

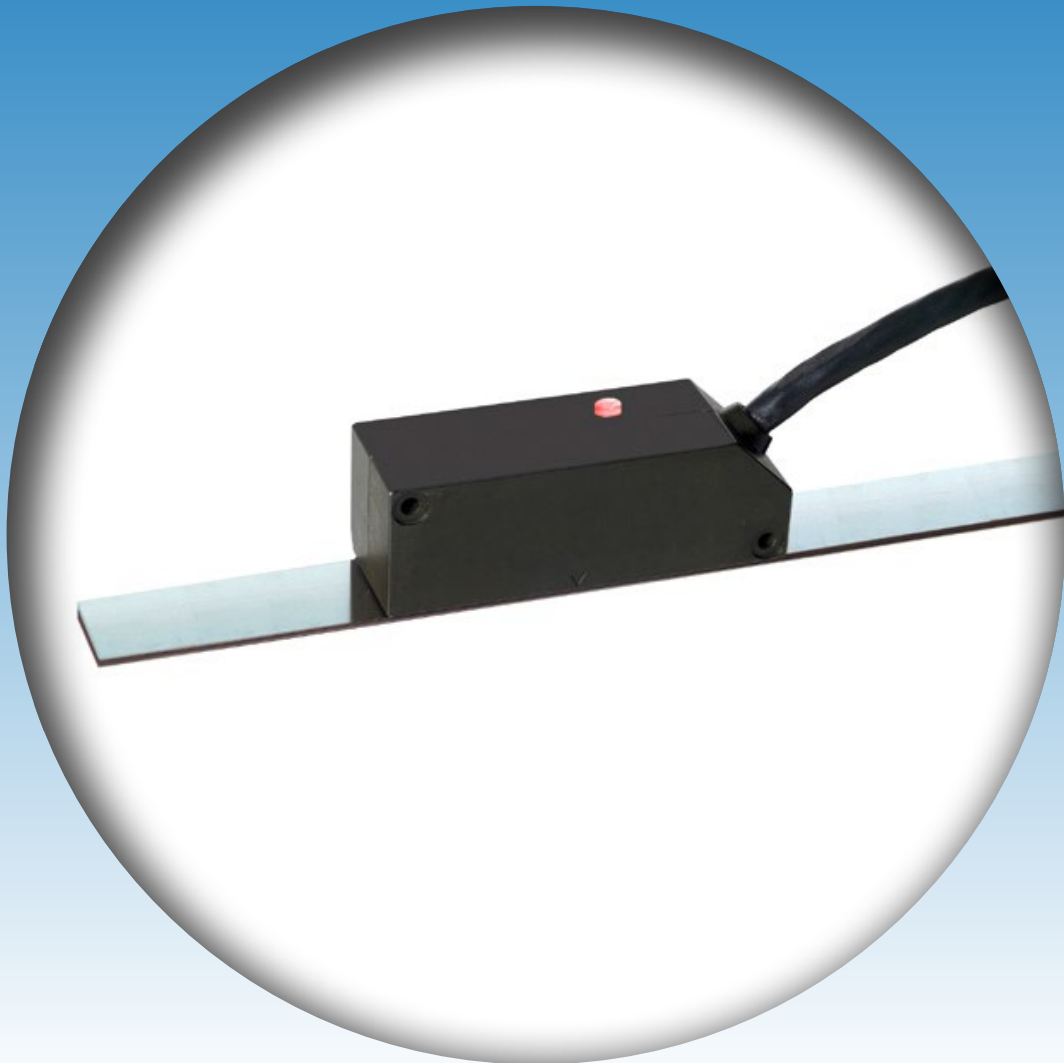
hohner

Elektrotechnik Werne

Operating Manual

Series EMAX / EMAL

Magnetic Absolute Length Measuring System



Your partner for standard and special designs
- precise, reliable and fast -

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2 General, Safety, Transport and Storage




2.1 Information Operating Manual

This manual contains important information regarding the handling of the device. For your own safety and operational safety, please observe all safety warnings and instructions. Precondition for safe operation is the compliance with the specified safety and handling instructions. Moreover, the existing local accident prevention regulations and the general safety rules at the site of operation have to be observed. Please read the operating manual carefully before starting to work with the device! It is part of the product and should be kept close to the device and accessible for the staff at any time. The illustrations in the manual are for better demonstration of the facts. They are not necessarily to scale and can slightly differ from the actual design.


2.2 Explanation of Symbols

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


Warning notes:

	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.
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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.

2.3 Statement of Warranties

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

2.4 Demounting and Disposal

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

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

Disposal:

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



CAUTION!

Wrong disposal causes environmental damages!

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

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

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.

2.5 General Causes of Risk

This chapter gives an overview of all important safety aspects to guarantee an optimal protection of employees and a safe and trouble-free operation. Non-observance of the instructions mentioned in this operating manual can result in hazardous situations.

2.6 Personal Protective Equipment

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

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

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

Protective clothing:



PROTECTIVE CLOTHING

... is close-fitting working clothing with light tear strength, tight sleeves and without distant parts. It serves preliminarily for protection against being gripped by flexible machine parts.

Do not wear rings, necklaces or other jewellery.



PROTECTIVE GLOVES

...for protecting the hands against abrasion, wear and other injury of the skin.



PROTECTIVE HELMET

...for protection against injuries of the head.

2.7 Conventional Use

The product described in this manual was developed to execute safety-related functions as a part of an entire assembly or machine. The ELGO-device is only conceived for the conventional use described in this manual. The ELGO EMAX / EMAL linear encoders only serve to measure lengths.



CAUTION!

Danger through non-conventional use!

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

Therefore:

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

Avoid in particular:

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

Claims resulting from damages due to non-conventional use are not possible.

Only the operator is liable for damages caused by non-conventional use.

2.8 Safety Instructions for Transport, Unpacking and Loading



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

2.9 Handling of Packaging Material

Notes for proper disposal: ↗ 2.4

2.10 Inspection of Transport

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

In case of externally recognizable transport damages:

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



NOTE!

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

2.11 Storage

Store the device only under the following conditions:

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

3 Product Features

The series EMAX / EMAL is an absolute length measuring system. Sensor and translator and interpolation unit are together in the same compact housing. The magnetic tape of series EMAB is paste up to a plain area. The EMAX / EMAL encoders 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 only difference between EMAX and EMAL is the maximum measuring length:

- EMAX up to 10 m
- EMAL up to 20 m

Different interfaces are available, e.g. SSI or CANopen (DS406).

More information about available interfaces [☞ 6](#)

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 guided version is delivered completely with magnetic tape guide and a guide carriage.

Overview of features:

- no referencing required
- direct contact free measurement
- distance between sensor and magnetic tape can be between 0.1 ... 1.5 mm
->Distance not ok = red LED on
- measuring length up to 10 m (EMAX) resp. 20 m (EMAL)
- high resolution 10 μm
- repeat accuracy +/- 1 increment
- very resistant against dirt

3.1 Functional principle

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

The fine interpolation trace encloses alternately north and south pole traces with a distance of 5 mm, these are scanned with resistance bridges and provide a resolution of 0.01 mm. The absolute value provides the sensor line with 16 single Hall sensors; these sensors are scanning the code sections of the north and south poles. The absolute value on the magnetic tape recurs every 10 m with an EMAX resp. every 20 m with an EMAL system.

