Temposonics
AN AMPHENOL COMPANY

Temposonics®

Magnetostrictive Linear Position Sensors

R-Series Ethernet/IP™
Operation Manual

EtherNet/IP™
ODVA™ CONFORMANT

Table of contents

1. Introduction

1.1 Purpose and use of this manual

Before starting the operation of Temposonics® sensors read this documentation thoroughly and follow the safety information.

The content of this technical documentation and of its various annexes is intended to provide information on mounting, installation and commissioning by qualified automation personnel [1] or instructed service technicians who are familiar with the project planning and dealing with Temposonics® sensors.

1.2 Used symbols and warnings

Warnings are intended for your personal safety and for avoidance of damage to the described product or connected devices. In this documentation, safety information and warnings to avoid dangers that might affect the life and health of operating or service personnel or cause material damage are highlighted by the preceding pictogram, which is defined below.

Symbol	Meaning
NOTICE	This symbol is used to point to situations that may lead to material damage, but not to personal injury.

2. Safety instructions

2.1 Intended use

This product may be used only for the applications provided under item 1 and item 2 and only in conjunction with the third-party devices and components recommended or approved by MTS Sensors. As a prerequisite of proper and safe operation, the product requires correct transport, storage, mounting and commissioning and must be operated with utmost care.

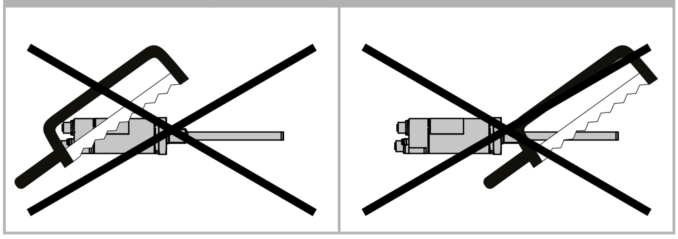
1. The sensor systems of all Temposonics® series are intended exclusively for measurement tasks encountered in industrial, commercial and laboratory applications. The sensors are considered as system accessories and must be connected to suitable evaluation electronics, e.g. a PLC, IPC, indicator or other electronic control unit.
2. The position sensors must be used only in technically safe condition. To maintain this condition and to ensure safe operation, installation, connection and service work may be performed only by qualified technical personnel.

1/ The term qualified technical personnel characterizes persons who:
– are familiar with the safety concepts of automation technology applicable to the particular project,
– are competent in the field of EMC,
– have received adequate training for commissioning and service operations
– are familiar with the operation of the device and know the information required for correct operation provided in the product documentation.

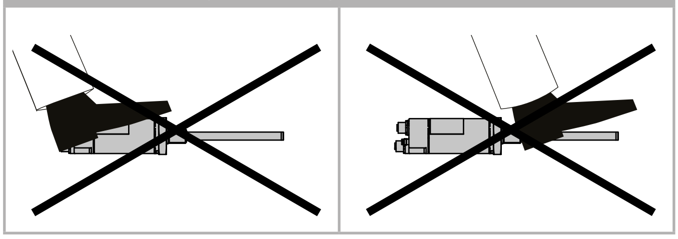
2.2 Forseeable misuse

Forseeable misuse	Consequence
Wrong sensor connection	The sensor does not work properly or will be destroyed
Operate the sensor out off the operating temperature	No signal output The sensor can be damaged
Power supply is out of the defined range	Signal output is wrong/ no signal output/ the sensor will be damaged
Position measurement is influenced by an external magnetic field	Signal output is wrong
Cables are damaged	Short circuit – the sensor can be destroyed/sensor does not respond
Magnet spacers are missing/ are installed in the wrong order	Error in position measurement
Wrong connection of ground/shield	Signal output is disturbed The electronics can be damaged
Use of a magnet that is not certified by MTS Sensors	Error in position measurement

Do not reprocess the sensor afterwards.
➔ The sensor might be damaged.



Do not step on the sensor.
➔ The sensor might be damaged.



2.3 Installation, commissioning and operation

The position sensors must be used only in technically safe condition. To maintain this condition and to ensure safe operation, installation, connection and service work may be performed only by qualified technical personnel.

If danger of injury to persons or of damage to operating equipment is caused by sensor failure or malfunction, additional safety measures such as plausibility checks, limit switches, EMERGENCY STOP systems, protective devices etc. are required. In the event of trouble, shut down the sensor and protect it against accidental operation.

Safety instructions for commissioning
To maintain the sensor operability, it is mandatory to follow the instructions given below.
1. Protect the sensor against mechanical damage during installation and operation.
2. Do not open or dismantle the sensor.
3. Connect the sensor very carefully and pay attention to the polarity of connections and power supply.
4. Use only approved power supplies.
5. It is indispensable to ensure that the specified permissible limit values of the sensor for supply voltage, environmental conditions, etc. are met.
6. Check the function of the sensor regularly and provide documentation of the checks.
7. Before system switch-on, ensure that nobody's safety is jeopardized by starting machines.

2.4 Safety instructions for use in explosion-hazardous areas

The sensor is not suitable for operation in explosion-hazarded areas.

2.5 Warranty [2]

MTS Sensors grants a warranty period for the Temposonics® position sensors and supplied accessories relating to material defects and faults that occur despite correct use in accordance with the intended application [2]. The MTS Sensors obligation is limited to repair or replacement of any defective part of the unit. No warranty can be taken for defects that are due to improper use or above average stress of the product, as well as for wear parts. Under no circumstances will MTS Sensors accept liability in the event of offense against the warranty rules, no matter if these have been assured or expected, even in case of fault or negligence of the company.
MTS Sensors explicitly excludes any further warranties. Neither the company's representatives, agents, dealers nor employees are authorized to in- crease or change the scope of warranty.

2.6 Return

For diagnostic purposes, the sensor can be returned to MTS Sensors or an authorized repair facility. Any shipment cost will be borne by the sender [2]. For a corresponding form, see chapter 9 (Annex).

2/ see also applicable MTS Sales and supply conditions, e.g. under www.mtssensors.com

3. Identification

3.1 Order structure of R-Series RP

Temposonics® order code

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
R	P							D	5	6	1	N	1	0	1			
a		b	c					d			e	f				g		

a		Sensor model
R	P	Profile

b	Design
S	Magnet slider, joint on top (Part number: 252182)
V	Magnet slider, joint at front (Part number: 252184)
M	U-magnet, OD33 (Part number: 251416-2)

c					Stroke length
X	X	X	X	M	0025…5080 mm
X	X	X .	X	U	001…200 in.

Standard stroke length (mm)*

Stroke length	Ordering steps
25 … 500 mm	25 mm
500…2500 mm	50 mm
2500…5080 mm	100 mm

Standard stroke length (in.)*

Stroke length	Ordering steps
1 … 20 in.	1 in.
20…100 in.	2 in.
100…200 in.	4 in.

d			Connection type
D	5	6	2 × 4 pin M12 female, 1 × 4 pin M8 male

e	Operation voltage
1	+24 VDC (−15 / +20 %)

f				Output
N	1	0	1	EtherNet/IP™

Optional: for multi-position measurement only
(Order additional magnets seperately)

g			Magnet number for multi-position measurement[3]
Z	X	X	02…20 magnets

*/ Non Standard stroke lengths are available; must be encoded in 5 mm / 0.1 in. increments
3/ Note: Please specify magnet numbers for your sensing application and order separately

3.2 Order structure of R-Series RH

Temposonics® order code

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
R	H							D	5	6	1	N	1	0	1			
a		b	c					d			e	f				g		

a		Sensor model
R	H	Rod

b	Design
M	Flange M18×1.5 (Standard)
V	Flange M18×1.5 with Fluoroelastomer housing-seal
D	Flange M18×1.5 bushing on rod end
R	Flange M18×1.5 thread M4 at rod end
J	Flange M22×1.5 rod Ø 12.7 mm, 800 bar
S	Flange M¾"×16UNF - 3A
B	B Sensor cartridge only (no flange or pressure tube, stroke length <1830 mm (72 in.))

c					Stroke length
X	X	X	X	M	0025…7620 mm
X	X	X	X	U	001…300 in.

Standard stroke length (mm)*

Stroke length	Ordering steps
25 … 500 mm	5 mm
500 … 750 mm	10 mm
750…1000 mm	25 mm
1000…2500 mm	50 mm
2500…5080 mm	100 mm
5000…7620 mm	250 mm

Standard stroke length (in.)*

Stroke length	Ordering steps
1 … 20 in.	0.2 in.
20 … 30 in.	0.4 in.
30 … 40 in.	1 in.
40…100 in.	2 in.
100…200 in.	4 in.
200…300 in.	10 in.

d			Connection type
D	5	6	2 × 4 pin M12 female, 1 × 4 pin M8 male

e	Operation voltage
1	+24 VDC (−15 / +20 %)

f				Output
N	1	0	1	EtherNet/IP™

Optional: for multi-position measurement only
(Order additional magnets seperately)

g			Magnet number for multi-position measurement[4]
Z	X	X	02…20 magnets

***/** Non Standard stroke lengths are available; must be encoded in 5 mm / 0.1 in. increments
4/ Note: Please specify magnet numbers for your sensing application and order separately

3.3 Order structure of R-Series RD4

Temposonics® order code

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
R	D	4										D	5	6	N	1	0	1			
a			b	c		d	d					g			f				g		

a	Sensor model		
R	D	4	Detachable sensor electronics

b	Design
S	Pressure fit flange
M	Threaded flange M18×1.5-6g, AF23
C	Threaded flange M18×1.5-6g, AF46
T	Threaded flange ¾“–16UNF–3A.
D	Threaded flange ¾“–16UNF–3A.

c	Integral cable of sensor rod	

For side cable entry:

D	1	PUR-cable, length 250 mm (9.8 in.)
D	2	PUR-cable, length 400 mm (15.7 in.)
D	3	PUR-cable, length 600 mm (23.6 in.)

For bottom cable entry:

R	2	Single wires with flat connector, length 65 mm (2.6 in.)
R	4	Single wires with flat connector, length 170 mm (6.7 in.)
R	5	Single wires with flat connector, length 230 mm (9.1 in.)
R	6	Single wires with flat connector, length 350 mm (13.8 in.)

d	Sensor electronics
S	Side cable entry
B	Bottom cable entry

c	Stroke length				
X	X	X	X	M	Flange M & C: 0025…5080 mm Flange S: 0025…2540 mm
X	X	X.	X	U	Flange M & C: 001…200 in. Flange S: 001…100 in.

Standard stroke length (mm)*

Stroke length	Ordering steps
25 … 500 mm	5 mm
500 … 750 mm	10 mm
750…1000 mm	25 mm
1000…2500 mm	50 mm
2500…5080 mm	100 mm

Standard stroke length (in.)*

Stroke length	Ordering steps
1…20 in.	0.2 in.
20…30 in.	0.4 in.
30…40 in.	1 in.
40…100 in.	2 in.
100…200 in.	4 in.

f	Connection type		
D	5	6	2 × 4 pin M12 female, 1 × 4 pin M8 male

f	Output			
N	1	0	1	EtherNet/IP™

Optional: for multi-position measurement only
(Order additional magnets seperately)

g	Magnet number for multi-position measurement[5]		
Z	X	X	02…20 magnets

*/ Non Standard stroke lengths are available; must be encoded in 5 mm / 0.1 in. increments
5/ Note: Please specify magnet numbers for your sensing application and order separately

3.4 Order structure of R-Series RF

Temposonics® order code

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
R	F								D	5	6	1	N	1	0	1			
a		b	c						g			e	f				g		

a	Sensor model
R F	Flexible sensor rod

b	Design
C	Basic sensor
M	Flange M18×1.5-6g
S	Flange ¾"×16UNF-3A

c	Stroke length (Longer strokes are available. Contact applications engineering for details.)
X X X X X M	00100…10060 mm
X X X X X U	0004.0…0396.0 in.

Standard stroke length (mm)*

Stroke length	Ordering steps
100 … 1000 mm	50 mm
1000…10060 mm	250 mm

Standard stroke length (in.)*

Stroke length	Ordering steps
4 … 40 in.	2 in.
40…396 in.	10 in.

f	Connection type
D 5 6	2 × 4 pin M12 female, 1 × 4 pin M8 male

e	Operation voltage
1	+24 VDC (−15 / +20 %)

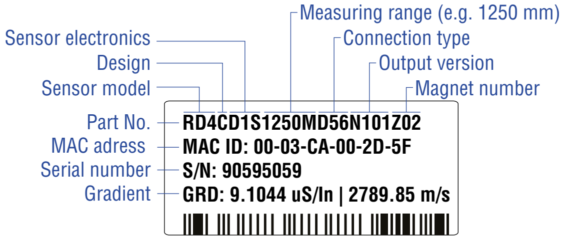
f	Output
N 1 0 1	EtherNet/IP™

Optional: for multi-position measurement only
(Order additional magnets seperately)

g	Magnet number for multi-position measurement[6]
Z X X	02…20 magnets

***/** Non Standard stroke lengths are available; must be encoded in 5 mm / 0.1 in. increments
6/ Note: Please specify magnet numbers for your sensing application and order separately

3.5 Nameplate (example)



3.6 Approvals

CE certification (only for RP & RH; RF: The conformity is fulfilled, assumed the wave guide of the sensor is embedded in an EMC-sealed and grounded housing), EPSG certified, GOST certified, UL/cUL certified (only for RP/RH)

3.7 Scope of delivery

R-Series RP (profile):
Sensor, Position magnet, 2 mounting clamps up to 1250 mm (49 in.) + 1 clamp for each 500 mm (20 in.)

R-Series RH (rod):
Sensor, O-ring

R-Series RD4 (detached electronics):
RD4-S
Sensor, O-ring, Back-Up ring
RD4-C/M/T/D
Sensor, O-ring

R-Series RF (flexible sensor rod):
RF-M / RF-S:
Sensor, Threaded Flange, O-ring

4. Product description and commissioning

4.1 Functionality and system design

Product designation
– Position sensor Temposonics® R-Series

Construction series
– Temposonics® R-Series RP/RH/RD4/RF
– Stroke length: RP 25…5080 mm (1…200 in.)
RH 25…7620 mm (1…300 in.)
RD4 25…5080 mm (1…200 in.)
RF 100…10060 mm (4…396 in.)*
– Output signal: EtherNet/IP™

Application
The Temposonics® sensor is used for measurement and conversion of the length (position) variable in the field of automated system and mechanical engineering.

Principle of operation and system construction
For position measurement, the absolute, linear Temposonics® position sensors make use of the properties offered by the specially designed magnetostrictive waveguide. Inside the sensor a torsional strain pulse is induced in the waveguide by momentary interaction of two magnetic fields. The interaction between these two magnetic fields produces a strain pulse, which is detected by the electronics at the head of the sensor. One field is produced by a moving position magnet, which travels along the sensor rod with the waveguide inside. The other field is generated by a current pulse applied to the waveguide. The position of the moving magnet is determined precisely by measuring the time elapsed between the application of the current pulse and the arrival of the strain pulse at the sensor head. The result is a reliable position measurement with high accuracy and repeatability.

*/ (Longer strokes available, please contact applications engineering for details.)

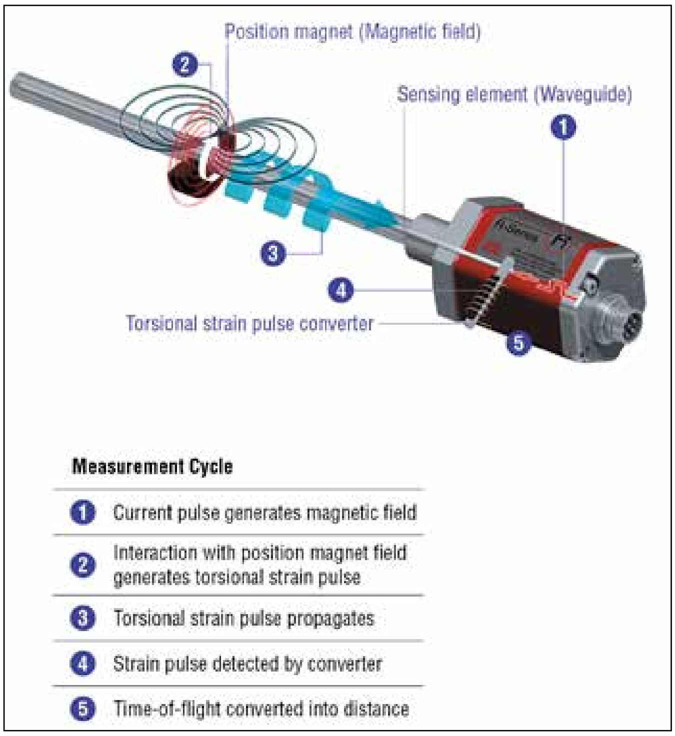


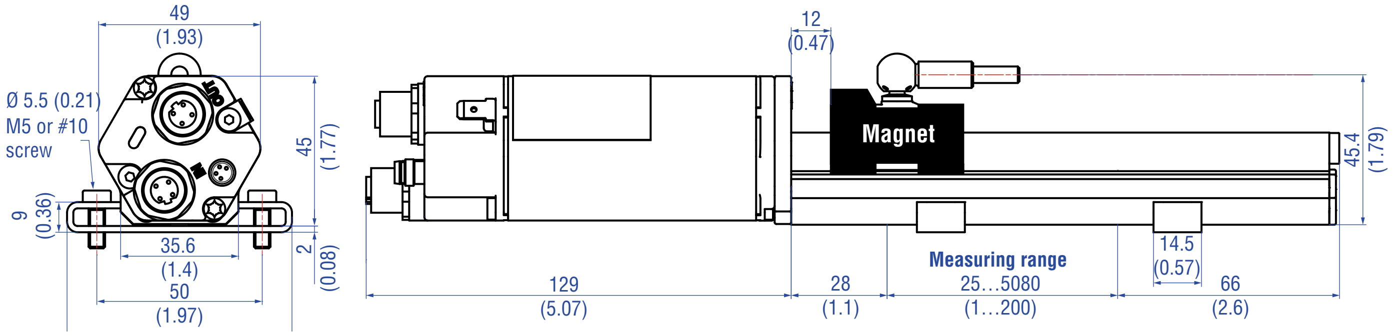
Fig. 1: Principle of operation: Time-based magnetostrictive position sensing principle

Modular mechanical and electronic construction
– The sensor housing protects the sensor element.
– The sensor electronics housing, a rugged aluminum construction, contains the complete electronic interface with active signal conditioning.
– The external position magnet is a permanent magnet. Mounted on the mobile machine part, it travels along the sensing element and triggers the measurement through the housing wall.
– Depending on the type, the sensor is connected to the controller via a plug.
– The sensor can be connected directly to a control system. Its electronics generates a strictly position-proportional signal output between zero and end position.

