

Operating Manual

SERIES MTM-A-000

Magnetic-translational Absolute Measuring System



- Permanent position detection even in power-off condition
- Position / path determination at round profile rods
- Wear-free, contactless measurement principle
- Very robust and proven measuring technology
- Interface: Analog output or CANopen
- High shock and vibration resistance
- Insensitive to contamination
- Power supply 10 ... 30 VDC

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Document- No. 799000850

Document- Name MTMA-000-MA-E_10-19

Document- Revision Rev. 0

Issue Date 2019-03-08

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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.
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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.

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 MTM-A-000 length measuring system only serves to measure positions, lengths and/or speeds.

**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)

**IMPORTANT!**

When storing the coded rod, it must be explicitly ensured that it is not placed in the vicinity of foreign magnets (refer also to section "Technical Data" ☞ 6.3, "Environmental Conditions").

5 Product Features

The MTM-A-000 measuring system is based on the physical principle of magnetism and is used for a high-precision determination of the position, the moved distance and/or the speed. Based on this wear-free and contactless absolute measuring system, MTM-A-000 is suitable for fixed round rod profiles - for example for non-rotating piston rods of hydraulic cylinders in mobile automation.

The system consists of the following components:

- Round rod resp. piston rod (provided by the customer for absolute coding by ELGO)
- Application related sensor system (ELGO made)
- Mechanical accessories for sensor adaptation on request

5.1 Principle of Scanning

In order to determine the absolute position, the basis of the magnetic MTM-A-000 linear encoder consists of a scanning technology, which scans the magnetically coded round rod contactless and completely wear-free.

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



5.2 The absolute Measuring Principle

The absolute measuring principle ensures maximum safety, as the current position value is always present. Even in the event of a power failure, no data is lost. The measuring system only needs to be referenced once by learning the upper and lower position (see 8.4 Calibration of the Measuring Range).



Figure 1: Example of an absolute coded round rod track

5.3 Available Output Signals

Depending on the ordered interface option (see type designation 11) the sampled signal information is converted by the internal evaluation electronics into one of the following output signals:

- Interface option **CA0** → CANopen standard interface according to DS406 (encoder profile)
- Interface option **I20** → Analog 12 bit output signal (0 ... 20 mA), proportional to the measured value
- Interface option **I24** → Analog 12 bit output signal (4 ... 20 mA), proportional to the measured value
- Interface option **V04** → Analog 12 bit output signal (0.5 ... 4.5 V), proportional to the measured value
- Interface option **V10** → Analog 12 bit output signal (0 ... 10 V), proportional to the measured value

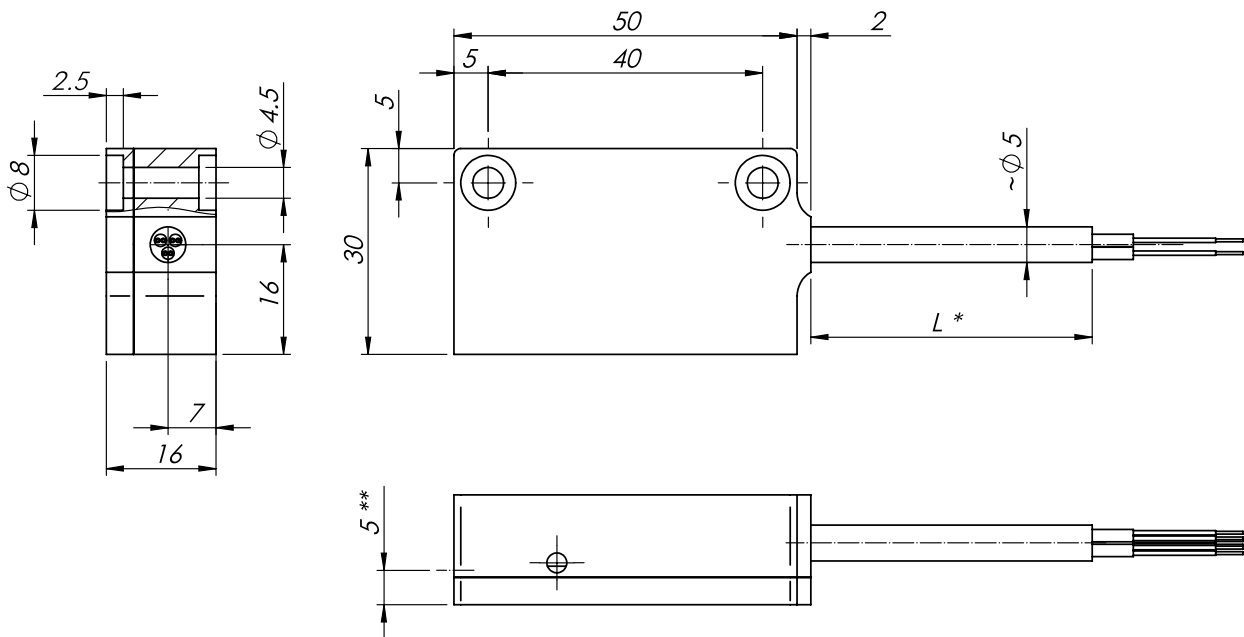
More information can be found in chapter 9 Connections and Interfaces.

