

Operating Manual

SERIES MAX3

Compact Magnetic Absolute Linear Encoder with LED Distance Detection



- Absolute measurement with 1 mm resolution
- Contactless, wear-free measuring principle
- Ideally suited for mobile automation applications
- Measuring lengths of up to 2450 mm possible
- Insensitive to dust, dirt and water
- Position detection even in de-energized state
- Only one time definition of the Min and Max position
- No further calibration or referencing required
- Automatic distance detection (LED lights up red if the distance between sensor and magnetic tape is too large)
- 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.
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:

	<p>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.</p>
	<p>PROTECTIVE GLOVES ...for protecting the hands against abrasion, wear and other injury of the skin.</p>
	<p>PROTECTIVE HELMET ...for protection against injuries of the head.</p>

4.7 Conventional Use

The ELGO-device is only conceived for the conventional use described in this manual.
The ELGO linear encoder MAX3 only serves to measure lengths and positions.



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

MAX3 is a magnetic absolute length measuring system designed for measuring lengths up to 2450 mm. Thanks to its compact design, the non-contact and wear-free measuring principle as well as its high IP40 protection class (optionally IP65), the measuring system is particularly suitable for use in harsh environments (e. g. mobile automation).

The sensors and the necessary evaluation electronics are integrated in a compact metal housing, which converts the scanned signals into the desired interface format. By using the supplied adhesive tape, the absolutely coded magnetic tape is glued onto a flat surface. The maximum allowed mounting distance between sensor and magnetic tape is 1.5 mm.

The absolute measuring system offers decisive advantages:

A major advantage of the MAX3 is its compact design, which makes it equally suitable for retrofitting as well as new installations in existing machines and vehicles.

Due to the absolute measuring principle, no further referencing is required after the minimum and maximum positions have been defined once.

Essential features are:

- Absolute Measurement for increased safety
- Contactless measuring principle
- Resolution 1 mm (others on request)
- Measuring length up to 2450 mm
- Automatic distance monitoring: An LED signalizes too large distances between sensor and magnetic tape



5.1 Functional Principle

A Hall sensor line is guided over a coded magnetic tape which is written with an absolute track and always provides the current absolute position. The sensor system scans the code sequence of the north and south poles and determines the absolute value with a resolution of 1 mm. Usable ELGO magnetic tapes are the 10 mm wide variant **AB20-21-10-1-R-D-10** or the 20 mm wide **AB20-21-20-1-R-D-10**.

This absolute measured value is processed by the internal evaluation electronics and is available either via a CANopen interface or as an analog output signal (mA or V). From here it can be further processed by the subsequent electronics.



Figure 1: Single-track coding of the magnetic tape

5.2 Advantages of the absolute Measurement

The absolute measuring principle ensures maximum safety, as the current position value is always present. Even in the event of a power failure, no data is lost. The measuring system only has to be referenced once by learning the upper and lower position (see 7.4 Calibration of the Measuring Range).

5.3 Available Output Interfaces

Depending on the interface option ordered (see Type Designation 0), the sampled signal information is converted by the internal evaluation electronics into one of the following output signals:

Interface option **CA0** → CANopen standard interface according to DS406 (encoder profile)

Interface option **I20** → Analog 12 bit output signal (0 ... 20 mA), proportional to the measured value

Interface option **I24** → Analog 12 bit output signal (4 ... 20 mA), proportional to the measured value

Interface option **V04** → Analog 12 bit output signal (0.5 ... 4.5 V), proportional to the measured value

Interface option **V10** → Analog 12 bit output signal (0 ... 10 V), proportional to the measured value

Further information can be found in chapter 8 Connections and Interfaces.

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 \varnothing 0) 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