4.2 Styles and installation of R-Series RP

Temposonics® RP offers modular construction, flexible mounting configurations and easy installation. Position measurement is non-contact via two versions of permanent magnets.

- A sliding magnet running in profile housing rails. Connection with the moving machine part is via a ball jointed arm for taking up axial forces.
- A floating magnet, mounted directly on the moving machine part, travels over the profile at a low distance. Its air-gap allows the correction of small misalignments at installation.



Controlling design dimensions are always in metric units and measurements in ( ) are in inches

Fig. 2: RP Style dimensional drawing

4.2.1 Mounting distances

Active measuring range

The technical data of each sensor is checked as well as documented and the active stroke length (useful electrical stroke) with its start and end position is adjusted during final inspection and testing (see Fig. 2).

NOTICE

On all sensors, the areas left and right of the active stroke length are provided for mounting and damping of the measuring signal. They should not be used for measurement, but the active stroke length can be exceeded without problem.

Mechanical zero

To ensure that the entire measuring range can be used electrically, the position magnet must be mounted mechanically as follows:

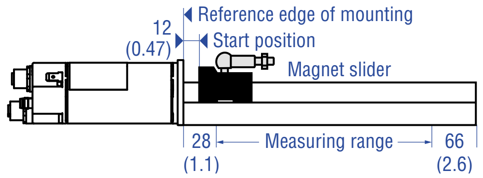


Fig. 3: Temposonics® profile with magnet slider

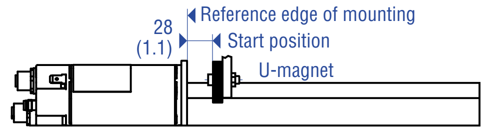


Fig. 4: Temposonics® profile with U-magnet

Multi-position measurement

The minimum distance between the magnets is 75 mm (3 in.).

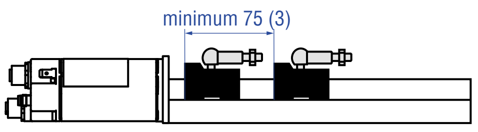


Fig. 5: Minimum distance for multi position measurement with magnet slider

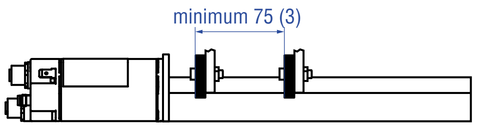


Fig. 6: Temposonics® profile with U-magnet

Controlling design dimensions are always in metric unitsand measurements in ( ) are in inches

4.2.2 Installation of RP

The position sensor can be installed in any position. Normally, the sensor is firmly installed and the position magnet is fastened to the mobile machine part. Thus it can travel along the measuring rod contactlessly.

The sensor is fitted on a flat machine surface using the mounting clamps (fig. 7). A length-dependent number of these clamps are delivered with the sensor and must be distributed over the profile at regular distances.

For fastening, we recommend using M5×20 screws to DIN 6912 that shout be tightened with a maximum torque of 5 Nm.

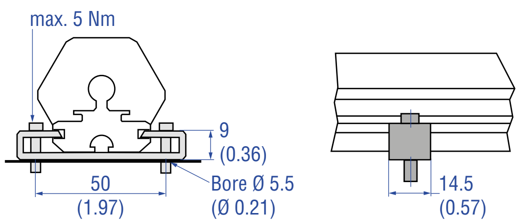


Fig. 7: Mounting clamps with cylinder screw M5×20, fastening torque < 5 Nm

Alternative: If only limited space is available, the profile sensor can be mounted also via the T-rail in the profile bottom using an M5 T-slot nut or a sliding block (fig. 8).

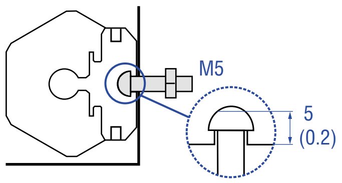


Fig. 8: T-slot nuts M5

NOTICE

Don't mount the sensors in the area of strong magnetic or electric noise fields. Take care to mount the sensor in an axially parallel position to avoid damaging the carriage, magnet and measuring rod.

The sensor is isolated from the machine ground. For this reason, earthing via the flat-pin connector on the sensor electronics housing is indispensable (fig. 9).

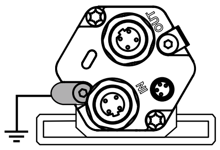


Fig. 9: Grounding profile sensor

4.2.3 Magnet mounting

Mounting the U-magnet

The U-magnet is removable and can be used for profile- and rod-style sensors. Using a non-magnetizable mounting device is mandatory. The magnet must not rub against the measuring rod. Alignment errors are compensated via the air gap.

– Max. surface pressure: 40 N/mm²
– Max. tightening torque for M4 screws: 1 Nm; use washer, if necessary

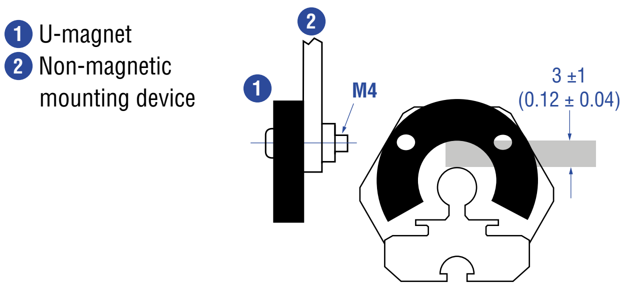


Fig. 10: Mounting device for U-magnet

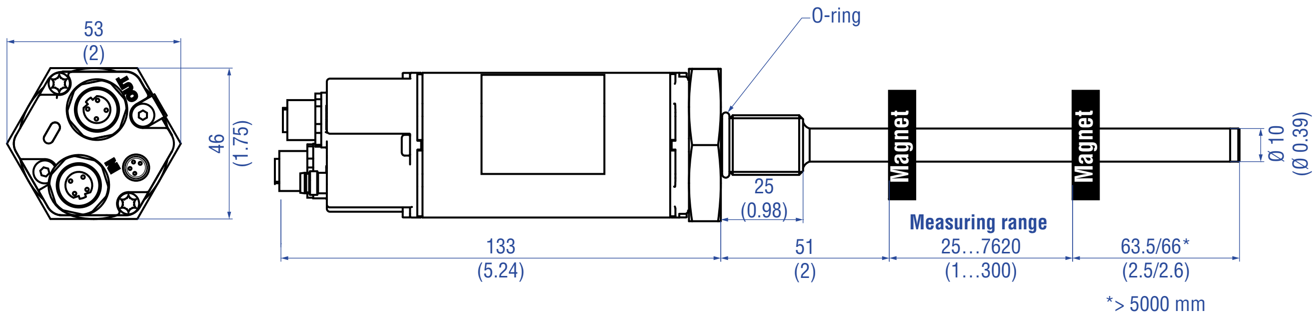
NOTICE

A maximum permissible air gap of 3 ±1mm (0.12 in.) must not be exceeded.

Controlling design dimensions are always in metric units and measurements in ( ) are in inches

4.3 Styles and installation of R-Series RH

Temposonics® RH with a pressure resistant stainless steel flange and sensing rod. They are suitable in all fluid power cylinders and externally in all applications where space is a problem. Position measurement is via ring or U-magnets travelling along the sensing rod without any mechanical contact.



Controlling design dimensions are always in metric units and measurements in ( ) are in inches

Fig. 11: RH Style dimensional drawing

4.3.1 Mounting distances

Active measuring range

The technical data of each sensor is checked as well as documented and the active stroke length (useful electrical stroke) with its start and end position is adjusted during final inspection and testing (see Fig. 11).

NOTICE

On all sensors, the areas left and right of the active stroke length are provided for mounting and damping of the measuring signal. They should not be used for measurement, but the active stroke length can be exceeded without problem.

Mechanical zero

To ensure that the entire measuring range can be used electrically, the position magnet must be mounted mechanically as follows:

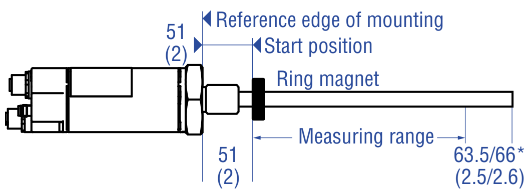


Fig. 12: Temposonics® rod with ring magnet

Multi-position measurement

The minimum distance between the magnets is 75 mm (3 in.).

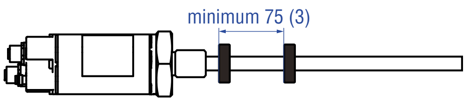


Fig. 13: Minimum distance for multi position measurement

4.3.2 Installation of RH

Installation of a rod-style sensor

The rod-style version has been developed for direct stroke measurement in a fluid cylinder.

– Mounted on the bottom of the piston, the ring magnet travels over the rod contactlessly and marks the position exactly through the rod wall.
– Inside the pressure-resistant sensor housing immerging into the open piston rod, the basic sensor is mounted by means of only two screws. It is the only part that needs replacing if servicing is required, i.e. the hydraulic circuit remains closed.

NOTICE

After re-installing, securing the basic sensor screws, e.g. using Loctite 243, is mandatory.

Rod with inner sensor element immersed in the cylinder

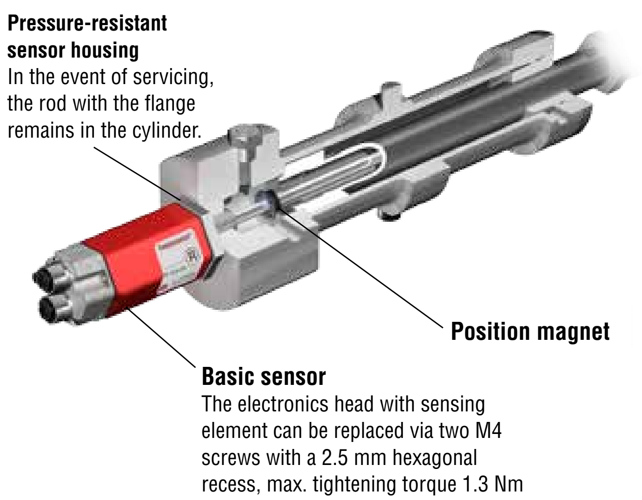


Fig. 14: Sensor in fluid cylinder

Hydraulics sealing
There are two ways for sealing the flange contact surface:
1. A sealing by using an O-ring (e.g. 22.4×2.65 mm) in a cylinder bottom groove (fig. 16).
2. A sealing via an 15.3×2.2 mm O-ring (for metric thread flange) or 0.644" x 0.087" O-ring (for SAE thread flange) in the undercut (fig. 15). In this case, a screw hole based on ISO 6149-1 (fig. 17) must be provided.

– The flange contact surface must be seated completely on the cylinder mounting surface.
– The cylinder manufacturer determines the pressure-resistant gasket (copper gasket, O-ring, etc.).
– The position magnet should not rub against the rod.
– The plunger borehole (Ø 10 mm rod: > Ø 13 mm (Ø 0.52 in.) Ø 12.7 mm rod: > 16 mm (0.63 in.)) depends on the pressure and piston speed.
– The peak pressure should not be exceeded.
– Protect the measuring rod against wear.

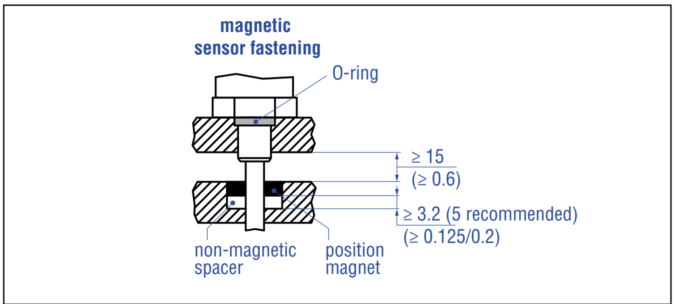


Fig. 15: Installation with non-magnetic material

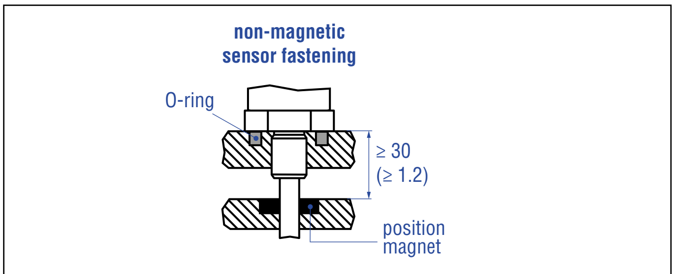


Fig. 16: Installation with magnetic material

Thread (d_1×P)	d_2	d_3	d_4	d_5	L_1	L_2	L_3	L_4	Z°
M18 × 1.5	55 mm	13 mm	24.5 mm	19.8 mm	2.4 mm	28.5 mm	2 mm	26 mm	15°
¾ x 16	See Appendix B								

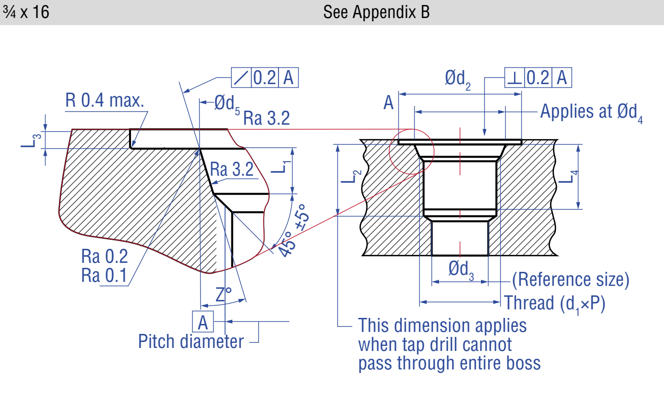


Fig. 17: Notice for threaded flange M18×1.5 based on DIN ISO 6149-1

Controlling design dimensions are always in metric units and measurements in ( ) are in inches

NOTICE

For mounting by means of screws, use only a hexagonal flange width across flats 46 mm (1.8 in.) below the sensor electronics housing (electronics) and avoid exceeding the maximum fastening torque of 50 Nm (for RH-J: 125 Nm).

4.3.3 Magnet mounting

Mounting the ring magnet
Install the magnet using non-magnetizable material for mounting device, screws, spacers etc.
– Max. permissible surface pressure: 40 N/mm²
– Max. fastening torque for M4 screws: 1 Nm; use washers, if necessary

Mounting the U-magnet
Using a non-magnetizable mounting device is mandatory. The magnet must not rub against the measuring rod. Alignment errors are compensated via the air gap.
– Max. surface pressure: 40 N/mm²
– Max. fastening torque for M4 screws: 1 Nm; use washer, if necessary

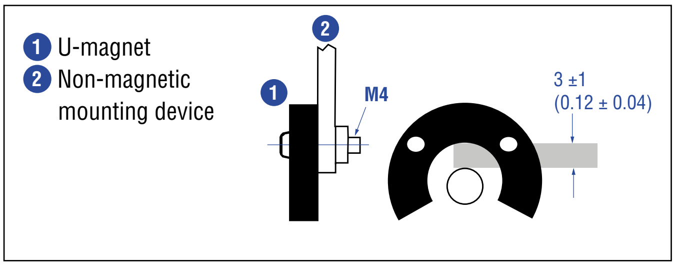


Fig. 18: Mounting device for U-magnet

NOTICE

A maximum permissible air gap of 3 ±1mm (0.12 in.) must not be exceeded.

