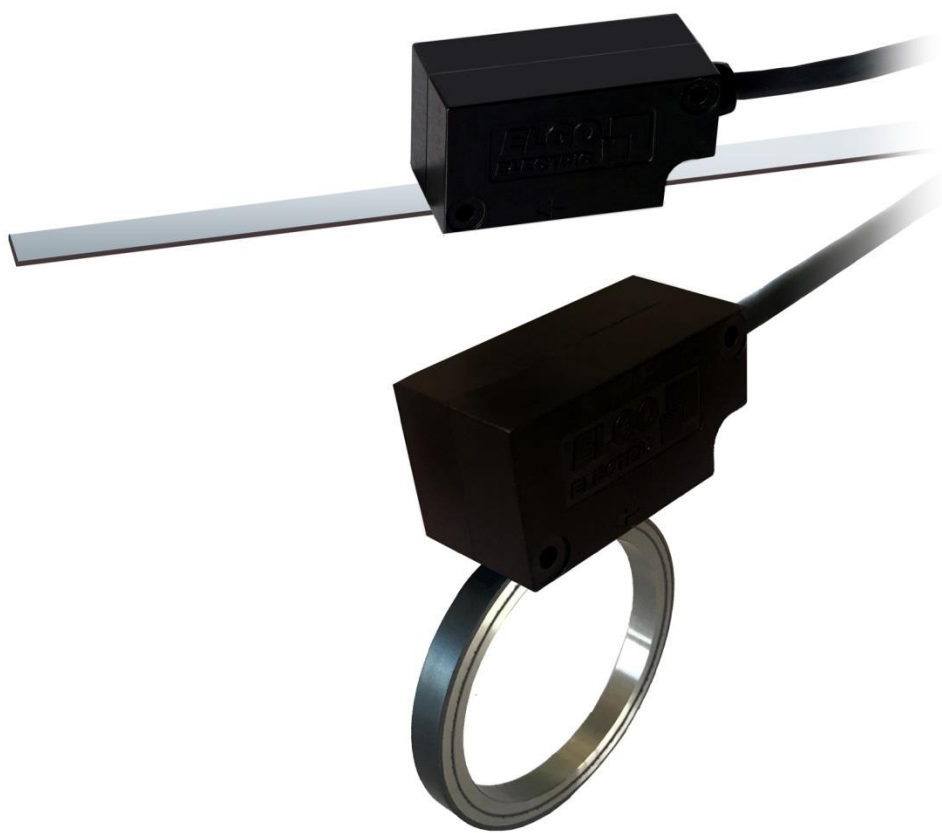


Operating Manual

SERIES *FMAX2* / *FMAX3*

Magnetic Absolute Measuring System for linear and rotative Applications



- Magnetic absolute measurement with 19 bit resolution
- Cost-effective alternative to comparable measuring systems
- Suitable for linear and rotary applications
- Ideal solution for motor feedback systems
- Two versions for different measuring lengths:
FMAX2: max. 192 mm / FMAX3: max. 240 mm
- Insensitive to dust, dirt and water
- Contactless, wear-free measuring principle
- Position detection even in de-energized state
- Additional incremental output signals
(HTL, TTL or SIN/COS) optionally available
- Quick and easy installation

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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.

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 jewelry.
	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 FMAX2 / FMAX3 linear encoder only serves for measurement of linear, radial and rotational values.



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.

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

FMAX2 is a magnetic absolute measuring system designed for linear measuring lengths up to 192 mm or for rotative applications with a diameter of around 61 mm. In contrast, the FMAX3 variant processes lengths up to max. 240 mm and diameters of 80 mm. A compact metal housing includes the sensor system and the required evaluation electronics, which convert the measured signals into an SSI interface format.

In linear application with a coded magnetic tape, the sensor system processes operating speeds of up to 16 m/s. In the rotary range and when using a coded magnetic ring, speeds of up to 6,000 rpm can be processed. Hard ferrite rings are available on request.



Figure 1: FMAX2/3 linear & rotative

Advantages:

With its high measuring accuracy at 19-bit resolution and non-contact scanning, FMAX2 / FMAX3 represents a cost-effective and wear-free alternative to comparable measuring systems. Furthermore, the system is very quick and easy to install.

Applications:

A typical application for FMAX2 and FMAX3 are motor feedback systems. The system is also suitable for a wide range of linear, radial and rotary applications in mechanical engineering, e.g. in wood, sheet metal and metal processing.

5.1 Linear Measurement with Magnetic Tape

For linear measuring tasks, the dual-track absolute coded magnetic tape is glued onto a flat surface by using the supplied adhesive tape. The absolute measuring system is mounted with a maximum reading distance of 0.3 mm to the magnetic tape. When using the magnetic without cover tape, an extended reading distance of up to 0.6 mm is possible. The width of the magnetic tape is 10 mm.

5.2 Rotative Measurement with Magnetic Ring

For radial or rotative measuring tasks, a 6 mm wide ELGO magnetic tape is bonded at the factory to a steel ring. This "magnetic ring" contains 128 individual poles ($\cong$ 64 pole pairs). It can be mounted on the axis either as a thermal fit or by gluing. For more details refer to section 7.3.

The maximum permitted reading distance of the sensor to the magnetic ring is 0.6 mm.

5.3 Functional Principle

For scanning, two Hall sensors are guided over a magnetic tape or a magnetic ring with a master track and a nonius track. Both tracks consist of an alternating north/south pole magnetization. From the combinatorics of the phase position of the two magnetic tracks a clear assignment of the absolute position is possible. The pole pitch of the master track is 1.5 mm for FMAX2 and 2 mm for FMAX3.

