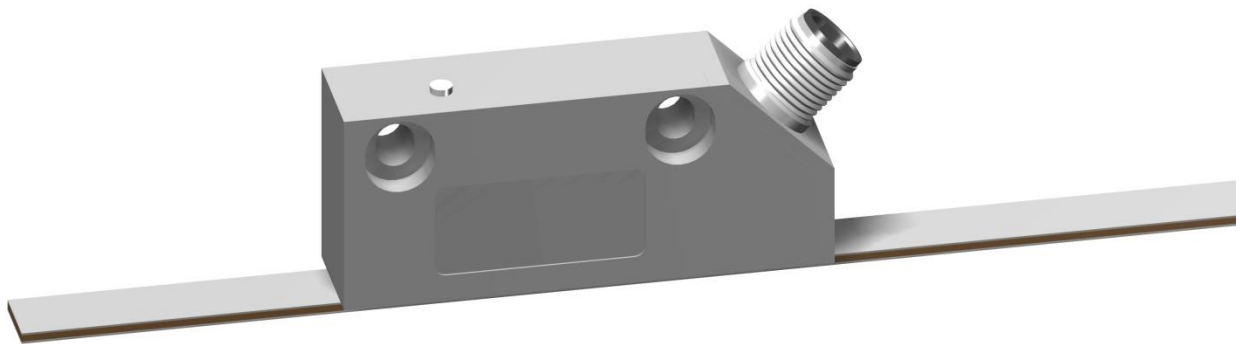


Operating Manual

SERIES EMAX2

Magnetic Absolute Length Measuring System with LED Distance Detection



- Absolute encoder with 10 μm resolution
- Direct and contact free measurement
- Measuring length up to 10 m possible
- No referencing required (position changes are also recognized in the de-energized state)
- Too large distances between sensor and magnetic tape are detected automatically and signaled by an LED
- Additional incremental square wave or sine-cosine signals for dynamic movement control available
- Available interfaces are SSI (binary or Gray code), RS422, addressable RS422, CANopen (DS406) or CAN with basic ELGO protocol

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Document- No. 799000830

Document- Name EMAX2-00-MA-E_03-22

Document- Revision Rev. 5

Issue Date 2022-01-20

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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 EMAX2 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

The EMAX2 series is an absolute length measuring system. Sensor, translator and interpolation unit are placed together in a compact zinc die-cast housing. The absolute coded magnetic tape is paste up to a plain area.

The EMAX2 linear encoder can be mounted with a maximum distance of 1.5 mm to the magnetic tape. With a reduced measuring accuracy the sensor distance can be up to 2.0 mm. The measuring length of the EMAX2 can be up to 10 meters.

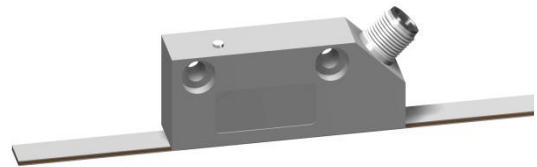
Typical applications are handling systems, conveyor and storage technology, hydraulic presses, stamping machines, casting machines, linear slides, linear drives and pick and place systems.

The absolute measuring system offers decisive advantages:

An important advantage of the EMAX2 is the compact design, which makes the system equally suitable for retrofitting into existing plants as well as for new installations. Due to the absolute measuring principle, the zero point only needs to be set once. Then no further referencing is required. Furthermore, the measuring system impresses with its non-contact and completely wear-free scanning and insensitivity to dust and dirt. To meet the higher degree of protection IP65, the EMAX2 sensor can be supplied as sealed version (option V).

Essential features are:

- Absolute Measurement: no referencing required, position changes are also recognized in the de-energized state
- Resolution 0.01 mm
- Contactless measuring principle
- Measuring length up to 10 m possible
- Automatic distance monitoring: an LED signalizes too large distances between sensor and magnetic tape
- Additional incremental square wave or 1 Vpp sine-cosine signals for dynamic movement control available



The EMAX2 sensors can be equipped with different interfaces. It is possible to choose between SSI (optionally as Gray or binary code), RS422 resp. addressable RS422 or CANopen according to the "DS406" encoder profile or CAN interface according to the ELGO CAN standard protocol. See section 8 for more information.

5.1 Functional Principle

A Hall sensor and a magneto-resistive impedance measuring bridge are guided over a two-track magnetic tape with a fine-interpolation trace and an absolute trace. Together with the sensor line the absolute track provides an absolute value and the fine-interpolation track provides together with the interpolation electronic the measuring systems high resolution.

The fine interpolation track encloses alternately north and south pole elements with a distance of 5 mm. These are scanned with resistance measuring bridges and provide a resolution of 0.01 mm. The absolute value is provided by the sensor line with 16 single Hall sensors; these sensors are scanning the code sections of the north and south poles. The absolute value on the magnetic tape repeats itself every 10 m with EMAX2.

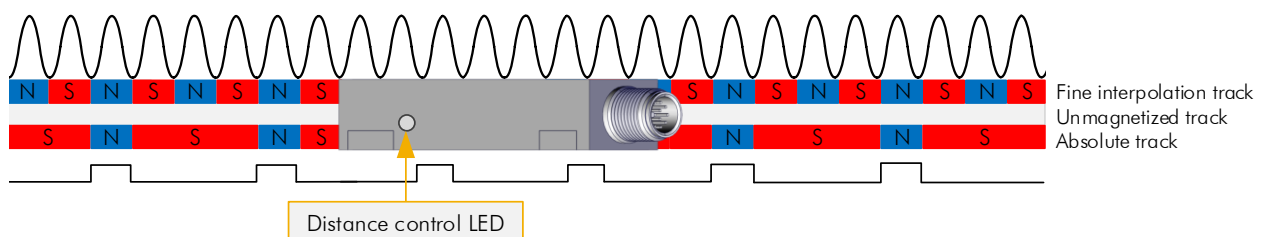


Figure 1: Functional principle of EMAX2

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 ☞ 11) 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