<u>Large stroke lengths from 1 meter (39 in.)</u>
Horizontally installed sensors should be supported mechanically at the rod end. Longer rods require evenly distributed mechanical support over the entire length. In this case an U-magnet (see fig. 19) is used for measurement.

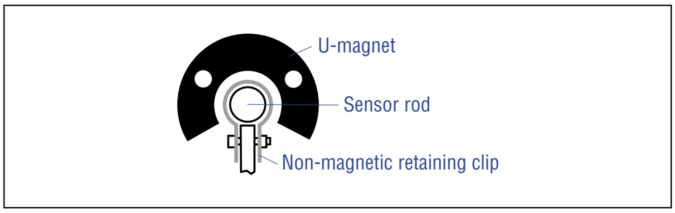
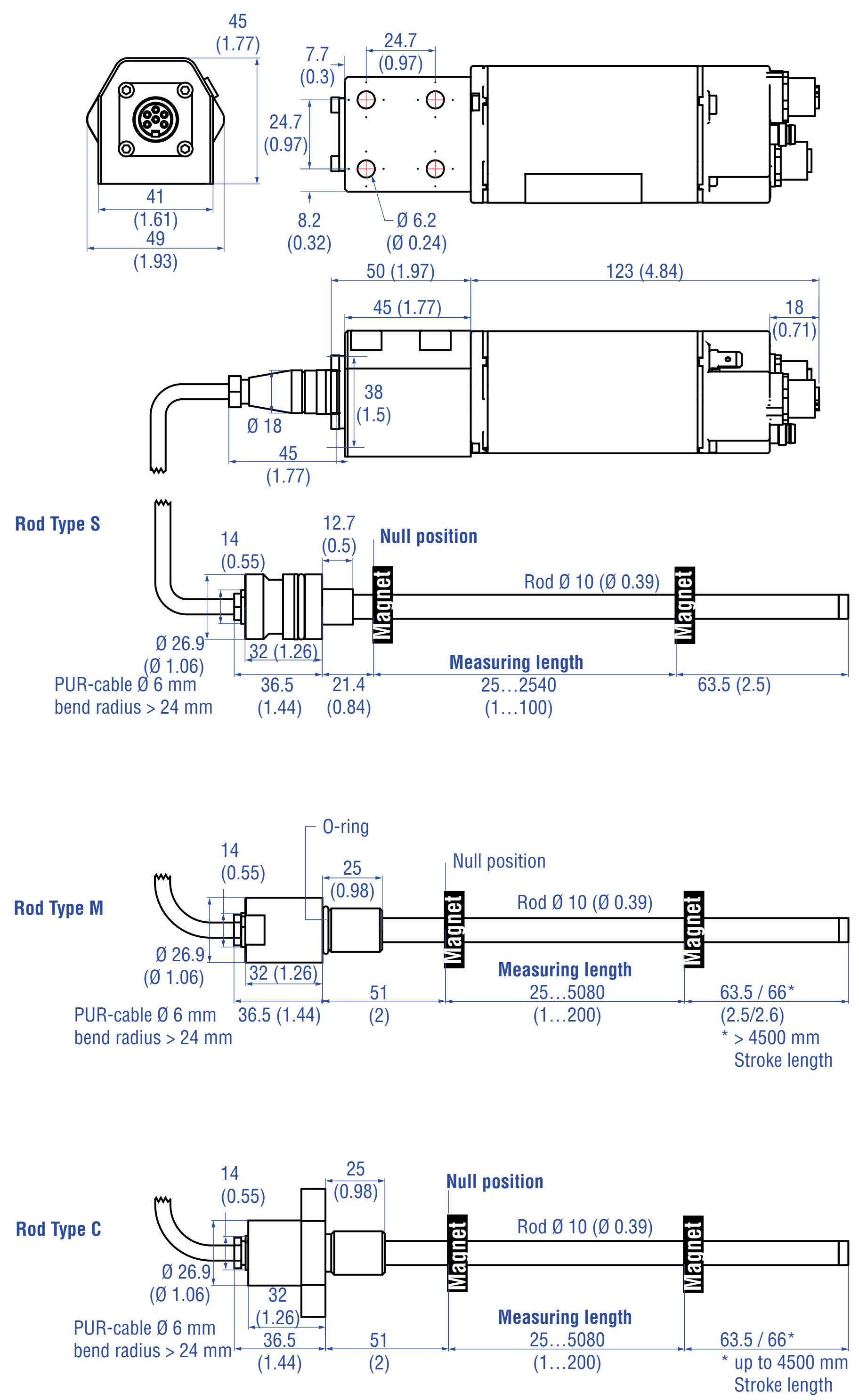


Fig. 19: Example of sensor support

4.4 Styles and installation of R-Series RD4

Temposonics® RD4 is a high-performance position sensor with a detached electronics, which allows a flexible installation. The sensor is completely modular in mechanic and electronic design. The sensor rod with the built-in waveguide is connected via a short cable with the electronics.
Temposonics® RD4 is an ideal sensor where space is a problem while still allowing for easy maintenance. The sensor can either be used for integration into a fluid power cylinder or in external industrial applications.

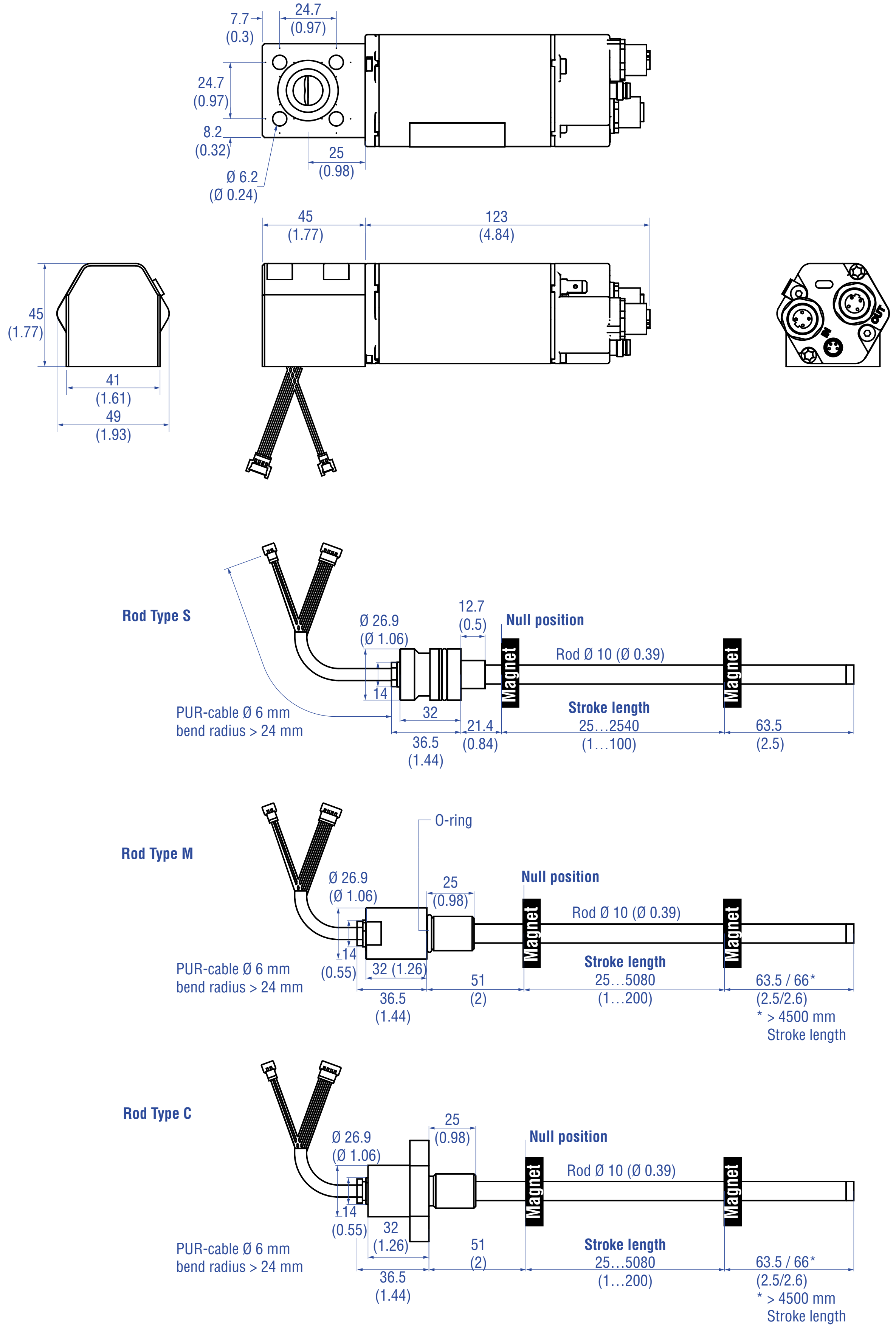
Electronics with side cable entry for the measuring rod



Controlling design dimensions are always in metric units and measurements in ( ) are in inches
Unless otherwise stated, apply to the general tolerances according to DIN ISO 2768-m

Fig. 20: RD4 style dimensional drawing with side mount electronics

Electronics with bottom cable entry for the mesuring rod



Controlling design dimensions are always in metric units and measurements in ( ) are in inches
Unless otherwise stated, apply to the general tolerances according to DIN ISO 2768-m

Fig. 21: RD4 style dimensional drawing with bottom entry electronics

4.4.1 Mounting distances

Active measuring range

The technical data of each sensor is checked as well as documented and the active stroke length (useful electrical stroke) with its start and end position is adjusted during final inspection and testing (see Fig. 22).

NOTICE

On all sensors, the areas left and right of the active stroke length are provided for mounting and damping of the measuring signal. They should not be used for measurement, but the active stroke length can be exceeded without problem.

Mechanical zero

To ensure that the entire measuring range can be used electrically, the position magnet must be mounted mechanically as follows:

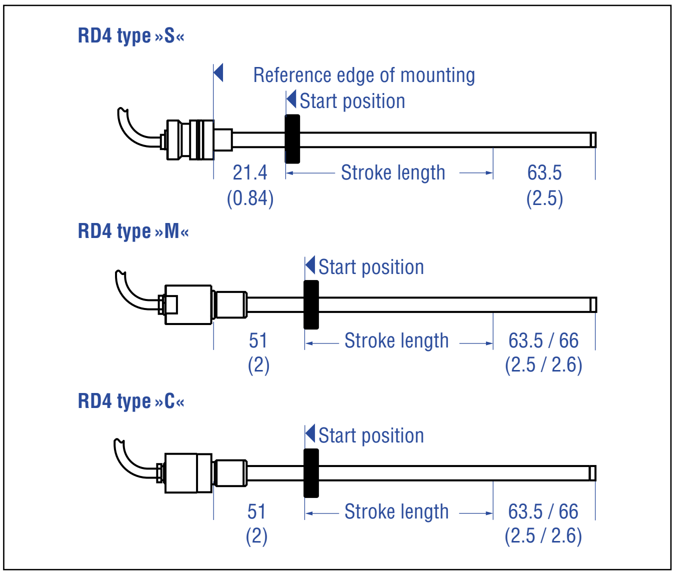


Fig. 22: Mechanical zero

Mounting ring manget

Mount the magnetic with the non-magnetic material for mounting, screws, spacers, etc..

– Max. permissible surface pressure: 40 N/mm²

– Max. fastening torque for M4 screws: 1 Nm; use washers, if necessary

Multi-position measurement

The minimum distance between the magnets is 75 mm (3 in.)

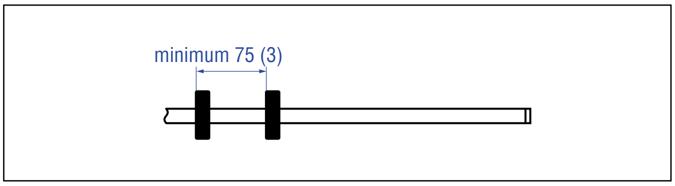


Fig. 23: Minimum distance for multi position measurement

Controlling design dimensions are always in metric units and measurements in ( ) are in inches

4.4.2 Installation of RD4 with pressure fit flange »S«

Cylinder mounting
For installation in fluid power cylinders, the standard sensor system consists of the rod and the mounting flange, and the B type electronics. Install the rod using the fit and seal it off by means of the O-ring and the supporting ring. Block the rod using a shoulder screw. The adaptor plate of the separate electronics housing facilitates mounting on the outside of small cylinders. Advantage of this version: Connection to the measuring rod is via the bottom of the housing. Thus the sensor system is fully encapsulated and protected against external disturbances.

Note for cylinder installation:
- The position magnet should not grind on the measuring rod.
- The bore in the piston rod is dependent on the hydraulic pressure and the piston's velocity. The minimum drilling should be 13 mm (0.52 in.).
- Do not exceed the peak pressure.
- Protect the measuring rod against wear.

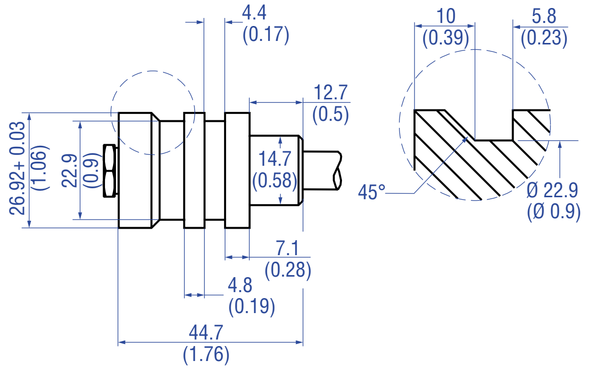


Fig. 24: Pressure fit flange details

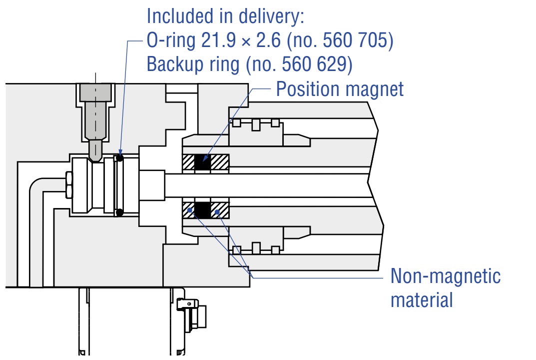


Fig. 25: Mounting example Pressure fit flange »S« and sensor electronics with bottom cable entry

Bore in cylinder Ø 13…17 mm (Ø 0.51…0.67 in.) to push single wires with flat connector through.

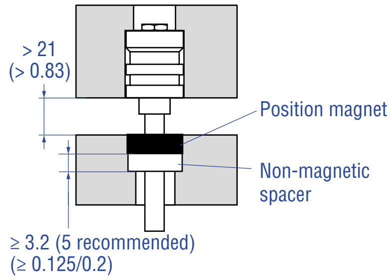


Fig. 26: Minimum installation dimensions for magnetic material

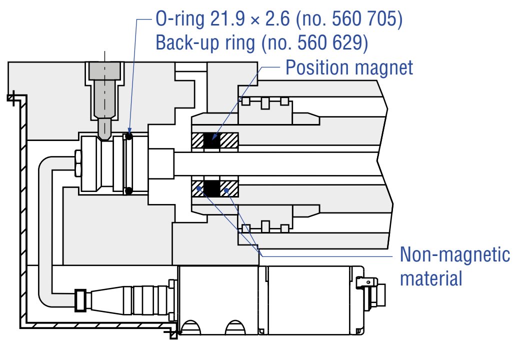


Fig. 27: Mounting example Pressure fit flange »S« and sensor electronics with side cable

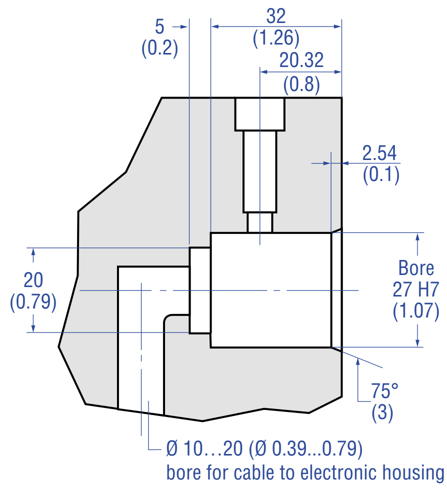


Fig. 28: Mounting detail: Setscrew 8 M6 - ISO 7379 with internal hexagon

NOTICE

To fulfill the EMC standards for emission and immunity the following points are necessary:
- The sensor electronics housing has to be connected to machine ground.
- The cable between the sensor and the electronics must be integrated into a metallic housing.

Controlling design dimensions are always in metric units and measurements in ( ) are in inches

4.4.3 Installation of RD4 with threaded flange »M« & »T«

Rod

The sensor's pipe will be fixed via the threaded flange M18×1.5 or 3/4"-16 UNF.
Mounting should be with non-magnetic material. If using magnetic material necessarily follow the displayed installation dimensions.

