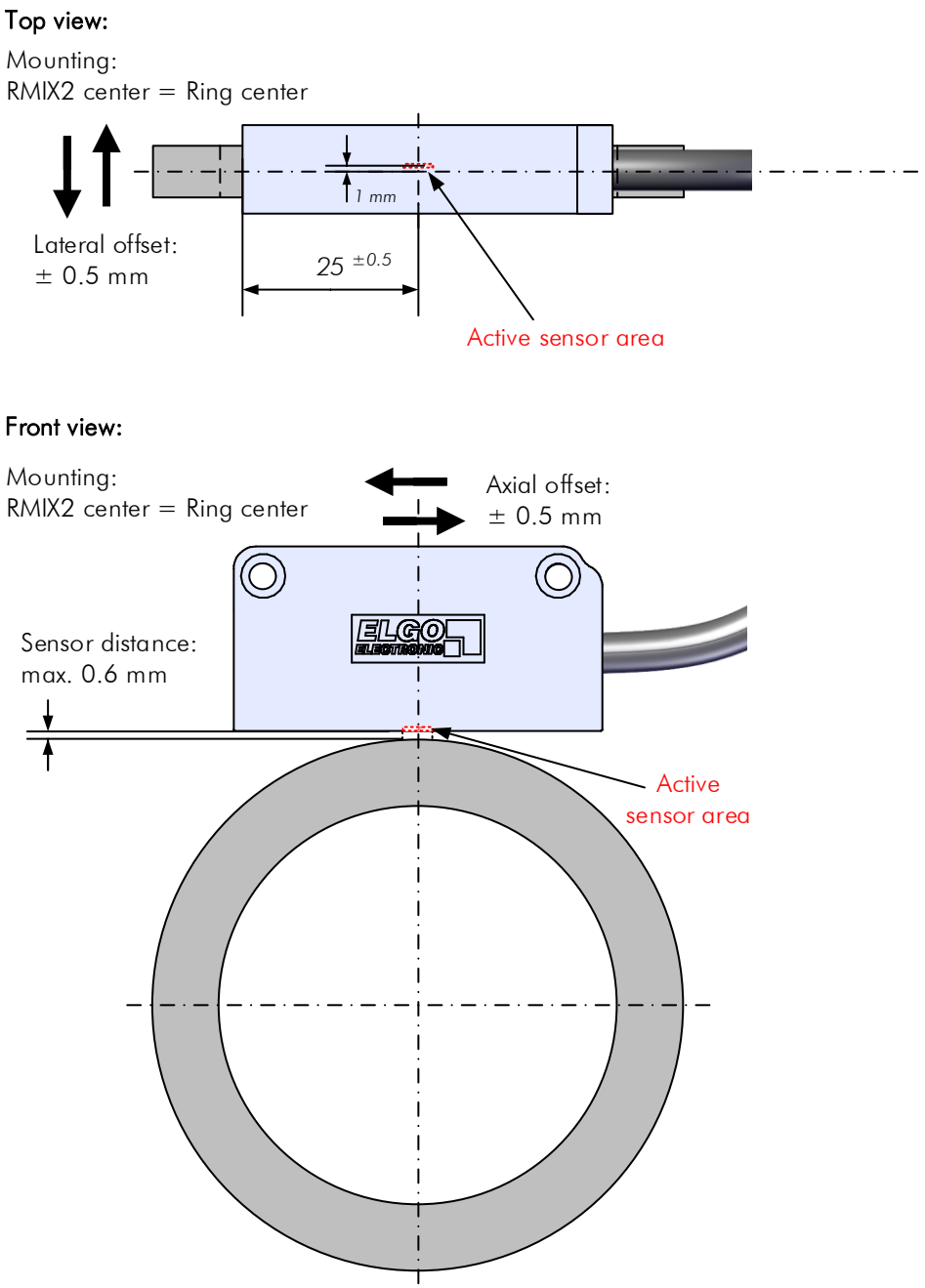


Figure 9: Alignment of RMIX2 with a Magnet Ring

For mounting the magnet ring on an axle or shaft see section☞ 7.2 Installation of Magnet Rings.

8 Connections

8.1 Signal Cable Pin Assignment

Table 3: Pin assignment RMIX2

Open cable ends (standard)		
Color	Function	Beschreibung
white	0 V (GND)	GND (ground)
brown	5 VDC / 10 … 30 VDC	VCC (power supply input)
green	Channel A	signal output
grey	Channel B	signal output
blue	Channel Z	index pulse output
yellow	Channel A‘	inverted signal output
pink	Channel B‘	inverted signal output
red	Channel Z‘	inverted index pulse output
blank	PE	cable shielding

9 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 9.1. 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).

