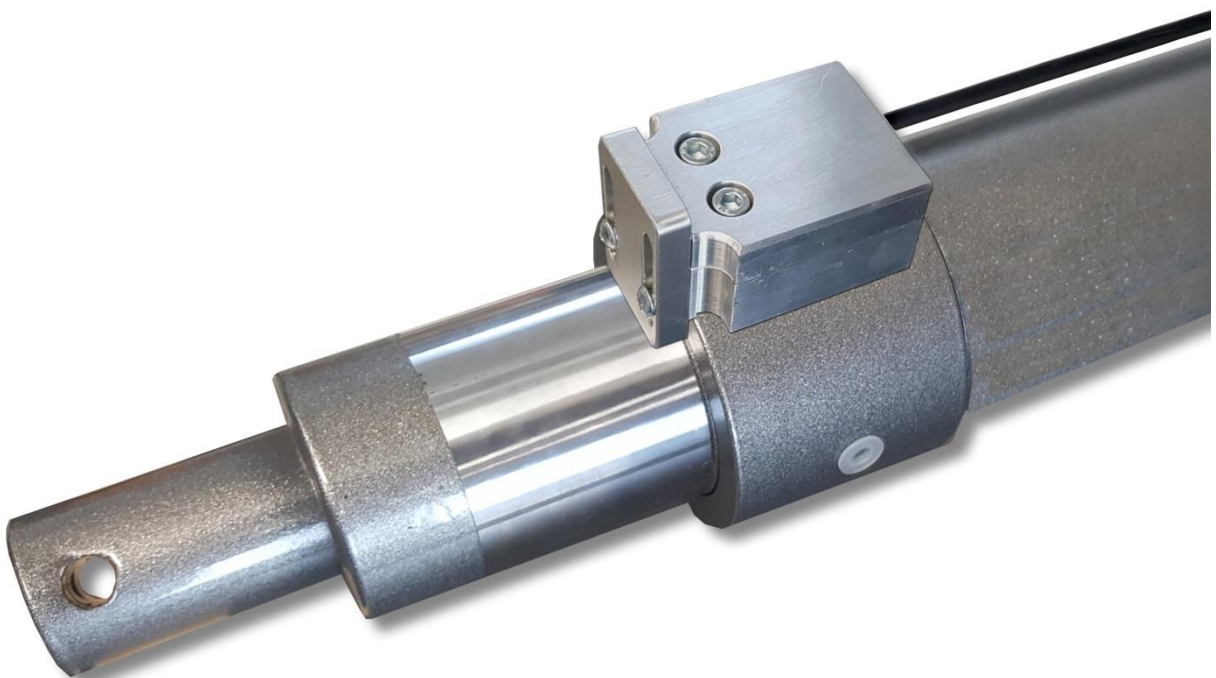


Operating Manual

SERIES MTM-Q-000

Magnetic-translational Measuring System - QUASI ABSOLUTE



- 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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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 MTM-Q-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" ☞ 6.5, "Environmental Conditions").

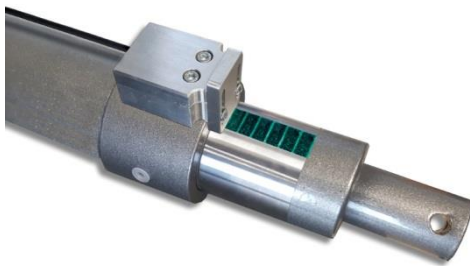
5 Product Features

The MTM-Q-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 single-track measuring system, ELGO offers these “quasi absolute” systems for fixed round rod profiles, e. g. non-rotating piston rods of hydraulic cylinders.

The system consists of the following components:

- Round rod resp. piston rod (provided by the customer for coding by ELGO)
- Application related sensor (ELGO made)

5.1 Principle of Scanning



The basis of the magnetic incremental MTM-Q-000 linear encoder consists of a scanning technology, which scans the north and south poles on the coded round rod and produces a single sine/cosine wave for each pole.

The complete sine/cosine signal process is interpolated electronically. Depending on refinement of the interpolation, together with the pole pitch of the coded round rod, the resolution of the measuring system is determined. The standard pole pitch is 16 mm.

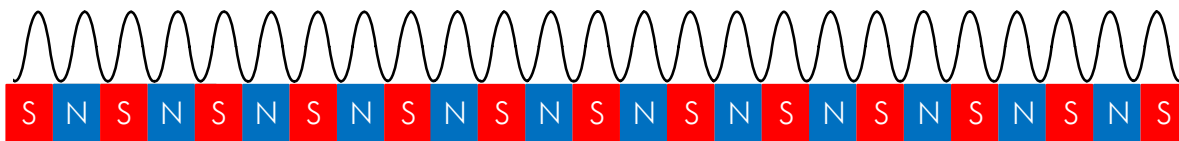


Figure 1: Magnetic single-track coding on the round rod

5.2 The quasi-absolute Measuring Principle

A rechargeable battery line integrated in the sensor transforms the incremental measuring system into a quasi-absolute measuring system, as the current position is - even in the de-energized state - permanently detected and further processed internally. Under optimal charging and ambient conditions, the service life of the batteries is up to one year after disconnection of the supply voltage.