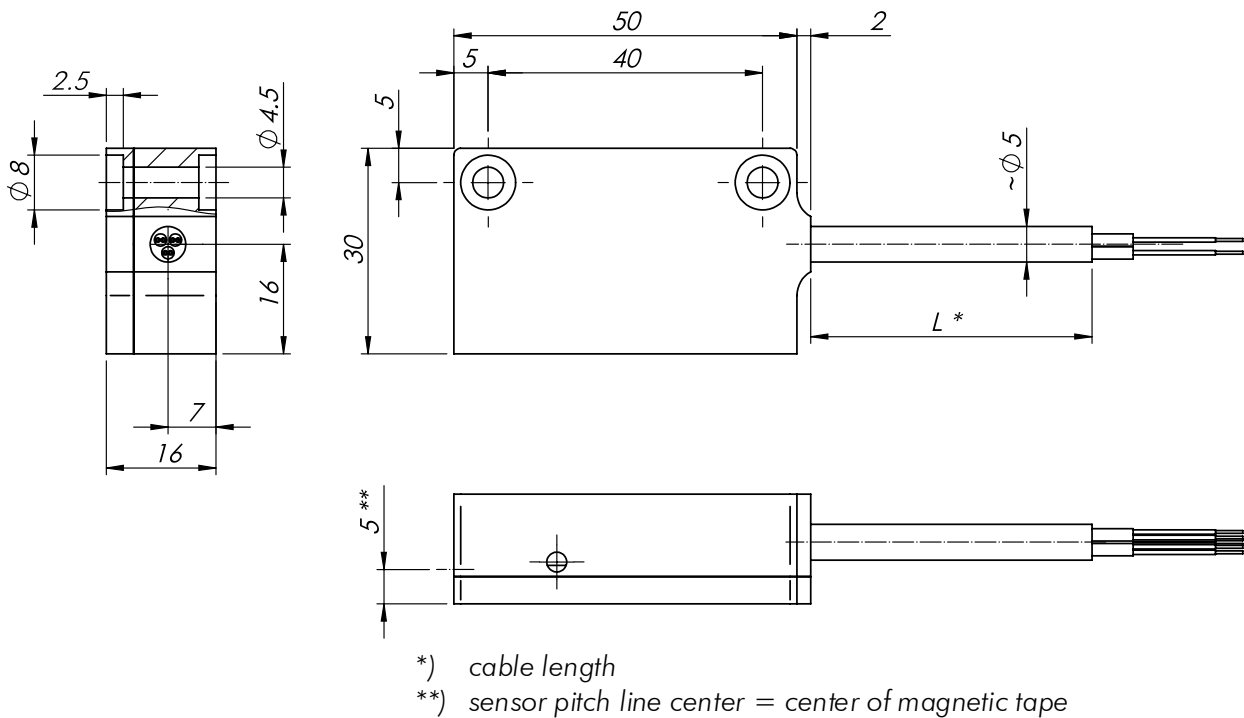


Figure 2: Dimensions sensor

6.3 Technical Data Sensor

MAX3 (standard version)

Mechanical Data

Measuring principle	absolute
Repeat accuracy	±1 increment
System accuracy	±1 mm at max. 2450 mm at measuring length (standard)
Minimum distance sensor - tape	min. 0.25 mm
Maximum distance sensor - tape	max. 1.0 mm
Measuring length	max. 2450 mm
Housing material	galvanized aluminium
Dimensions	L x W x H = 52 x 16 x 30 mm
Required magnetic tape	AB20-21-10-1-R-D-10 or AB20-21-20-1-R-D-10
Basic pole pitch	2.1 mm
Sensor cable length	standard: 1.5 m (others on request)
Weight	approx. 50 g without cable; cable approx. 60 g/m

Electrical Data

Power supply voltage	10 ... 30 VDC
Residual ripple	10 ... 30 VDC <10 %
Current consumption	max. 80 mA
Available interfaces (order information ☞ 0)	CANopen standard (DS406) 12 bit analog output (0 ... 20 mA) 12 bit analog output (4 ... 20 mA) 12 bit analog output (0.5 ... 4.5 V) 12 bit analog output (0 ... 10 V) SSI (binary or Gray) on request
Connections	standard: open cable ends optionally: 5-pin (male) M12 round connector (others on request)
Resolution	1 mm
Operating speed	max. 2.0 m/s

Environmental Conditions

Storage temperature	-25 ... +85° C
Operation temperature	-25 ... +85° C
Humidity	max. 95 %, non-condensing
Protection Class	standard: IP40 / optionally: IP65 (order information ☞ 0)

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 AB20-21-10-1-R-D-10 / AB20-21-20-1-R-D-10

Coding	absolute, dual track system
Pole pitch	2.1 mm
Number of magnetic tracks	1
Number of bits	10 bit coding
Operation temperature installed	-20 °C ... +65 °C (-20°C ... +80°C when using without adhesive tape, options „B“ or „D“)
Storage temperature uninstalled	Short-term: -10°C ... +60°C Medium-term: 0°...+40°C Long-term: +18°C (-20°C ... +80°C when using without adhesive tape, options „B“ or „D“)
Gluing temperature:	+18°C ... +30°C
Accurateness at 20°C	± (20 + 20 x L) L= measuring length in meters
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
Width of the magnetic tape	10 mm or 20 mm (see Accessories ☞ 10.1)
Height of the magnetic tape	with back iron, without adhesive tape: 1.35 mm (± 0.11) with back iron + adhesive tape, without protective foil: 1.55 mm (± 0.13) with back iron + adhesive tape + protective foil: 1.63 mm (± 0.14)
Height of the cover tape	without adhesive tape and protective foil: 0.20 mm (± 0.01) with adhesive tape without protective foil: 0.40 mm (± 0.03) with adhesive tape and protective foil: 0.48 mm (± 0.04)
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)
Available measuring lengths	max. 10 m
Weight magnetic tape	ca. 62 g/m (incl. magnetic tape and cover tape)
Tape imprint	ELGO standard, printing color black, digit height $\geq 5 \text{ mm}$
Relative humidity	max. 95 %, non-condensing
Protection class	IP65
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 tape.