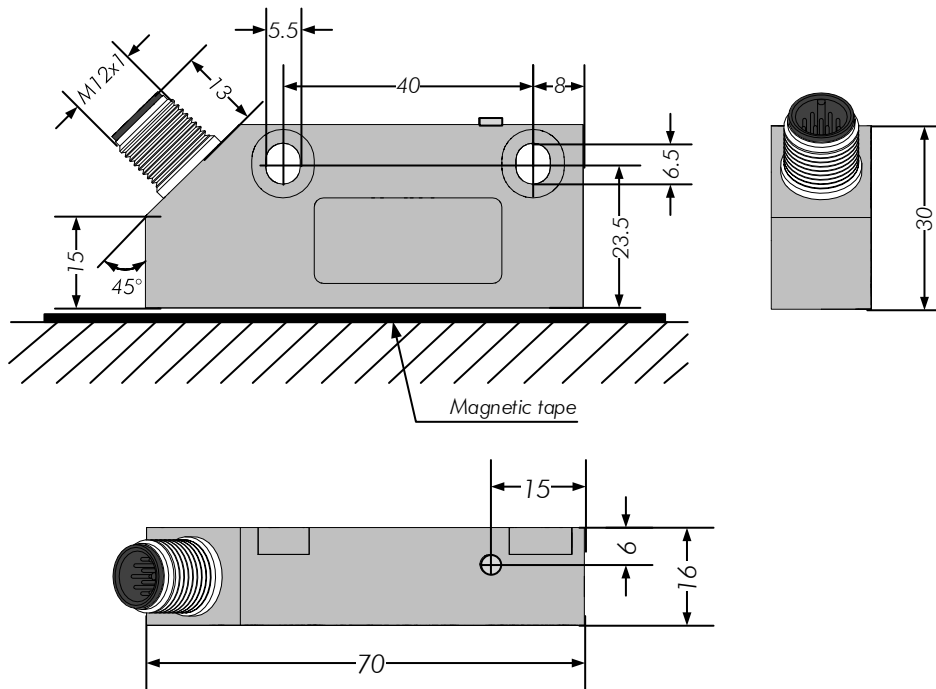


Figure 2: Dimensions sensor

6.3 Technical Data Sensor

EMAX2 (standard version)

Mechanical Data

Measuring principle	absolute
Repeat accuracy	±1 increment
System accuracy in μm at 20° C (L = measuring length in meters)	Standard resolution 010: ($\pm 150 + 20 \times L$), Resolution option* F10: ($\pm 75 + 20 \times L$) *) resolution options see type designation ↗ 11
Distance sensor - magnetic tape	max. 1.5 mm (2.0 mm at reduced measuring accuracy)
Basic pole pitch	5 mm
Sensor housing material	zinc die-cast
Sensor housing dimensions	L x W x H = 70 x 16 x 30 mm
Required magnetic tape	AB20-50-10-2-R-11
Maximum measuring length	10 m
Connections	12-pin round connector M12 (external)
Sensor cable	- DKA cable (accessory) length = 5 m (others on request) - fixed cable outlet in desired cable length available on request
Weight	approx. 50 g (without cable); cable approx. 60 g/m (accessory)

Electrical Data

Power supply voltage	10 ... 30 VDC
Residual ripple	10 ... 30 VDC < 10 %
Current consumption	max. 150 mA
Interfaces	SSI (Gray or binary), RS422, addressable RS422, CANopen (DS406 encoder profile) or CAN BASIC ELGO
Resolution	0.01 mm
Operating speed	max. 4 m/s

Environmental Conditions

Storage temperature	-20 ... +85° C
Operation temperature	-10 ... +70° C (-25 ... +85° C on request)
Humidity	max. 95 %, not condensing
Protection Class	IP40 (standard) IP65 (option V) Higher protection class on request

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 AB20-50-10-2-R-11





Coding	absolute, dual track system
Pole pitch	5 mm
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
Relative humidity	max. 95 %, non-condensing
Accurateness 20°C in µm	(± 150 + 20 x L) (standard 010 ↗ 11) (± 75 + 20 x L) (option F10 ↗ 11) 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
Dimensions (W x H)	→ with carrier tape, without adhesive tape: 10 mm (± 0,1) x 1.35 mm (± 0.11) → with carrier tape + adhesive tape, without protection foil: 10 mm (± 0,1) x 1.56 mm (± 0.13) → with carrier tape + adhesive tape + protection foil: 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)
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 ≥ 5 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 tape.
Protection class	IP65

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 MB20-50-10-1-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 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

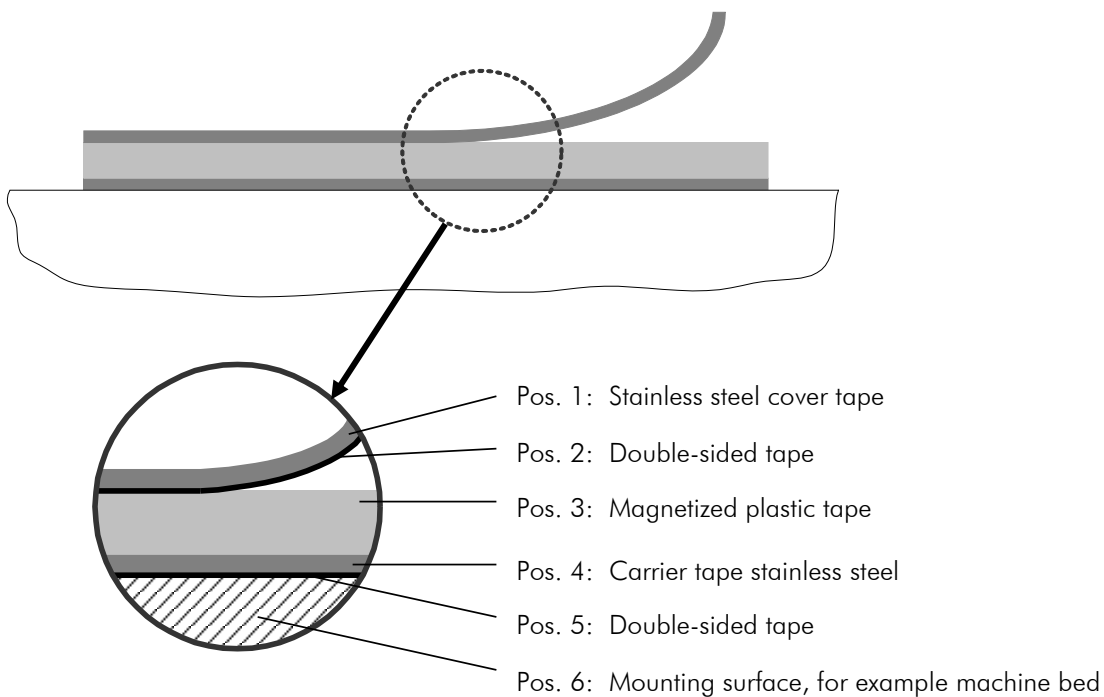


Figure 3: Components of the magnetic tape

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.