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 **000** → Analog 12 bit output signal (0.5 ... 4.5 V), proportional to the measured value
- Interface option **001** → Analog 12 bit output signal (4 ... 20 mA) , proportional to the measured value
- Interface option **CA0** → CANopen standard according to the DS406 device profile for encoders

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 MTM-Q Measuring System

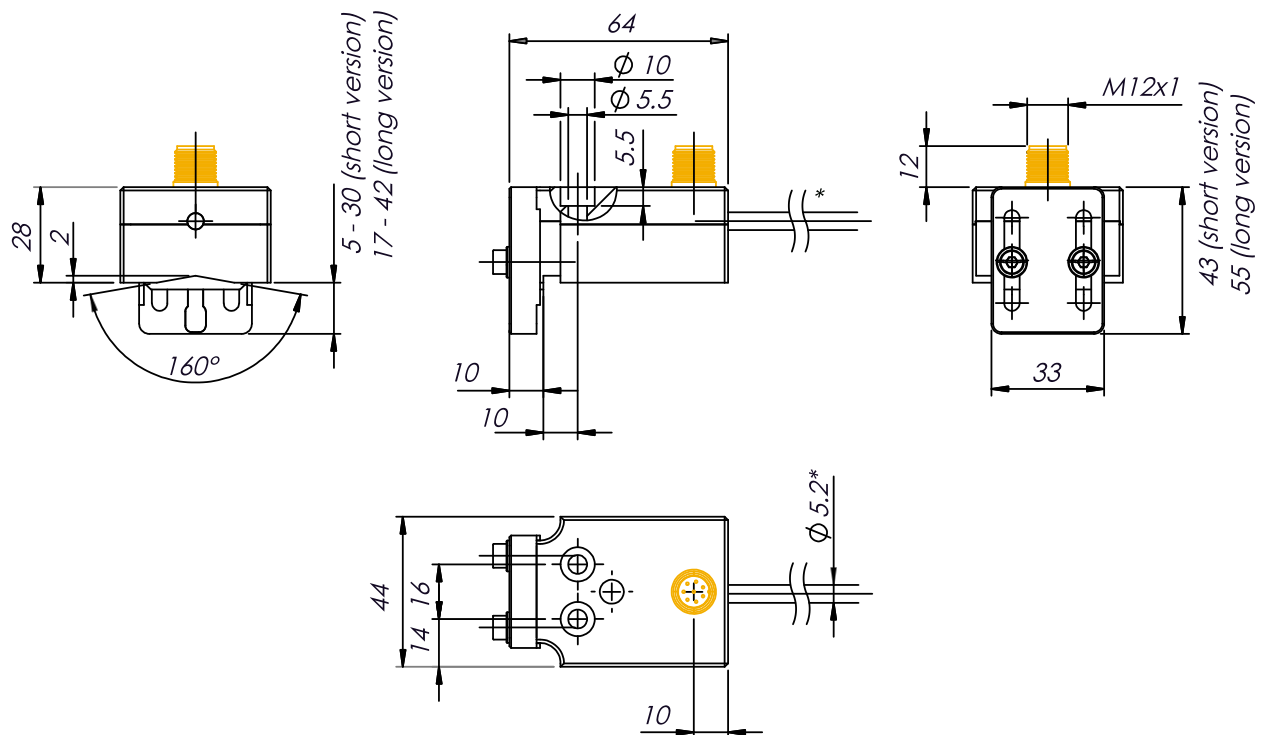




Figure 2: Dimensions of the entire MTM-Q system

  Only available with connection option 1 (see ☞ 11)
*) Cable outlet is not required for this version

6.3 Dimensions Sensor Holder "S" (short)

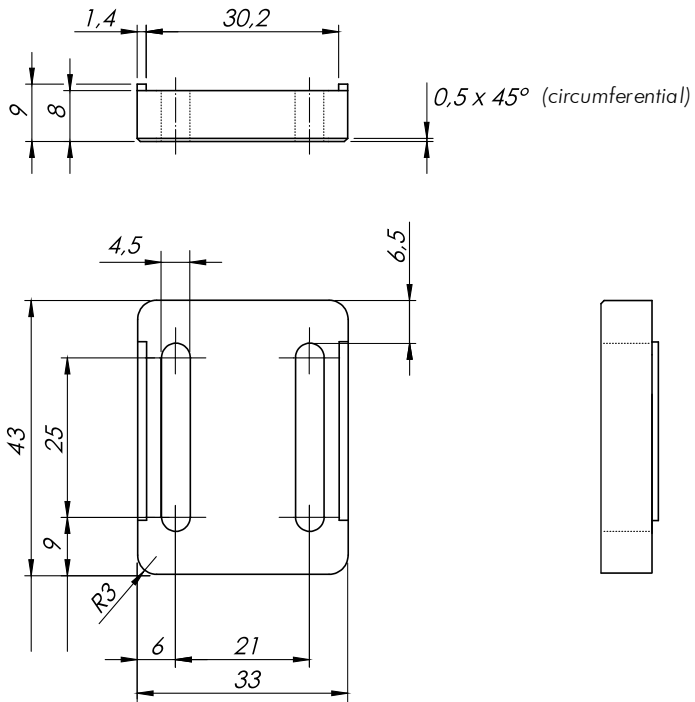


Figure 3: Dimensions sensor holder "S" (short)