Cylinder mounting

– The position magnet should not grind over the measuring rod.
– The bore in the piston rod is dependent on the hydraulic pressure and the piston's velocity. The minimum drilling should be 12 mm (0.5 in.).
– Do not exceed the peak pressure.
– Protect the measuring rod against wear
– Pressure sealing is defined by cylinder manufacturer

Mounting example threaded flange »M«

Sealing results from the provided O-ring mounted in the undercut.

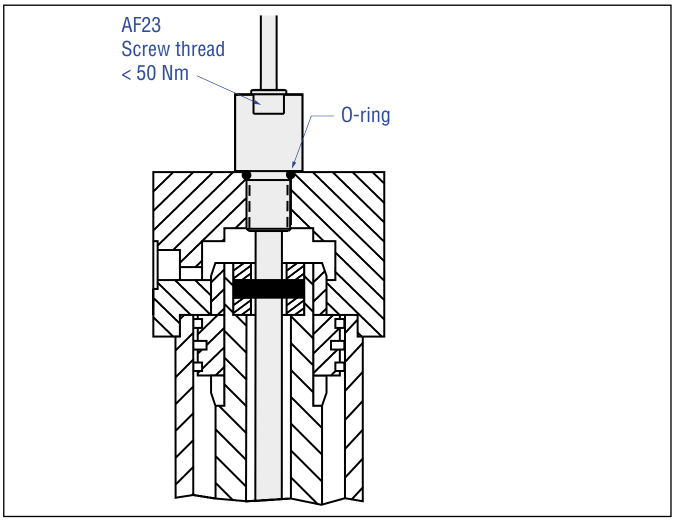


Fig. 29: Mounting example for threaded flange

Thread (d_1×P)	d_2	d_3	d_4	d_5	L_1	L_2	L_3	L_4	Z°
M18×1.5	55 mm	13 mm	24.5 mm	19.8 mm	2.4 mm	28.5 mm	2 mm	26 mm	15°
3/4x16	See Appendix B								

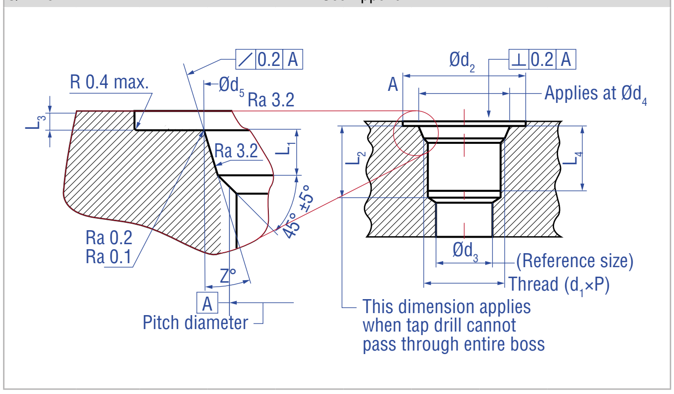


Fig. 30: Alternative screwing bore: Threaded flange M18×1.5 based on DIN ISO 6149-1

Controlling design dimensions are always in metric units and measurements in ( ) are in inches

4.4.4 Installation of RD4 with threaded flange »C« & »D«

The sensor's pipe will be fixed via the threaded flange M18×1.5 or 3/4"-16 UNF.

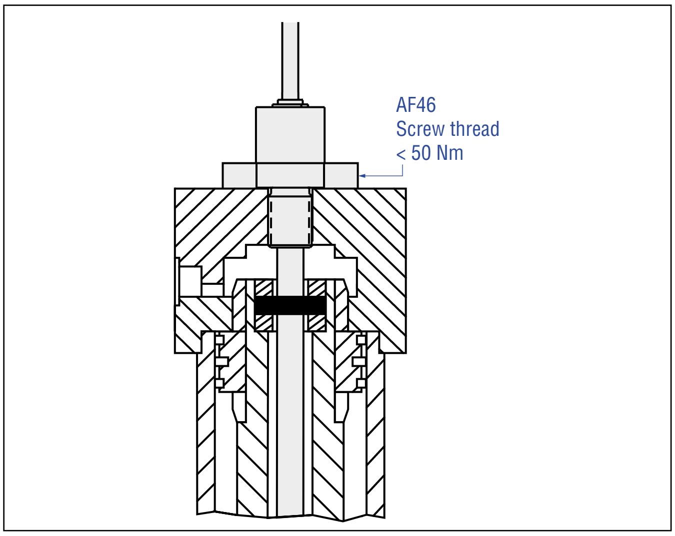


Fig. 31: Mounting example for threaded flange »C«

Position magnet

For accurate position measurement mount the magnet with non-magnetic fastening material (screws, supports etc.).

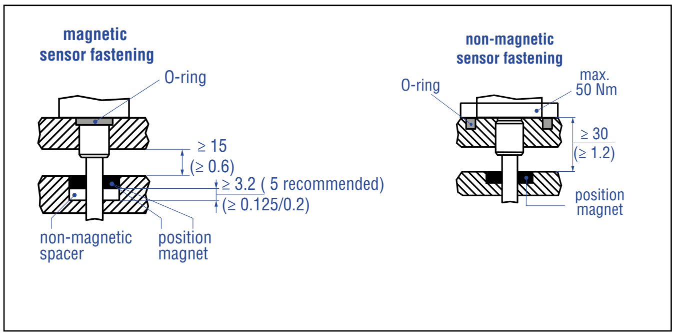


Fig. 32: Installation with non-magnetic & magnetic material

Alternative screwing bore

Thread (d_1×P)	d_2	d_3	d_4	d_5	L_1	L_2	L_3	L_4	Z°
M18×1.5	55 mm	13 mm	24.5 mm	19.8 mm	2.4 mm	28.5 mm	2 mm	26 mm	15°
3/4x16	See Appendix B								

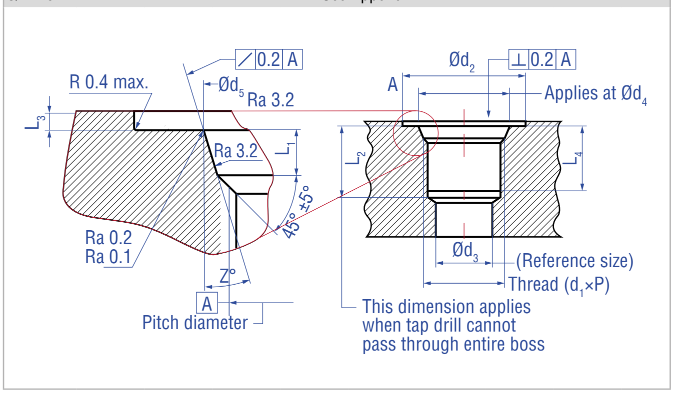


Fig. 33: Alternative screwing bore: Threaded flange M18×1.5 based on DIN ISO 6149-1

4.4.4 Magnet installation

Mounting the ring magnet
Install the magnet using non-magnetizable material for mounting device, screws, spacers etc.
– Max. permissible surface pressure: 40 N/mm^2
– Max. fastening torque for M4 screws: 1 Nm; use washers, if necessary

Mounting the U-magnet
Using a non-magnetizable mounting device is mandatory. The magnet must not rub against the measuring rod. Alignment errors are compensated via the air gap.
– Max. surface pressure: 40 N/mm^2
– Max. fastening torque for M4 screws: 1 Nm; use washer, if necessary

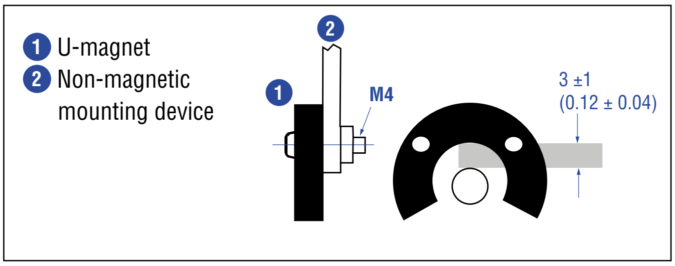


Fig. 34: Mounting device for U-magnet

NOTICE
A maximum permissible air gap of 3 ±1 mm (0.12 in.) must not be exceeded.

<u>Large stroke lengths from 1 meter (39 in.)</u>
Horizontally installed sensors should be supported mechanically at the rod end. Longer rods require evenly distributed mechanical support over the entire length. In this case an U-magnet (see fig. 35) is used for

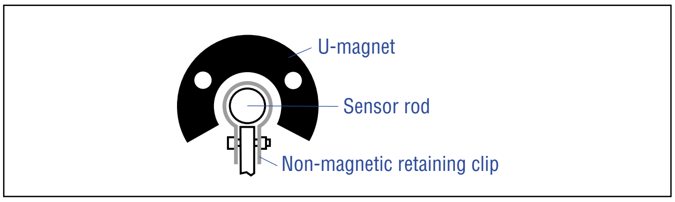


Fig. 35: Example of sensor support

NOTICE
Use the electronics and sensor rod with the same serial number together! For further information contact the application engineering team.

4.5 Styles and installation of R-Series RF

Temposonics® RF is a high-performance sensor with a bendable sensor rod. Thanks to its flexible design, the sensor is available for measuring lengths up to 10 m. Temposonics® RF can perform up to 20 independent displacement measurements and velocity measurements simultaneously. This makes the sensor ideal for use in paper cutting machines or on very long machine axes. Temposonics® RF is also available as profile-style version (accessories).

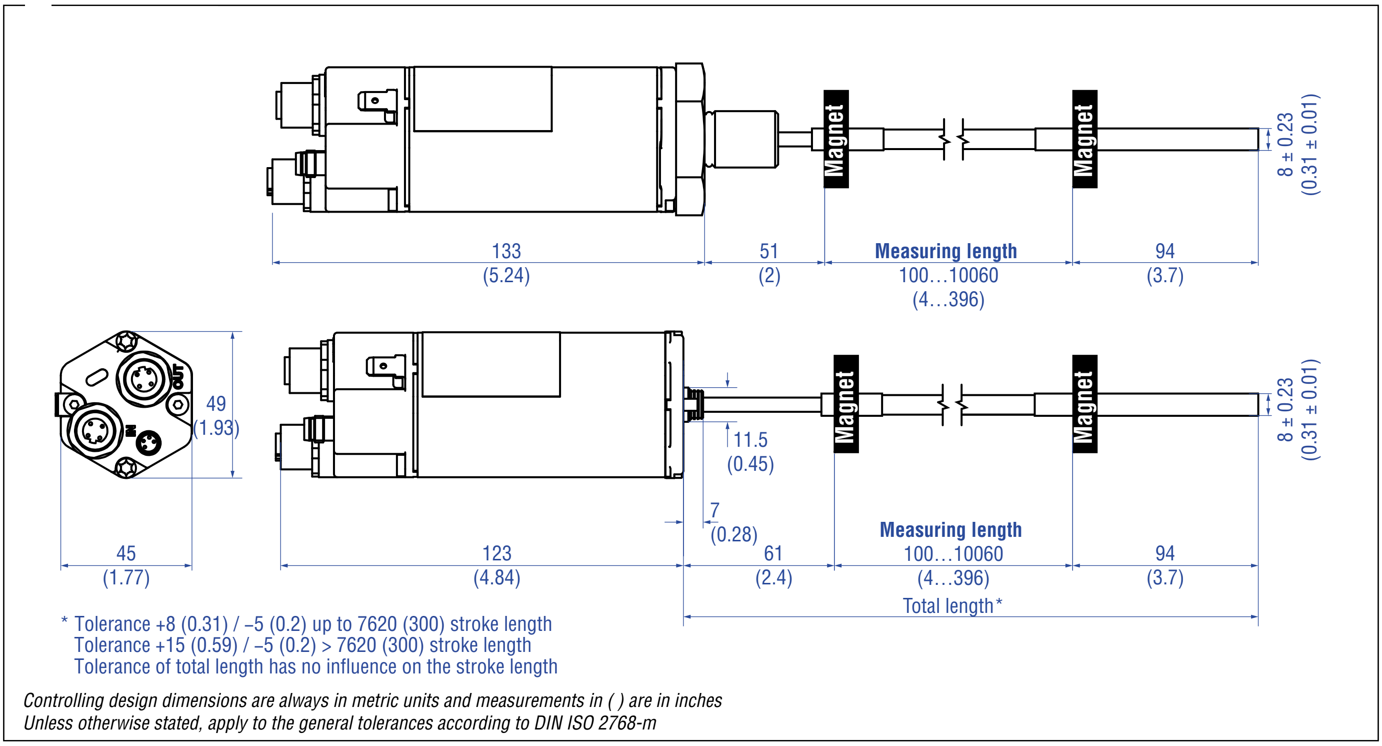


Fig. 36: RF style dimensional drawing

4.5.1 Mounting distances

Active measuring range

The technical data of each sensor is checked as well as documented and the active stroke length (useful electrical stroke) with its start and end position is adjusted during final inspection and testing (see Fig. 36).

NOTICE

On all sensors, the areas left and right of the active stroke length are provided for mounting and damping of the measuring signal. They should not be used for measurement, but the active stroke length can be exceeded without problem.

Mechanical zero

To ensure that the entire measuring range can be used electrically, the position magnet must be mounted mechanically as follows:

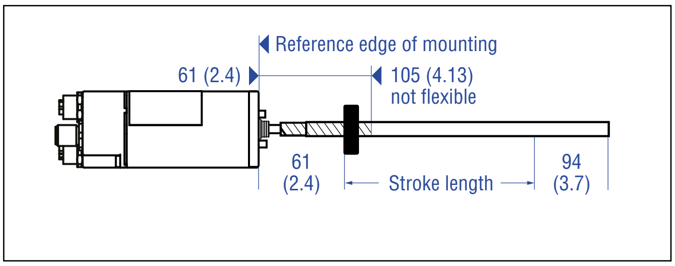


Fig. 37 Mechanical zero

Controlling design dimensions are always in metric units and measurements in ( ) are in inches

Multi-position measurement

The minimum distance between the magnets is 75 mm (3 in.).

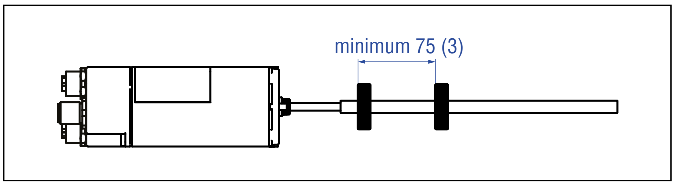


Fig. 38: Minimum distances for multi position measurement

4.5.2 Installation of RF

Mounting of sensor electronics housing requires the use of 2 non-magnetizable screws M4×59.

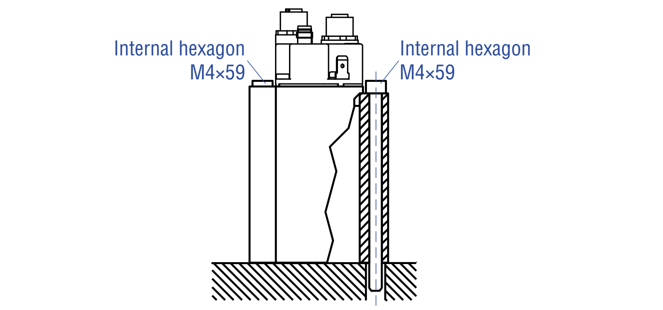


Fig. 39: Mounting screw M4×59

Long sensors require a support tube (inner diameter of 9.4 mm (0.37 in.)) of non-magnetizable material, straight or bent to the desired

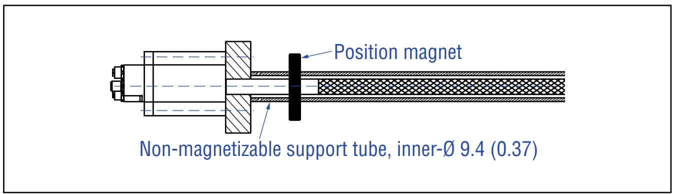


Fig. 40: Linear measurement

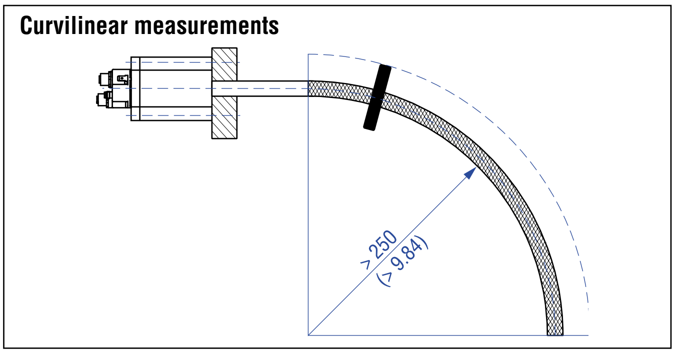


Fig. 41: Minimum bending radius

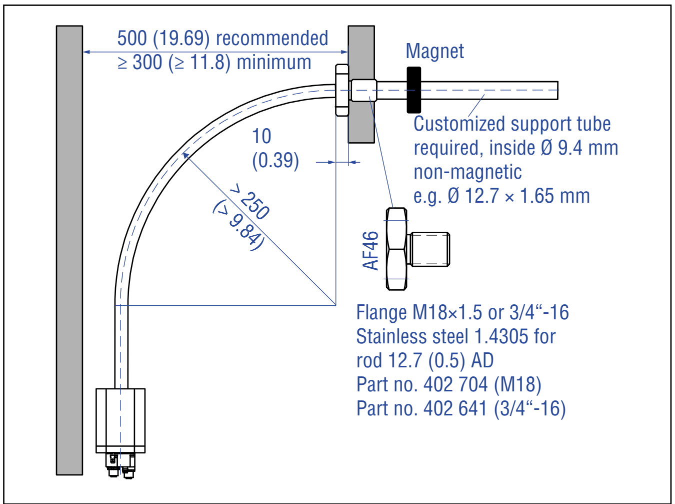


Fig. 42: Mounting example for distances

NOTICE

A flexible sensor requires supports or anchoring to maintain proper alignment between sensor rod and the magnet, otherwise the sensor output signal can be interfered or lost.