6 Technical Data

6.1 Identification

The type label serves for the identification of the unit. It is located on the housing of the measuring system and gives the exact type designation (☞ 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 of the MTM-A Standard Housing



*) cable length

***) average sensor pitch line = center of the round rod

Figure 2: Dimensions of the MTM-A standard sensor housing

6.3 Technical Data MTM-A-000

MTM-A-000 (standard version)

Mechanical Data

Measurement principle	absolute
Repeat accuracy	± 1 increment
System accuracy	± 1 mm at max. 2450 mm measurement length (standard)
Distance sensor - round rod	1.0 mm with 10 mm wide coding 1.5 mm with 20 mm wide coding or all-round coding
Round rod diameter	min. 20 mm
Round rod coding	Standard: coded magnetic track (10 or 20 mm wide) Optionally: coded total scope (possible on request)
Measuring length	max. 2450 mm (available in 10 mm steps ☞ 11)
Sensor housing material	galvanized aluminium
Sensor housing dimensions	L x W x H = 52 x 16 x 30 mm
Sensor cable length	standard: 1.5 m (others on request)
Weight	approx. 50 g without cable (cable: approx. 60 g/m)
Mounting position MTM-A system	depends on application

Electrical Data

Power supply voltage	10 ... 30 VDC
Residual ripple	10 ... 30 VDC < 10 %
Consumption	max. 80 mA
Available Interfaces (depends on order ☞ 11)	CANopen standard (DS406) 12 bit analog output (0 ... 20 mA) 12 bit analog output (4 ... 20 mA) 12 bit analog output (0.5 ... 4.5 V) 12 bit analog output (0 ... 10 V)
Connection type (depends on order ☞ 11)	Standard: open cable ends Option: 5-pin M12 x 1 round connector
Maximum operating speed	up to 2.0 m/s

Environmental Conditions

Store temperature	-25 ... +85° C
Operating temperature	-25 ... +85° C
Humidity	max. 95 %, none-condensing
Protection class (entire system)	standard: IP65 / optionally: IP69K (see section ☞ 11)
Influence of external magnet on the coding of the round rod	External magnetic fields must not exceed 64 mT (640 Oe; 52 kA/m) on the coded round rod surface (comparable to a rare earth magnet), as this can damage or destroy the round rod coding.

6.4 Usable Round Rod Diameters

Available round rod diameters acc. to ISO 3320: 20, 22, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320 and 360 mm

6.5 Usable Cylinder Diameters

Available cylinder diameters acc. to ISO 3320:

40, 50, 63, 80, 100, 110, 120, 125, 160, 200, 250, 320 and 400 mm

7 Sensor adaption to Round Rod and Cylinder

In order to adapt the MTM-A-000 sensor to the cylinder and round rod by the customer, various mechanical solutions are conceivable. The following figure shows a few examples of possible mechanical integration into the entire system:

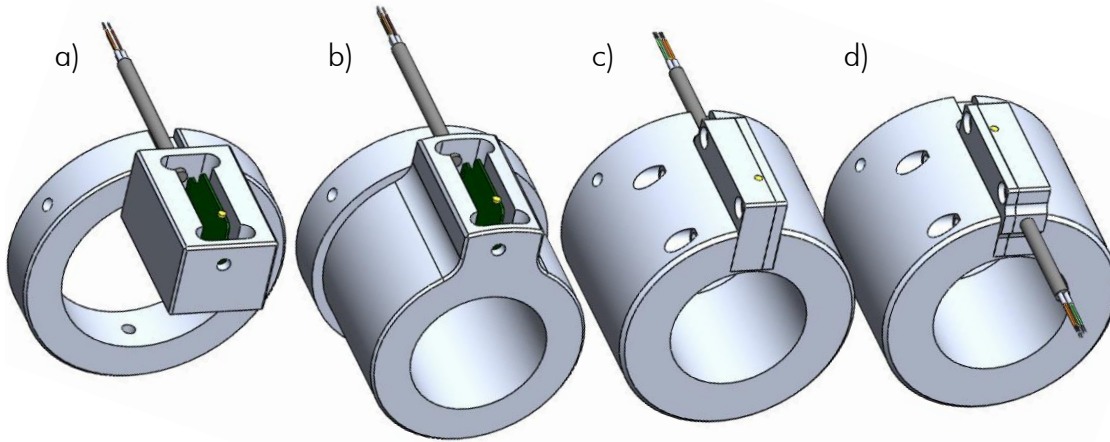


Figure 3: Sensor adaption examples

- a) Flange ring with holder for integrated sensor system (without sensor housing)
- b) Mounting ring for integrated sensor system (without sensor housing)
- c) Mounting ring for MTM-A-000 with standard sensor housing (☞ 6.2)
- d) Identical to c) but in reverse mounting direction

On request and at an extra charge, the required mechanical accessories for sensor adaptation can be provided by ELGO Electronic GmbH & Co. KG.

Since a specified maximum reading distance between sensor and round rod must not be exceeded for contactless scanning, the mounting tolerances described in section ☞ 8.3.1 must be observed and adhered to. Otherwise, the measuring system cannot work correctly.

7.1 Integration Example

The following figure shows an example for the adaptation of an MTM-A-000 in the standard sensor housing with a mounting ring, as suggested above under c):

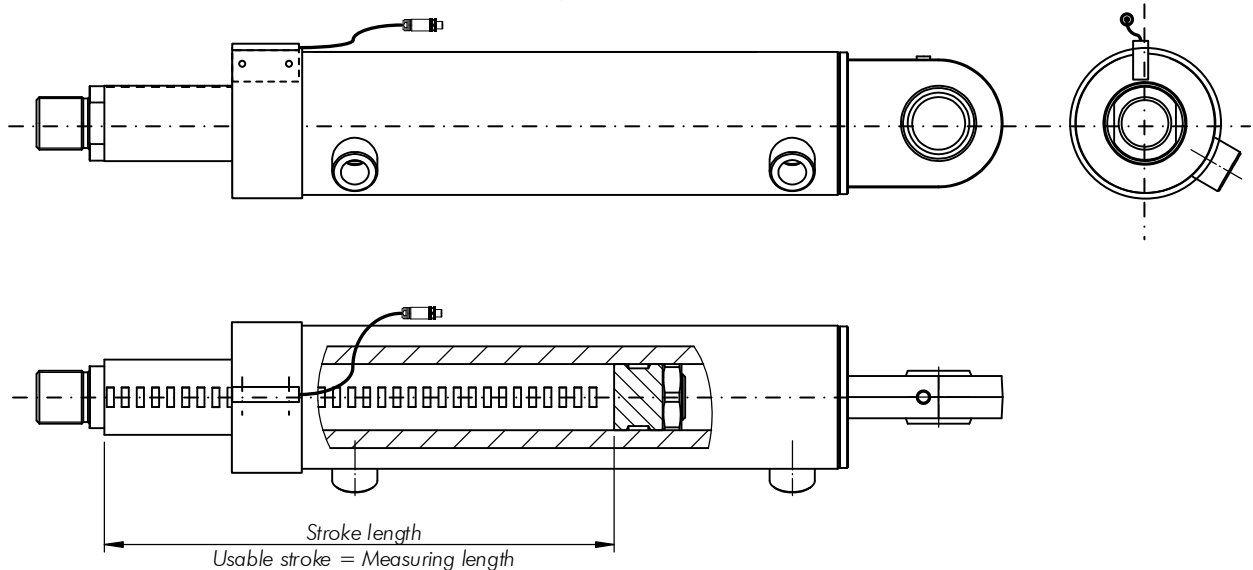


Figure 4: Integration example via mounting ring

8 Installation and First Start-Up

**CAUTION**

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

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

The operator is obliged to take appropriate safety measures.