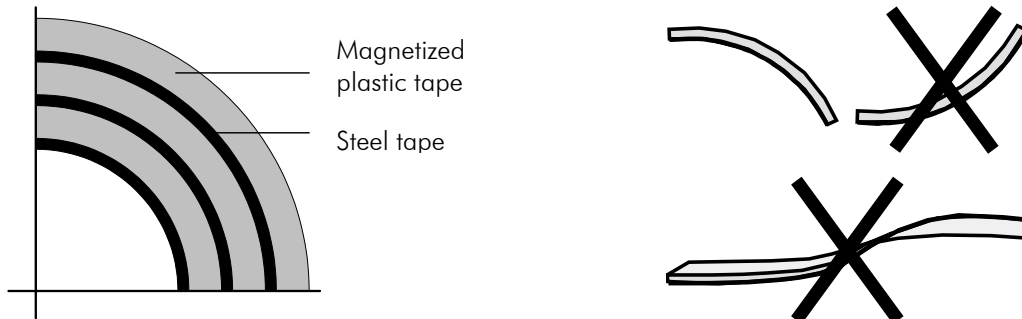


Figure 4: Magnetic tape handling

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

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

$$\text{Length cover tape} = \text{measuring length} + \text{sensor length} + 50 \text{ mm (end caps)}$$



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 (☞ 11.1) 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 (☞ 11.1)

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

7.3.1 Mounting direction of the EMAX2 sensor on the magnetic tape

Since the magnetic tape has two magnetized tracks, the sensor and magnetic tape must always be mounted in the correct direction in order to obtain correct measurement results. **Marking arrows on the tape and sensor clearly indicate the correct mounting direction.** The pole finder foil, which is available as an accessory (☞ 11.1) and is placed on the magnetic tape, can also be used to determine the respective pole pitches. The pole pitches result in the following mounting direction:

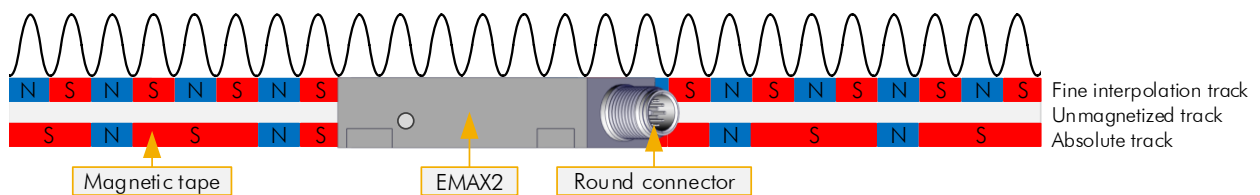


Figure 5: Mounting direction of sensor and tape

7.3.2 Mounting tolerances



REMARKS!

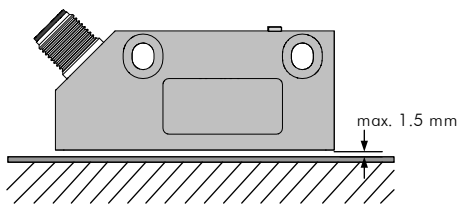
- Ensure correct distance between sensor and magnetic tape 0.1 mm ... max. 1.5 mm!
- With reduced measuring accuracy, a distance of up to 2.0 mm is also possible. The LED on the sensor housing lights RED as soon as this distance is exceeded.
- The direction arrow on sensor & tape must point in the same direction during installation.
- Observe the specified tolerances when installing the system!
Outside these areas the function is not guaranteed!

Mount the sensor with two M5 cylinder head screws of suitable length (see 6.2).

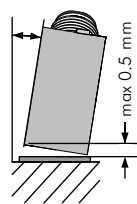
Table 2: Mounting tolerances

Tolerances	
Magnetic tape type	AB20-50-10-2-R-11
Distance sensor - tape	max. 1.5 mm (max. 2.0 mm at measuring accuracy)
Pitch	The maximum permissible reading distance must not be exceeded at any position
Yaw angle	$< \pm 1.0^\circ$
Roll	The maximum permissible reading distance must not be exceeded at any position
Lateral offset	± 0.5 mm

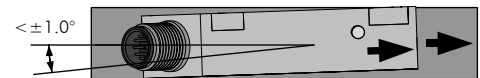
Sensor distance



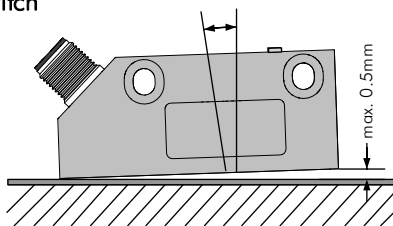
Roll



Yaw angle



Pitch



Lateral offset

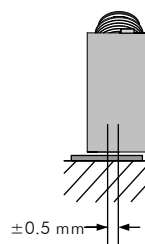


Figure 6: Mounting tolerances of the sensor

7.3.3 Offset Calibration

After mounting and connecting the magnetic tape and measuring system (sensor head), a value is transmitted via the interface. Since this does not correspond to the machine zero point, it should be possible to store an offset on the control side.



NOTE!

An offset calibration is necessary in each case of a replacement of the EMAX2 encoder (sensor head) or magnetic tape.

8 Interfaces

8.1 SSI (Options SB0 and SG0)

Principle of the function: 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 frequencies up to max. 250 KHz can be ensured.

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

With EMAX2 the PFB is always „LOW“, unless the maximum allowed distance from sensor to tape is exceeded.