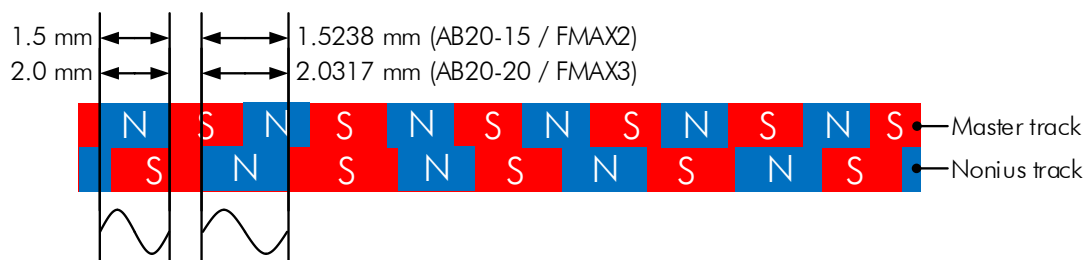


Figure 2: Magnetic tape / ring - dual-track encoding

5.4 Absolute Measuring Principle

With the absolute measuring principle, the current position value is always present. No data is lost even in the event of a power failure. In the installed condition it is generally recommended to calibrate the measuring system once. Afterwards no further calibration is required.

5.5 Optional Incremental Signal Outputs

On request, the FMAX2 / FMAX3 measuring system can optionally be equipped with incremental HTL, TTL or SIN/COS output signals, which can be used for speed evaluation in addition to the position measurement. More details can be found in chapter 9 Optional Incremental Outputs.

6 Technical Data

6.1 Identification

The type label serves for the identification of the unit. It is located on the housing of the device and indicates the exact type designation (=order reference 12) with the corresponding part number. Furthermore, the type label contains a unique, traceable device number. When corresponding with ELGO please always indicate this data.

6.2 Dimensions Sensor

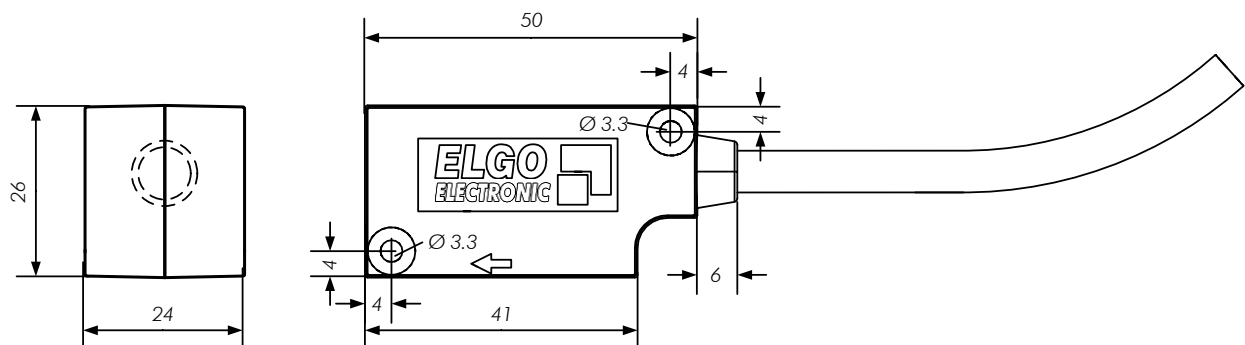


Figure 3: Dimensions FMAX2/3 sensor

6.3 Technical Data Sensor

FMAX2 / FMAX3 (Standard Version)

Mechanical Data

Measuring principle	absolute
Repeat accuracy	± 1 increment
System accuracy in μm at 20° C	± (50 + 20 x L) L = Messlänge in Meter
Distance sensor - magnetic tape	max. 0.3 mm with cover tape, resp. 0.6 mm without cover tape
Distance sensor - magnetic ring	max. 0.6 mm
Pole pitch FMAX2	1.5 mm (master track) / 1.5238 mm (nonius track)
Pole pitch FMAX3	2,0 mm (master track) / 2.0317 mm (nonius track)
Sensor housing material	zinc die cast
Sensor housing dimensions	L x W x H = 50 x 24 x 26 mm
Required magnetic tape FMAX2	AB20-15-10-2-R or AB20-15-10-2-R-D (without cover tape) see Accessories ➤ 12.2
Required magnetic tape FMAX3	AB20-20-10-2-R or AB20-20-10-2-R-D (without cover tape) see Accessories ➤ 12.2
Max. measuring length FMAX2	up to 192 mm
Max. measuring length FMAX3	up to 240 mm
Required magnetic ring FMAX2	MRR-00-061-050-006-0128 see Accessories ➤ 12.2.1
Required magnetic ring FMAX3	MRR-00-061-050-006-0128 see Accessories ➤ 12.2.2
Magnetic ring outer-Ø FMAX2	61.1 mm
Magnetic ring outer-Ø FMAX3	80.0 mm
Connections	open cable ends (connectors on request)
Sensor cable	1.5 m (others on request)
Sensor cable bending radius	60 mm
Weight	approx. 50 g; cable approx. 60 g/m

Electrical Data

Power supply voltage	10 ... 30 VDC
Residual ripple	< 10 %
Current consumption	max. 150 mA
Interface	SSI (binary or Gray code)
Resolution	19 bit
Operating speed (linear)	max. 16 m/s
Rotation speed	max. 6.000 rpm

Environmental Conditions

Storage temperature	−25 ... +85 °C
Operating temperature	−25 ... +85 °C
Humidity	max. 95 %, non-condensing
Protection class	IP54 (IP67 with Option V)