7 Installation and First Start-Up

	<p>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.</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 appropriate safety measures.</p> <p>The first start-up may only be performed by qualified staff that has been trained and authorized by the operator.</p>
---	--

7.1 Operating Area

	<p>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!</p>
	<p>CAUTION! 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!</p>
	<p>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>

7.2 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.

7.2.1 The Magnetic Tape

For MAX3 the 10 mm wide ELGO magnetic tape **AB20-21-10-1-R-D-10** or alternatively the 20 mm wide magnetic tape **AB20-21-20-1-R-D-10** can be used. In the standard case, the magnetic tape is delivered as described below. It is installed by gluing onto 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

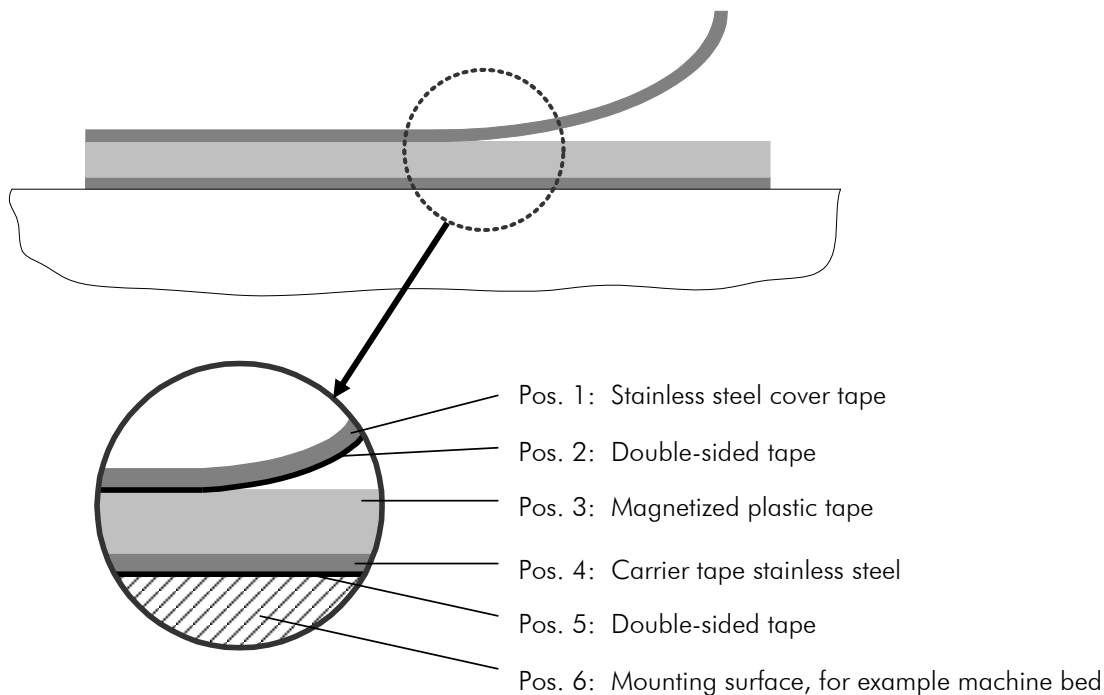


Figure 3: Components of the magnetic tape

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.

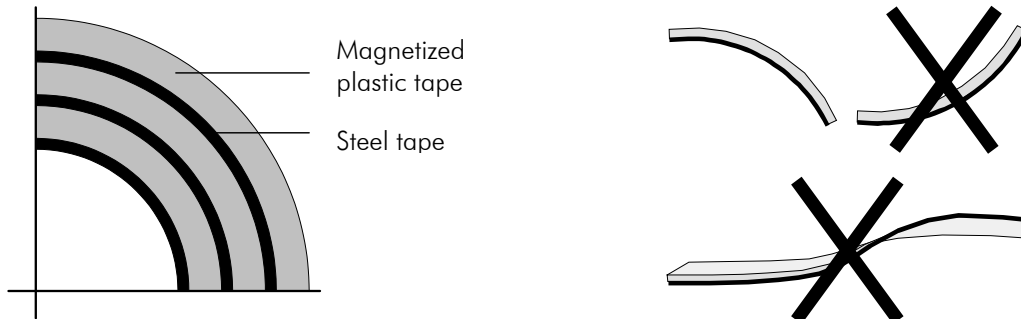


Figure 4: Magnetic tape handling

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

The magnetic tape is already cut to the required length at the factory.