Thread (d_1×P)	d_2	d_3	d_4	d_5	L_1	L_2	L_3	L_4	Z°
M18×1.5	55 mm	13 mm	24.5 mm	19.8 mm	2.4 mm	28.5 mm	2 mm	26 mm	15°
3/4x16	See Appendix B								

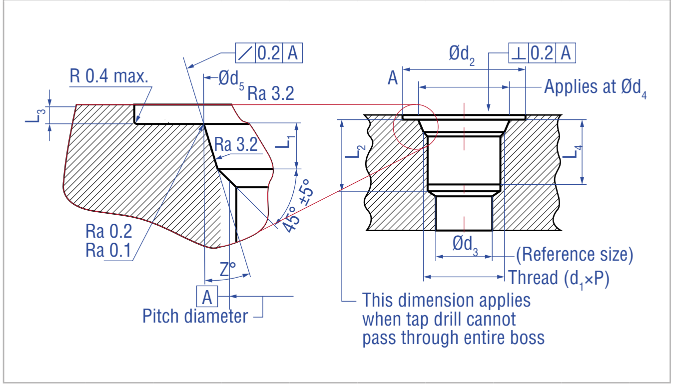


Fig. 43: Threaded flange M18×1.5 based on DIN ISO 6149-1

For easy installation the sensor is supplied with a hex 46 flange (accessory) bored for above mounting screws.

Information about the mounting of the optinal accessories see:
- optional profile product brief 551 442
- optional rod with flange product brief 551 770

4.5.3 Magnet installation

Mounting the ring magnet

Install the magnet using non-magnetic material for mounting device, screws, spacers etc.

- Max. permissible surface pressure: 40 N/mm²
- Max. fastening torque for M4 screws: 1 Nm; use washers, if necessary

Mounting the U-magnet

The U-magnet can be used for rod-style sensors (HD pressure pipe) or profile style sensors (HFP profile). Using a non-magnetizable mounting device is mandatory. The magnet must not rub against the measuring rod. Alignment errors are compensated via the air gap.

- Max. surface pressure: 40 N/mm²
- Max. fastening torque for M4 screws: 1 Nm; use washer, if necessary

1 U-magnet
2 Non-magnetic mounting device

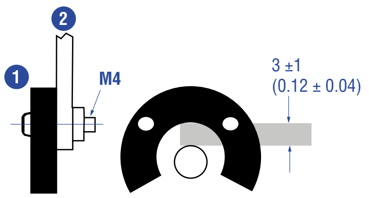


Fig. 44: Mounting device for U-magnet

NOTICE

A maximum permissible air gap of 3 ±1 mm (0.12 in.) must not be exceeded.

<u>Large lengths from 1 meter for optional HD tube:</u>

Horizontally installed sensors should be supported mechanically at the rod end. Longer rods require evenly distributed mechanical support over the entire length. In this case an U-magnet (see fig. 45) is used for measurement.

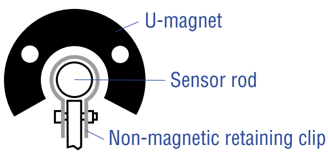


Fig. 45: Example of sensor support

4.6 Electrical connections

The placement of the sensor and cabling have a decisive influence on the sensor's EMC resistance. Hence correct installation of this active electronic system and
the EMC of the entire system must be protected by using suitable metal connectors, shielded cables and grounding.
Overvoltages or faulty connections can damage its electronics despite protection against wrong polarity

NOTICE
Do not make connections under voltage!

Instruction for connection

- Low-resistance, twisted pair, shielded cables should be used and the shield should be connected to earth externally in the evaluation electronics
- Control and sign leads should be kept separate from power cables and sufficiently far away from motor cables, frequency inverters, valve lines, relays, etc.
- Use only connectors with metal housing and connect the shield to connector housing.
- The connection surface at both shield ends should be as large as possible.
- Keep all non-shielded leads as short as possible
- The earth connection should be as short as possible with a large cross section. Avoid ground loops.
- With potential differences between machine and electronics earth connections, no compensating currents are allowed to flow across the cable shield.

Notice:

- install potential compensating lead with large cross section, or use cables with separate double shielding, and connect only one end of shield.
- Use only stabilized power supplies in compliance with the specified connecting values.

NOTICE
The profile sensor must be grounded on the flat plug on the electronics housing.

Connection types

The sensor must be connected directly with the control system according to wiring diagram:

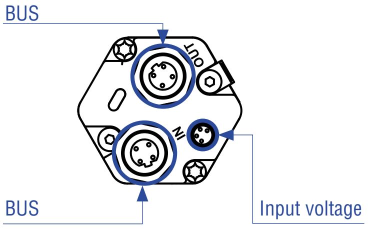


Fig. 46: Location of connections

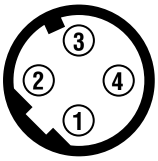
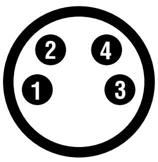
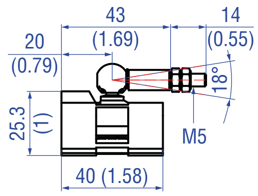
D56 (BUS In/Out)		
M12 D-coded	**Pin**	**Function**
	1	Tx (+)
	2	Rx (+)
	3	Tx (–)
	4	Rx (–)
Input voltage		
M8 connector	**Pin**	**Function**
	1	+24 VDC (–15 / +20 %)
	2	Used for DHCP reset only[7]
	3	DC Ground (0 V)
	4	Used for DHCP reset only[7]

Fig. 47: Caption

7 Pins 2 and 4 on the M8 Input Voltage connector are only used to reset the sensor to DHCP mode. They should be independent of each other and floating (not grounded) under normal operation.

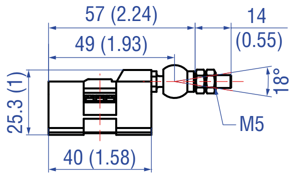
4.7 Frequently ordered accessories - Additional options available in our Accessories Guide 551444

Position magnets for profile model (RP)



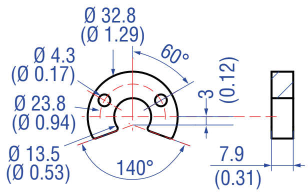
Magnet slider S
Part no. 252 182

Material: GFK, magnet hard ferrite
Weight: ca. 35 g
Operating temperature: −40…+75 °C (−40…+167 °F)



Magnet slider V
Part no. 252 184

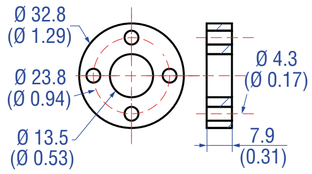
Material: GFK, magnet hard ferrite
Weight: ca. 35 g
Operating temperature: −40…+75 °C (−40…+167 °F)



U-magnet OD33
Part no. 251 416-2

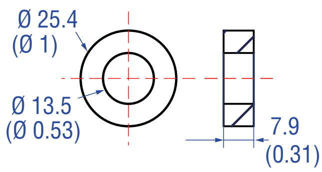
Material: PA ferrite
Weight: ca. 10 g
Surface pressure: max. 40 N/mm²
Fastening torque for M4 screws: max. 1 Nm
Operating temperature: −40…+100 °C (−40…+212 °F)

Position magnets for rod models (RH, RD4 & RF)



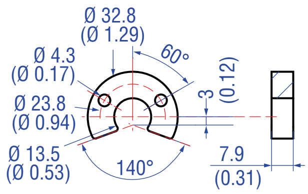
Ring magnet OD33
Part no. 201 542-2

Material: PA ferrite GF20
Weight: ca. 14 g
Surface pressure: max. 40 N/mm²
Fastening torque for M4 screws: max. 1 Nm
Operating temperature: −40…+100 °C (−40…+212 °F)



Ring magnet OD25,4
Part no. 400 533

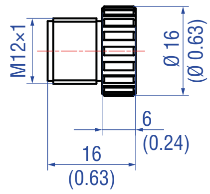
Material: PA ferrite
Weight: ca. 10 g
Surface pressure: max. 40 N/mm²
Operating temperature: −40…+100 °C (−40…+212 °F)



U-magnet OD33
Part no. 251 416-2

Material: PA ferrite
Weight: ca. 10 g
Surface pressure: max. 40 N/mm²
Fastening torque for M4 screws: max. 1 Nm
Operating temperature: −40…+100 °C (−40…+212 °F)

Accessory



Connector end cap
Part no. 370 537

Female connectors should be covered by this protective cap

Connection types

Power cable, female 4 pin (M8) and cable with pigtail termination
Part no.: 5 m: 530 066
10 m: 530 096
15 m: 530 093

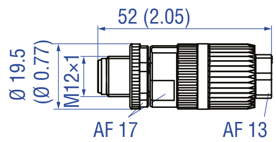
Wire gage: 4 × 0.25 mm² shielded
Cable jacket: PUR; gray
Max. cable Ø: 8 mm

Industrial Ethernet cable (Cat 5e Es) d-coded
Part no. 530 064

Connector type: two male, 4 pin (M12)
Cable length: 5 m (16.4 ft.)
Cable jacket: PUR cable jacket; green
Operating temperature: −40…+70 °C (−40…+158 °F)

Industrial Ethernet cable (Cat 5e Es) d-coded
Part no. 530 065

Connector type: RJ45 connector male, 4 pin (M12)
Cable length: 5 m (16.4 ft.)
Cable jacket: PUR cable jacket; green
Operating temperature: −40…+70 °C (−40…+158 °F)



Male, straight, 4 pin
Part no. 370 523

Housing: zinc nickel plated
Termination: isolation displacement
Wire: AWG24- AWG22
Cable Ø: 5.5…7.2 mm

Controlling design dimensions are always in metric units and measurements in ( ) are in inches

5. Operation

5.1 Getting started

The sensor is factory-set to its order sizes and adjusted, i.e. the required output signal corresponds exactly to the selected measuring length.

Example: Output Ethernet/IP = 0…100 % stroke length

Diagnostic display

(Red/green) LEDs in the sensor electronics lid provide information on the current sensor condition.

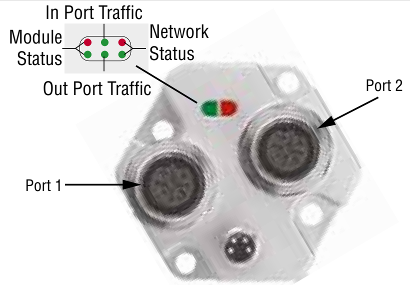


Fig. 48: Location of the status LED

LED Status

Green		Red		
Network Status				
●	ON	○	OFF	Connection established
◐	Flashing	○	OFF	No connection
○	OFF	●	ON	Unrecoverable error
○	OFF	◐	Flashing	Recoverable error
Port 1 (IN)				
●	ON	○	OFF	LINK activity on port 1
◐	Flickers	○	OFF	Data transfer on port 1
○	OFF	●	ON	No magnet / Wrong quantity of magnets
Port 2 (OUT)				
●	ON	○	OFF	LINK activity on port 2
◐	Flickers	○	OFF	Data transfer on port 2
Module Status				
●	ON	○	OFF	IP address configured
◐	Flashing	○	OFF	IP address not configured
○	OFF	◐	Flashing	Duplicate of IP address recognized

Fig. 49: Location of the status LED

NOTICE

1. Before initial switch-on, check carefully if the sensor has been connected correctly.
2. Ensure that the sensor control system cannot be displaced in an uncontrolled way when switching on.
3. If the sensor is operational and in operating mode after switching on, the diagnostics LED is lit permanently (green).
4. Check the preset span start and end values of the measuring range (see chapter 4) and correct them via the customer's control system, if necessary.

6. IP Address Configuration

An example of configuring a MTS EtherNet/IP sensor will be shown using an Allen-Bradley CompactLogix L35E controller, and the RSLogix 5000 software from Rockwell. This example is written with the understanding that the customer already has an EtherNet/IP capable controller, and a working EtherNet/IP network.
The procedure to incorporate a MTS EtherNet/IP sensor into a network is shown in the following 3 steps. Step 1 describes setting the IP address of the sensor and step 2 installing the MTS EtherNet/IP EDS file (download at www.mtssensors.com). To utilize the EDS file with the add-on profile feature, the RSLogix 5000 software must be version 20 or later. By using the EDS add-on profile, the sensor parameters and configuration data are loaded automatically to complete steps 3.1 and 3.2. If not installing the sensor EDS file, or if using an earlier version of the RSLogix 5000 software, chapters 7.3 through 7.5 describe how to manually load the sensor parameter data. Also, if needed later, the descriptions in step 3.2 can help when reviewing the sensor parameter data and for making any changes.

NOTICE

Physically connect the sensor to your network, but do not apply power to the sensor. You will be instructed when it is time to power the sensor.

6.1 Setting the IP address of the sensor

Each sensor comes from the factory with BOOTP and DHCP modes active, and a unique MAC ID (see sensor label). This allows you to communicate with the sensor in order to configure the sensor for your network. Before you can use a sensor on your network you must first assign it an permanent, unused IP Address on your network. In the following example we will use Rockwell's BOOTP/DHCP Server program to assign an IP Address to the sensor.

6.1.1 Open the **BOOTP/DHCP Server** software.
▶ The 'BOOTP/DHCP Server' window opens.

6.1.2 To add your sensor to the 'Relation List', click the **New** button in the 'Relation List' pane.
▶ The 'New Entry' window opens.

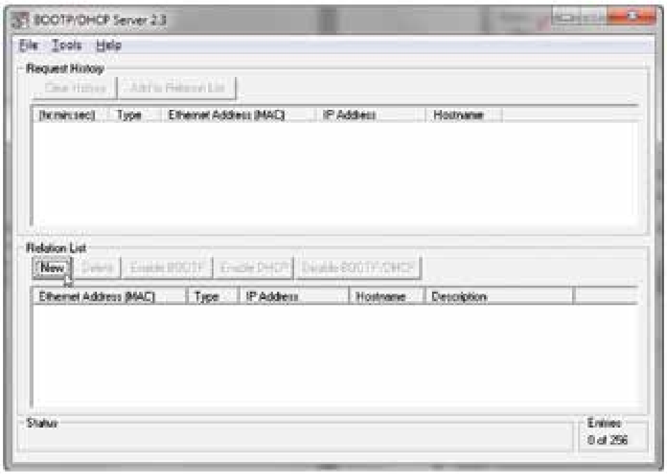


Fig. 48: Create new relation list entry

NOTICE

1. Choose an IP address that is not being used on your network or subnetwork.
2. After the IP address is assigned to the sensor, record the IP address and have it available as you will need it to communicate with the sensor.

6.1.3 In the 'New Entry' window, enter the **MAC ID** (see sensor label). Enter a unique **IP address** you will use for the sensor, **record the IP address** and click **OK**.

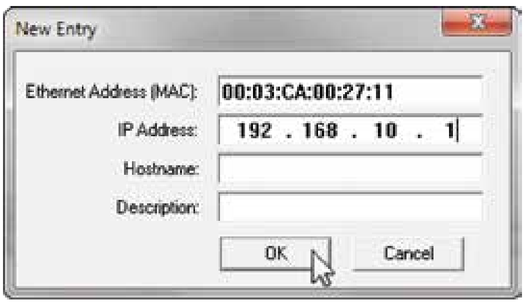


Fig. 50: Enter MAC ID and unique IP adress

6.1.4 Verify that your unique **IP address** and **MAC ID** appear in the 'Relation List' window. If the relation list window does not contain both **MAC ID** and **IP address**, repeat steps 6.1.2 to 6.1.4.