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

8.1 Operating Area

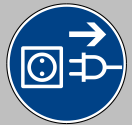
**WARNING!**

Do not use the device in explosive 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.



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.

8.2 Installation of the Sensor

8.2.1 Alignment of the active Sensor Area

In the case of a 10 mm or 20 mm wide, single-track coded rod, the sensor housing must be positioned so that the center of the sensor pitch line is in the center of the magnetic absolute coding. The center of the sensor pitch line is located at a distance of 5 mm from the outer edge of the sensor housing (see figure).

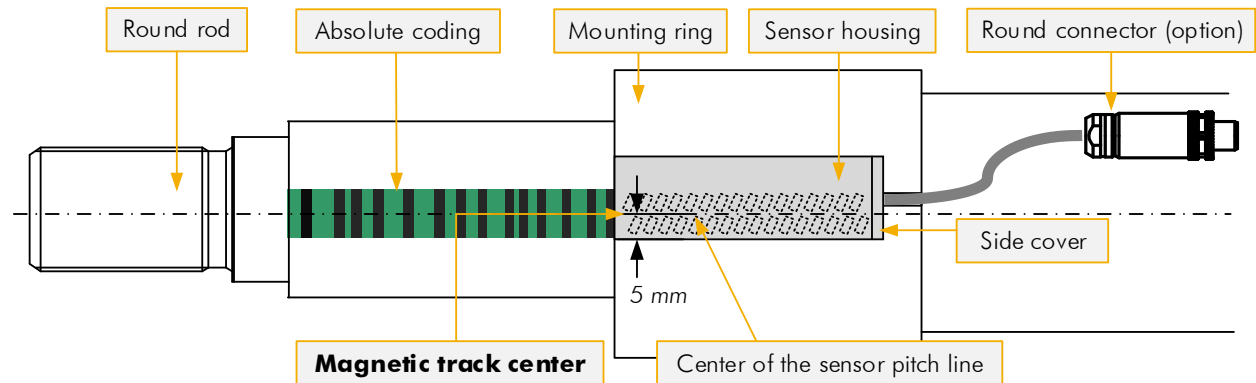
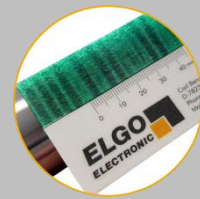


Figure 5: Alignment of the active sensor area



Hint:

To make the magnetically coded track visible during alignment, the pole finder foil (Art. No.: 710000130) can be used, which is available as an accessory (☞ 11.1).



8.3 Adjustment of Reading Distance and Lateral Offset

Depending on the order specification, a 10 mm or 20 mm wide single-track coding or a complete all-round coding is used. Since the magnetic field lines are differently pronounced with a narrower and wider coding, different maximum reading distances and lateral offset tolerances result for the mounting of the sensor to the round rod.

8.3.1 Mounting Tolerances

Table 1: Mounting tolerances

Coding	Order index	Reading distance	Lateral offset	Pitch & Roll Angle	Yaw Angle
10 mm	1 (☞ 11)	↓ max. 1 mm	↔ max. ± 1.0 mm	see figure 7	< ±1.0°
20 mm	2 (☞ 11)	↓ max. 1.5 mm	↔ max. ± 2.0 mm	see figure 7	< ±1.0°
All-round	3 (☞ 11)	↓ max. 1.5 mm	↔ max. ± 2.0 mm	see figure 7	< ±1.0°