6.4 Dimensions Sensor Holder "L" (long)

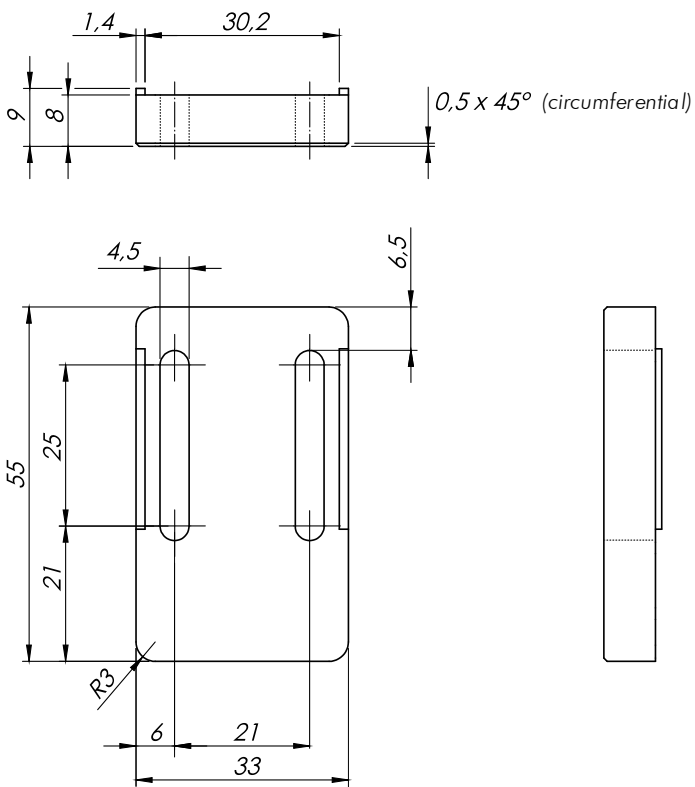


Figure 4: Dimensions sensor holder "L" (long)

6.5 Technical Data MTM-Q-000

MTM-Q-000 (standard version)

Mechanical Data

Measurement principle	quasi absolute
Repeat accuracy	± 1 increment
System accuracy in μm at 20°C	± (1000 + 20 x L) L = measuring length in meters
Distance sensor - round rod	see section 8.3.1 Mounting Tolerances
Basic pole pitch of round rod	16 mm
Round rod diameter	min. 20 mm
Measuring length	up to max. 2500 mm (available in 10 mm steps 11)
Sensor cable length	standard: 1.5 m (others on request)
Weight	MTM-Q with short sensor holder: approx. 170 g; MTM-Q with long sensor holder: approx. 180 g; cable: approx. 60 g/m
Mounting position MTM-Q-System	depends on application

Electrical Data

Power supply voltage	10 ... 30 VDC
Residual ripple	10 ... 30 VDC < 10 %
Consumption	max. 150 mA
Battery operating time	up to 1 year after power-off (under optimal charging and ambient conditions)
Available Interfaces (depends on order 11)	12 bit analog output (voltage) 0.5 ... 4.5 V 12 bit analog output (current) 4 ... 20 mA CANopen standard (DS406)
Connection type (depends on order 11)	Connection option 0: open cable ends Connection option 1: 8-pin M12 x 1 round connector on housing Connection option 2: 8-pin M12 x 1 round connector on signal cable
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.

6.6 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

6.7 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

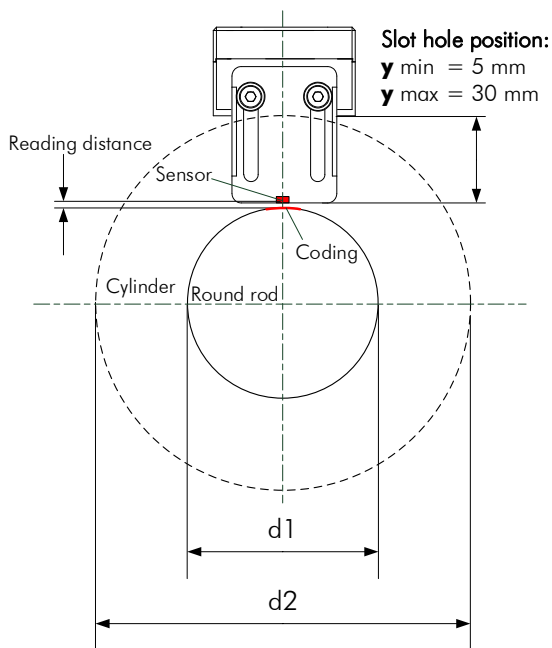
7 Sensor Holder, Round Rod and Cylinder

These three components are mechanically dependent on each other. If the assembly is incorrect, the system cannot operate correctly, since a specified maximum reading distance (☞ 8.3.1) between sensor and round rod must not be exceeded for non-contact scanning. This chapter describes how to assemble these three components.