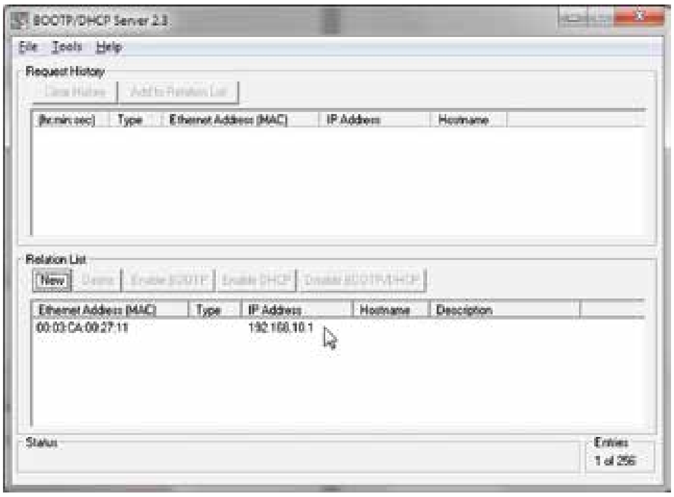


Fig. 51: Populated relation list

6.1.5 Apply power to the sensor. The sensor should take around 10 to 15 seconds to begin to broadcast its MAC ID.

6.1.6 Verify that your **IP address** and **MAC ID** appear in the 'Request History' box.

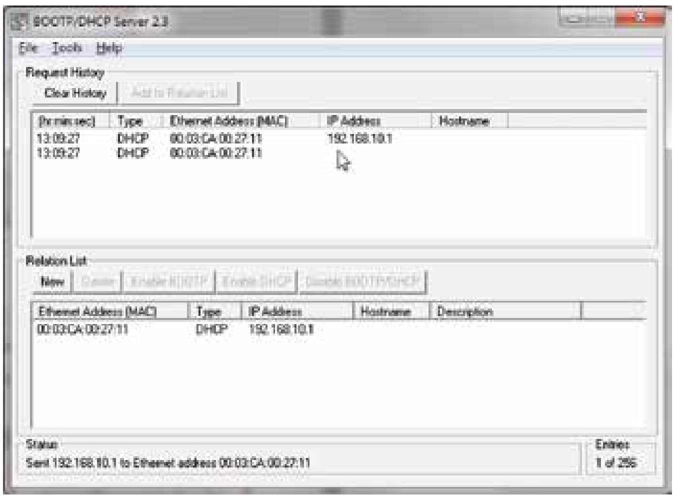


Fig. 52: Request History shows MAC ID and IP adress

NOTICE

Step 1.7 will make your sensors unique IP address permanent. It will disable BOOTP and DHCP, and the IP address will be stored in the EEPROM of the sensor.

6.1.7 Click to select your sensor in the 'Relation List' box and click the disable BOOTP/DHCP button.

6.1.8 The 'Status' message at the bottom of the window will read "Command Successful" if the disable command was successful. The sensor is now assigned a permanent IP address. If needed, repeat step 6.1.7 until the disable command

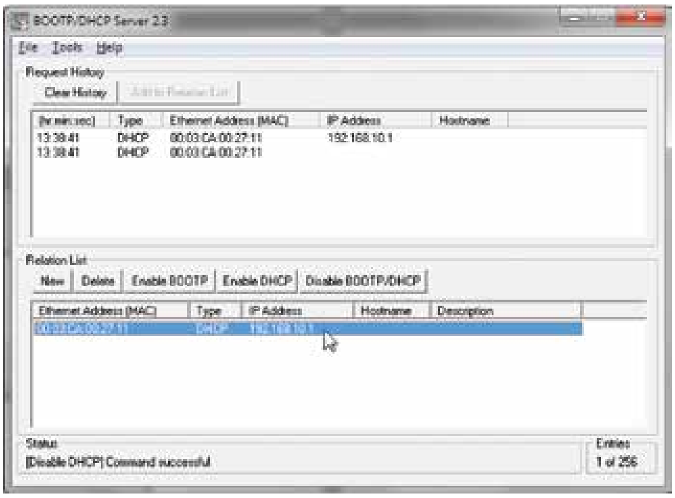


Fig. 53: Sensor shows the permanent IP adress

6.1.9 Exit the BOOT/DHCP Server software. If installing the MTS EtherNet/IP EDS file (download at www.mtssensors.com) continue with chapter 7.1. To utilize the EDS file, the RSLogix 5000 software must be version 20 or later.
If not installing the sensor EDS file, or if using an earlier version of the RSLogix 5000 software, the sensor parameter data must be manually loaded. In that case, continue with Steps 2 and 3.

7. Integration in RSLogix5000

7.1 Install the MTS EtherNet/IP EDS file

(only required for the first installation)

7.1.1 Open the **RSLogix 5000** software interface

7.1.2 Click the **Tools** menu and select "**EDS Hardware Installation Tool**"

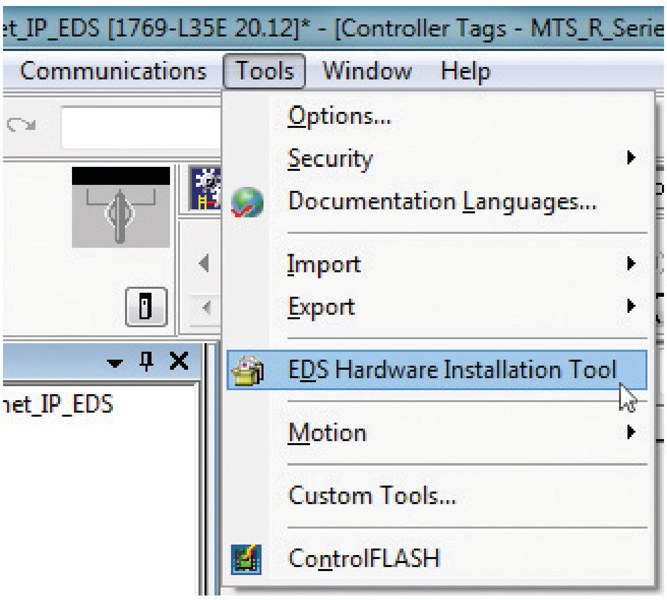


Fig. 54: Select the "EDS Hardware Installation Tool"

7.1.3 The 'EDS Wizard' window opens, click **Next**, in the '**Options**' window select **Register an EDS file(s)** and click "**Next**".

Fig. 55: EDS wizard launch screen

Fig. 56: Register an EDS file

7.1.4 The 'Registration' window opens, click **Browse** and select the **EDS file** provided either with the sensor or downloaded from the MTS website. Click "**Next**".

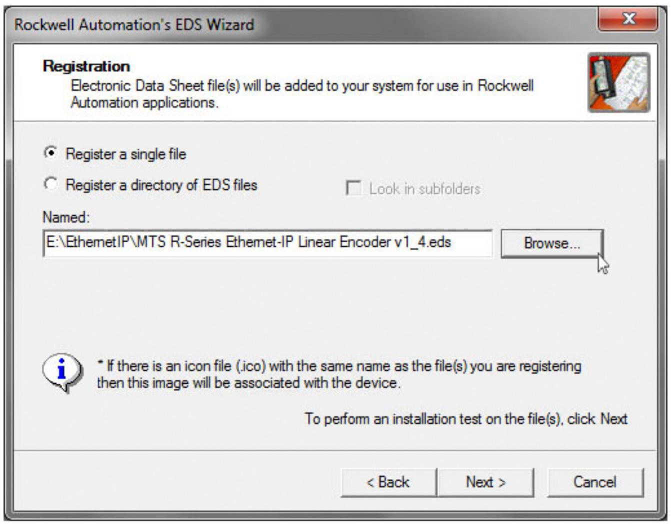


Fig. 57: Enter the path to the EDS file

7.1.5 If the installation completed successfully, the 'EDS File installation test results' window displays. Click "**Next**".

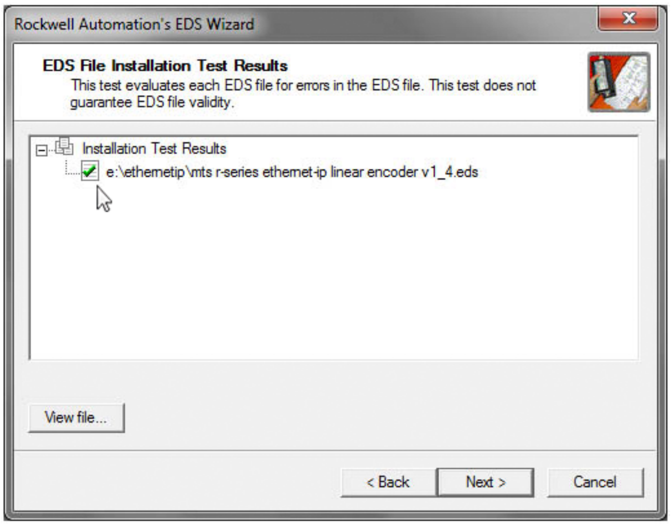


Fig. 58: Confirmation of path to the EDS file

7.1.6 The 'Final Task Summary' window opens, click "**Next**".

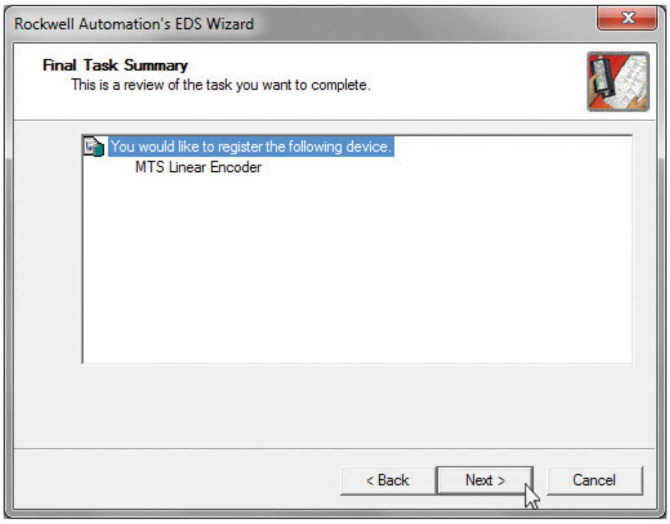


Fig. 59: Confirmation of EDS file origin

7.1.7 Click "Finish".

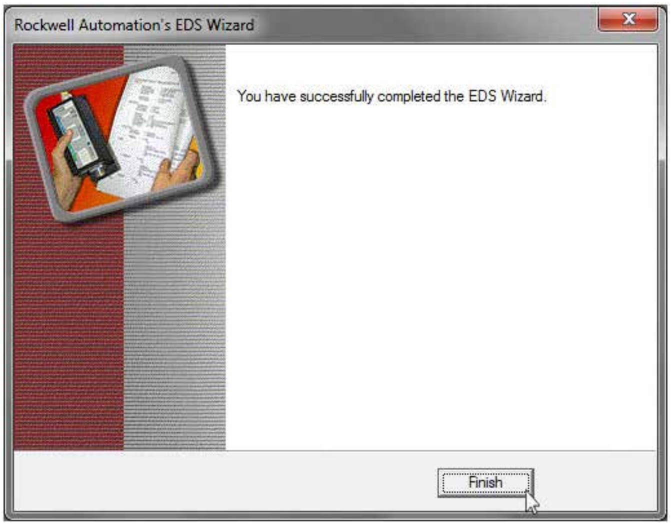


Fig. 60: EDS Installation Complete

7.2 Add sensor to I/O configuration using EDS file

7.2.1 After completing the EDS wizard, return to the main window of RSLogix 5000. In the controller organizer sidebar, expand the I/O Configuration tree and right-click your network. Select "**New Module**".

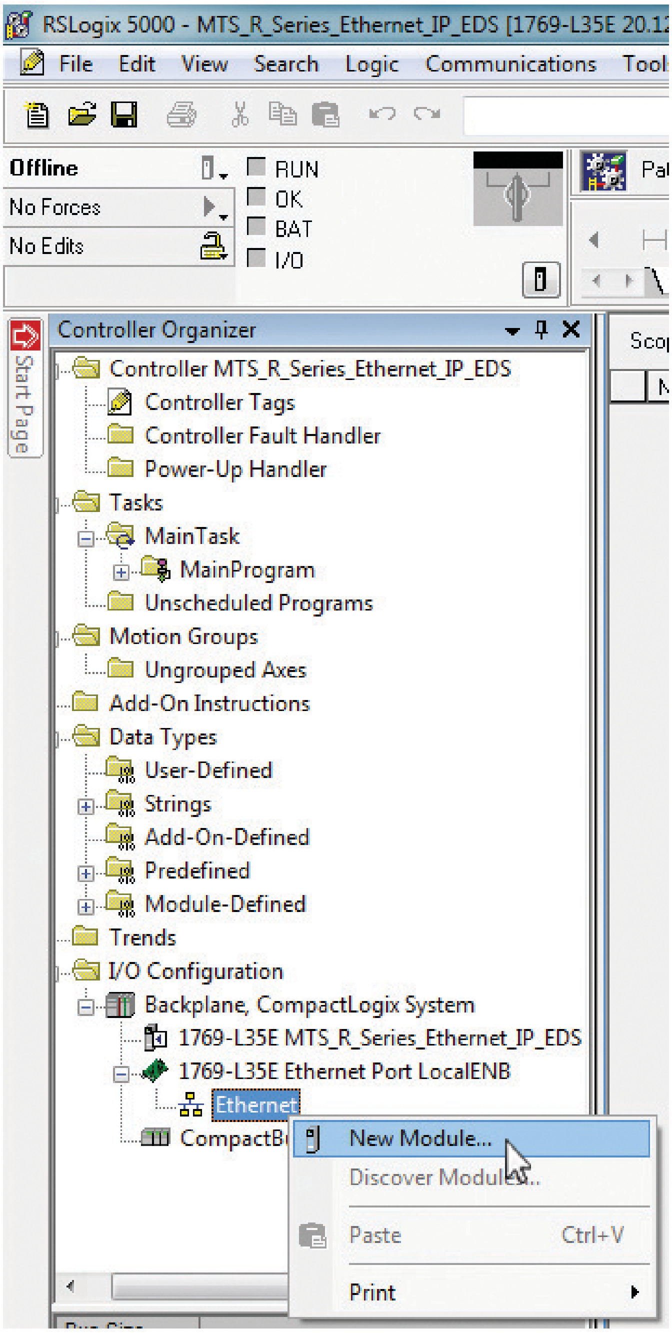


Fig. 61: Add a new module to the RSLogix 5000 IO tree

7.2.2 In the **Select Module Type** window, choose "R-Series EtherNet/IP" and click "**Create**".

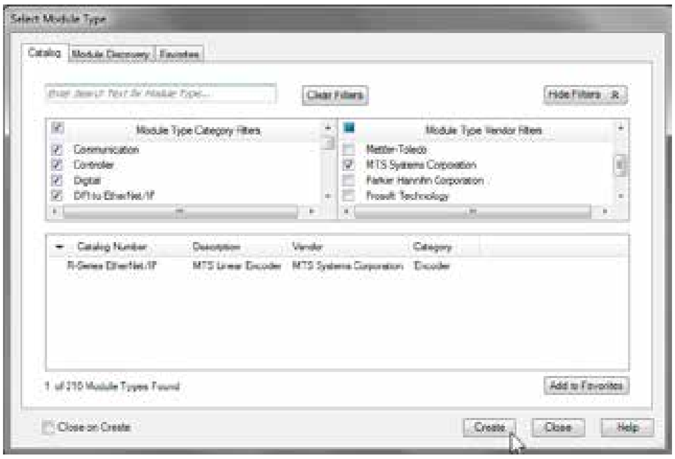


Fig. 62: Create new module

7.2.3 In the **New Module** window, enter a name in the 'Name' field, select the **Ip Address** radio button and enter the **Fixed IP Address** that is assigned to the sensor. Click "**OK**" and close the new module window.