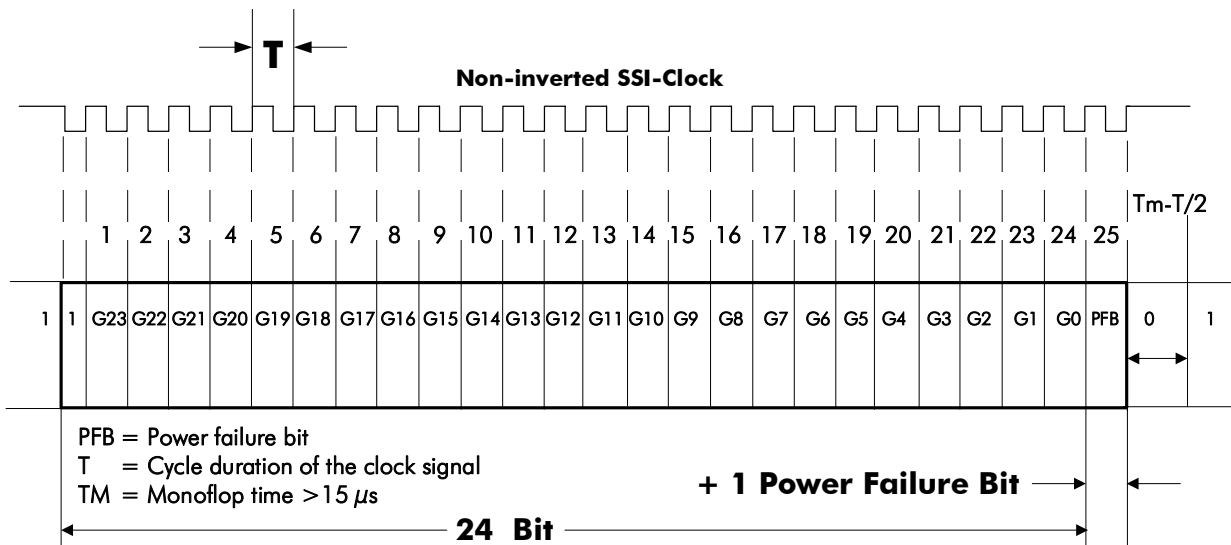
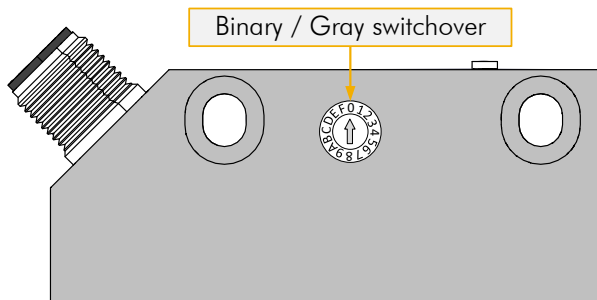


Figure 7: SSI: Reading the data

8.1.1 SSI - Binary / Graycode switchover

On the side of the sensor housing is a rotary coding switch (under a protective cap), which serves to switch the data format of the SSI interface between binary and Gray code.



Position	Code
F	binary
0	Gray

Figure 8: SSI: Rotary coding switch Gray / binary

8.1.2 SSI - Terminating Resistor

For variants equipped with an SSI interface, the clock line (receiver) is always terminated with an internal 120 Ω terminating resistor.

8.2 CANopen (Option CA0)

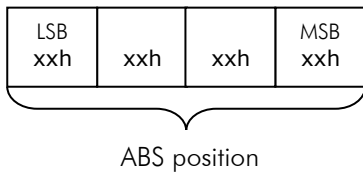
When ordering option “CA0”, the encoder is equipped with a CAN interface according to the CANopen standard “DS406 encoder profile”. To start the communication with the EMAX2 (start sending) an NMT command must be given first. The following identifiers are given:

CAN - Identifier
(4 Byte Telegram)

181 h (16) = Identifier

4 Bytes = Position

Bit rate = depends on order information (☞ 11 “Type Designation”) resp. setting (☞ 8.2.1)



All available CAN options and information about the DS406 device profile can be found in the corresponding EDS or XDD file. Download: https://www.elgo.de/fileadmin/user_upload/software/EMAX_DS406.zip

Figure 9: CAN interface

8.2.1 CANopen: Set Identifier and Bit Rate

Two rotary coding switches are located on the side of the sensor housing (each under a protective cap). The desired bit rate can be set with the left rotary coding switch, while the right switch is used to set the CAN identifier from 181₍₁₆₎ to 18F₍₁₆₎.

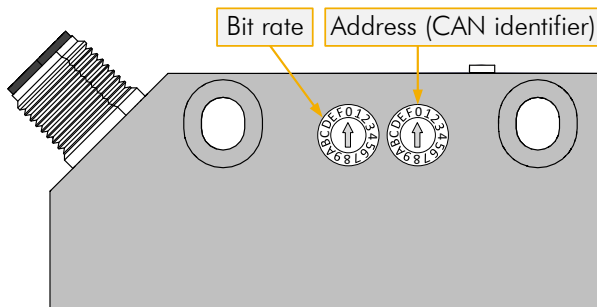


Figure 10: Rotary coding switches for CANopen bit rate and identifier

Table 3: CANopen: bit rate and identifier settings

Position	Bit rate (left)	Position	CAN identifier (right)
0	-	0	Identifier from memory
1	-	1	181
2	-	2	182
3	-	3	183
4	-	4	184
5	-	5	185
6	-	6	186
7	-	7	187
8	Bit rate from memory	8	188
9	1 MBit/s	9	189
A	800 kBit/s	A	18A
B	500 kBit/s	B	18B
C	250 kBit/s	C	18C
D	125 kBit/s	D	18D
E	100 kBit/s	E	18E
F	50 kBit/s	F	18F

8.3 CAN BASIC ELGO (Option CN0)

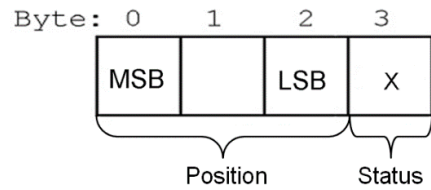
Interface / Protocol:

When ordering option "CN0", the EMAX2 encoder is equipped with a CAN interface according to the ELGO CAN standard protocol. The following identifiers are given:

Table 4: Identifier option CN0

80 (16) + EMAX2 address	Identifier to request the absolute position
10 (16) + position of rotary coding switch (4 byte telegram)	Identifier contains absolute position of the device EMAX2 (resolution 0.01 mm)