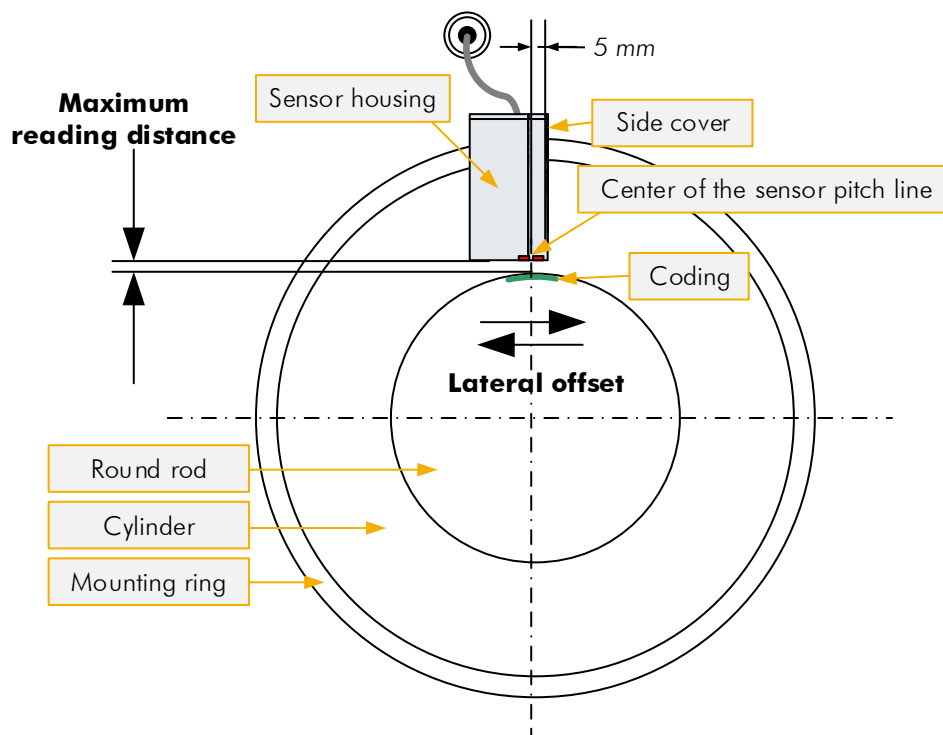


Figure 6: Adjustment of reading distance and lateral offset

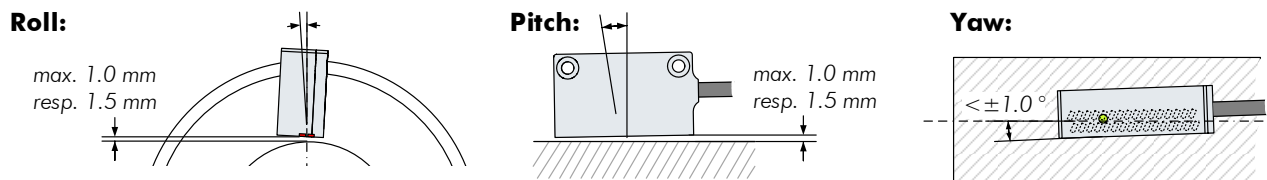



Figure 7: Angular tolerances


	<p>REMARK</p> <p>Any mechanical loads that may occur must be taken into account when adjusting the reading distance.</p>
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8.4 Calibration of the Measuring Range

8.4.1 Calibration for Versions with CAN Interface

A hardware calibration as described in section 8.4.2 is not required for this version. The calibration of the upper and lower set point is performed via the CANopen interface.

8.4.2 Calibration for Versions with Analog Output

	<p>REMARKS</p> <ul style="list-style-type: none"> The calibration must be performed for each newly installed MTM-A-000 measuring system before or during commissioning. Even when replacing the measuring system or rod (e. g. in case of servicing) a new calibration must be performed.
---	--

One second after power-up, the device is ready for operation. In addition, the MTM-A-000 system with analog output offers the possibility of initiating the learning process during the first ten seconds after power-up. A lower and upper set point must be defined for which the **TEACH** input is required.

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

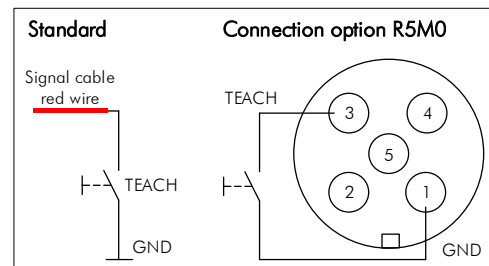


Figure 8: TEACH input wiring

To calibrate the set points, please proceed as follows:

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

→ Press the connected **TEACH** button.

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

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

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

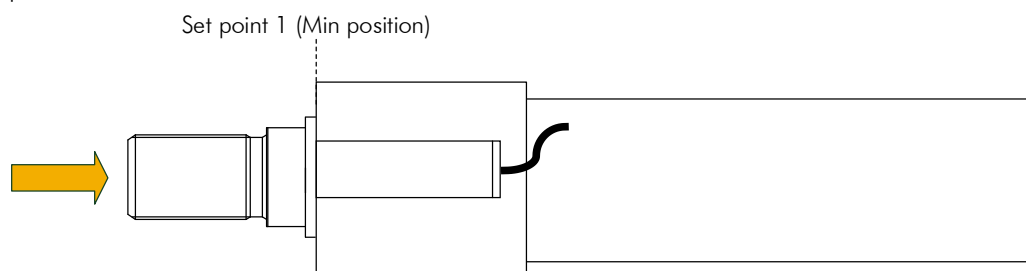
b) Keep the button pressed (max. 8 seconds), until the LED lights statically red:

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

Outside these times, the learning process is interrupted.