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. An 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 (☞ 7.2.3)
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 (☞ 10.1)

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 Sensor

Fasten the sensor with two M4 cylinder head screws of suitable length (see ¶ 6.2). For absolute coded magnetic tapes it is important that the sensor is mounted in the correct direction to the tape. Otherwise no measurement is possible. Therefore the mounting direction resp. counting direction of the sensor is indicated by arrows on the upper side of the magnetic tape.

7.3.1 Sensor Alignment with 10 mm wide Magnetic Tape

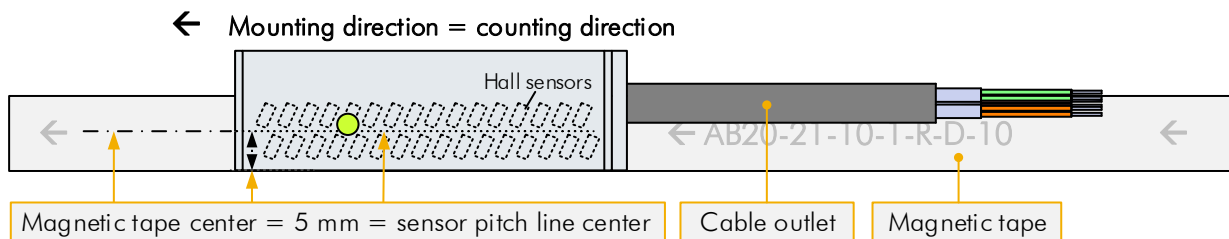


Figure 5: Sensor alignment with 10 mm wide tape

The cable outlet of the sensor points against the counting direction. The center pitch line of the sensor must be aligned to the center of the magnetic tape (see figure above). The easiest way to achieve this is to mount the sensor flush to the magnetic tape on the correct side.

More information about the mounting tolerances can be found in section ¶ 7.3.3.

7.3.2 Sensor Alignment with 20 mm wide Magnetic Tape

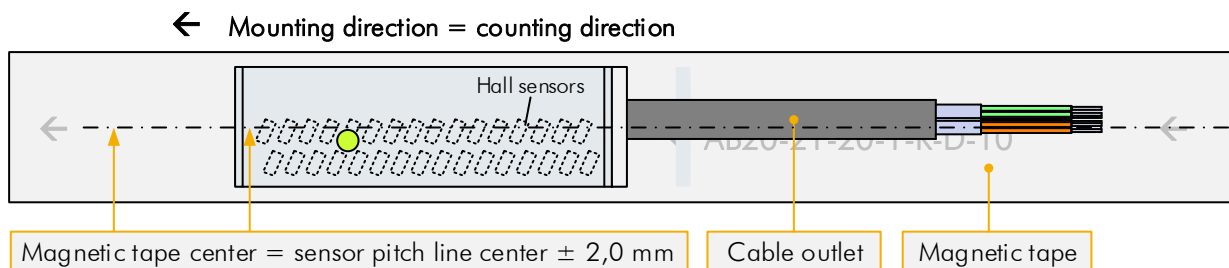


Figure 6: Sensor alignment with 20 mm wide tape

The cable outlet of the sensor points against the counting direction. The center of the sensor must be aligned with the center of the magnetic tape (see figure above). Thus the complete Hall sensor pitch line is covered by the magnetic tape coding. Advantage: The 20 mm wide band variant has a higher lateral offset tolerance.

More information about the mounting tolerances can be found in section ¶ 7.3.3.

7.3.3 Mounting Tolerances



REMARKS!

- Ensure correct distance sensor / magnetic tape 0.1 mm ... max. 1.0 mm!
The LED on the sensor housing lights up red as soon as this distance is exceeded.
- The cable outlet of the sensor points against the counting direction (see section ¶ 7.3.1.)
- Observe the specified tolerances when installing the system!
Outside these areas the function is not guaranteed!