6.4 Technical Data Magnetic Tape

The magnetic tape consists of two components:

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

Magnetic Tape

Coding	absolute, dual-track system
Basic pole pitch	AB20-15-10-2-R : 1.5 mm (only for FMAX2) AB20-20-10-2-R : 2.0 mm (only for FMAX3)
Operation temperature installed	−20 °C ... +65 °C (−20 °C ... +80 °C if usage without adhesive tape resp. options „B“ or „D“)
Storage temperature uninstalled	Short-term: −10 °C ... +60 °C Medium-term: 0 °C ... +40 °C Long-term: +18 °C (−20 °C ... +80 °C if usage without adhesive tape resp. options „B“ or „D“)
Gluing temperature:	+18°C ... +30°C
Relative humidity	max. 95 %, non-condensing
Material carrier tape	Precision strip steel 1.4310 / X10CrNi 18-8 (EN 10088-3)
Double-faced adhesive tape	3M-9088 (observe instructions), 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	$\alpha \approx 16 \times 10^{-6} \text{ 1/K}$
Thermal length expansion	$\Delta L[\text{m}] = L[\text{m}] \times \alpha[1/\text{K}] \times \Delta \vartheta[\text{K}]$ (L = tape length in meters, $\Delta \vartheta$ = relative temperature change)
Bending radius	min. 150 mm (min. 50 mm if usage without adhesive tape resp. options „B“ or „D“)
Available lengths	32 m (up to 70m on request)
Weight magnetic tape	ca. 62 g/m (incl. magnetic tape and cover tape)
Tape imprint	ELGO standard, printing color black, digit height $\geq 5 \text{ mm}$
Influence of external magnets	External magnetic fields must not exceed 64 mT (640 Oe; 52 kA/m on the surface of the magnetic tape as this could damage or destroy the code on the magnetic tape.
Protection class	IP65

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 qualified 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 the Magnetic Tape



NOTE: External Magnetic Fields

The magnetic ring must not be influenced by external magnetic fields! The magnetic ring 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.

7.2.1 The Magnetic Tape

Magnetic tape with 1.5 mm pole pitch for FMAX2:

- AB20-15-10-2-R → with cover tape, max. distance sensor / tape = 0.3 mm
- AB20-15-10-2-R-D → without cover tape, max. distance sensor / tape = 0.6 mm

Magnetic tape with 2.0 mm pole pitch for FMAX3:

- AB20-20-10-2-R → with cover tape, max. distance sensor / tape = 0.3 mm
- AB20-20-10-2-R-D → without cover tape, max. distance sensor / tape = 0.6 mm

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 below):

- 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

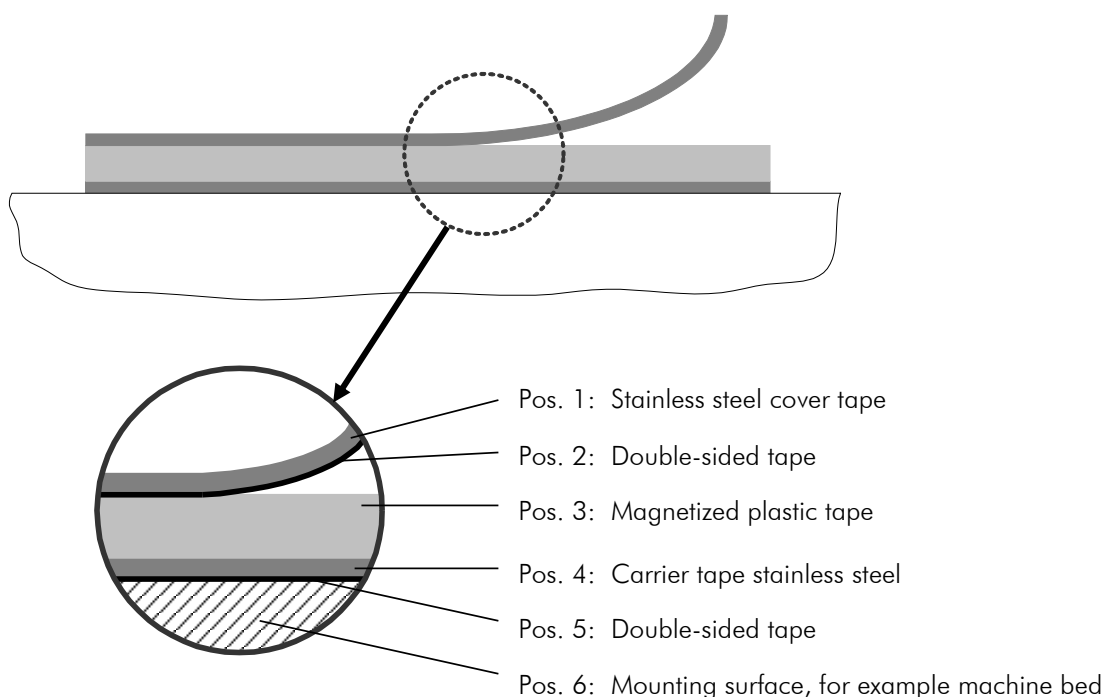


Figure 4: Components of the magnetic tape

7.2.2 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.