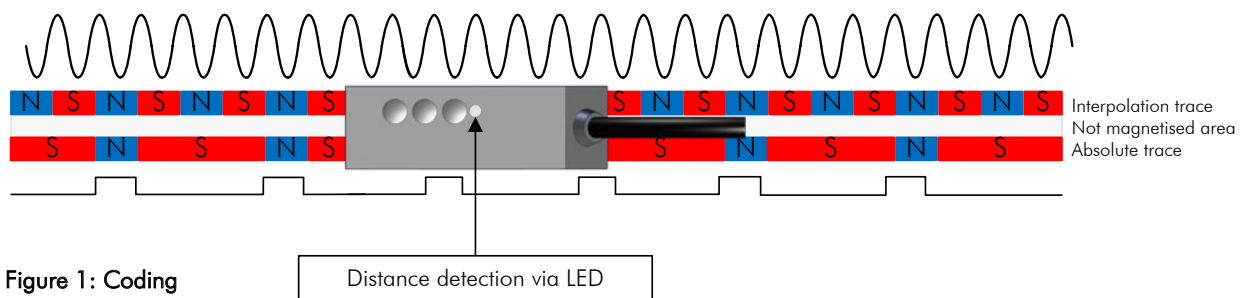


Figure 1: Coding

Distance detection via LED

4 Technical Data

4.1 Identification

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

4.2 Dimensions Sensor

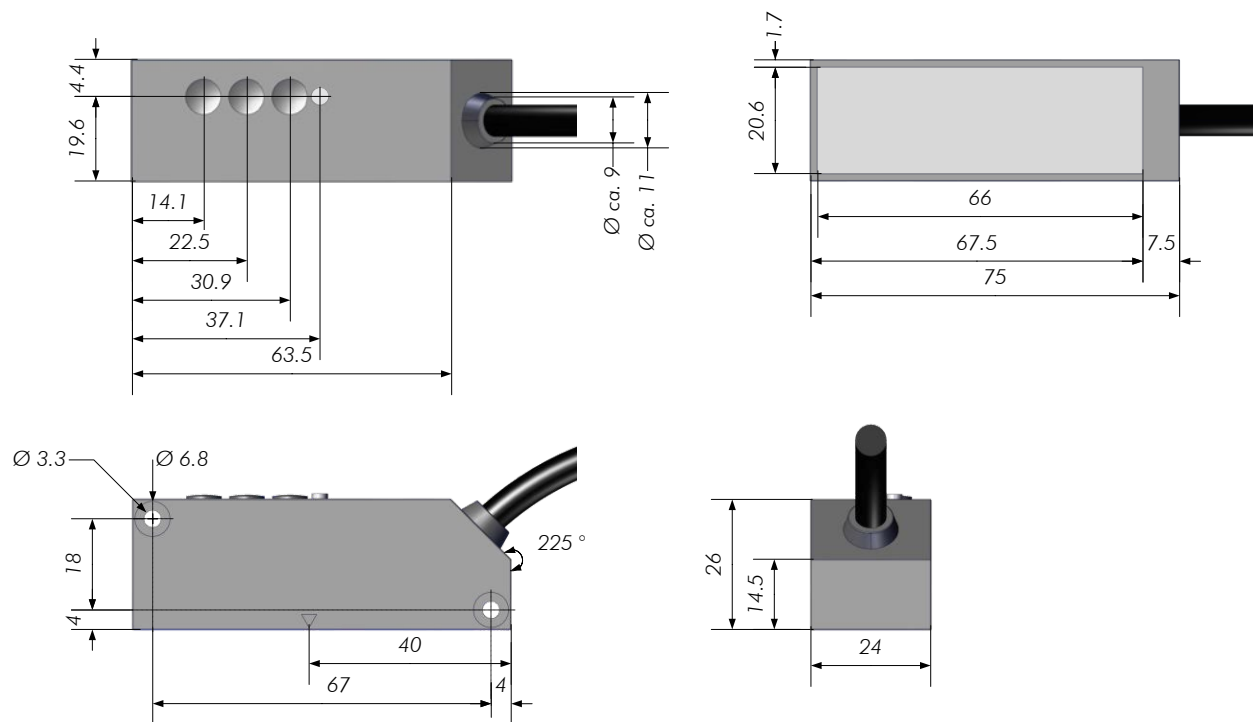


Figure 2: Dimensions Sensor

4.3 Dimensions Guide Carriage FW2080

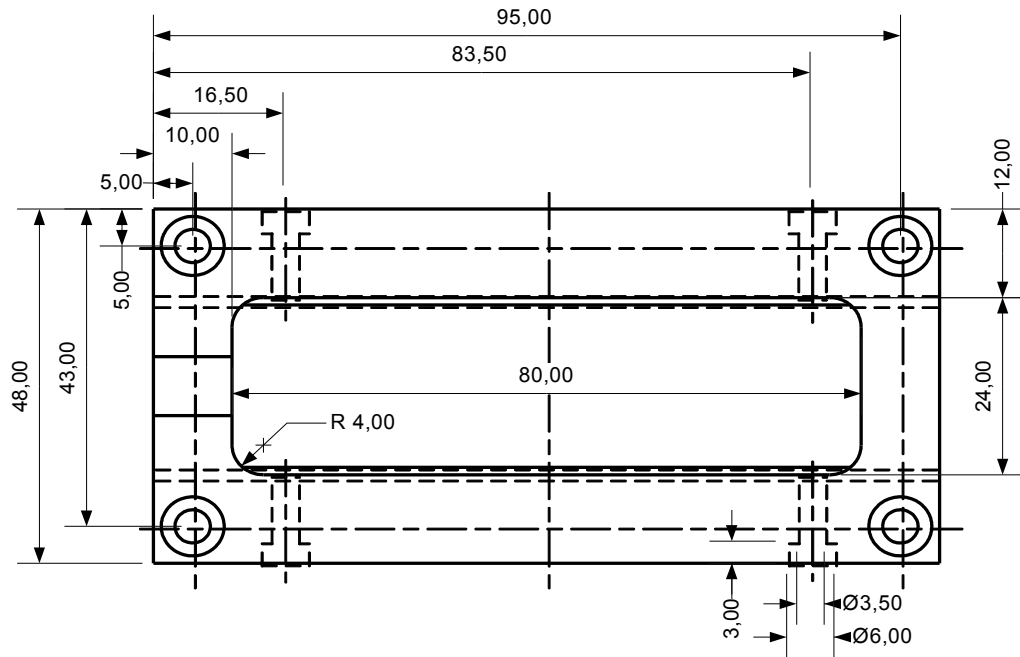


Figure 3: Top view

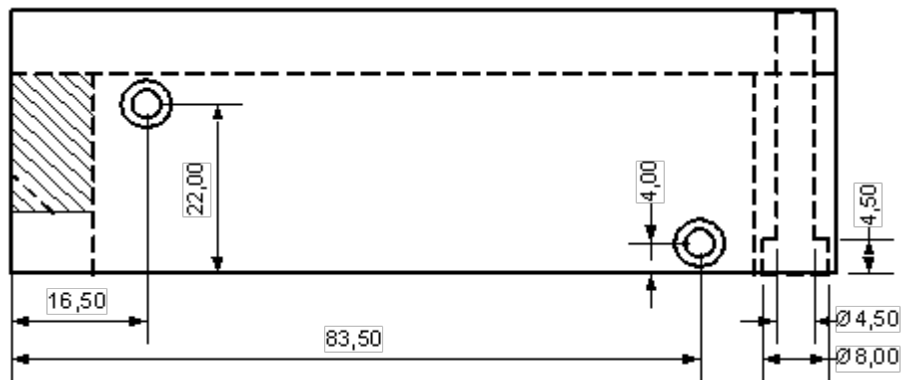


Figure 4: Side view

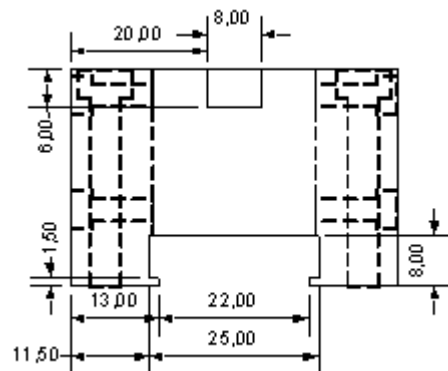


Figure 5: Front view

4.4 Technical Data Sensor

EMAX / EMAL (standard version)