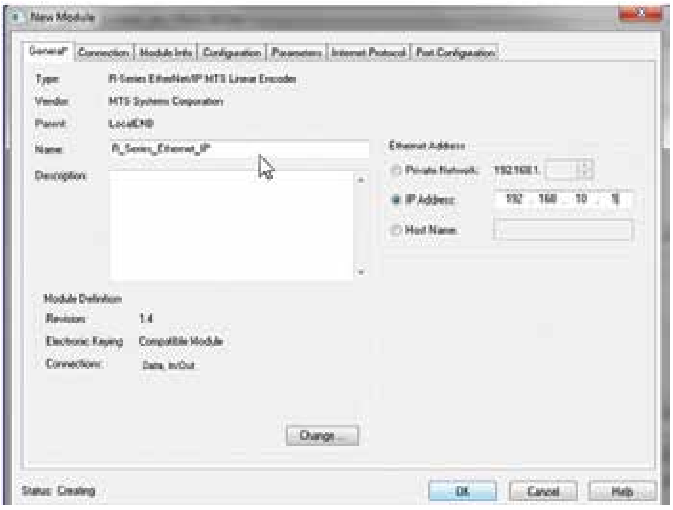


Fig. 63: Confirm the new module settings

7.2.4 Verify that the new sensor is listed in the I/O Configuration tree.

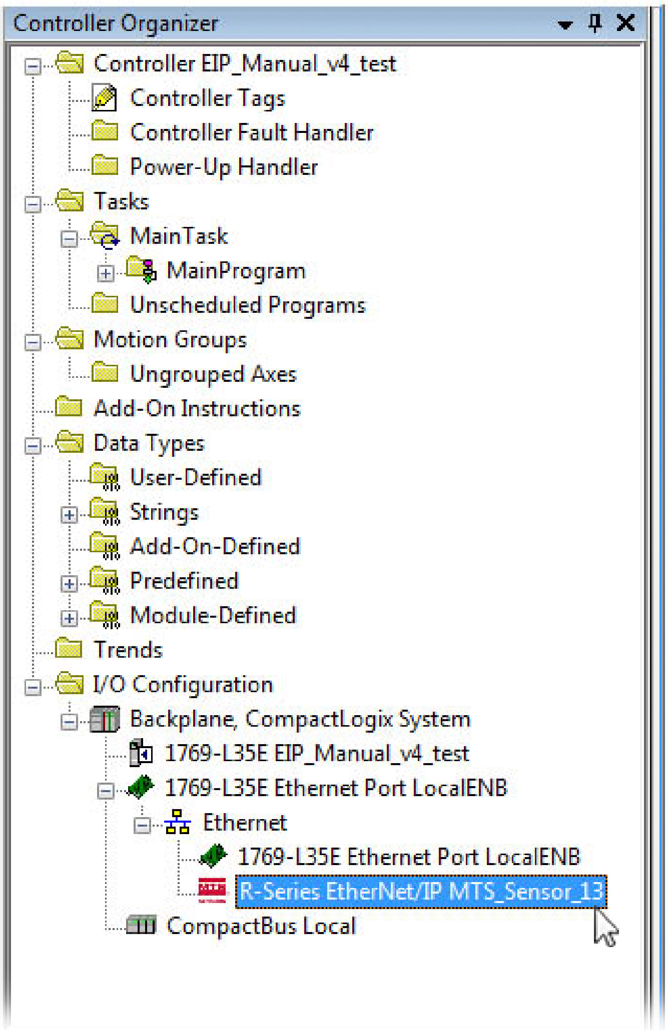


Fig. 64: New module on the network

The MTS EtherNet/IP™ sensor is now added to the network and connected, ready to use.

NOTICE

If the sensor is disconnected, a yellow warning sign (shown below) will appear over the module icon.

7.3 Add sensor to I/O configuration w/o using EDS file

Before you begin, you will need the sensors permanent IP address you recorded in from section 6.1.3.

7.3.1 Open the **RSLogix 500** software interface.

7.3.2 Open the controllers' directory tree. Click **I/O configuration**, then right click your **network**. Select "**New Module**". The "Select Module" window opens.

7.3.3 In the "Select Module" window, select "Generic Ethernet Module" and press "**OK**". The "New Module" window opens.

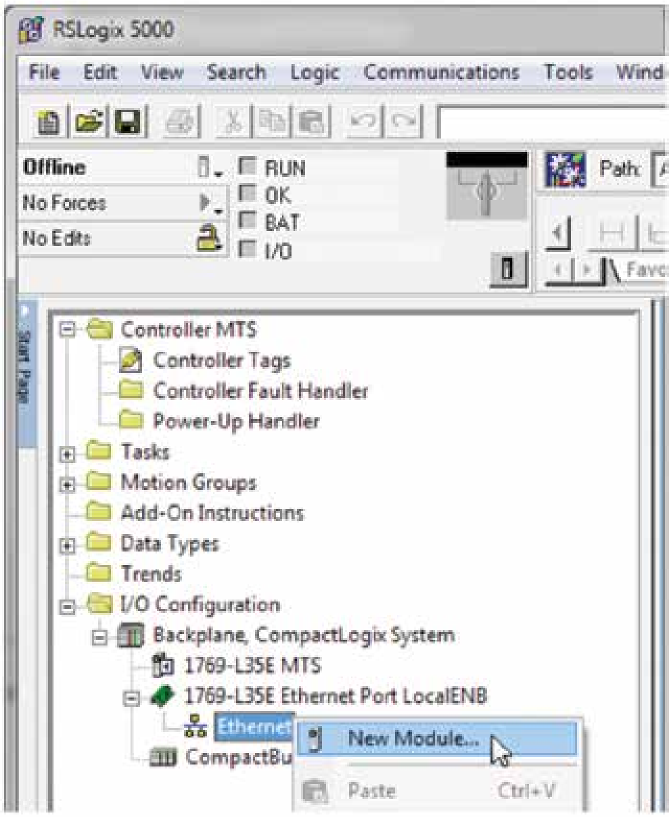


Fig. 65: Add a new module to the RSLogix 5000 IO tree

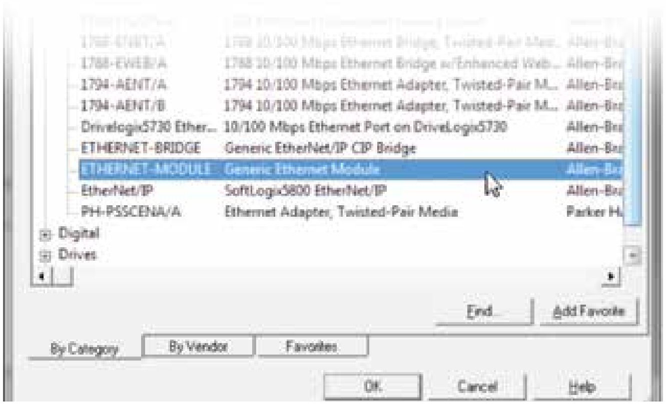


Fig. 66: Add a new Generic module

7.3.4 In the ‘**New Module**’ window (shown below) perform steps 7.3.4.1 – 7.3.4.4 to configure the new generic ethernet module to the R-Series EtherNet/IP sensor.

NOTICE
Enter the “**Connection Parameters**” and “**Comm Format**” exactly in the following order in steps 7.3.4.1 – 7.3.4.4, otherwise your sensor may not function properly.

7.3.4.1 In the “**Name**” field enter the “**Sensor Name**” as described in the “**I/O Configuration tree**” (it might be beneficial to include reference to the device ID).

7.3.4.2 In the “**Comm Format**” field, to “Set the Comm Format” to select Input Data - DINT - Run/Program from the drop down menu

7.3.4.3 In the “Address / Host Name” field, select the IP address option and enter the fixed IP address you assigned to the / sensor in “Step 1”.

7.3.4.4 To set the ‘Connection Parameters’ Enter the following

Name	Instance field	Size field
Input assembly	101	50
Output assembly	100	
Configuration assembly	10	20

Select the open module properties check box and click “OK”. The “Module Properties” window opens.

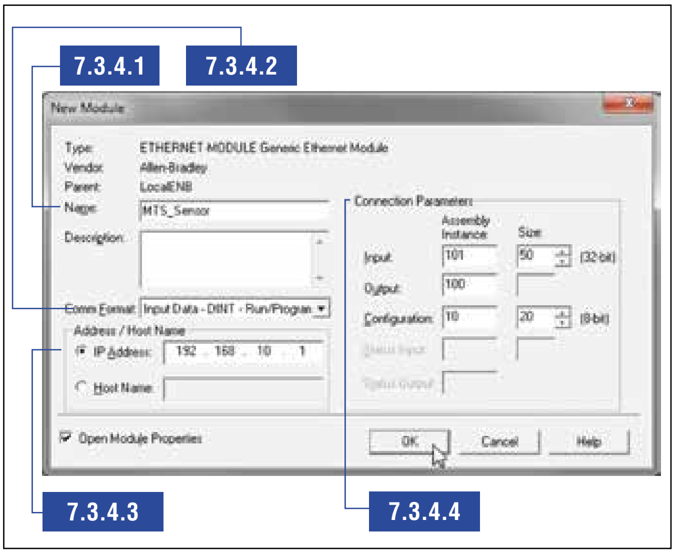


Fig. 67: New Module window

7.4 Set Module RPI

7.4.1 Click the “**Connection**” tab. Set the “**Requested Packet Interval**” value and press “**OK**”. (The default value is 10 milliseconds, but the sensor is capable of a RPI as low as 2 milliseconds).

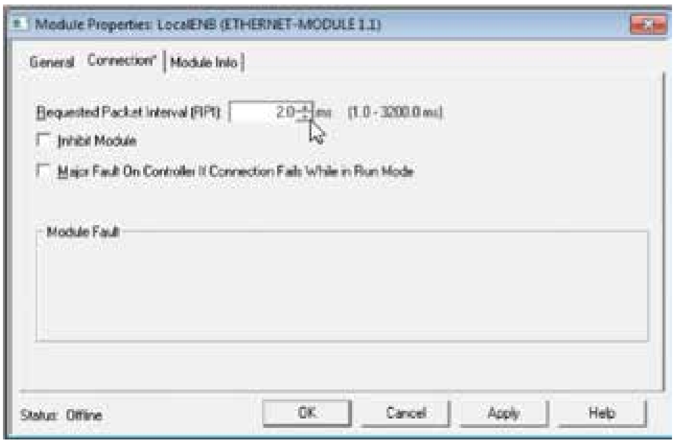


Fig. 68: New module properties

NOTICE
Sensor RPI limitations are: • 2 ms up to 4800 mm stroke • 4 ms up to 7620 mm stroke

7.5 Verify Generic EtherNet Module

7.5.1 Verify that the new sensor is listed on the I/O Configuration tree.

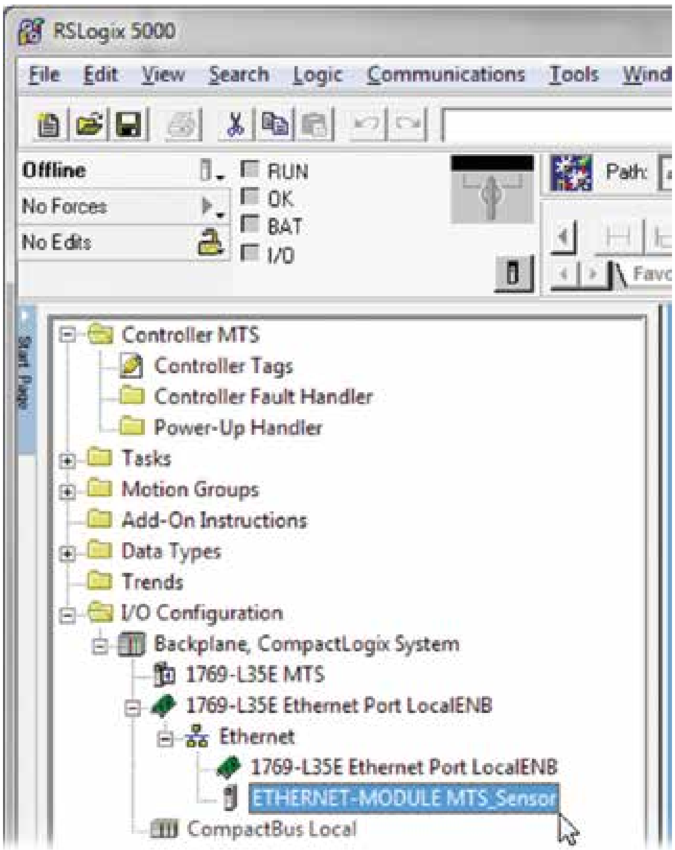


Fig. 69: New generic module has been added to the network

7.6 Controller tags configuration data

7.6.1 In the '**I/O configuration tree**', click to open the '**Controller Tags**' directory. The controller tag table displays in the left pane (shown below). The description column fields will be blank by default.

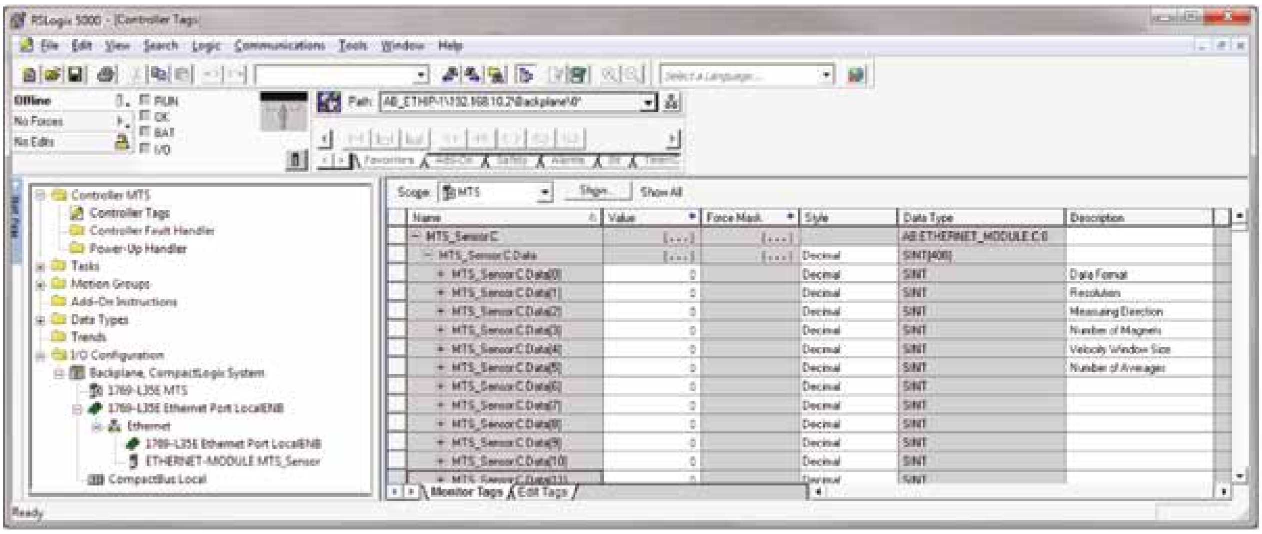


Fig. 70: Device control tags

7.6.2 In the '**Style**' column, change the field data default from hex to decimal.

7.6.3 Locate Data Byte [0] through [5] In the '**Name**' column. In the '**Description**' column, enter the following Data Byte field information. The following factory default configuration data is set to all 'zeros' (This value is sufficient for most applications).

Name	Description	Default Value	Description
Data Byte [0]	Data format	0	4 bytes signed position, 4 bytes signed velocity (repeats for each magnet)
		1	4 bytes signed position (repeats for each magnet)
		2	4 bytes signed velocity (repeats for each magnet)
		3	First 4 bytes status- Then repeating for each magnet, 4 bytes sigend popsition, 4 bytes signed voelocity
Data Byte [1]	Resolution	0	0.001 mm (default value)
		1	0.001 mm
		2	0.002 mm
		5	0.005 mm
		10	0.010 mm
		20	0.020 mm
		50	0.050 mm
		100	0.100 mm
		200	0.200 mm
		500	0.500 mm
Data Byte [2]	Measuring direction	0	Forward (counts increase as you move away from the electronics)
		1	Reverse (counts decrease as you move away from the electronics)
Data Byte [3]	Number of magnets	0	Used for missing magnet detection purposes only. If the 'Value' = 0, the sensor will determine how many magnets are on the sensor at startup. It will use the determined number of magnets to determine missing magnet status. The missing magnet status is reported in the status attribute of the Position Sensor object and through the LEDs in the connector flange.
Data Byte [4]	Velocity window size	0	The number of cycles that is used to calculate the velocity. The larger the number of cycles the more resolute the velocity becomes, but the slower the sensor is to respond to a change in velocity. Values of 1 – 1000 are valid.
Data Byte [5]	Number of averages	0	A simple moving average that can be used to filter the position data in noisy environments. Values of 1 – 100 are valid.

7.7 Changing Configuration Values

In the 'Value' column, update the configuration field data if needed.

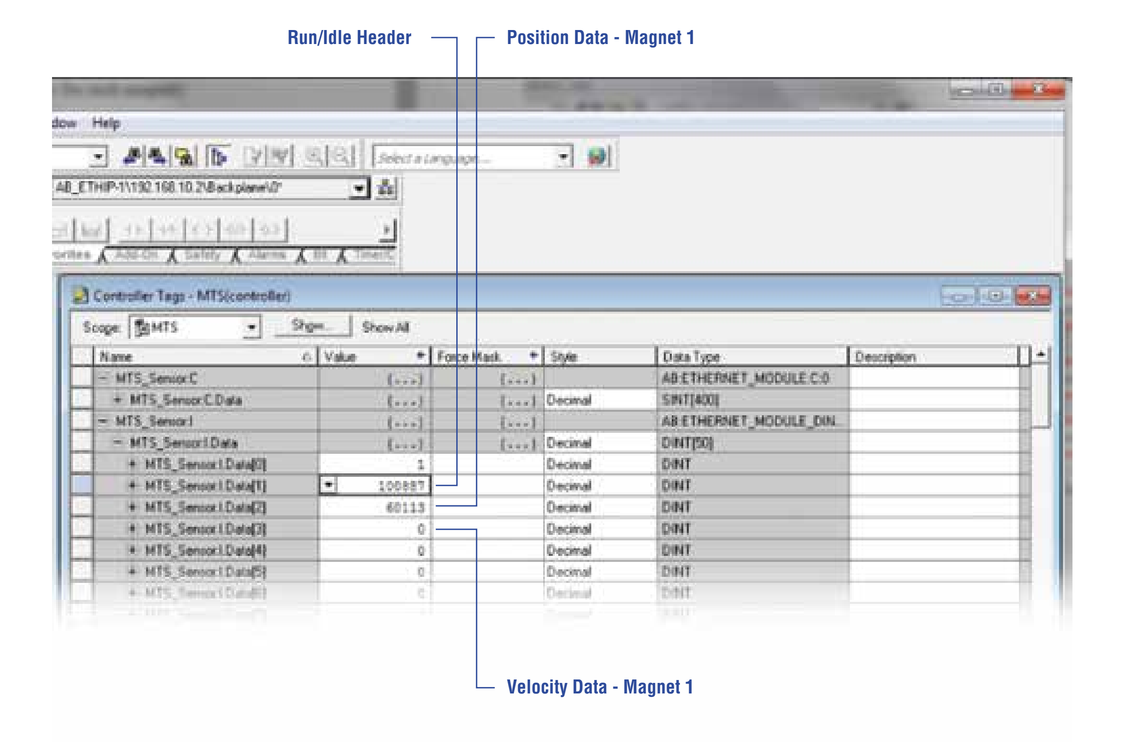


Fig. 71: Device data tags

The following are 'Value' field descriptions, Acceptable values for each field are as follows.