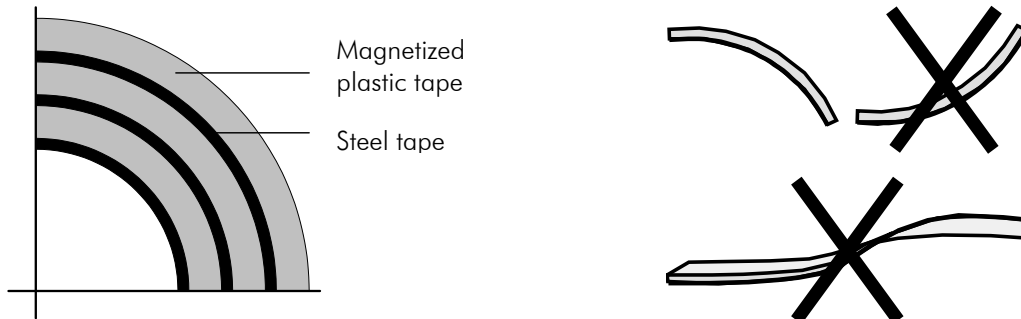


Figure 5: Handling

7.2.3 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/cm².

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.

7.2.4 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 + 50 mm sensor length + 50mm (when using 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 (☞ 12.2.4) 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 (☞ 7.2.3)
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 (☞ 12.2.4)

7.2.1 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

7.3 Installation of the Magnetic Ring

Mounting on the axle is carried out either as a thermal fit or by adhesive bonding. If the magnetic ring is to be bonded, we recommend using the adhesive "Loctite AA 326" including pretreatment with the activator "Loctite 7649". The adjustment to the shaft should be made uniformly over the entire circumference so that no unbalance can occur.



NOTE: External Magnetic Fields

The magnetic ring must not be influenced by external magnetic fields! The magnetic ring 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.

7.4 Mounting the Sensor

For mounting, two mounting holes are available on the sensor housing. Please fasten the sensor with two or three M3 screws of sufficient length (see dimensional drawing 6.2).

7.5 Active Sensor Area

The figure illustrates the exact position of the active sensor area.

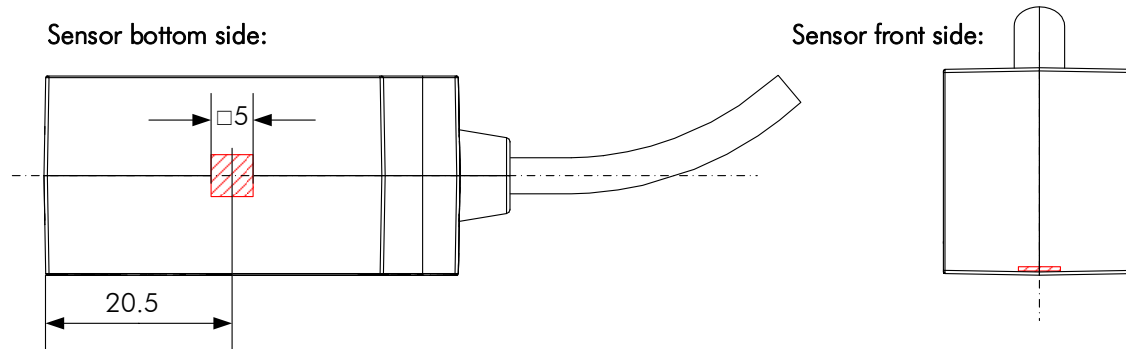


Figure 6: Active sensor area

7.5.1 Alignment to Magnetic Tape

To ensure that the active sensor surface is correctly positioned over the tape, the sensor must be aligned centrally to the magnetic tape. A lateral offset of ± 0.5 mm is permitted. The reading distance between the sensor and the magnetic tape should be selected over the entire measuring distance so that the sensor does not touch the tape and at the same time does not exceed a value of 0.3 mm (or 0.6 mm without cover tape).

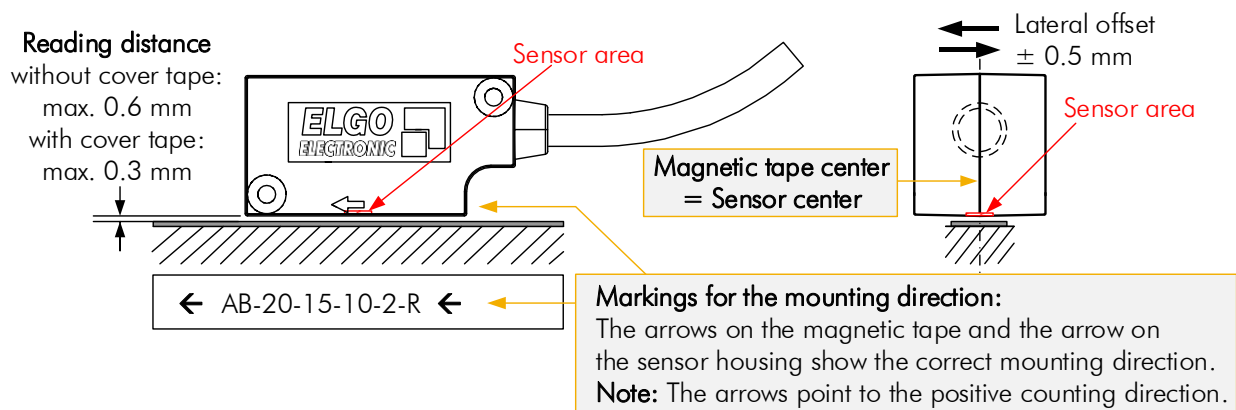


Figure 7: Alignment Sensor - Magnetic Tape



NOTE:

- When mounting the sensor, it must also be ensured that the mounting tolerances described in section 7.5.3 are observed.
- Instructions for installation of the magnetic tape can be found in section 7.2.