Mechanical Data

Measuring principle	absolute
Measurement	linear
Repeat accuracy	+/- 1 Increment
System accuracy in μm at 20°C	+/- (150 μm + 20 μm x L) (standard 010 ☞ 8) +/- (50 μm + 20 μm x L) (option F10 ☞ 8) L = measuring length in meters
Distance sensor / magnetic tape	max. 1.5 mm (2.0 mm with reduced measuring accuracy)
Basic pole pitch	5 mm
Sensor housing material	Zinc die cast
Sensor housing dimensions	Sensor: L x W x H = 75 x 24 x 26 mm Sensor with guide carriage: L x W x H = 100 x 34 x 48 mm
Necessary type	EMAX: AB20-50-20-R-11 EMAL: AB20-50-10-R-12
Maximum measuring length	EMAX up to 10 m EMAL up to 20 m
Connection	open cable ends (more options ☞ 8)
Sensor cable	1.5 m standard cable length (others upon request)
Weight	Sensor approx. 100 g without cable, (cable approx. 60 g/m)

Electrical Data

Supply voltage	+ 10 ... 30 VDC
Residual ripple	10 ... 30 V: <10%
Power input	max. 150 mA
Interfaces	SSI, CANopen (DS406), RS422, RS232
Resolution	0.01 mm
Speed	max. 4 m/s

Conditions

Storage temperature	-20 °C ... +85 °C
Operation temperature	-10 °C ... +70 °C (-25 °C ... +85 °C upon request)
Humidity	max. 95 %, not condensing
Protection Class	IP40 (Standard) IP65 (Option V)

4.5 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 AB20-50-20-2-R-11 and AB20-50-20-2-R-12

Coding	absolute, two trace 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 µm + 20 µm x L) (standard 010 ☞ 8) +/- (50 µm + 20 µm x L) (option F10 ☞ 8) 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	20 mm (+/- 0.3 mm) x 1.8 mm (+/- 0.1 mm)
Length expansion coefficient	$\alpha \approx 16 \times 10^{-6} \text{ 1/K}$
Thermal length expansion	$\Delta L[\text{m}] = L[\text{m}] \times \alpha[\text{1/K}] \times \Delta \vartheta[\text{K}]$ (L = tape length in meters, $\Delta \vartheta$ = relative temperature change)
Available measuring lengths	EMAX: max. 10 m EMAL: max. 20 m Min. 0,2 m
Weight magnetic tape	ca. 62 g/m (incl. magnetic tape and cover tape)
Tape imprint	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

5 Installation and First Start-Up



CAUTION

Please read the operating manual carefully before using the device! Strictly observe the Installation instructions! In case of damage caused by failure to observe this operating manual, the warranty expires.

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

The operator is obliged to take appropriate safety measures. The first start-up may only be performed by staff that has been trained and authorized by the operator.

5.1 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!



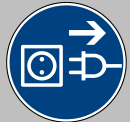
CAUTION!

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.

5.2 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.

5.2.1 Structure of magnetic tape

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 (Figure 6: Components of the magnetic tape):

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

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

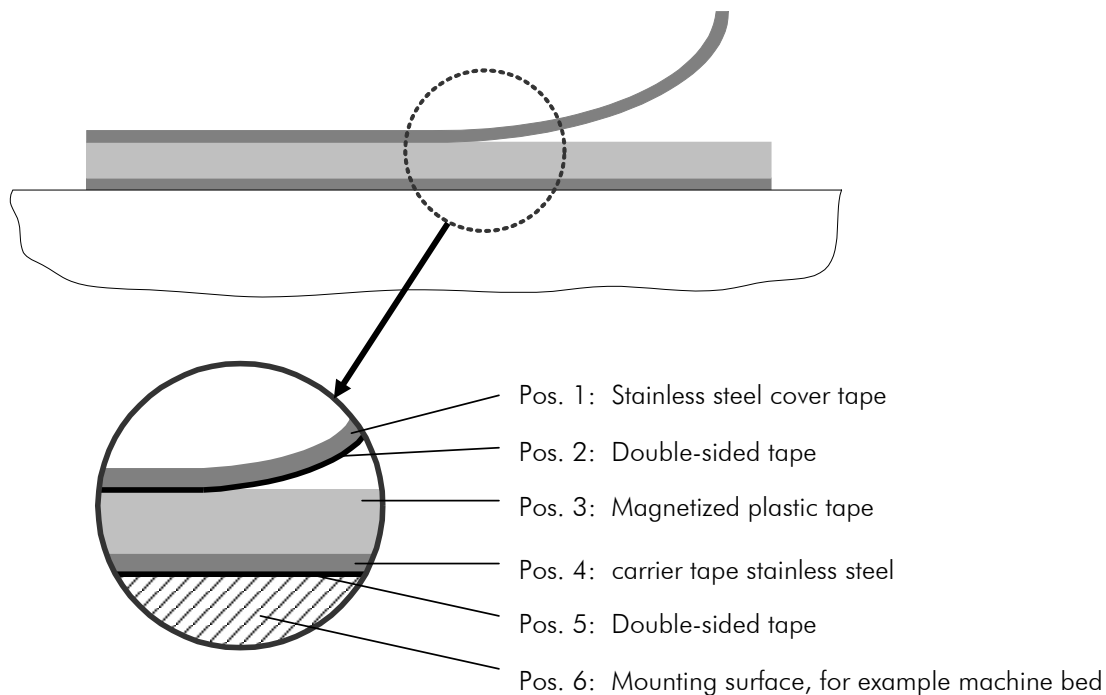


Figure 6: Components of the magnetic tape

5.2.2 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 must be noted here

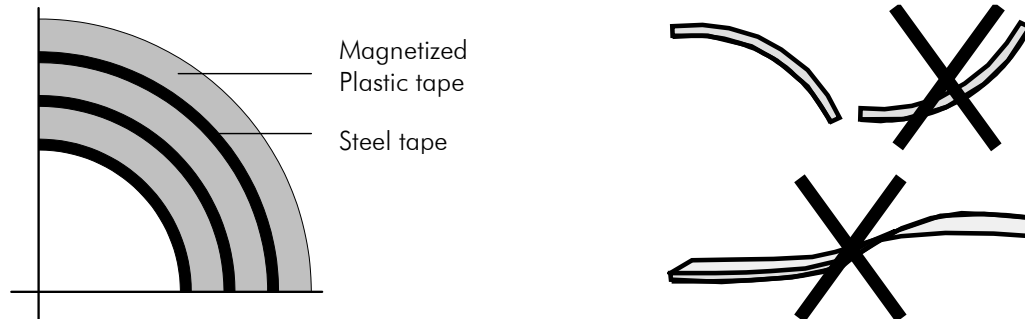


Figure7: Handling

5.2.3 Processing hint for the gluing of magnetic tapes

Surface-Preparation: In order to guarantee optimal adhesion, all antiadhesive 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 heptanes. 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 + 21 °C and 38 °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.