7.1 Choice of the Sensor Holder short / long

Depending on the difference between rod diameter and cylinder diameter, one of the two sensor holders must be selected. The slotted holes allow an adjustment range of 25 mm. The following figure and table below illustrate which minimum and maximum difference Δ between the round rod diameter $d1$ (☞ 6.6) and the cylinder diameter $d2$ (☞ 6.7) can be covered by the variants S (short) and L (long):

Sensor holder S (short):



Sensor holder L (long):

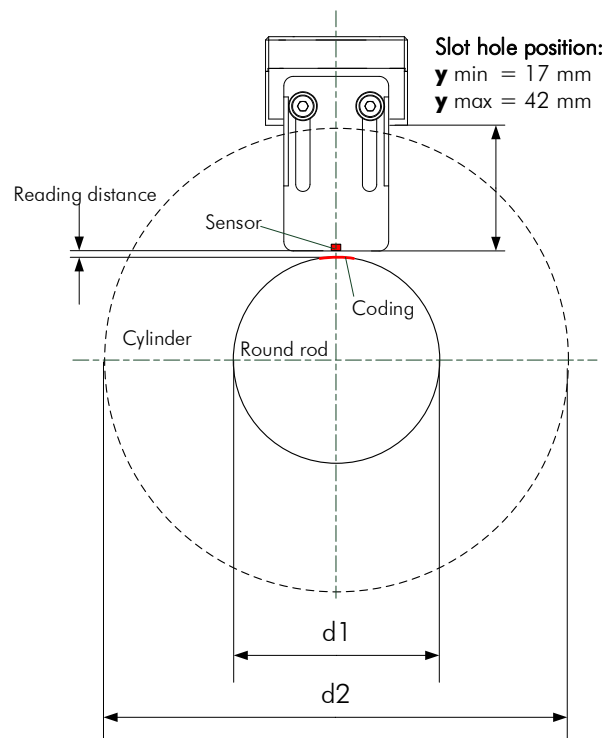
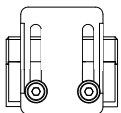


Figure 5: Sensor holder „S“ (short) and „L“ (long)

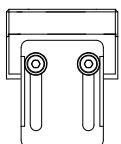
Variant	y_{min}^*	Maximum Reading Distance	min. $\Delta d1 / d2$	y_{max}	max. $\Delta d1 / d2$
S (short)	5 mm*	+ 2 mm (at 10 mm coding) + 5 mm (at 20 mm coding)	= 7 mm (at 10 mm coding) = 10 mm (at 20 mm coding)	30 mm	60 mm
L (long)	17 mm*	+ 2 mm (at 10 mm coding) + 5 mm (at 20 mm coding)	= 19 mm (at 10 mm coding) = 22 mm (at 20 mm coding)	42 mm	84 mm



The slot hole position y_{min}^* determines the minimum possible difference between the diameter of the round rod and the cylinder „min $\Delta d1 / d2$ “.



*) The maximum permissible reading distance of the sensor (small red area) must always be added to the position y_{min} , since this must not be exceeded under any circumstances and the sensor holder cannot be adjusted further upwards.



The slot hole position y_{max} determines the maximum possible difference between the diameter of the rod and the cylinder. „max $\Delta d1 / d2$ “.

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

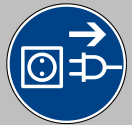
**WARNING!**

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!

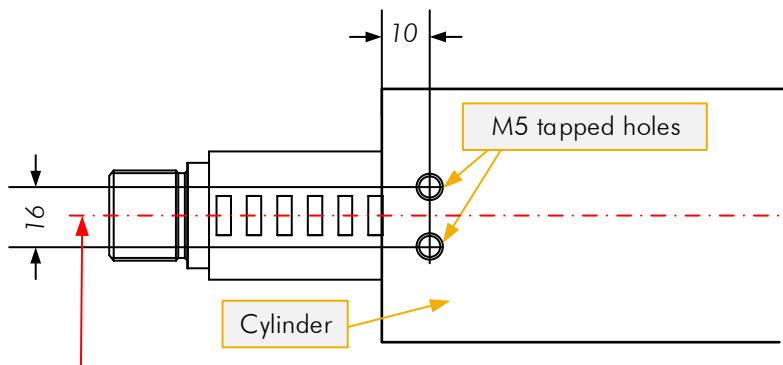
Before switching on the device, connections and plug connectors have to be checked!