7.5.2 Alignment to Magnetic Ring

To ensure that the active sensor surface is correctly positioned to the magnetic ring, the sensor center (viewed from the front) must be aligned to the center of the magnetic ring. A lateral offset of ± 0.5 mm is permitted. Seen laterally, the center of the active sensor area (see figure below) must be aligned to the center of the magnetic ring. This is achieved by positioning the outer edge of the sensor front (as shown in the figure) with a distance of 20.5 mm to the magnetic ring center. The permitted cross offset is ± 0.1 mm.

The reading distance between sensor and magnetic ring should be selected over the entire circumference of the ring so that the sensor does not touch the ring and at the same time does not exceed a value of 0.6 mm.

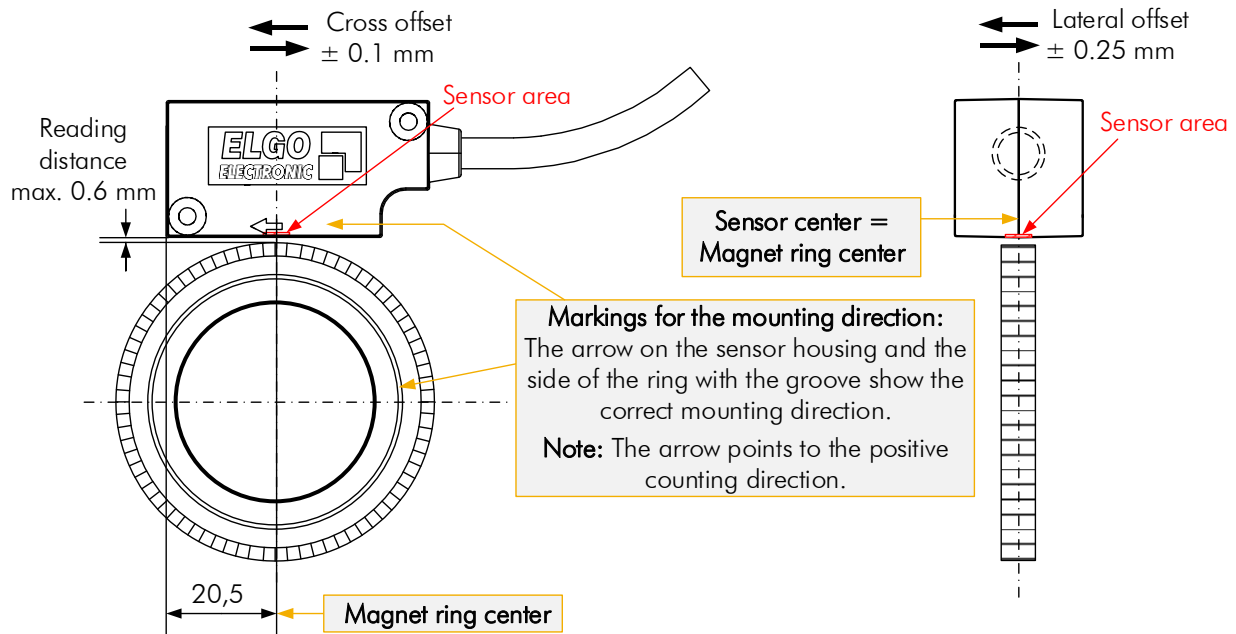


Figure 8: Alignment Sensor - Magnetic Ring



NOTE:

- When mounting the sensor, it must also be ensured that the mounting tolerances described in section 7.5.3 are observed.
- For notes on bonding the magnetic ring to the shaft, see section 7.3.

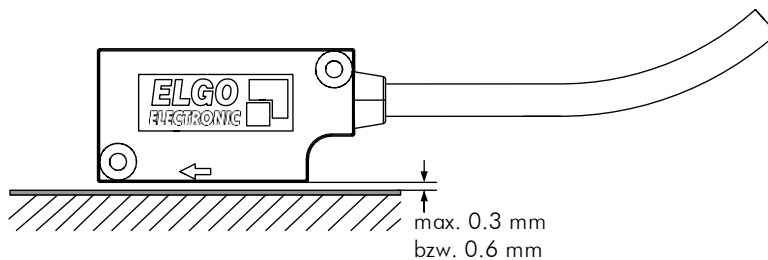
7.5.3 Mounting Tolerances

The mounting tolerances listed below apply equally to FMAX2 and FMAX3. The figures below are shown with magnetic tape. However, the tolerances for the angles "Tilt", "Pitch" and "Yaw" apply regardless of whether a magnetic tape or a magnetic ring is used.

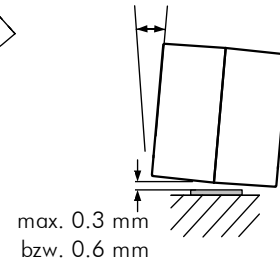
Table 2: Mounting tolerances

Tolerances	
Required magnetic tape FMAX2	AB20-15-10-2-R or AB20-15-10-2-R-D (without cover tape)
Required magnetic ring FMAX2	MRR-00-061-050-006-0128
Required magnetic tape FMAX3	AB20-20-10-2-R or AB20-20-10-2-R-D (without cover tape)
Required magnetic ring FMAX3	MRR-00-080-072-007-0128
Reading distance sensor / tape	0.3 mm (resp. 0.6 mm when using without cover tape)
Reading distance sensor / ring	0.6 mm
Tilt angle for tape and ring	the max. permissible reading distance must not be exceeded at any position
Pitch angle for tape and ring	the max. permissible reading distance must not be exceeded at any position
Lateral offset with magnetic tape	± 0.5 mm
Lateral offset with magnetic ring	± 0.25 mm
Cross offset with magnetic ring	± 0.1 mm (see drawing in section 7.5.2)
Yaw angle for tape and ring	$\pm 1,5^\circ$