5.2.4 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 (see chapter 9.2) 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 surface (☞ 5.2.3)
2. Let magnetic tape and cover tape adjust their temperature (acclimatization)
3. Remove protection foil of adhesive tape on magnetic tape
4. Glue the magnetic tape by using great pressure
5. Thoroughly clean the surface of magnetic tape
6. Remove the protection foil of adhesive tape on cover tape
7. Glue the cover tape by using great pressure
8. Safeguard the ends of the cover tape against peeling off (e. g. by using end caps ☞ 8.2)

5.3 Installation of the Sensor



NOTE!

The correct distance sensor / magnetic tape is monitored and displayed by the LED on the sensor.

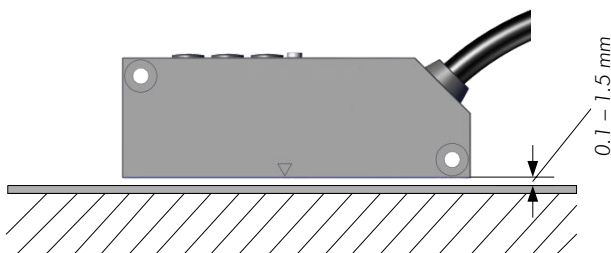
-> Distance not correct = LED glow red

When installing the sensor head use two M3 screws.
Tolerances for distance and angles must be observed.

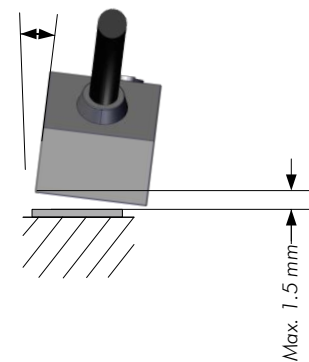
Table 1: Tolerances

Tolerances	
Magnetic tape type	AB20-50-20-2-R-11 and AB20-50-20-2-R-12
Ride height (distance to the tape)	0.1 ... 1.5 mm
Pitch	The max. Distance 1,5 mm must not be exceeded at any position
Yaw angle	0 ° +/- 0.5 °
Roll	The max. Distance 1,5 mm must not be exceeded at any position
Lateral offset	+/- 0.5 mm

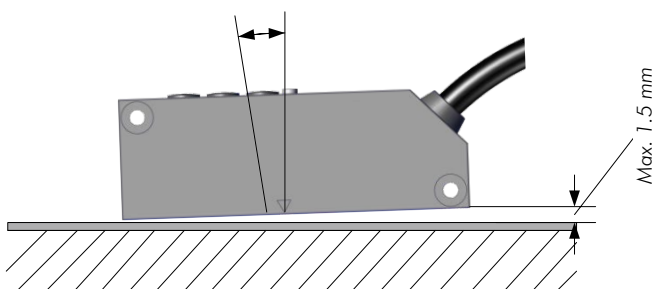
Ride height



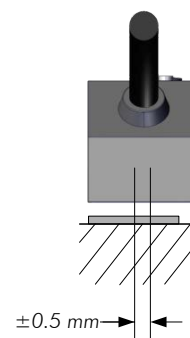
Roll



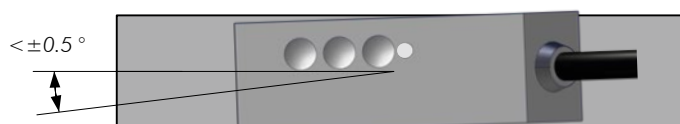
Pitch



Lateral offset



Yaw angle



5.3.1 Mounting Direction of EMAX / EMAL Sensor to Magnetic Tape

Sensor and magnetic tape have to be mounted to the same direction (direction of arrow): The provided pole searcher film allows to determine the respective pole pitches when lying on the tape.

From that the following installation direction results:

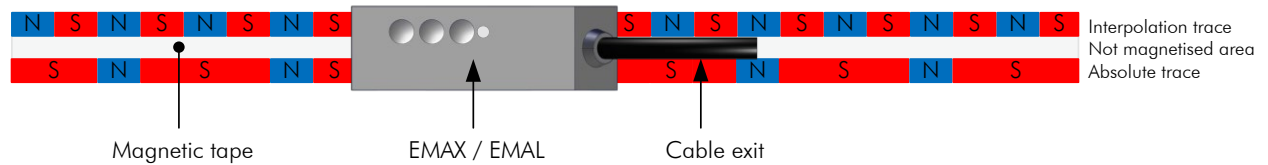


Figure 9: Mounting direction on magnetic tape

Markers on tape and sensor are additionally indicators for the mounting direction.

With an EMAX / EMAL combined with FW2080 the mounting direction is marked on the sensor and guide rail.

6 Connections and Interfaces

The following chapters give detailed information about connections and interfaces.

6.1 Interface SSI (option 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).

Some encoders contain a Power Failure Bit (PFB):

With EMAX the PFB is always „low“.

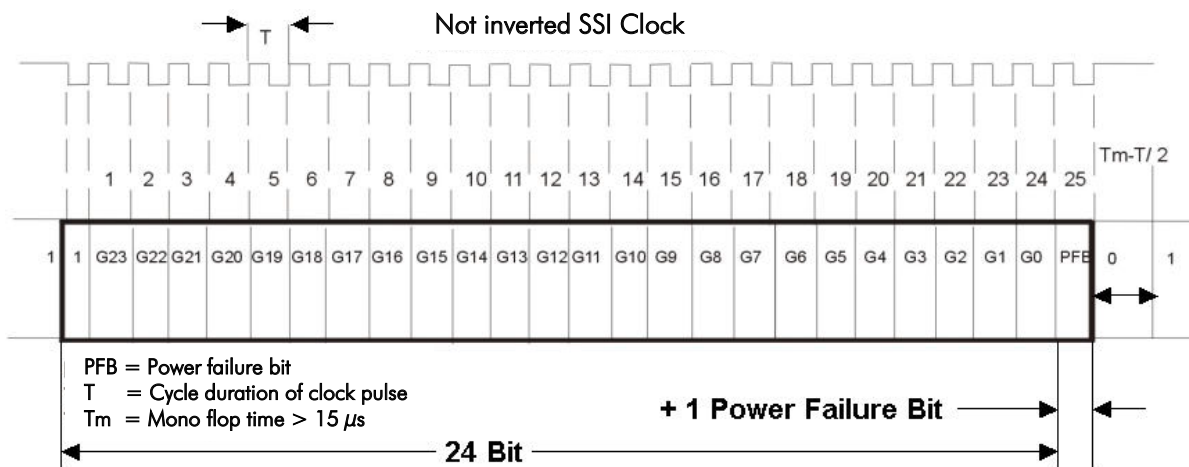


Figure 10 Interface SSI function

By using the decoding switch, which is located behind a protection cap on the top of the sensor, the data format of the SSI interface can be changed over with the help of a micro screwdriver from Binary code to Gray code.