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 Mounting / Installation of the Sensor

8.2.1 Mechanical Cylinder Preparation

To mount the MTM-Q-000 measuring system, the cylinder must first be provided with two M5 tapped holes as shown in Figure 6. The center of the cylinder must be in the middle of the coding*.



Center sensor = center cylinder = center of round rod coding*

*) The position of the coding is marked on the end face of the rod.

Figure 6: Mounting holes at the cylinder



IMPORTANT!

- **Minimum drilling depth:** To ensure that the MTM-Q-000 sensor is firmly seated, the drilling resp. thread depth must be at least 5 mm.
- **Minimum drilling depth:** However, the drilling depth must always be selected in such a way that the function of cylinder and round rod is not impaired resp. that existing components (e. g. rod, scraper ring, sealing elements or similar) cannot be damaged.

8.2.2 Mounting the Sensor on the Cylinder

1. First loosen the screws of the front side sensor mounting plate, so that the plate can freely be moved via the two slotted holes (see left in the figure below).
2. Then the sensor can be mounted on the cylinder by using the two $\varnothing 5.5$ mm mounting holes of the sensor housing (see right in the figure below).

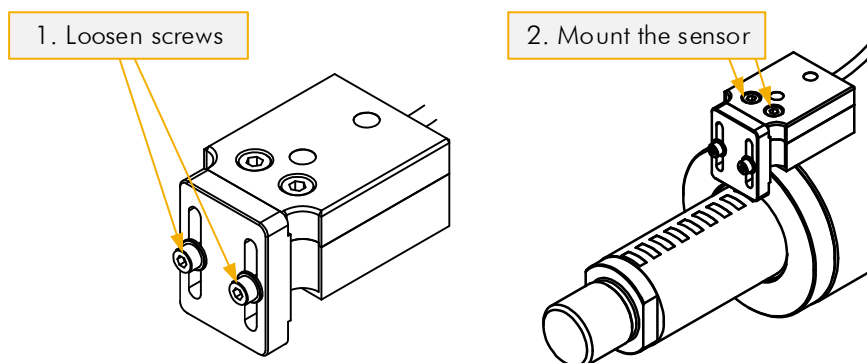


Figure 7: Mounting the Sensor on the Cylinder

Mounting screws: For mounting the sensor to the cylinder, two M6 socket head screws (optionally hexagon socket or Torx) of sufficient length must be selected.

8.3 Adjusting the Reading Distance

Depending on the rod diameter resp. order specification (☞ 11), a 10 mm or 20 mm wide coding is used. Since the magnetic field lines are of different strengths with a narrower and wider coding, different maximum reading distances result with which the sensor may be mounted to the rod.

Due to the 25 mm adjustment range of the sensor holder, the correct distance to the rod can be adjusted with the MTM-Q-000 measuring system, which is already fixed on the cylinder. The following mounting tolerances must be observed:

8.3.1 Mounting Tolerances

Coding width	Order index	Reading distance to the round rod	Lateral offset
10 mm	10 (☞ 11)	↓ max. 2 mm	↔ max. ± 3 mm
20 mm	20 (☞ 11)	↓ max. 5 mm	↔ max. ± 6 mm



IMPORTANT!

Since there is a non-visible cable connection between the sensor holding plate and the housing of the MTM-Q-000, the adjustable plate must only be adjusted carefully in the desired direction. **Please do not pull or tear suddenly!**