Table 2: Mounting tolerances

Tolerances	
Magnetic tape type	AB20-21-10-1-R-D-10 or AB20-21-20-1-R-D-10
Reading distance	min. 0.25 ... max. 1.0 mm
Pitch angle	the maximum permissible reading distance must not be exceeded at any position
Yaw angle	$< \pm 1.0^\circ$
Lateral angle	the maximum permissible reading distance must not be exceeded at any position
Lateral offset (10 mm tape)	sensor pitch line center = magnetic tape center ± 1.0 mm
Lateral offset (20 mm tape)	center of MAX3 sensor = magnetic tape center ± 2.0 mm

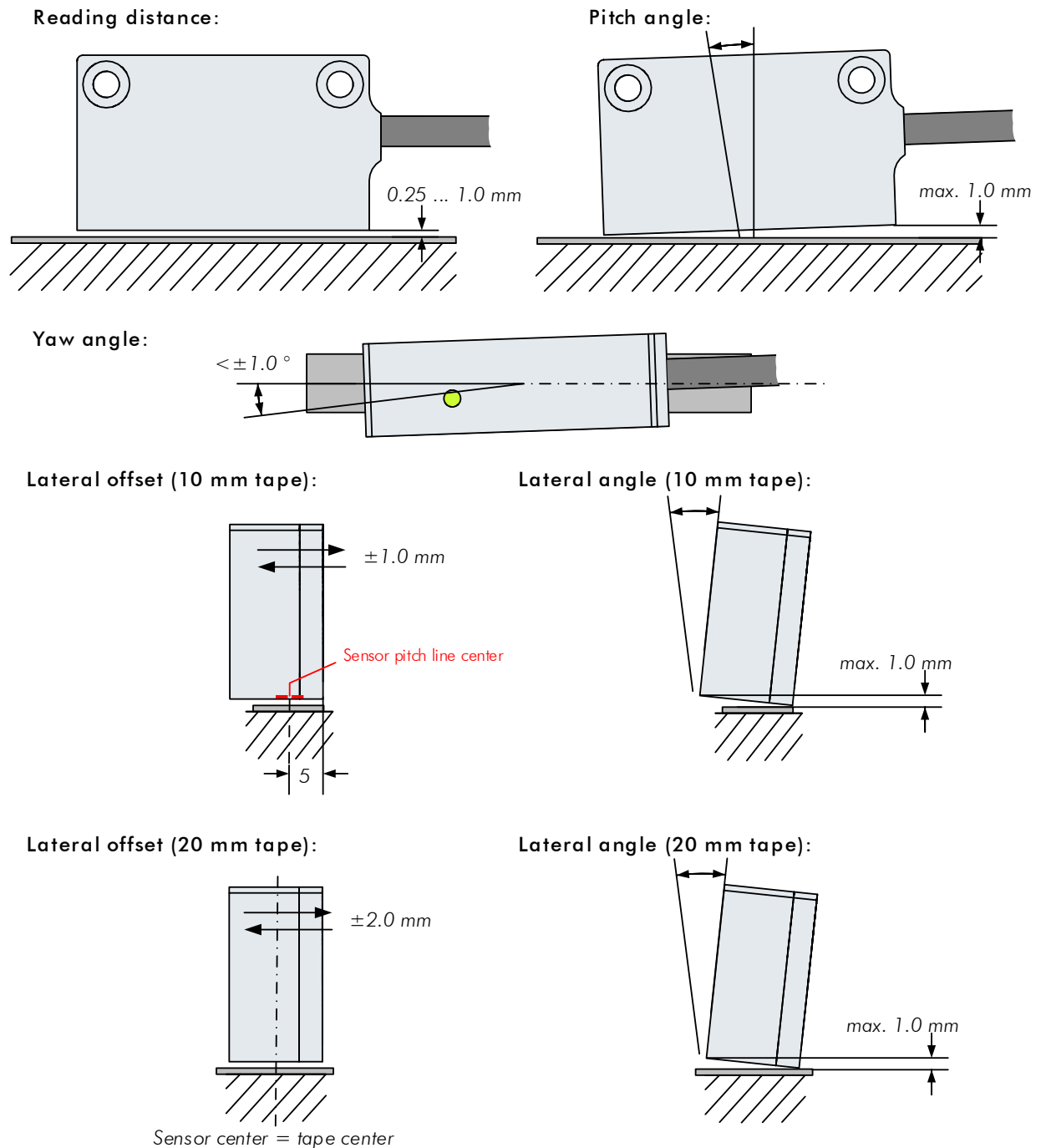



Figure 7: Mounting tolerances of the sensor

7.4 Calibration of the Measuring Range

7.4.1 Calibration for Versions with CAN Interface

A hardware calibration as described in section 7.4.2 is not required for this version. The calibration of the upper and lower set point is performed via the CANopen interface.