9.1 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 thorough 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 µF / 100 Ω)
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

9.2 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 ☞ 7.

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

9.3 Maintenance

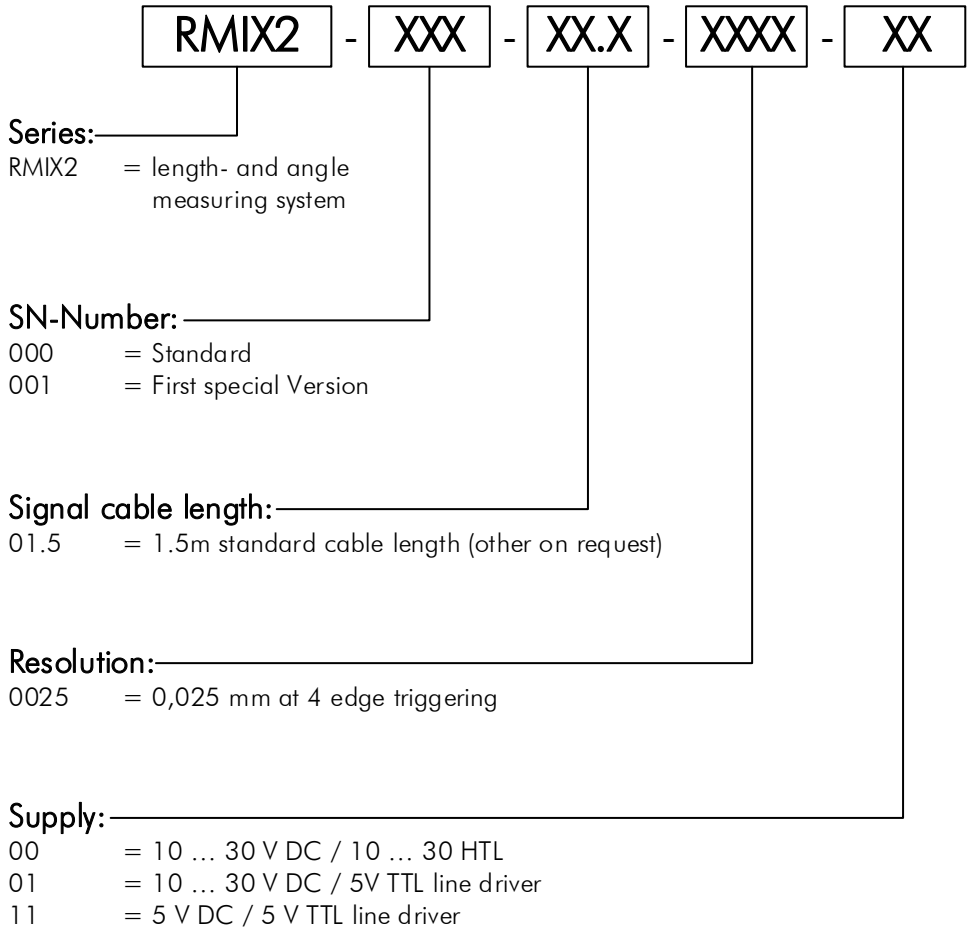
The device is maintenance-free.

9.4 Cleaning

WARNING!

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

10 Type Designation



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

10.1 Accessories

Table 4: Accessories

Order Designation	Description
MB20-20-10-1-R-XX.X*	Magnetic Tape with 2 mm pole pitch *) *please specify length in XX.X m*
End cap set 10 mm	2 x end cap for 10 mm wide magnetic tapes and 2 x M3 x 8 screw. Serves as additional fixation and to protect the ends of the magnetic tape.
FS1000 / FS1500 / FS2000	Magnetic tape guide rail (available lengths: 1 m, 1.5 m or 2.0 m). For higher lengths the guide rails can be lined up together.
AP-00-1m** or AP-00-2m**	The 20 mm wide and 2 mm high aluminium cover profile can be used as an alternative to the cover tape. The magnetic tape is glued into the existing 10 mm groove without the cover tape and is therefore optimally protected. ***) available lengths: "AP00-1m" = 1 m or "AP00-2m" = 2 m*
MR2030	Magnetic Ring with 2 mm pole pitch Dimensions: Outer Ø 19.75 mm, Inside Ø 14.7 mm, Width 4.1 mm
MR3860	Magnetic Ring with 2 mm pole pitch Dimensions: Outer Ø 38 mm, Inside Ø 30 mm, Width 6.5 mm
MR72114	Magnetic Ring with 2 mm pole pitch Dimensions: Outer Ø 72 mm, Inside Ø 54 mm, Width 7 mm

Notes:

11 Index

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