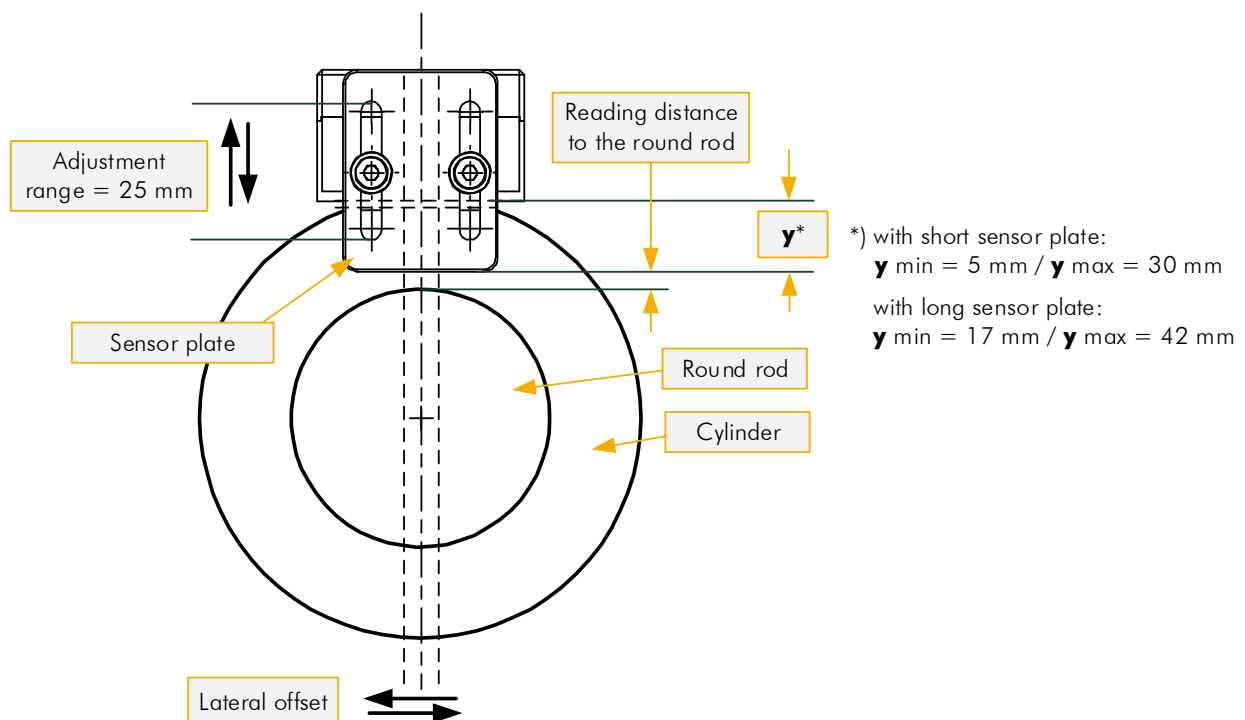


Figure 8: Mounting tolerances of the sensor holder

After adjusting the reading distance, the two screws of the sensor holder can be tightened firmly.



REMARK

Any mechanical loads that may occur must be taken into account when adjusting the reading distance.

8.4 Calibration of the measuring range



REMARKS

- The calibration must be performed for each newly installed MTM-Q-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.

8.4.1 Calibration for Versions with Analog Output

To calibrate the MTM-Q-000 measuring system, a lower and upper set point must be defined. For this purpose, the two inputs **SET 1** and **SET 2** are required (see also section 9.2.1).

Ideally, these two inputs are - temporarily for the calibration procedure - wired with a switch or push-button against +VCC (see figure on the right).

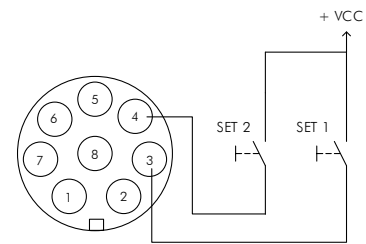
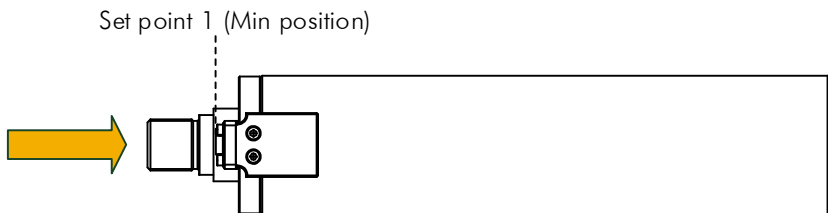


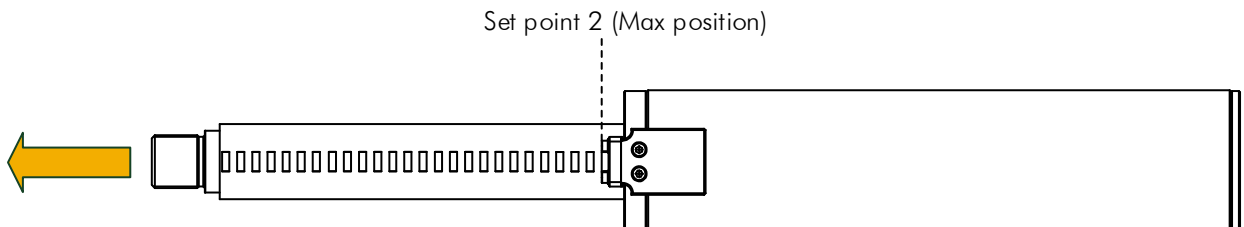
Figure 9: SET inputs

For calibration, proceed as follows:

1. **Starting position** = both SET inputs open resp. not activated.
2. **Set point 1:** Move the round rod to the lower set point (e.g. zero point or arbitrary minimum position).



3. **Activate the learning mode**, by simultaneously pressing input **SET 1** and **SET 2** for at least 3 seconds and then release again.
4. To save the smallest possible set point, briefly press input **SET 1**.
5. **Set point 2:** Move the round rod to the upper set point (resp. maximum position).



6. To save the upper set point, briefly press **SET 2**.
7. The **learning mode is automatically exited** by pressing **SET 2** as described in point 6.

8.4.2 Calibration for Versions with CAN Interface

A hardware calibration as described in 8.4.1 is not required for this version. The calibration of the upper and lower set point is performed via the CANopen interface.