7.4.2 Calibration for Versions with Analog Output

	<p>REMARKS</p> <ul style="list-style-type: none"> The calibration must be performed for each newly installed MAX3 measuring system before or during commissioning. Even when replacing the measuring system or magnetic tape (e. g. in case of servicing) a new calibration must be performed.
---	---

One second after power-up, the device is ready for operation. In addition, the MAX3 system with analog output offers the possibility of initiating the learning process during the first ten seconds after power-up. A lower and upper set point must be defined for which the **TEACH** input is required.

Ideally, this input is - temporarily for the calibration procedure - wired with a switch or push-button against GND (see figure).

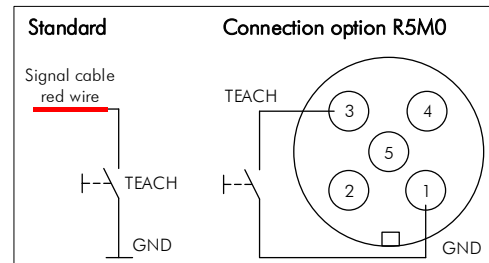


Figure 8: TEACH input wiring

To calibrate the set points, please proceed as follows:

Starting position = **TEACH** input is open resp. not activated.

→ Press the connected **TEACH** button.

During the first second of pressing, the LED changes rapidly between red and green.

a) Keep the button pressed within 1 ... 3 seconds, until the LED lights statically green:

→ By releasing the button in the green phase, the learning of the lowest position (min) is initiated.

b) Keep the button pressed (max. 8 seconds), until the LED lights statically red:

→ By releasing the button in the red phase, the learning of the uppermost position (max) is initiated.

Outside these times, the learning process is interrupted.

7.4.2.1 Teach Set Point 1 (Min)

Move the MAX3 sensor to the lower set point (e.g. zero point) of the measuring distance and release the **TEACH** button during the green phase.

Set point 1 (Min position resp. zero point)



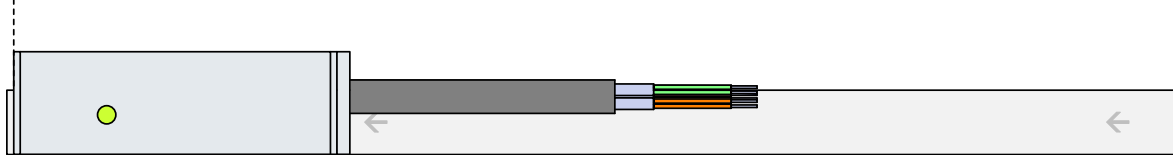
3 x flashing, followed by 3 x pressing the **TEACH** button → stores the lower set point.

This is confirmed by the LED with a single green hold for 1.5 seconds.

7.4.2.2 Teach Set Point 2 (Max)

Move the MAX3 sensor to the upper set point (maximum position) of the measuring distance and release the **TEACH** button during the red phase.

Set point 2 (Max position)



6 x flashing, followed by 6 x pressing the **TEACH** button → stores the upper set point.

This is confirmed by the LED with a single green hold for 1.5 seconds.

- After a successful learning sequence, the current position values are stored in non-volatile memory.
- The MAX3 system is ready for operation with the newly taught-in scaling.

7.4.2.3 Possible causes of faulty teaching

If after teaching a set point, the LED finally appears red instead of green for 1.5 seconds, the key sequence was not correct and the learning process is discarded. The learning process will also be denied if:

1. No valid position is measured.
2. The max position is to be learned, but the current position is below the min position already stored.
3. The min position is to be learned, but the current position is higher than the already stored max position.

An invalid learning process is indicated by ten slow changes between red - green - red.

8 Connections and Interfaces

8.1 Connection Options

Standardly the MAX3 measuring system is supplied with open cable ends (see figure 9).
Optionally, a 5-pin M12 round connector can be equipped (see figure 10 / order information see 0).