8.4.2.1 Teach Set Point 1 (Min)

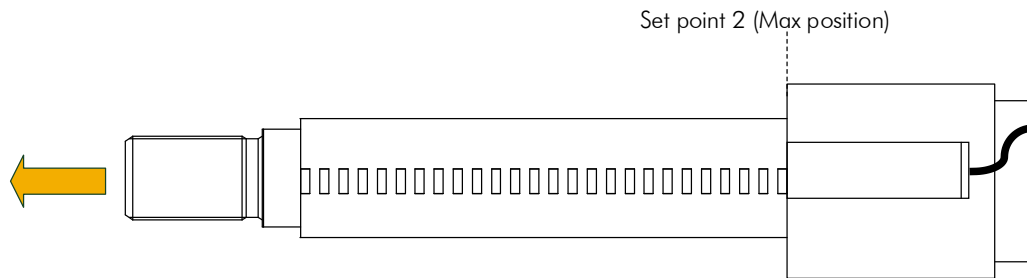
Move the round rod to the lower set point (e.g. zero point) and release the **TEACH** button during the green phase.



3 x flashing, followed by 3 x pressing button → stores the lower set point. This is confirmed by the LED with a single green hold for 1.5 seconds.

8.4.2.2 Teach Set Point 2 (Max)

- Move the round rod to the upper set point (e.g. maximum position) and release the **TEACH** button during the red phase.



6 x flashing, followed by 6 x pressing button → stores the upper set point.
This is confirmed by the LED with a single green hold for 1.5 seconds.

- After a successful learning sequence, the current position values are stored in non-volatile memory.
- The MTM-A-000 system is ready for operation with the newly taught-in scaling.

8.4.2.3 Possible causes of faulty teaching

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

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

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

9 Connections and Interfaces

9.1 Connection Options

Two different connection options are available for the MTM-A-000 system (order information see ¶ 11). For the version with plug connector a 5-pin M12 x 1 round connector is used.

9.1.1 Open Cable Ends (Standard)

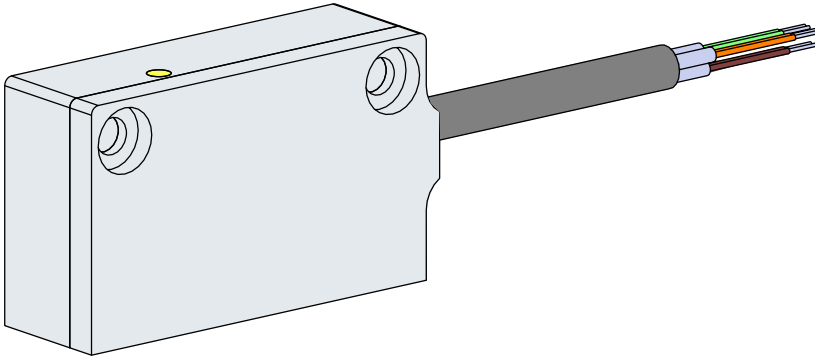


Figure 9: Standard connection - open cable ends

9.1.2 5-pin (male) M12 Round Connector (Connection Option 2)