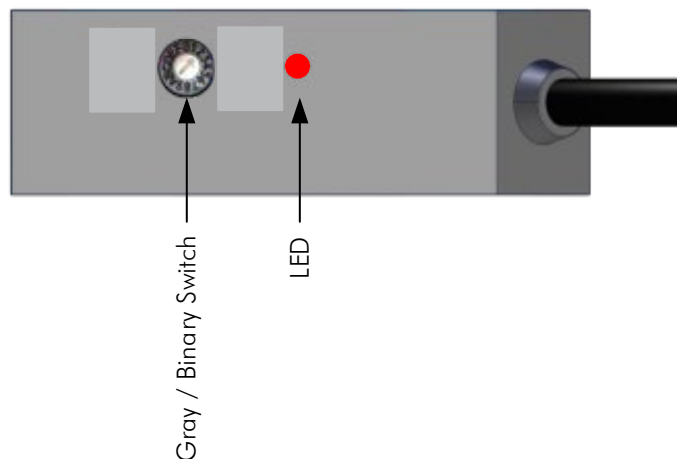


Figure 11 SSI: Binary / Grey coding

Position	Code
1	Binary
0	Gray

6.2 Interface CANopen (option CA0)

When ordering option "CA0", the encoder is equipped with a CAN interface according to the CANopen standard DS406.

To start the communication (start sending) an NMT-command must be given first.

If the position value is needed to be sent automatically after power on, therefore is the special number SN-011 available. (☞ 8)

The following identifiers are given:

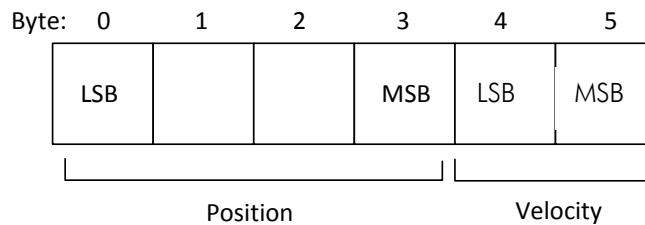
CAN - Identifier

(6 Byte telegram)

181 h (16) = Identifier

First 4 bytes = Position (resolution 0.01 mm), bit rate 250 KB/s

Following 2 bytes = velocity in mm/s



The CAN-Identifier can be adjusted in the range of 181h (16) to 18F (16) by rotary code switches, which are located behind a protection cap on the top of the sensor housing:

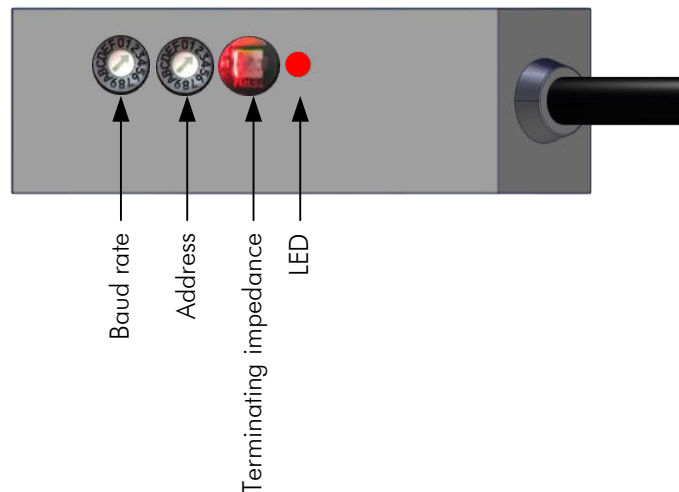


Figure 12 CAN Identifier settings

Table 2: CAN-Identifier CANopen Option CA0

Position	CAN Identifier
0	Identifier from memory
1	181
2	182
3	183
4	184
5	185
6	186
7	187
8	188
9	189
A	18A
B	18B
C	18C
D	18D
E	18E
F	18F

Table 3: Baud rate CANopen Option CA0

Position	Baud rate
8	Baud rate from memory
9	1 Mbit/s
A	800 kbit/s
B	500 kbit/s
C	250 kbit/s
D	125 kbit/s
E	100 kbit/s
F	50 kbit/s

6.3 CAN BASIC ELGO (Option CN0)

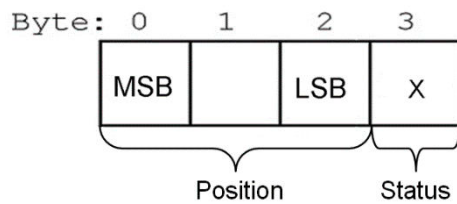
Interface / Protocol:

When ordering option "CN0", the EMAX / EMAL 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) + EMAX address	Identifier to request the absolute position
10 (16) + position of decoding switch (4 byte telegram)	Identifier contains absolute position of the device EMAX / EMAL (resolution 0.01 mm)

4 byte acknowledgement telegram

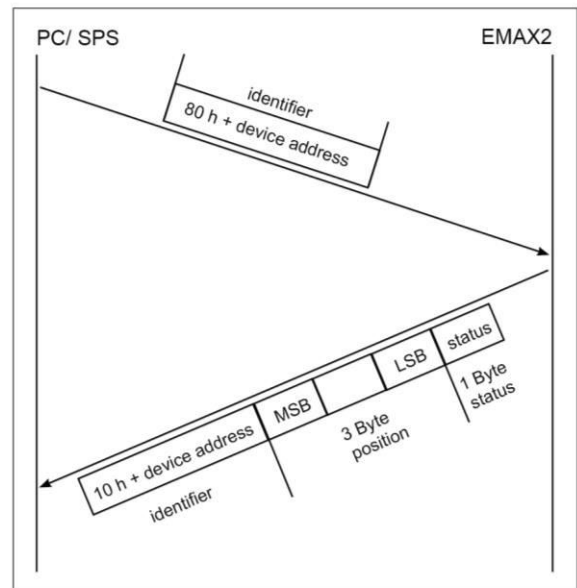


Status

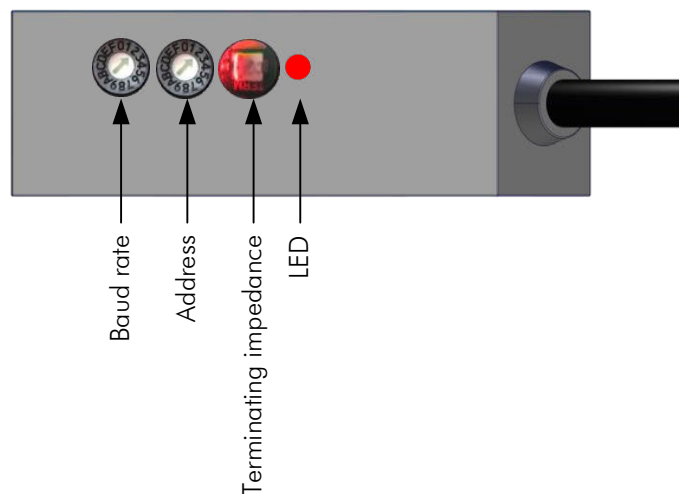
X = 0 → without error

X = 1 → error magnetic tape

Position	Baud rate
0	1 Mbit/s
1	500 kbit/s
2	250 kbit/s
3	125 kbit/s
4	100 kbit/s



The settings of address (range from 0₍₁₆₎ to F₍₁₆₎) and baud rate can be done by using the rotary coding switches, which are located behind a protection cap on the top of the sensor housing



6.4 Interface RS422 (Option 420) & RS232 (Option 230)

Depending on the order specification the encoder can be equipped with a RS422 (option "420") or RS232 interface (option "230"). Both versions use the same protocol and differ only in their level height.