8.1.1 Open Cable Ends (Standard)

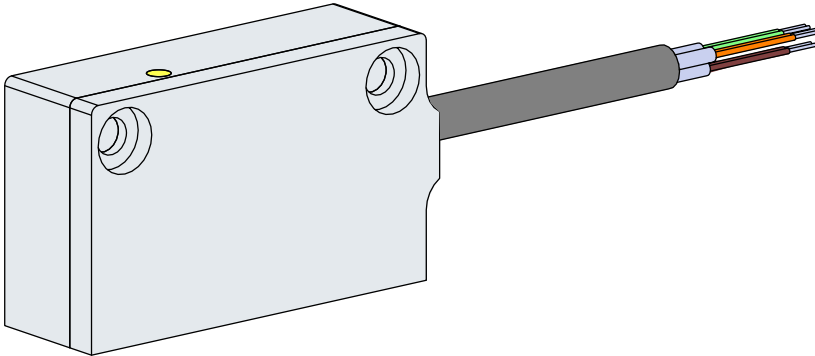


Figure 9: Standard connection - open cable ends

8.1.2 5-pin (male) M12 Round Connector (Option R5M0)

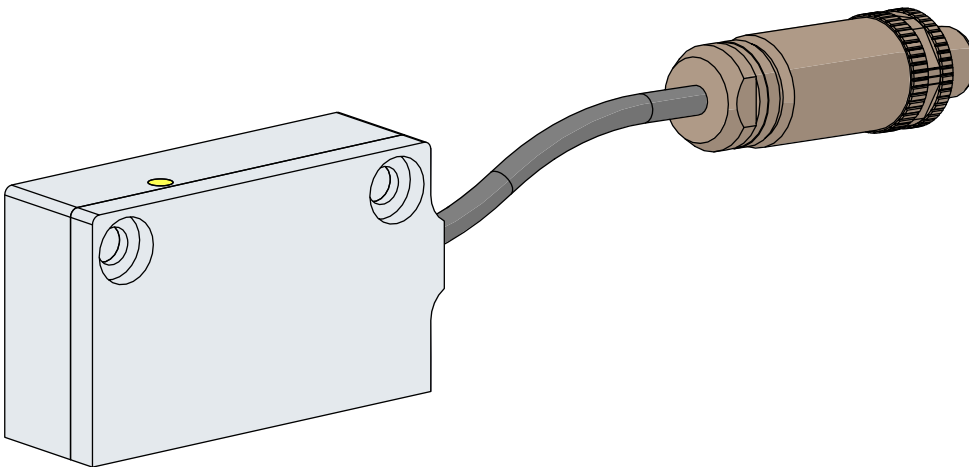


Figure 10: Connection option R5M0 (5-pin round connector)

8.2 Analog Output

The 12 bit analog output operates proportional to the position value. Depending on the selected interface option (see 0) the output is designed for operation with voltage or current.

8.2.1 Analog Output Scaling

The resolution to the analog interface is 700 μm . In the delivery state, each position increment of 700 μm corresponds to a change of one bit in the DAC value.

In order to adapt the system to the desired application, two positions must be learned during commissioning (TEACH procedure). The lowest TEACH position (min) and all lower TEACH positions are assigned to the DA converter value "0". The uppermost TEACH position (Max) and all positions above are assigned to the DAC value "4095". Within the two TEACH positions, each internal position step of 700 μm corresponds to a DAC change of 4095 / (uppermost teach position - lowermost teach position).

For more information about the TEACH positions, see 7.4.2 Calibration for Versions with Analog Output.

8.2.2 Connections Analog Output

The connections are made via open cable ends.

Table 3: Connections - Analog output (open cable ends)


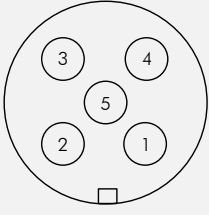
Connection Type	Drawing	Pin	Function	Description
Standard: Open cable ends		black	0 V / GND	Ground
		brown	+VCC	10 ... 30 VDC
		red	TEACH	Teach input
		orange	-	n. c.
		green	Analog OUT	+ Volt / + mA
		yellow	Analog GND	- Volt / - mA

Table 4: Connections - Analog output (Option R5M0)

Connection Type	Drawing	Pin	Function	Description
Option R5M0: 5-pin M12 round connector		1	TEACH	Teach input
		2	+VCC	10 ... 30 VDC
		3	0 V / GND	Masse
		4	Analog OUT	+ Volt / + mA
		5	Analog GND	- Volt / - mA
With shielded versions, the shield is connected to the housing				

8.3 CANopen Interface

When ordering the CA0 interface option, the MAX3 measuring system is equipped with a CAN interface according to CANopen standard DS406 for encoder device profiles.

The CAN interface is terminated internally with a 120 Ω terminating resistor as standard. If no internal termination is required, the additional option "A" must be specified with the order (☞ 0).