4 byte acknowledgement telegram



Status
X = 0 → no error
X = 1 → error magnetic tape

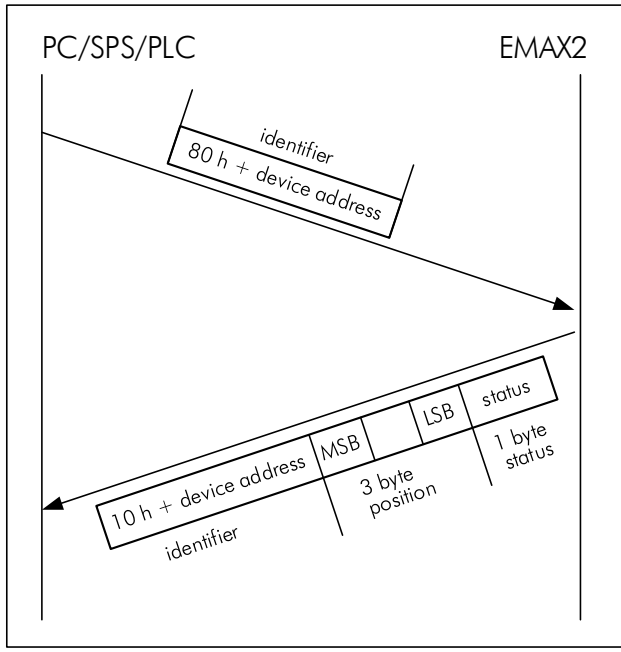
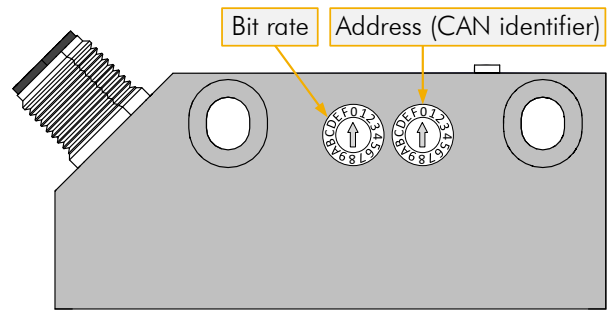


Figure 11: Rotary coding switches for bit rate and address

The bit rate and address are set by using the two rotary coding switches (on the side under a protective cap).

Table 5: CAN ELGO-Basic: Bit rate and address settings

Position	Bit rate (left)	Position	EMAX2 address (right)
0	1 MBit/s	0	0
1	500 kBit/s	1	1
2	250 kBit/s	2	2
3	125 kBit/s	3	3
4	100 kBit/s	4	4
5	-	5	5
6	-	6	6
7	-	7	7
8	-	8	8
9	-	9	9
A	-	A	A
B	-	B	B
C	-	C	C
D	-	D	D
E	-	E	E
F	-	F	F

8.4 CAN - Termination Resistor

For variants with CAN interface, standardly a terminating resistor of 120 Ω is equipped in the interface input. If no internal terminating resistor is required, the "Additional option A" (without terminating resistor) must be specified when ordering.

8.4.1 Example of a Follow-Up Circuit

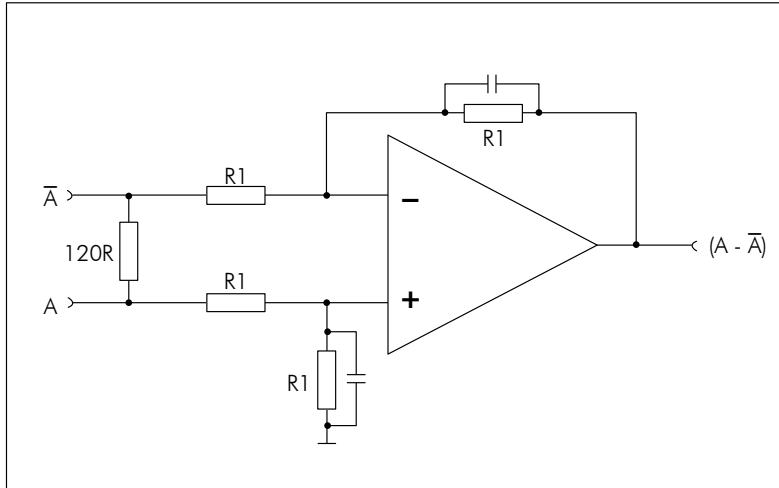


Figure 12: CAN example of a follow-up circuit

8.5 RS422 (Option 420)

Depending on the order specification the encoder can be equipped with a RS422 (option "420"). The desired bit rate can be set using the rotary coding switch located on the side of the housing (under a protective cap):

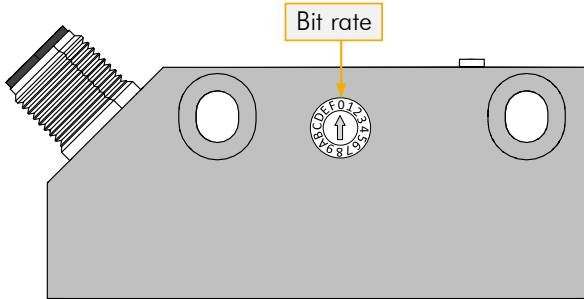


Figure 13: Code switches for RS422

Table 6: RS422: bit rate settings

Position	Bit rate
8	9600 Bit/s
9	600 Bit/s
A	1200 Bit/s
B	2400 Bit/s
C	4800 Bit/s
D	19200 Bit/s
E	38400 Bit/s
F	115200 Bit/s

The data transmission has the following format:

1 Start Bit / 8 Data Bits / 1 Stop Bit / No Parity

Data protocol:

The actual value is transmitted with the programmed bit rate, 8 Data bits, 1 Stop bit, without parity bit in the following format:

02h STX

xxh ABS data MSB

xxh ABS data

xxh ABS data LSB

03h ETX

00h

0Dh

The scanned absolute position is shown binary with 0.01 mm resolution in the 3 ABS data bytes.

Standard	9600 Baud, 8 data bits, 1 stop bit, no parity 7 bytes, 02 MSB MSB-1 LSB 03 00 0D
	<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> ↑ STX </div> <div style="text-align: center;"> ↑ binary position value </div> <div style="text-align: center;"> ↑ ETX </div> </div>

Other protocols on request.

8.6 Addressable RS422 Version (Option A20)

By using the rotary coding switches on the housing side (under a protective cap), the bit rate and the device address can be set in the range of 0B... 1A:

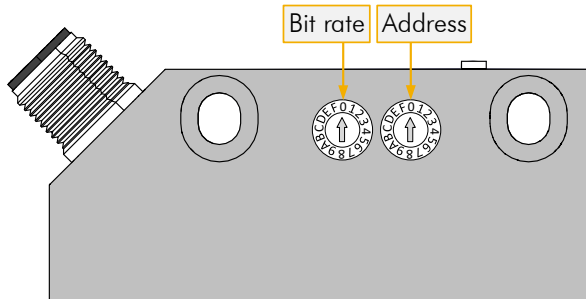


Figure 14: Code switches for addressable RS422

Table 7: Addressable RS422: bit rate and address settings

Position	Bit rate (left)	Position	EMAX2 address (right)
0	9600 Bit/s addressable [Adrb]	0	0B
1	600 Bit/s Adrb	1	0C
2	1200 Bit/s Adrb	2	0D
3	2400 Bit/s Adrb	3	0E
4	4800 Bit/s Adrb	4	0F
5	19200 Bit/s Adrb	5	10
6	38400 Bit/s Adrb	6	11
7	115200 Bit/s Adrb	7	12
8	9600 Bit/s auto-sending [Asnd]	8	13
9	600 Bit/s Asnd	9	14
A	1200 Bit/s Asnd	A	15
B	2400 Bit/s Asnd	B	16
C	4800 Bit/s Asnd	C	17
D	19200 Bit/s Asnd	D	18
E	38400 Bit/s Asnd	E	19
F	115200 Bit/s Asnd	F	1A

Protocol of an addressable EMAX2:
General format of a message to the EMAX2:

0x02	Byte1	Byte2	Byte3	0x03
STX			check	ETX

0x02 (STX) starts a message

0x03 (ETX) close the message

Byte3 (check) is the arithmetic sum of 0x02(STX), Byte1 and Byte2.