9 Connections and Interfaces

9.1 Connection Options

Three different connection options are available for the MTM-Q-000 system (order information see ¶ 11). For both versions with plug connectors, an 8-pin M12 x 1 round connector is used.

9.1.1 Connection Option 0

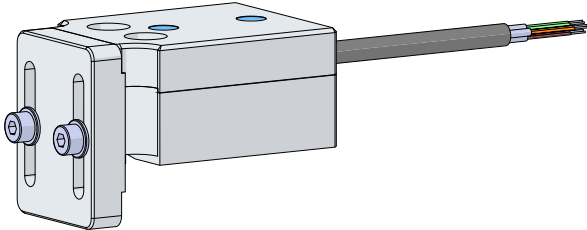


Figure 10: Connection option 0 – open cable ends

9.1.2 Connection Option 1

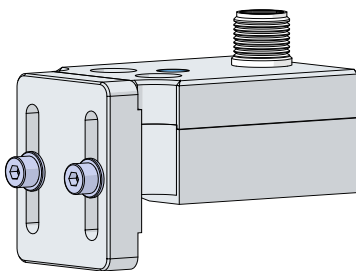


Figure 11: Connection option 1 - round connector on housing

9.1.3 Connection Option 2

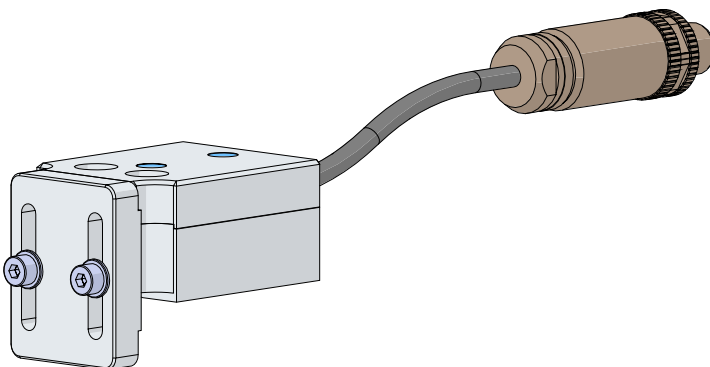


Figure 12: Connection option 2 – round connector on signal cable



PLEASE NOTE!

- All connection options equipped with a signal cable are (factory-made) strain relieved.
- For versions with a fixed plug and without signal cable a screened signal cable must be used to ensure an interference-free operation.
- If a drag chain suitable cable is used, an adequate strain relief must be provided by the customer.

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 (0.5 ... 4.5 V) or current (4 ... 20 mA).

Depending on the order specification, the connections are made via open cable ends or via an 8-pin M12 round connector, which is attached directly to the sensor housing or to the end of the signal cable.

9.2.1 Connections Analog Output

Table 1: Analog output - connection option 0

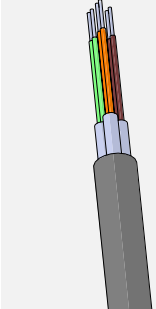
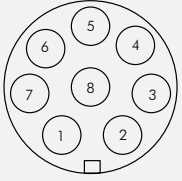
Connection Type	Drawing	Color	Function	Description
Connection option 0: Open cable ends		black	0 V / GND	Ground
		brown	+VCC	10 ... 30 VDC
		red	SET 1	Set input 1
		orange	SET 2	Set input 2
		green	Analog OUT	+ Volt resp. mA
		yellow	Analog GND	- Volt resp. mA

Table 2: Analog output - connection options 1 and 2

Connection Type	Drawing	Pin	Function	Description
Connection options 1 and 2: 8-pin. M12 round connector	 (socket, soldering side)	1	0 V / GND	Ground
		2	+VCC	10 ... 30 VDC
		3	SET 1	Set input 1
		4	SET 2	Set input 2
		5	Analog OUT	+ Volt resp. mA
		6	Analog GND	- Volt resp. mA
		7	-	n. c.
		8	-	n. c.
With shielded versions, the shield is connected to the housing				

9.1 CANopen Interface

When ordering the **CA0** interface option, the MTM-Q-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-Q-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 0.01 mm), Bit rate = 250 KB/s*
Next 2 bytes = Speed in mm/s

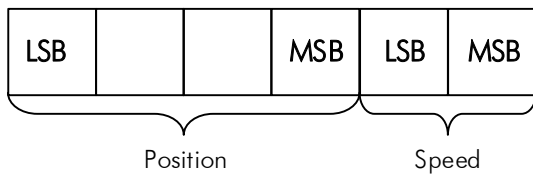


Figure 13: CANopen interface

*) 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 3: CANopen - connection option 0

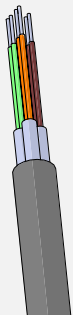
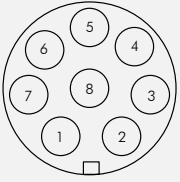
Connection Type	Drawing	Color	Function	Description
Connection option 0: Open cable ends		black	0 V / GND	Ground
		brown	+VCC	10 ... 30 VDC
		red	-	n. c.
		orange	-	n. c.
		green	CAN HIGH	positive CAN signal
		yellow	CAN LOW	negated CAN signal

Table 4: CANopen - connection options 1 and 2

Connection Type	Drawing	Pin	Function	Description
Connection options 1 and 2: 8-pin. M12 round connector	 (socket, soldering side)	1	0 V / GND	Ground
		2	+VCC	10 ... 30 VDC
		3	-	n. c.
		4	-	n. c.
		5	CAN HIGH	positive CAN signal
		6	CAN LOW	negated CAN signal
		7	-	n. c.
		8	-	n. c.