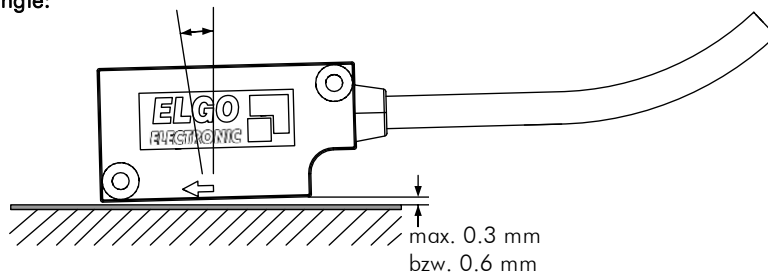
Reading distance:



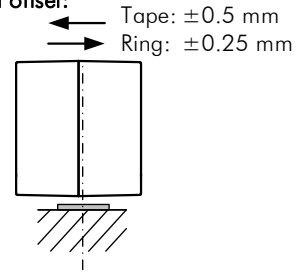
Tilt angle:



Pitch angle:



Lateral offset:



Yaw angle:

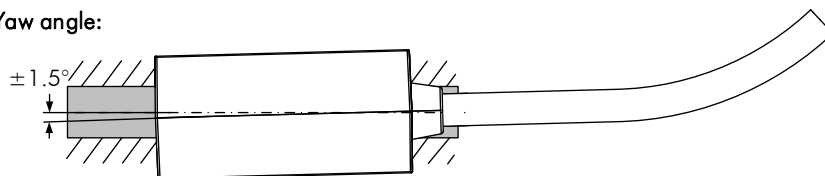


Figure 9: Mounting tolerances sensor

8 SSI Interface

8.1 SSI - Functional Principle

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).

With the SSI interface, transmission rates up to max. 250 KHz can be ensured.

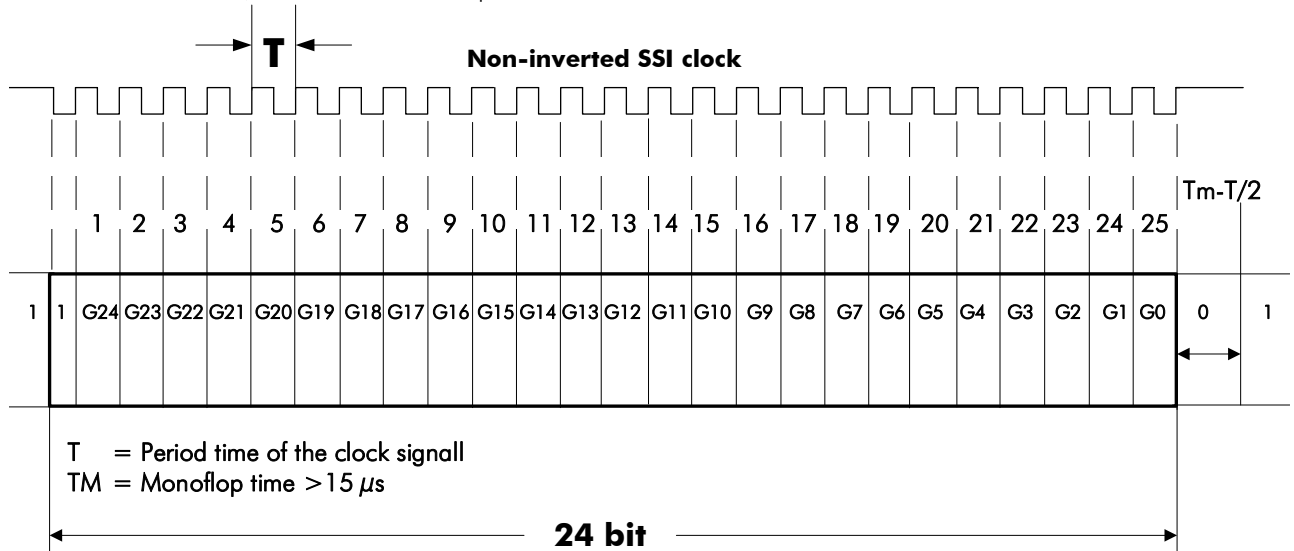


Figure 10: Read SSI data

Two different codings are possible for the SSI:

- Order option **SB0** with 25 bit binary code
 - Order option **SG0** with 25 bit Gray code
- Details see Type Designation 12.1

9 Optional Incremental Outputs

9.1 Incremental A/B Signals (TTL / HTL)

Optionally two 90° phase shifted, rotary pulse encoder compatible square-wave signal outputs with HTL or TTL level (push/pull) are available. Order specifications see 12.1.

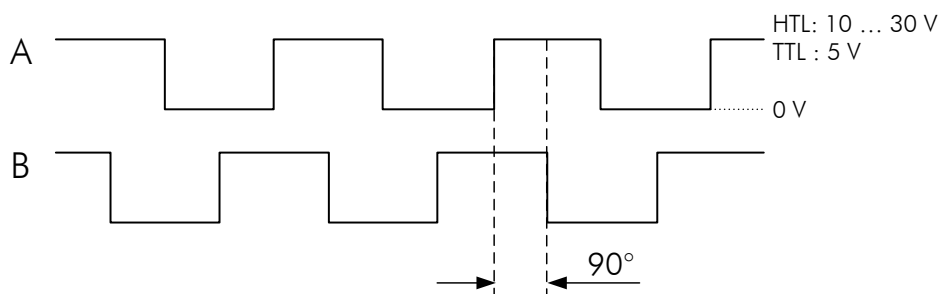


Figure 11: Incremental A/B signals (TTL / HTL)

9.2 Incremental Sine/Cosine Signals (Option SC30 / SC40)

Incremental sine/cosine output signals with 1 V_{pp} (push-pull, short-circuit proof) are also available as another option. FMAX2 outputs one sine period at 3 mm movement. With FMAX3 it is 4 mm movement per sine period. Detailed order specifications can be found in section 12.1.