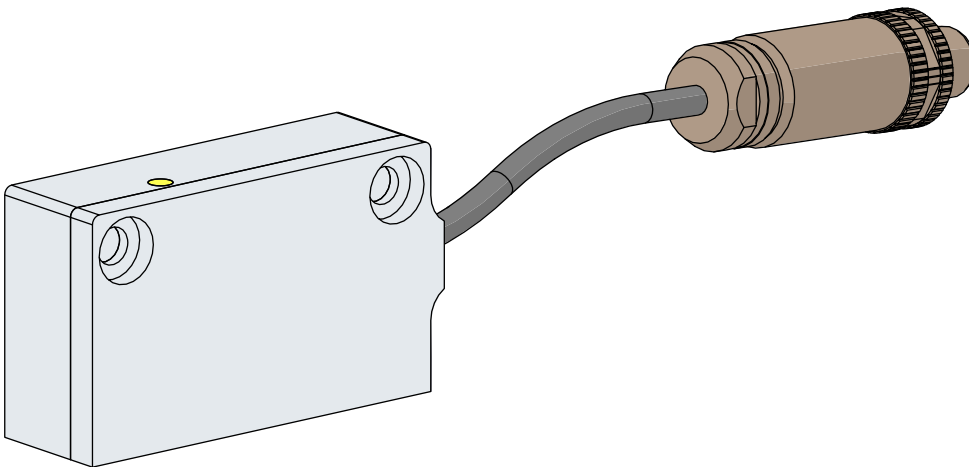


Figure 10: Connection option 2 - (5-pin male M12 round connector)

9.2 Analog Output

The 12 bit analog output operates proportional to the position value. Depending on the selected interface option (see 11), the output is designed for operation with voltage or current.

9.2.1 Scaling of the Analog Output

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

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

For more information about the TEACH positions, see 8.4.2 Calibration for Versions with Analog Output

9.2.2 Connections Analog Output

Depending on the order specification, the connections are made via open cable ends or via an 5-pin M12 round connector which is attached to the end of the signal cable.

Table 2: Analog output with open cable ends


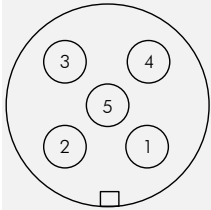
Connection Type	Drawing	Color	Function	Description
Standard: Open cable ends		black	0 V / GND	Ground
		brown	+VCC	10 ... 30 VDC
		red	TEACH	Teach input
		orange	-	-
		green	Analog OUT	+ Volt / + mA
		yellow	Analog GND	- Volt / - mA

Table 3: Analog output with 5-pin M12 round connector

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

9.1 CANopen Interface

When ordering the **CA0** interface option, the MTM-A-000 measuring system is equipped with a CAN interface according to CANopen standard DS406 for encoder device profiles.

In order to start the communication with the MTM-A-000 an NMT command has to be sent first.

The following identifiers are given:

CAN - Identifier

(6 Byte telegram)

181 (16) = Identifier

First 4 bytes = Position (resolution 1 mm), Bit rate = 250 KB/s*

Next 2 bytes = Speed in mm/s

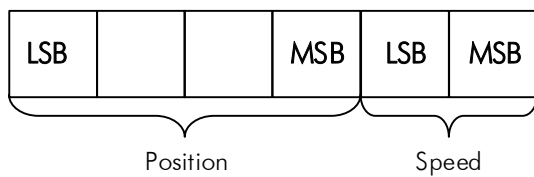


Figure 11: CANopen interface

*) The bit rate and other parameters can be changed via CAN interface. Available CAN options and further information about the DS406 device profile can be found in the downloadable EDS and XDD file.

Download link: https://www.elgo.de/fileadmin/user_upload/software/MTMQ_DS406.zip

9.1.1 Connections CANopen Interface

Table 4: CANopen with open cable ends

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

Table 5: CANopen with 5-pin M12 round connector

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

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 thorough suitable cable routing.



The screen of the signal output cable should only be connected to the following circuit on one side. The screens should not be grounded on both sides. Signal cables always have to be routed separately from the load power line. A safety distance of at least 0.5 m has to be kept from inductive and capacitive sources of interference such as contactors, relays, motors, switching power supplies, clocked controllers etc.!

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

1. Installation of RC-circuits via contactor coils of AC-contactors (e.g. 0.1 μ F / 100 Ω)
2. Installation of recovery diodes via DC-inductors
3. Installation of RC-circuits via the different motor phases (in the terminal box of the motor)
4. Do not connect protective earth and ground
5. Connect a mains filter ahead of the external power pack

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 8.



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.