ETX is not included in the checksum

General format of a message from the EMAX2:

0x02	Byte1	Byte2	Byte3	Byte4
STX				

Position-request from the EMAX2 with address i:
Message to the EMAX2

0x02	0x04	i	check	0x03
STX			check	ETX

0x04 characterizes the message as position-request

i is the address of the requested **EMAX2** ($i = 0x0b... 0x7f$).

Answer of the requested EMAX2:

0x02	PosHigh	PosMid	PosLow	EMAX2 address
------	---------	--------	--------	---------------

The position value consists of 3 byte:

PosLow (bit 0 ... bit 7), PosMid (bit 8 ... bit15), PosHigh (bit16 ... bit23).

Bit 0 has the value $10 \mu\text{m}$. Position-values are always smaller than 0xffff00.

Please note: The last byte is no ETX, like in all the other messages, but the **EMAX2** address.

Interrogation of the address of an EMAX2:

Connect always only a single **EMAX2** to be interrogated via RS422/RS232 converter to COM port of a PC.

Message to the EMAX2:

0x02	0x05	0x05	0x0c	0x03
STX	address request		check	ETX

Answer of the EMAX2:

0x02	0xff	0xff i	0x03
STX		EMAX2 address	ETX

Note: The combination 0xff 0xff does not appear in normal mode for position answers of EMAX2 (directly after STX) It is a sign for a special message not a position (in this case with $0x0b \leq i \leq 0x7f$ it is the answer to the interrogation of the address).

Negative answer: If one of the described operations failed for some reasons, the EMAX2 encoder will give a negative answer with a concerning error code.

EMAX2 answers:

0x02	0xff	0xff	Err	0x03
STX	0xff	0xff	Error Code	ETX

With Err = 0x04... 0x0a

Table 8: Error messages of an addressable EMAX2

Code	Description
0x04	Wrong succession of bytes sent to EMAX2 for example if the 4. byte after the STX is no ETX or the byte after STX is not 0x04, 0x05 or 0x06.
0x05	Receive Error: Error concerning the interface (for example if there has been sent a message with a wrong baud rate etc.)
0x06	Invalid EMAX2 address: appears while trying to assign an address less than 0x0b or greater than 0x7f
0x07	Lost EMAX2 Address: The check of the internal, redundant stored address is failed. This message is issued immediately after the reconnecting the power supply, if an error was found during reading out the EEPROM's or the problem cannot be resolved by an redundant stored address.
0x08	Internal EEPROM- storage error.
0x09	Error in calculation of position (No tape, tape damaged or to big distance)
0x0a	Check-Sum-Error - Check-Sum of a message sent to EMAX2 is wrong

8.7 Connection to a RS422 Master

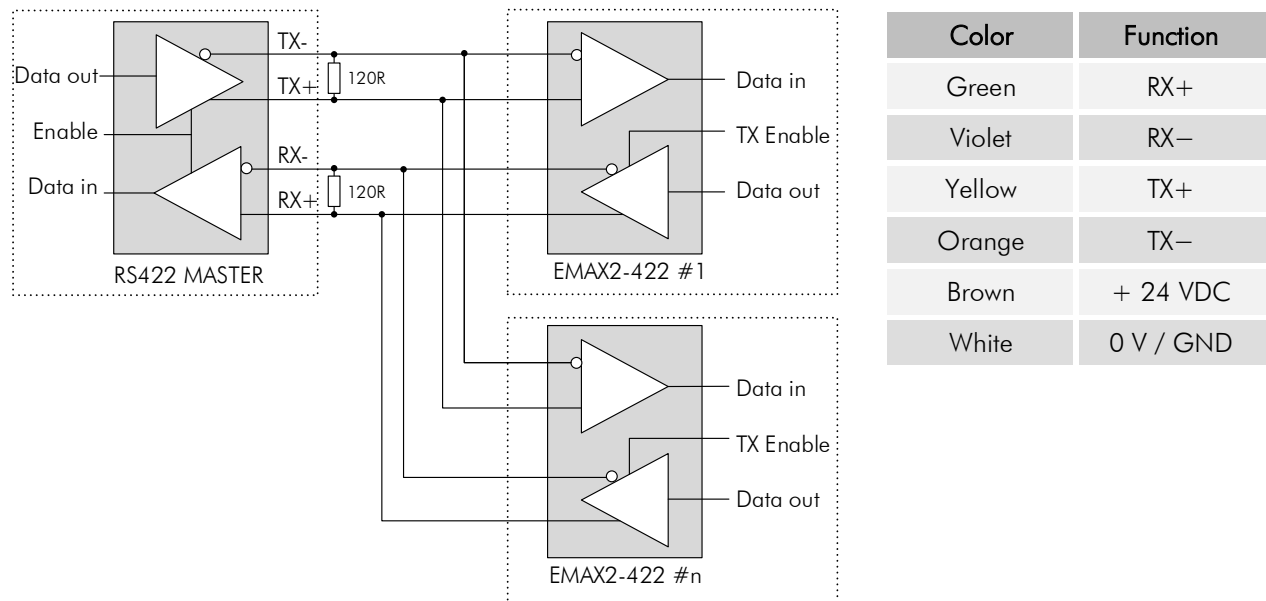


Figure 15: Connection to a RS422 Master

8.8 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 § 11 „Type Designation“.