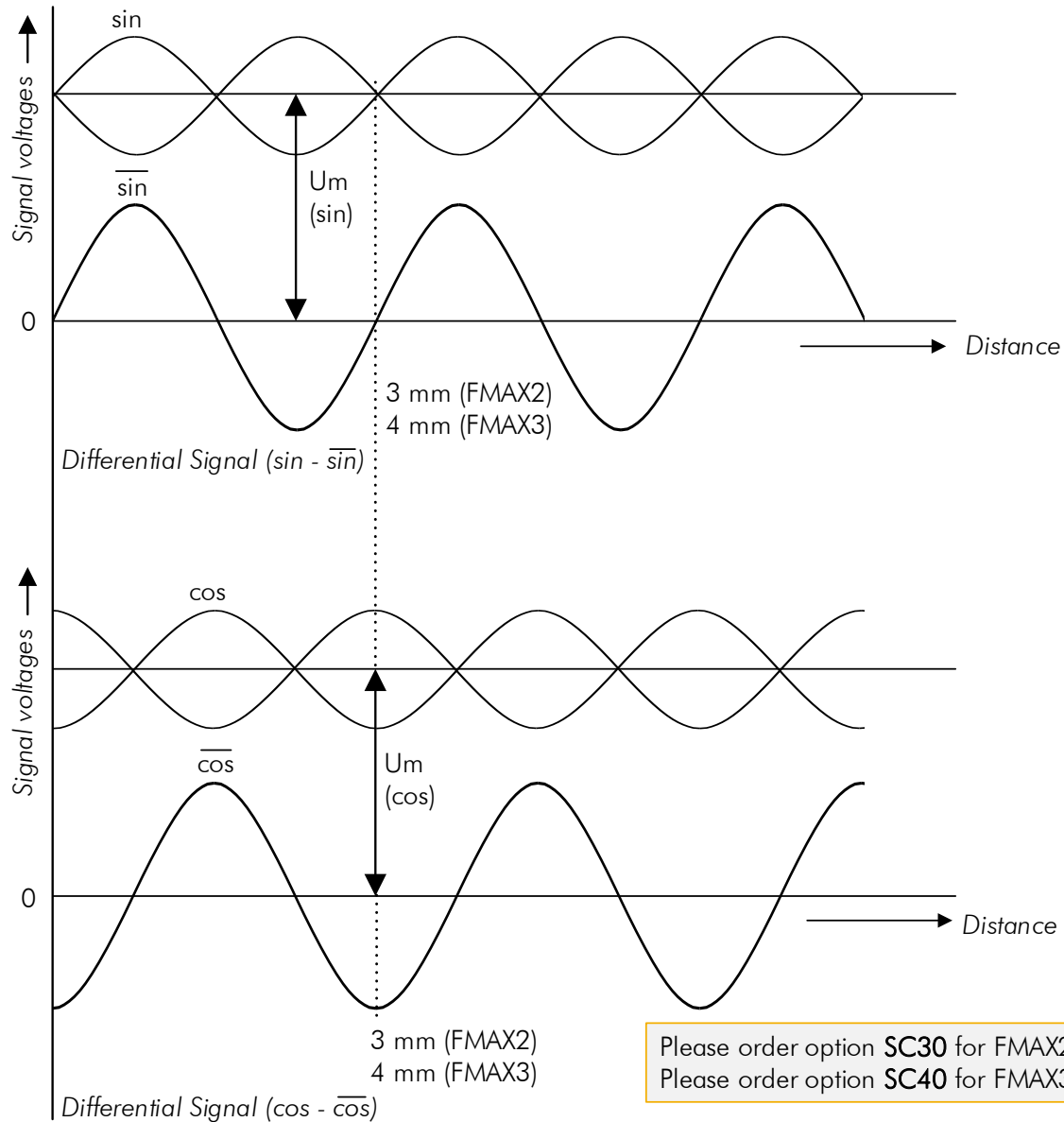


Figure 12: Incremental sine/cosine signals

Table 3: Data of the sine/cosine signals

Parameter	Designation	min.	typ.	max.	Unit
Medium voltage	$U_m(\sin)$, $U_m(\cos)$	2.4	2.5	2.6	V
Amplitude	$\sin - \overline{\sin}$ $\cos - \overline{\cos}$	400	500	600	mV
Ratio	$(\sin - \overline{\sin}) / (\cos - \overline{\cos})$	0.9	1.0	1.1	-
Phase shift	φ	85	$90 \pm 10 \%$	95	° degrees
Distortion factor	K	-	-	3	%

10 Connections

The connections are made via open cable ends (connectors on request).