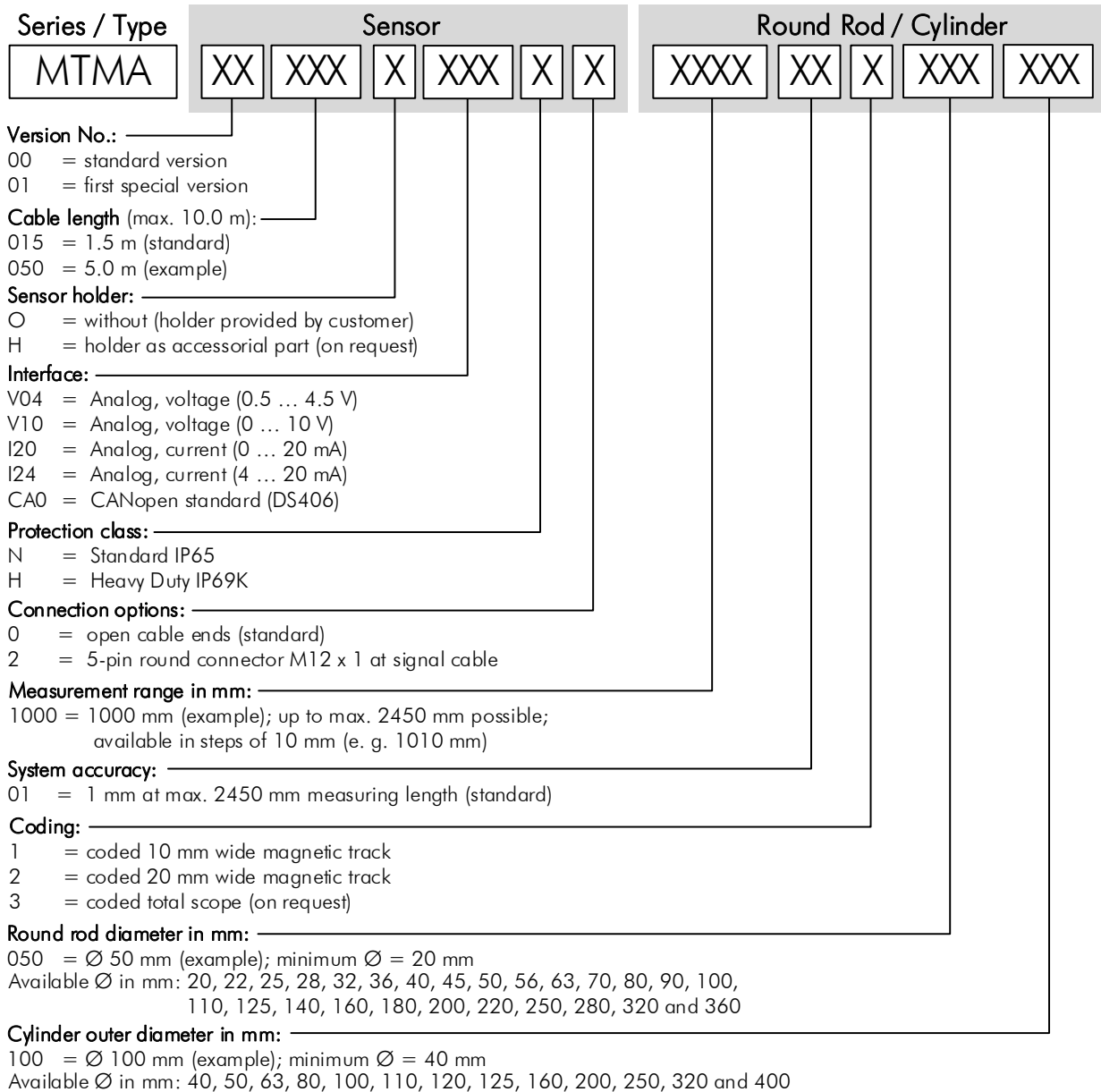
10.4 Cleaning

The cleaning of the MTM-A-000 measuring system is usually carried out in combination with the mechanical components. The type of cleaning method must be selected according to the protection class (☞ 6.3) of the MTM-A-000.

- Standardly the degree of protection is IP65 and therefore offers protection against water jets.
- When ordering option "H" (Heavy Duty) the degree of protection is IP69K and therefore suitable for cleaning with high-pressure cleaners.

11 Type Designation

To order please use the following code:



PLEASE NOTE

The above division of the order code into blocks serves only as a better illustration. Please write your defined order code **always together** and **without hyphens, blanks and separators**.

11.1 Accessories

Table 6: Accessories

Order Designation	Description
710000130	PSF 30 x 30 mm - pole finder foil for magnetic tracks

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Document- No.: 799000850 / Rev. 0
Document- Name: MTMA-000-MA-E_10-19
Subject to change - © 2019
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