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 Baud rate, 8 Data bits, 1 Stop bit, without parity bit in the following format:

02h STX

xxh ABS data MSB

xxh ABS data

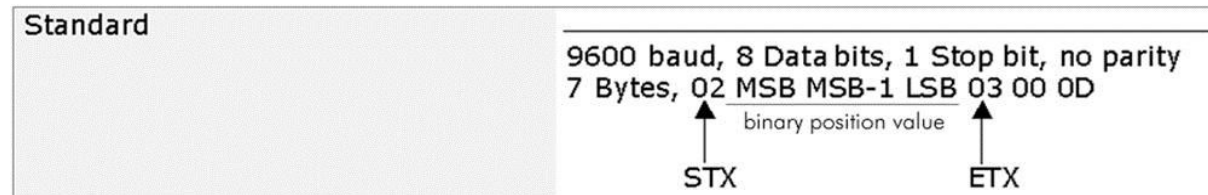
xxh ABS data LSB

03h ETX

00h

0Dh

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



Other protocols on request:

Table 5: Baud rate RS422 (Option420) and RS232 (Option 230)

Position	Baud 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

RS422: Further an addressable version is available as option "A20" (☞ 6.5).

6.5 RS422 Addressable Version (Option A20)

The device address can be defined by using a rotary code switch that is located behind a protective cap on the top of the sensor housing:

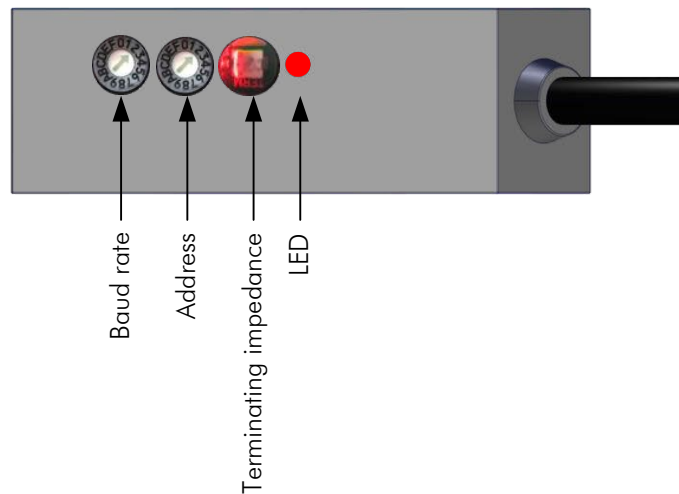


Figure 13: Set options on top of the housing

Table 6: Address on RS422 Option A20

Position	Address
0	0B
1	0C
2	0D
3	0E
4	0F
5	10
6	11
7	12
8	13
9	14
A	15
B	16
C	17
D	18
E	19
F	1A

Table 7: Address on RS422 Option A20

Position	Baud rate
0	9600 bit/s addressable [adrb]
1	600 bit/s [adrb]
2	1200 bit/s [adrb]
3	2400 bit/s [adrb]
4	4800 bit/s [adrb]
5	19200 bit/s [adrb]
6	38400 bit/s [adrb]
7	115200 bit/s [adrb]
8	9600 bit/s auto send [asnd]
9	600 bit/s [asnd]
A	1200 bit/s [asnd]
B	2400 bit/s [asnd]
C	4800 bit/s [asnd]
D	19200 bit/s [asnd]
E	38400 bit/s [asnd]
F	115200 bit/s [asnd]

Protocol of an addressable EMAX / EMAL:

General format of a message **to** the EMAX or EMAL:

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 EMAX or EMAL:

0x02	Byte1	Byte2	Byte3	Byte4
STX				

Position-request **from** the EMAX or EMAL with address i:

Message to the EMAX or EMAL

0x02	0x04	i	check	0x03
STX			check	ETX

0x04 characterizes the message as position-request
 i is the address of the requested EMAX / EMAL (i = 0x0b... 0x7f).

Answer of the requested EMAX or EMAL:

0x02	PosHigh	PosMid	PosLow	EMAX 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 μm. Position-values are always smaller than 0xffff00.
 Please note: The last byte is no ETX, like in all the other messages, but the **EMAX / EMAL** address.

Interrogation of the address of an **EMAX / EMAL**:

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

Message to the EMAX or EMAL:

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

Answer of the EMAX or EMAL:

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

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

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

EMAX or EMAL answers:

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

With Err = 0x04... 0x0a

Table 8: Error messages of an addressable EMAX / EMAL

Code	Description
0x04	Wrong succession of bytes sent to EMAX / EMAL 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 EMAX / EMAL address: appears while trying to assign an address less than 0x0b or greater than 0x7f.
0x07	Lost EMAX / EMAL 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 of 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 EMAX / EMAL is wrong

6.6 Connection to a RS422 Master

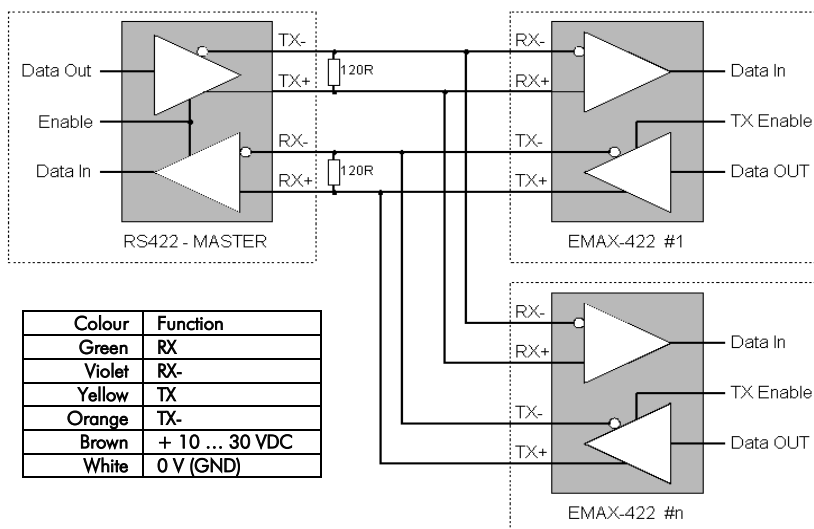


Figure 14: Connection to a RS422 Master

6.7 Sine – Cosines Incremental signal (Option SC50)

Optionally Sine-Cosine signals with 1 Vpp are available (push/pull output, short circuit resistant).