With shielded versions, the shield is connected to the housing

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 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.



WARNING!

Danger through non-conventional maintenance!

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

Therefore:

Maintenance works may only be completed by staff that has been authorized and trained by the operator.

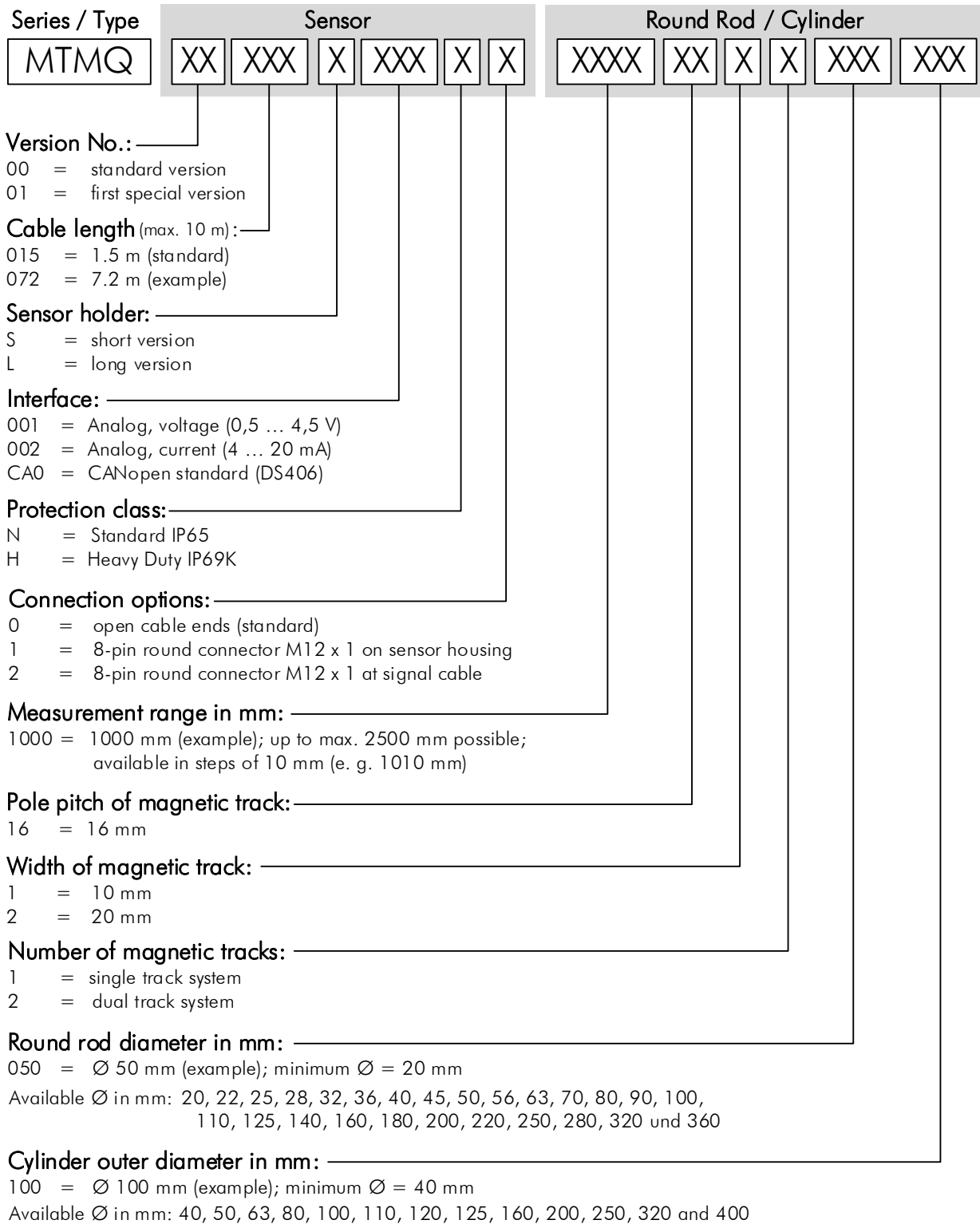
10.4 Cleaning

The cleaning of the MTM-Q-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 (☞ 6.5) of the MTM-Q-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**.

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