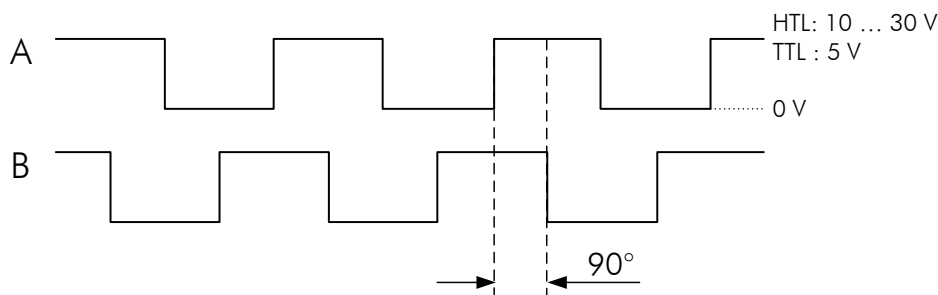


Figure 16: A/B - Incremental signals (TTL / HTL)

8.9 Incremental Sine-Cosine Signals (Option SC50)

Incremental sine/cosine output signals with 1 V_{pp} (push-pull, short-circuit proof) are also available as another option. Order specifications see § 11 „Type Designation.

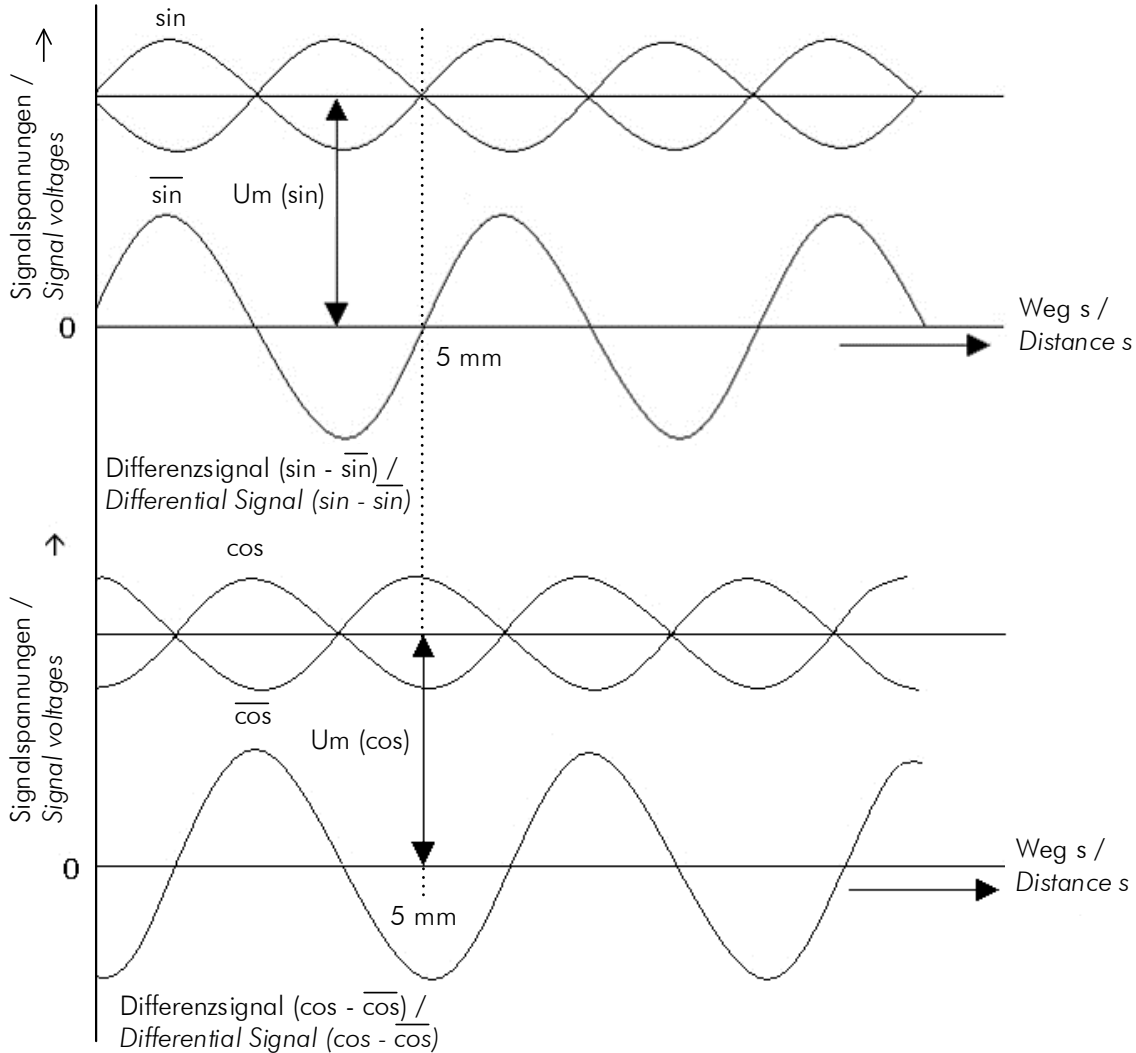


Figure 17: Incremental Sin-Cos output

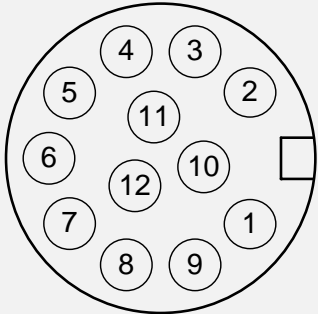
Table 9: Data of the Sin-Cos signal output

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

9 Connections

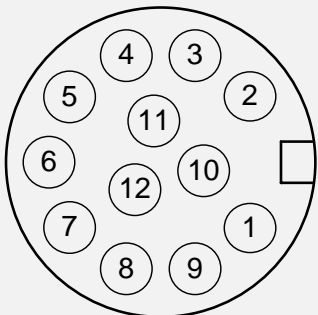
9.1 SSI (Interface Options SB0 and SG0)

Table 10: Connections of SSI / optionally with incremental signal outputs

Round connector 12-pol. M12 x 1	Pin	Function	Color of DKA cable (Accessory ☞ 11.1)
	1	0 V/GND	white
	2	10 ... 30 VDC	brown
	3	CLK +	green
	4	CLK –	yellow
	5	DATA +	grey
	6	DATA –	pink
	7	COS + or B +	blue
	8	COS – or B –	red
	9	SIN + or A +	black
	10	SIN – or A –	violet
	11	NC	-
	12	NC	-

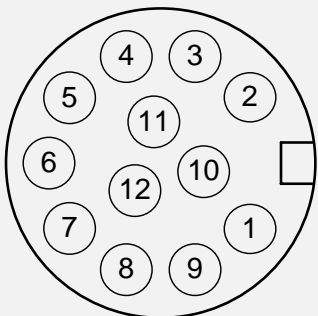
9.2 CANopen (Interface Option CA0)