Table 4: Pin assignment (standard)

Connection Type	Drawing	Color	Function	Description
Open cable ends		white	0 V / GND	Ground
		brown	+VCC	+10 ... 30 VDC
		yellow	DATA+	SSI data+
		orange	DATA–	SSI data–
		green	CLOCK+	SSI clock+
		violet	CLOCK–	SSI clock–
		black	-	not connected
		grey	-	not connected
		blank	PE	screen / shield

Table 5: Pin assignment with optional incremental HTL/TTL outputs

Connection Type	Drawing	Color	Function	Description
Open cable ends		white	0 V / GND	Ground
		brown	+VCC	+10 ... 30 VDC
		green	CLOCK+	SSI data+
		yellow	CLOCK–	SSI data–
		grey	DATA+	SSI clock+
		pink	DATA–	SSI clock–
		blue	Channel B	Channel B HTL and TTL (option)
		red	Channel B'	Channel B inverted TTL (option)
		black	Channel A	Channel A HTL and TTL (option)
		violet	Channel A'	Channel A inverted TTL (option)
		blank	PE	screen / shield

Table 6: Pin assignment with SIN/COS outputs (option SC30 / SC40)

Connection Type	Drawing	Color	Function	Description
Open cable ends		white	0 V / GND	Ground
		brown	+VCC	+10 ... 30 VDC
		green	CLOCK+	SSI data+
		yellow	CLOCK–	SSI data–
		grey	DATA+	SSI clock+
		pink	DATA–	SSI clock–
		blue	COS+	1 Vss COS (option)
		red	COS–	1 Vss COS inverted (option)
		black	SIN+	1 Vss SIN (option)
		violet	SIN–	1 Vss SIN inverted (option)
		blank	PE	screen / shield

11 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 11.1. 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).

11.1 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 μ F / 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

11.2 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

11.3 Maintenance

The device is maintenance-free.

11.4 Cleaning



WARNING!

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

12 Type Designation

12.1 Type Designation Sensor

FMAX	X	00	015	19	XXX	X	XXX
------	---	----	-----	----	-----	---	-----

Series/Type: _____
 FMAX = Absolute Encoder

Measuring Length / Outer Diameter: _____
 2 = max. 192 mm / Ø 61.1 mm
 3 = max. 240 mm / Ø 80.0 mm

Version: _____
 00 = Standard version
 01 = 1. special version

Signal Cable Length (in dm): _____
 015 = 15 dm (±1.5 m) standard length
 (others on request)

Resolution: _____
 19 = 19 Bit

Interface: _____
 SB0 = SSI interface, 25 bit binary code
 SG0 = SSI interface, 25 bit Gray code
 (others on request)

Additional Options: _____

Protection Class: _____
 V = Sealed IP67 construction

Additional Incremental Output Signals: _____
 H16B = FMAX2/FMAX3: HTL square wave signals with 16 bit resolution*
 T16B = FMAX2/FMAX3: TTL square wave signals with 16 bit resolution*
 SC30 = only for FMAX2: 1 Vpp SIN/COS outputs (1 period after 3 mm)
 SC40 = only for FMAX3: 1 Vpp SIN/COS outputs (1 period after 4 mm)

*) Other resolution on request



NOTE:

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

12.2 Accessories

12.2.1 FMAX2 Magnetic Tape & Accessories

Table 7: FMAX2 - magnetic tape & accessories

Order Designation	Description
AB20-15-10-2-R	Magnetic tape (pole pitch 1.5 mm) <u>only for FMAX2</u> . Please indicate the length in XX.X meters. Note: Order length = measuring length + 50 mm sensor length + 50 mm (for end caps)
AB20-15-10-2-R-D	As above, but without cover tape (increases the max. reading distance from 0.3 to 0.6 mm). Note: Order length = measuring length + 50 mm sensor length + 50 mm (for end caps)

12.2.2 FMAX3 Magnetic Tape & Accessories

Table 8: FMAX3 - magnetic tape & accessories

Order Designation	Description
AB20-20-10-2-R	Magnetic tape (pole pitch 2 mm) <u>only for FMAX3</u> . Please indicate the length in XX.X meters. Note: Order length = measuring length + 50 mm sensor length + 50 mm (for end caps)
AB20-20-10-2-R-D	As above, but without cover tape (increases the max. reading distance from 0.3 to 0.6 mm). Note: Order length = measuring length + 50 mm sensor length + 50 mm (for end caps)

12.2.3 FMAX2 / FMAX3 Magnetic Rings

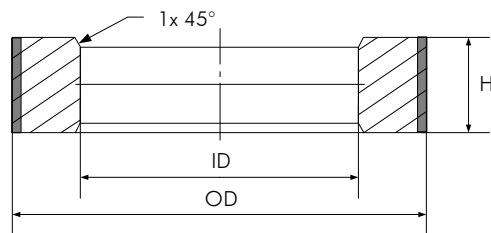


Figure 13: Magnetic ring dimensions

12.2.3.1 FMAX2 Magnetic Ring

Table 9: FMAX2 - magnetic ring

Order Designation	Description
MRR-00-061-050-006-0128	Magnetic ring <u>only for FMAX2</u> : OD = 61.1 mm, ID = 50 mm, H = 6.3 mm, number of poles = 128. The pole pitch is 1.5 mm. The magnetic layer consists of elastomer bonded hard ferrite. The carrier material consists of ferromagnetic steel 1.4104 (other carrier material on request).

12.2.3.2 FMAX3 Magnetic Ring

Table 10: FMAX3 - magnetic ring

Order Designation	Description
MRR-00-080-072-007-0128	Magnetic ring <u>only for FMAX3</u> : OD = 80 mm, ID = 72 mm, H = 7 mm, number of poles = 128. The pole pitch is 2 mm. The magnetic layer consists of elastomer bonded hard ferrite. The carrier material consists of ferromagnetic steel 1.4104 (other carrier material on request).

12.2.4 Other Accessories

Table 11: Other accessories

Order Designation	Description
End cap set 10 mm	2 end caps (10 mm) and 2 x M3 screws. Used for additional fixation of the magnetic tape and for protection of the magnetic tape ends.
POSU	Pole finder card 85 x 55 mm (makes the magnetic tape poles visible)

Notes:

Notes:

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