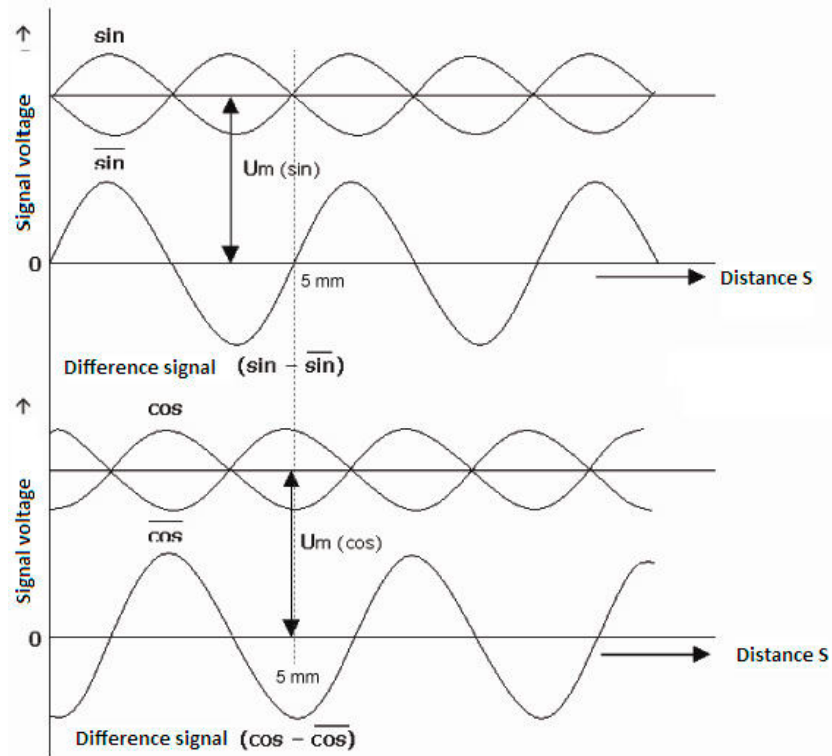


Figure 15: Sine – Cosine Incremental Signals

Table 9: Characteristics values for option SC50

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

6.8 Termination resistor

As standard the interfaces CANopen, is supplied with a termination impedance of 120 Ω inside of the interface input. The termination impedance can be deactivated with the S3 switch. The SSI interface is also supplied with an integrated termination resistor. When using option V (sealed IP65) the deactivation of the termination impedance has to be specified by ordering as option A (without termination resistor).

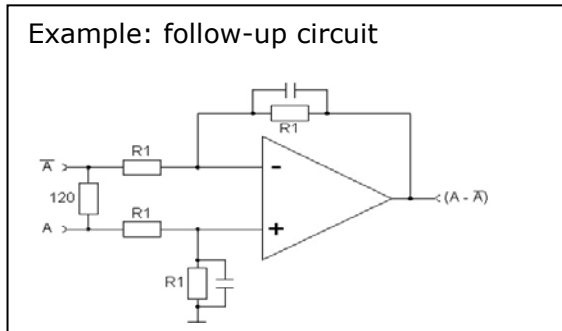


Figure 16 Position of Switch S3

In order to deactivate the termination impedance by switch S3, use a micro screwdriver and turn counter-clockwise.

6.9 Offset

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



NOTE!

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

6.10 Pin Assignment

6.10.1 SSI-Interface

Table 10 Connections of SSI interface cable 1

Signal cable	Option SSI (SG0, SB0)	Option SSI (SG0, SB0) Incremental HTL
White	0 V / GND	0 V / GND
Brown	+ 10 ... 30 VDC	+ 10 ... 30 VDC
Yellow	TX Data (+)	TX Data (+)
Orange	TX Data (-)	TX Data (-)
Green	CLK Clock (+)	CLK Clock (+)
Violet	CLK Clock (-)	CLK Clock (-)
Grey	-	Channel A
Black	-	Channel B
Shield	PE* \perp	PE* \perp

Table 11 Connections of SSI interface cable 2

Signal cable	Option SSI (SG0, SB0) Si-nus/Cosine SC50	Option SSI (SG0, SB0) Incremental TTL
White	0 V / GND	0 V / GND
Brown	+ 10 ... 30 VDC	+ 10 ... 30 VDC
Grey	TX Data (+)	TX Data (+)
Pink	TX Data (-)	TX Data (-)
Yellow	CLK Clock (+)	CLK Clock (+)
Green	CLK Clock (-)	CLK Clock (-)
Blue	Sine (+)	Channel A
Red	Sine (-)	Channel A'
Black	Cosine (+)	Channel B
Violet	Cosine (-)	Channel B'
Shield	PE* \perp	PE* \perp

*) Connect shield only at the device!

Table 12: Connections of SSI interface with option M8F0, 8 pin M16 round connector (female)

Pin	Color	Function
1	White	0 V / GND
2	Brown	+ 10 ... 30 VDC
3	Orange	Data (-)
4	Yellow	Data (+)
5	Violet	Clock (-)
6	Green	Clock (+)
7	n. c.	n. c.
8	n. c.	n. c.

Table 13: Connections of SSI interface with option MCM0, 12 pin M16 round connector (male)

Pin	Color	Function
A	White	0 V / GND
B	Brown	+ 10 ... 30 VDC
C	Green	Clock (-)
D	Yellow	Clock (+)
E	Grey	Data (+)
F	Pink	Data (-)
G	Blue	Sine (+)
H	Red	Sine (-)
J	Black	Cosine (+)
K	Violet	Cosine (-)
L	n. c.	n. c.
M	n. c.	n. c.

Table 14: Connections of SSI interface with option D9M0, 9 pin D-SUB connector (male)

Pin	Color	Function
1	White	0 V / GND
2	Brown	+ 10 ... 30 VDC
3	n. c.	n. c.
4	n. c.	n. c.
5	Blank	Shield
6	Green	Clock (+)
7	Violet	Clock (-)
8	Yellow	Data (+)
9	Orange	Data (-)

Table 15: Connections of SSI interface Option M8M0, 8 pin M16 round connector (male)

Pin	Color	Function
1	White	0 V / GND
2	Brown	+ 10 ... 30 VDC
3	Orange	Data (-)
4	Yellow	Data (+)
5	Violet	Clock (-)
6	Green	Clock (+)
7	Grey	HTL A
8	Black	HTL B

6.10.2 CANopen Interface

Table 16: Connections of CANopen interface (open cable ends)

Signal cable	Option CAN (CA0)	Option CAN (CA0) Incremental HTL	Option CAN (CA0) Incremental TTL
White	0 V / GND	0 V / GND	0 V / GND
Brown	+ 10...30 VDC	+ 10 ... 30 VDC	+ 10 ... 30 VDC
Yellow	CAN high	CAN high	CAN high
Orange	CAN low	CAN low	CAN low
Green	-	-	Channel A'
Violet	-	-	Channel B'
Grey	-	Channel A	Channel A
Black	-	Channel B	Channel B
Shield	PE* ⚡	PE* ⚡	PE* ⚡

*) Connect shield only at the device!

Table 17: Connections of CANopen interface with option D9M, 9 pin D-SUB connector (male)

Pin	Color	Function
1	n. c.	n. c.
2	Orange	Can Low
3	n. c.	n. c.
4	n. c.	n. c.
5	n. c.	n. c.
6	White	0 V / GND
7	Violet	Can High
8	n. c.	n. c.
9	Brown	+ 10 ... 30 VDC
Housing	Blank	Screen

6.10.3 RS422 Interface

Table 18: Connections of RS422 interface (open cable ends)

Color	Function
White	0 V
Brown	+ 10 ... 30 VDC
Yellow	TX (+)
Orange	TX (-)
Violet	RX (-) (only with A22 available)
Green	RX (+) (only with A22 available)
Grey	Channel A (Option I)
Black	Channel A (Option I)
Shield	PE* \perp

*) Connect shield only at the device!