Table 11: Connections of CANopen / optionally with incremental signal outputs

Round connector 12-pol. M12 x 1	Pin	Function	Color of DKA cable (Accessory ☞ 11.1)
	1	0 V/GND	white
	2	10 ... 30 VDC	brown
	3	CAN-L	green
	4	CAN-H	yellow
	5	NC	grey
	6	NC	pink
	7	COS + or B +	blue
	8	COS – or B –	red
	9	SIN + or A +	black
	10	SIN – or A –	violet
	11	NC	-
	12	NC	-

9.3 RS422 (Interface Options 420 and A20)

Table 12: Connections of RS422 / optionally with incremental signal outputs

Round connector 12-pol. M12 x 1	Pin	Function	Color of DKA cable (Accessory ☞ 11.1)
	1	0 V/GND	white
	2	10 ... 30 VDC	brown
	3	RX +	green
	4	RX –	yellow
	5	TX +	grey
	6	TX –	pink
	7	COS + or B +	blue
	8	COS – or B –	red
	9	SIN + or A +	black
	10	SIN – or A –	violet
	11	NC	-
	12	NC	-

10 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 10.1. 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).

10.1 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 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

10.2 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

10.3 Maintenance

The device is maintenance-free.

10.4 Cleaning



WARNING!

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

11 Type Designation

EMAX2	XX	XX	XXX	XXX	XXXX	X	XXXX	X	X	XXXX
	AA	BB	CCC	DDD	EEEE	F	GGGG	H	I	JJJJ

Series / Type: _____

EMAX2

Version No.: _____

00 = standard version

01 = 1. special version etc.

Signal Cable Length: _____

00 = standard version always without signal cable

XX = length in m (only with fixed cable outlet*)

*) fixed cable outlet only on request!

Resolution: _____

010 = 10 μm , with system accuracy in $\mu\text{m} \pm(150 + 20 \times L)$

F10* = 10 μm , with system accuracy in $\mu\text{m} \pm(75 + 20 \times L)$

Interface: _____

SB0 = SSI interface (25 Bit binary code)

SG0 = SSI interface (25 bit Gray code)

CA0 = CANopen (DS406)

CN0 = CAN BASIC ELGO

420 = RS422

A20 = addressable RS422

Bit rate: _____

09K6 = 9600 bit/s standard bit rate for RS422

19K2 = 19200 bit/s for RS422

38K4 = 38400 bit/s for RS422

125K = 125000 bit/s for CAN

250K = 250000 bit/s for CAN

500K = 500000 bit/s for CAN

1MHz = 1000000 bit/s for CAN

Additional Options:

Device address 0 ...F _____

0 = standard setting

= standard version always with 12-pin M12

round connector at the sensor housing

(fixed cable outlet on request)

Construction: _____

V = sealed IP65 construction (without rotary coding switches - please specify the desired configuration when ordering, as no further settings can be made afterwards)

Termination Resistor: _____

A = without internal termination resistor (CAN and A20 interface)

Incremental Signal Output: _____

H2N5 = HTL square wave signals with 2,5 μm resolution

H005 = HTL square wave signals with 5 μm resolution

H010 = HTL square wave signals with 10 μm resolution

H025 = HTL square wave signals with 25 μm resolution

T2N5 = TTL square wave signals with 2,5 μm resolution

T005 = TTL square wave signals with 5 μm resolution

T010 = TTL square wave signals with 10 μm resolution

T025 = TTL square wave signals with 25 μm resolution

SC50 = 1 Vss sine-cosine signals with 5 mm pole pitch

11.1 Order Examples

EMAX2	00	00	010	SB0	----	-	----	-	-	----
	AA	BB	CCC	DDD	EEEE	F	GGGG	H	I	JJJ

→ EMAX2 with 25 bit SSI interface, binary code

EMAX2	00	01	010	SG0	----	-	----	-	-	T005
	AA	BB	CCC	DDD	EEEE	F	GGGG	H	I	JJJ

→ EMAX2 with 25 bit SSI interface, Gray code, 1 m cable and TTL square wave signal output with 5 μ m resolution

EMAX2	00	00	010	CA0	125K	9	----	-	-	----
	AA	BB	CCC	DDD	EEEE	F	GGGG	H	I	JJJ

→ EMAX2 with CAN Open interface, bit rate 125 Kbit/s and device address 9



REMARK

When ordering, please use the described ordering code (see 11 "Type designation"). Options that are not required are filled in with "-".

PLEASE NOTE

The above division of the order code into blocks serves only for better illustration. Please always write your defined order code in one word and do not separate the blocks with hyphens, spaces or separators.

12 Accessories

Table 13: EMAX2 accessories

Order Designation	Description
AB20-50-10-2-R-11	Magnetic tape for EMAX2 (maximum measuring length = 10 m)
Magnetic tape end cap set 10 mm	2 end caps (10 mm) and two M3 screws; additional fixation in the radial and linear range, as well as for the protection of the magnetic tape ends
FS-1000	FS=guide rail (1000 = length in mm)
PNO1	SSI/ PROFIBUS Converter
DKA-00-RCF0-050-XXXX-12-T-D-S (Order specifications see below)	Signal cable for EMAX2: Device side with 12-pin M12 socket, cable length 5.0 m, customer side with open cable ends, 12-wire, twisted in pairs, drag chain suitable, with shield
POSU	Pole finder card 85 x 55 mm (makes the magnetic tape poles visible)

12.1 Type Designation DKA Signal Cable

DKA	-AA	-BBBB	-CCC	-DDDD	-EE	-F	-G	-H
<p>Version No.: _____</p> <p>00 = standard version 01 = 1. special version etc.</p> <p>Connections device side: _____</p> <p>RCF0 = M12 thread, 12 pin female round connector 0 = ELGO standard assignment</p> <p>Cable Length in decimeters: _____</p> <p>Available lengths: 050 = 5 m (standard), other lengths on request</p> <p>Connections customer side: _____</p> <p>XXXX = open cable ends, twisted and tinned RCM0 = M12 thread, 12-pin male round connector, 0 = ELGO standard assignment Other connectors on request</p> <p>Number of wires: _____</p> <p>08 = 8 wires (usable only for versions without additional incremental signal outputs) 12 = 12 wires</p> <p>Cable Design: _____</p> <p>T = Twisted pairs</p> <p>Suitability: _____</p> <p>D = Drag chain suitable</p> <p>Shield Braid: _____</p> <p>S = shielded N = not shielded</p>								

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Document- No.: 799000830 / Rev. 5
Document- Name: EMAX2-00-MA-E_03-22
Subject to change - © 2022
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