In order to start the communication with the MAX3 an NMT command has to be sent first. The following identifiers are given:

CAN - Identifier
(6 Byte telegram)

181 (16) = Identifier
First 4 bytes = Position (resolution 1 mm), Bit rate = 250 KB/s*
Next 2 bytes = Speed in mm/s

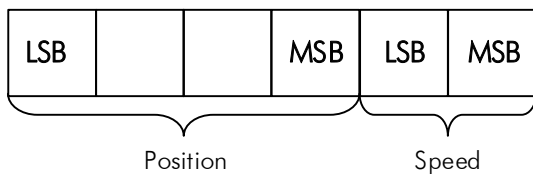


Figure 11: CANopen interface

*) The bit rate and other parameters can be changed via CAN interface. Available CAN options and further information about the DS406 device profile can be found in the downloadable EDS and XDD file.
Download link: https://www.elgo.de/fileadmin/user_upload/software/MAX3_DS406.zip

8.3.1 Connections CAN Interface

Table 5: Connections - CANopen - (open cable ends)

Connection Type	Drawing	Color	Function	Description
Standard: Open cable ends		black	0 V / GND	Ground
		brown	+VCC	10 ... 30 VDC
		red	-	n. c.
		orange	-	n. c.
		green	CAN HIGH	positive CAN signal
		yellow	CAN LOW	negated CAN signal
		blank	Shield	CAN shielding

Table 6: Connections - CANopen (Option R5M0)

Connection Type	Drawing	Pin	Function	Description
Option R5M0: 5-pin M12 round connector		1	Shield	CAN shielding
		2	+VCC	10 ... 30 VDC
		3	0 V / GND	Ground
		4	CAN HIGH	positive CAN signal
		5	CAN LOW	negated CAN signal

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 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 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

In principle, cleaning with a damp cloth is recommended, without the use of aggressive cleaning agents. Otherwise, a cleaning method according to the protection class (☞ 6.3) must be selected.

- The degree of protection is IP65 and therefore offers protection against water jets.

10 Type Designation

MAX3 - 00 - 01.5 - 1000 - 0x - x - x -

Designation:

MAX3 = Magnetic Absolute Encoder

Version:

00 = standard version

01 = first special version (etc.)

Cable Length (max. 10.0 m):

015 = 1.5 m (standard)

050 = 5.0 m (example)

Resolution in μm :

1000 = 1000 $\mu\text{m} \cong 1 \text{ mm}$

Supply / Level:

0x = 10 - 30 VDC / x

Connection Options:

- - - - = open cable ends (standard)

M12M0 = 5-pin (male) M12 round connector

Protection Class:

V = IP65

2098 - CO0 x x - 250K - 1 - x - P000

Pole Pitch in μm :

2098 = 2098 $\mu\text{m} \cong 2.098 \text{ mm}$

Interface 1:

I20 = 12 bit analog output (0 ... 20 mA)

I24 = 12 bit analog output (4 ... 20 mA)

V04 = 12 bit analog output (0.5 ... 4.5 V)

V10 = 12 bit analog output (0 ... 10 V)

CO0 = CANopen interface (DS406 encoder profile)

Termination:

T = with termination resistor only for CANopen

Galvanic isolation:

G = galvanic isolated only for CANopen

Bit Rate (only for CAN interface):

125k = 125000 bit/s

250k = 250000 bit/s

500k = 500000 bit/s

1MHz = 1000000 bit/s

Device Address:

0 = device address 0

1 = device address 1

Interface 2:

x = not available

Parameter:

P000 = parameter setting 000



REMARK:

When ordering, please use the code above. Options that are not required are not to fill in.

10.1 Accessories

Table 7: MAX3 accessories

Order Designation	Description
AB20-21-10-1-R-D-10	10 mm wide magnetic tape for MAX3 (max. measuring length = 2450 mm). <i>Order length = measuring length + 52 mm (sensor length) + 50 mm (end caps)</i>
End cap set 10 mm	2 end caps (10 mm) and 2 x M3 screw; for additional fixation of the magnetic tape, as well as for the protection of the magnetic tape ends.
AB20-21-20-1-R-D-10	20 mm wide magnetic tape for MAX3 (max. measuring length = 2450 mm). <i>Order length = measuring length + 52 mm (sensor length) + 50 mm (end caps)</i>
End cap set 20 mm	2 end caps (20 mm) and 2 x M3 screw; for additional fixation of the magnetic tape, as well as for the protection of the magnetic tape ends.
FS-1000, FS1500 or FS2000	Guide rail, suitable for 10 and 20 mm wide magnetic tape. Available lengths are 1.0 m, 1.5 m and 2.0 m. The rails can be lined up for higher measuring lengths.
710000130	PSF 30 x 30 mm pole finder foil for magnetic tapes

Notes:

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