Table 19: Connections of RS422 interface with option D9M0, 9-pin. D-SUB connector (male)

Pin	Color	Function
1	White	0 V / GND
2	Brown	+ 10 ... 30 VDC
3	n. c.	n. c.
4	n. c.	n. c.
5	Blank	Shield
6	Green	RX (+)
7	Violet	RX (-)
8	Yellow	TX (+)
9	Orange	TX (-)

Table 20: Pin Connection RS422 Interface option D9M5, 9-pin. D-SUB connector (male)

Pin	Color	Function
1	White	0 V / GND
2	Brown	+ 10 ... 30 VDC
3	Yellow	TX (+)
4	n. c.	n. c.
5	n. c.	n. c.
6	Orange	TX (-)
7	n. c.	n. c.
8	n. c.	n. c.
9	n. c.	n. c.
Housing	Blank	Shield

Table 21: Anschlussbelegung RS422 Schnittstelle Option M8M0, 8 pol. M16 Rundstecker

Pin	Color	Function
1	White	0 V / GND
2	Brown	+ 10 ... 30 VDC
3	Orange	TX (-)
4	Yellow	TX (+)
5	Violet	RX (+)
6	Green	RX (-)
7	Grey	HTL A
8	Black	HTL B

6.10.4 RS232 Interface

Table 22: Connections of RS232 interface (open cable ends)

Color	Function
White	0V
Brown	+ 10 ... 30 VDC
Yellow	RX
Orange	TX
Violet	-
Green	-
Grey	Channel A (Option I)
Black	Channel B (Option I)
Shield	PE* \perp

*) Connect shield only at the device!

Table 23: Connections of RS232 interface with option D9M0, 9-pin. D-SUB connector (male)

Pin	Color	Function
1	White	0 V / GND
2	Brown	+ 10 ... 30 VDC
3	n. c.	n. c.
4	n. c.	n. c.
5	Blank	Shield
6	Yellow	RX
7	n. c.	n. c.
8	Orange	TX
9	n. c.	n. c.

7 Disturbances, Maintenance, Cleaning

This chapter describes possible causes for disturbances and measures for their removal. In case of increased disturbances, please follow the measures for fault clearance in chapter 7.1. In case of disturbances that cannot be eliminated by following the advice and the fault clearance measures given here, please contact the manufacturer (see second page).

7.1 Fault Clearance



CAUTION!

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

External perturbations can be avoided through suitable cable routing.



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

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

1. Installation of RC-circuits via contactor coils of AC-contactors (e.g. 0,1 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

7.2 Re-start after Fault Clearance

After the fault clearance:

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



WARNING!

Danger of injury through non-conventional fault clearance!

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

Therefore:

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

If components need to be replaced:

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

7.3 Maintenance

The device is maintenance-free.

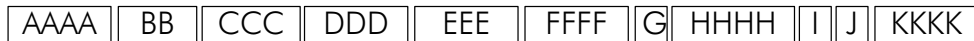
7.4 Cleaning



WARNING!

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

8 Type designation



A Series/Type:

- EMAX** Measuring length up to 10 m
- EMAL** Measuring length up to 20 m

B SN No.:

- 00** 0...99
- 11** EMAX sends automatically without NMT command and has 4 bytes position output without velocity output

C Signal cable length in dm:

- 015** = 1,5 m

D Resolution in μm :

- 010** 10 μm - at system accuracy in μm +/- (150 + 20 x L)
- F10*** 10 μm - at system accuracy in μm +/- (50 + 20 x L)
* Version F10 available at extra charge

E Interface:

- S0** SSI-Interface (25 bit binary code)
- S0** SSI-Interface (25 bit Gray code)
- CA0** CANopen (DS406)
- CN0** CAN BASIC ELGO
- 420** RS422
- A20** Adressable RS422
- 230** RS232

On request, the settings of the rotary code switch can be done ex works.

F Bit rate:

- 09k6** 9600 Bit/s - standard Bit rate for RS232 (230) and 422 (420/A20)
- 19k2** 19200 Bit/s for RS232 or RS422
- 38k4** 38400 Bit/s for RS232 or 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

G Address

- 0** Device address 0 ... F (Default setting: device address 0)

H Connections

- D9M** 9 pin (male) D-SUB (only for CAN interfaces available)
- D9M0** 9 pin (male) D-SUB (available for RS232, RS422 and SSI) with ELGO standard pin assignment
- D9M5** 9 pin (male) D-SUB (only for RS422 with Bit rate 09k6) with Option 5 (pin assignment suitable for Z25 indicators)
- M8F0** 8 pin (female) M16 connector with ELGO standard SSI assignment, suitable for ELGO PNO1 (only for SSI)
- M8M0** 8 pin (male) M16 connector (only for RS422 and SSI available)
- R5M0** 5 pin (male) M12 connector with ELGO standard assignment (only for CAN interfaces available)
- MCM0** 12 pin (male) M16 connector (only for interfaces with additional Sin/Cos or A/B signals)
- MCF0** 12 pin (female) M16 connector (only for interfaces with additional Sin/Cos or A/B signals)

I

- V** Sealed IP65 construction (**Important note:** This variant is delivered without rotary code switches. Please specify your configuration when order, since no more settings can be made after sealing.)

J

- A** Without termination impedance

K Incremental signals

- H2N5** Incremental square wave signals HTL with 2.5 μm resolution
- H005** Incremental square wave signals HTL with 5 μm resolution
- H010** Incremental square wave signals HTL with 10 μm resolution
- H025** Incremental square wave signals HTL with 25 μm resolution
- T2N5** Incremental square wave signals TTL with 2.5 μm resolution
- T005** Incremental square wave signals TTL with 5 μm resolution
- T010** Incremental square wave signals TTL with 10 μm resolution

GENERAL NOTES:

- Please fill in „-“ for ordering options, which are not desired.
- Version EMAL with max. 20 m measuring length at extra charge

8.1.1 Example of available Variants

Table 24: Example of available variants

Order description	Description
EMAX00015010SB0-----	EMAX with binary SSI interface, 25 bit and 1.5 m cable
EMAX0001510SB0-----M8FO-----	EMAX with binary SSI interface, 25 bit, 1.5 m cable and M16 plug connector (female) for PNO1
EMAX00015010SG0-----T2N5	EMAX with SSI-Gray Interface, 25 Bit, 1.5 m cable, TTL-square-wave signal, 2,5 μ m Resolution
EMAL00015010CA0125k0-----	EMAL for measuring lengths up to 20 m, according to ELGO standard, with CANopen interface, 1.5 m cable, 125 kbit/s and device address: 0

8.2 Accessories

Table 1 Accessories

Order description	Description	Article number
AB20-50-20-2-R-11	Magnetic tape for EMAX	731000110
AB20-50-20-2-R-12	Magnetic tape for EMAL	731000274
End cape	End cap to fix the magnetic tape	731031003
FS-1000	Guide rail for magnetic tape, length 1.0 m Length until 2.0 m possible For larger measuring lengths the guide rails can be rowed together	734FS0018
FW2080	Guide carriage for EMAX	734LF0003
SSI-PROFIBUS converter	Interface converter from SSI to PROFIBUS DP	820067040



NOTE

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

Notes:

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