7.7.1 'Value' = Data [0], 'Description' = Data Format:

Options are:

Value 0 = 4 bytes signed position, 4 bytes signed velocity (repeats for each magnet)

Value 1 = 4 bytes signed position (repeats for each magnet)

Value 2 = 4 bytes signed velocity (repeats for each magnet)

Value 3 = First 4 bytes status. Then repeating for each magnet, 4 bytes signed position, 4 bytes signed velocity.
The following format for the *4 status bytes* that are used in the **Type 3** Data Format.

Upper byte (bits 24-31) = Number of magnets found on the sensor

Lower byte (bits 0-7) = Status

Bit 0 = Magnet missing (0 = magnet not missing, 1 = magnet missing)

Bit 1 = CPU Watchdog (0 = not triggered, 1 = triggered)

Bits 2-7 = Not used

Middle 2 bytes (bits 8-23) = Unused

7.7.2 'Value' = Data [1], 'Description'= Resolution

(**NOTE:** Default 'Value' = 0 (0.001 mm), also equals 'Value' = 1 (0.001 mm)

The resolution is in micrometers (0.001mm)

The acceptable values are 1, 2, 5, 10, 20, 50, 100, 200 and 500

7.7.3 'Value' = Data [2], 'Description' = Measuring Direction

0 = Forward (Counts increase as you move away from the electronics)

1 = Reverse (Counts decrease as you move away from the electronics)

7.7.4 'Value' = Data [3], 'Description' = Number of Magnets:

Used for missing magnet detection purposes only. If the 'Value' = 0, the sensor will determine how many magnets are on the sensor at startup. It will use the determined number of magnets to determine missing magnet status. The missing magnet status is reported in the status attribute of the Position Sensor object and through the LEDs in the connector flange.

7.7.5 'Value' = Data [4], 'Description' = Velocity Window Size:

The number of cycles that is used to calculate the velocity. The larger the number of cycles the more resolute the velocity becomes, but the slower the sensor is to respond to a change in velocity. Values of 1 – 1000 are valid.

7.7.6 'Value' = Data [5], 'Description' = Number of Averages:

A simple moving average that can be used to filter the position data in noisy environments. Values of 1 – 100 are valid.

7.8 Controller tags input data

The following illustrates an *example* of 'Controller Tags' information based on the factory default configuration:

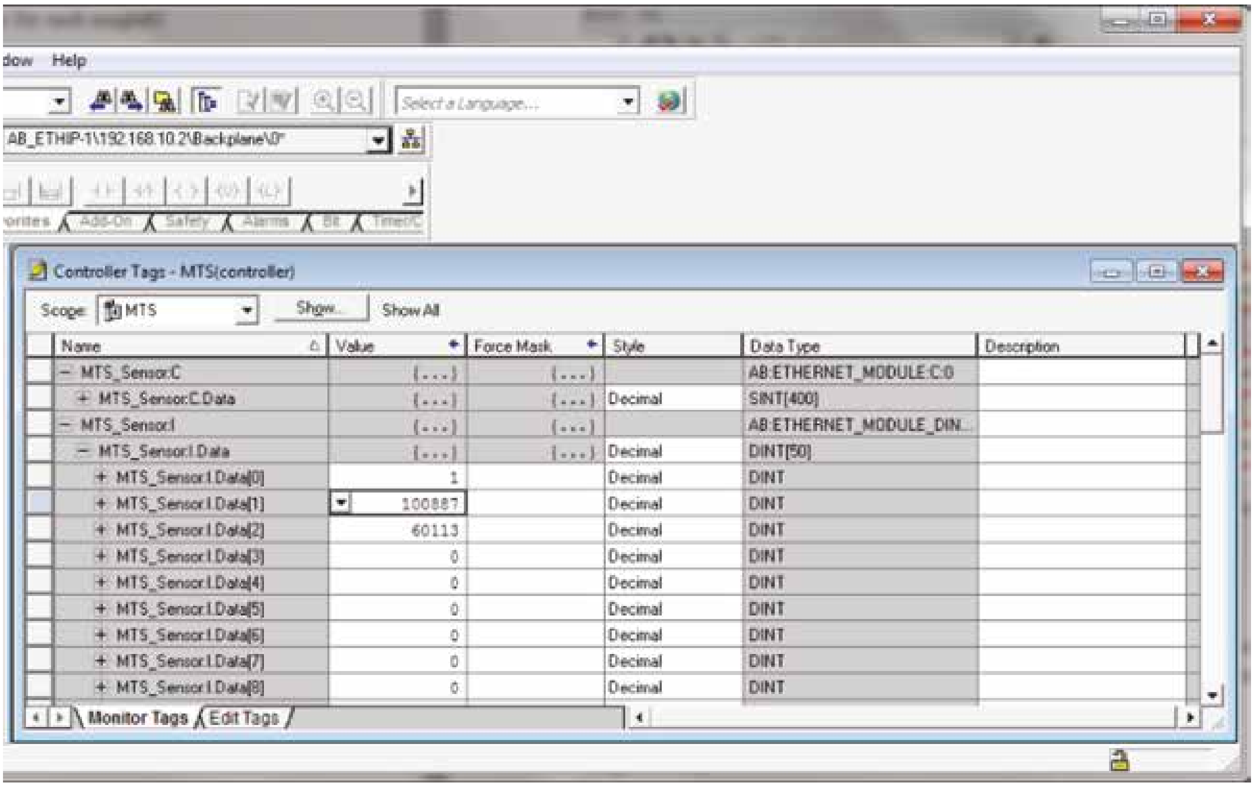


Fig. 72: 'Controller Tags' information *Examples* based on the factory default configuration are as follows:

7.8.1 Run/Idle Header

Data[0] is always the Run/Idle header. This is not required by the EtherNet/IP standard, but it is highly recommended. It can be used by the end user to determine if the system is in Run or Idle mode.

7.8.2 Magnet Data

The remaining data is laid out according to the data format selected in the configuration. The screen shot above shows the position data for magnet 1 in Data[1], and the velocity for magnet 1 in Data[2].

Magnet data - Position

The position data for magnet one in this example is 100887. This number multiplied by the resolution *(default = 0.001 mm)* gives you your position.

Position = (100887)*(0.001 mm) = 100.887 mm

Magnet data - Velocity

The velocity data for magnet one in this example is 60113. The velocity resolution is always 0.001 mm.

Velocity = (60113)*(0.001 mm) = 60.113 mm

7.8.3 Configuration complete

The MTS EtherNet/IP™ sensor is now added to the network and connected, ready to use.

8. Maintenance and troubleshooting

8.1 Error conditions, troubleshooting

See Chapter 5 (Operation) on page 24.

8.2 Maintenance

The sensor is maintenance-free.

8.3 Repair

Repairs on the sensor may be performed only by MTS Sensors or a repair facility explicitly authorized by MTS Sensors.

8.4 List of spare parts

No spare parts are available for this sensor.

8.5 Transport and storage

The conditions of tranport and storage of the sensor match the operating conditions mentioned in this document.

9. Technical data

Output	
Interface	EtherNet/IP™
Data transmission rate	Max. 100 Mbit/s
Measured value	Position, velocity / Option: Multi-position and multi-velocity measurement (max. 20 positions/velocities simultaneous)
Accuracy	
Resolution	1…1000 µm selectable
Cycle time	1.0 ms up to 2000 mm, 2.0 ms up to 4800 mm, 3.0 ms up to 7620 mm, 4.0 ms up to 10060 mm stroke length
Linearity [7]	< ±0.01% full stroke (minimum ±50 µm)
Repeatability	< ±0.001% full stroke (minimum ±2.5 µm)
Hysteresis	< 4 µm
Temperature coefficient	< 15 ppm/°C
Operating conditions	
Operating temperature	–30…+85 °C (–22…+185 °F)
Humidity	90 % rel. humidity, no condensation
Ingress protection [8]	RP: IP65 / RH: IP67 / RF: IP30 (IP67 when installed in pressure pipe) / RD4 electronics: IP67; RD4 sensor rod type S: IP30, all other RD4 rod types: IP65
Shock test	100 g (single shock), IEC standard 68-2-27
Vibration test	15 g / 10…2000 Hz, IEC standard 68-2-6 (resonance frequencies excluded)
EMC test	Electromagnetic emission: EN 61000-6-4, CI SPR 16 Electromagnetic immunity: EN 61000-6-2, EN 61000-4-2/3/4/6, CE qualified[9]
Magnet movement velocity	Any
Design/Material	
Sensor electronics housing	Aluminum
RP Sensor profile	Aluminum
RP stroke length	25…5080 mm (1…200 in.)
RH Sensor rod with flange	Stainless steel 1.4301 / AISI 304
RH stroke length	25…7620 mm (1…300 in.)
RD4 Sensor rod with flange	Stainless steel 1.4306 / AISI 304L
RD4 stroke length	25…5080 mm (1…200 in.)
RF Flexible sensor rod	Stainless steel conduit with Teflon® coating
RF stroke length	100…10060 mm (4…396 in.)
Installation	
Mounting position	Any
Electrical connection	
Connection type	2 × 4-pin (M12), 1 × 4-pin (M8) connector
Operating voltage	24 VDC (–15 / +20 %); UL Recognition requires an approved power supply with energy limitation (UL 61010-1), or Class 2 rating according to the National Electrical Code (USA) / Canadian Electrical Code.[11]
Ripple	< 0.28 Vpp
Current consuption	110 mA typical for RH and RP models (Note: Due to variations in cable length and topology as well as inrush current draw on power up, MTS recommends that 1 amp per sensor be available on the power supply used.)
Dielectric strength	500 VDC (DC ground to machine ground)
Polarity protection	Up to –30 VDC
Over voltage protection	Up to 36 VDC

8/ with magnet # 252 182.
9/ The IP rating is not part of the UL recognition.
10/ The conformity is fulfilled, assumed the wave guide of the sensor is embedded in an EMC-sealed and grounded housing.
11/ UL Recognition for RP and RH only.

10. Annex

Safety Declaration

Dear Customer,
If you return one or several sensors for verification or repair, we need you to sign a safety declaration. The purpose of this declaration is to ensure that the returned items do not contain residues of harmful substances and / or that any danger to persons when handling these items has been removed.

MTS order number: ___________________________________

Sensor type(s): ___________________________________

Serial number(s): ___________________________________

Sensor length: ___________________________________

The sensor has been in contact with the following materials:

Don't specify chemical formulas.
Please, include safety data sheets of the substances, if applicable.

In the event of suspected penetration of substances into the sensor, consult MTS to determine measures to be taken before shipment, if necessary.

Short description of malfunction:

Corporate information

Company: ___________________________________

Address: ___________________________________

____

Contact partner

Name: ___________________________________

Phone: ___________________________________

E-Mail: ___________________________________

We hereby certify that the measuring equipment has been cleaned and neutralized. Equipment handling is safe.
Personnel exposure to health risks during transport and repair has been removed.

Stamp

____
Signature

____
Date

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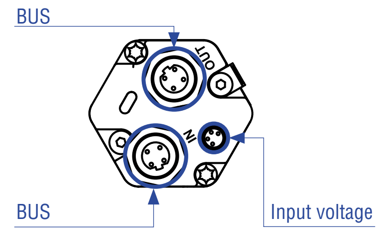
11. Appendix A - Sensor Reset

10.1 Step 1: Ground pins 2 and 4

In the event that the IP address has been configured on a sensor, but that IP address has been lost or forgotten. It will be necessary to reset the EtherNet/IP sensor back to DHCP mode so that a new IP address can be assigned. This is accomplished by using the 4 pins located on the M8 input voltage connector.



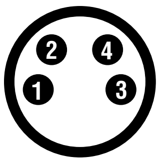
M8 connector	Pin	Function
	1	+24 VDC (–15 / +20 %)
	2	Used for DHCP reset only[7]
	3	DC Ground (0 V)
	4	Used for DHCP reset only[7]

Fig. 73: M8 input voltage connector

To begin the reset to DHCP, connect pin 1 to +24 VDC and connect pins 2, 3 and 4 to ground.

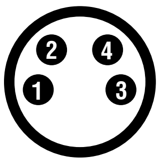
M8 connector	Pin	Function
	1	+24 VDC (–15 / +20 %)
	2	DC Ground (0 V)
	3	DC Ground (0 V)
	4	DC Ground (0 V)

Fig. 74: Wiring for sensor reset step one.

10.2 Step 2: Float Pins 2 and 4

After approximately 5 seconds, the In and Out Port Traffic LED's will both light up red. cause material damage are highlighted by the preceding pictogram, which is defined below.

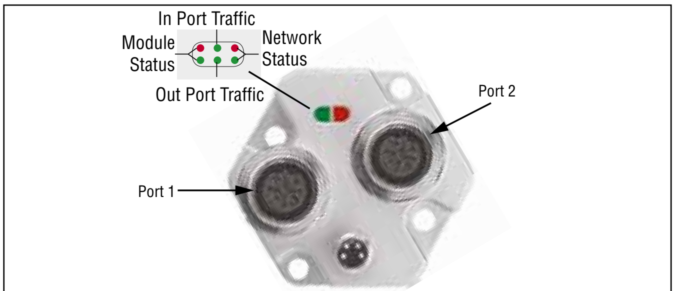


Fig. 75: Location of the status LED

After the LED's turn red, remove pins 2 and 4 from ground and let them float again. The In and Out Port LED's will turn off.

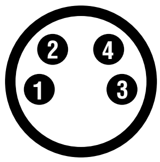
M8 connector	Pin	Function
	1	+24 VDC (–15 / +20 %)
	2	Floating
	3	DC Ground (0 V)
	4	Floating

Fig. 76: Wiring for sensor reset step two.

10.3 Step 3: Ground Pins 2 and 4

After approximately 5 seconds of allowing pins 2 and 4 to float, the In and Out Port LED's will again turn red. After the In and Out Port LED's are red, reconnect pins 2 and 4 to ground. The Module Status LED will change from green to red and then begin to flash green. The sensor no longer has a fixed IP address and is back in DHCP mode.

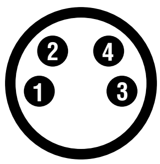
M8 connector	Pin	Function
	1	+24 VDC (–15 / +20 %)
	2	DC Ground (0 V)
	3	DC Ground (0 V)
	4	DC Ground (0 V)

Fig. 77: Wiring for sensor reset step three.

10.4 Reset Complete - Return Pins 2 and 4 to Floating

Power off the sensor and allow pins 2 and 4 to float for normal sensor operation.

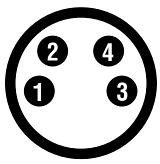
M8 connector	Pin	Function
	1	+24 VDC (–15 / +20 %)
	2	Floating
	3	DC Ground (0 V)
	4	Floating

Fig. 78: Wiring for sensor under normal operation.

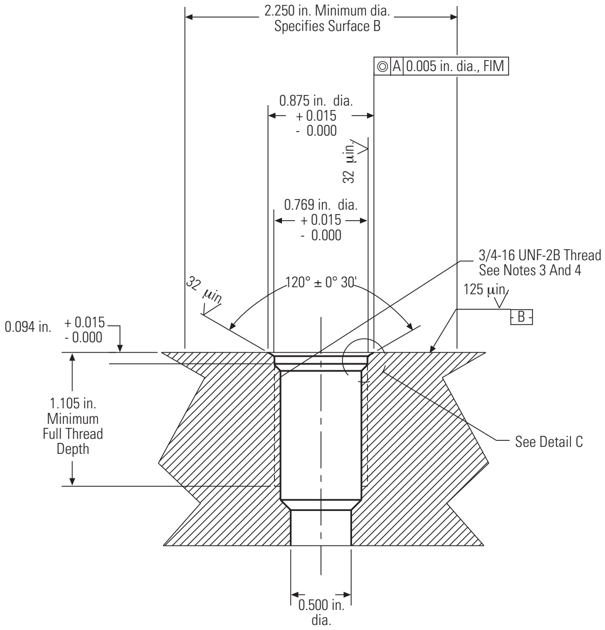
12. Appendix B - Port Details

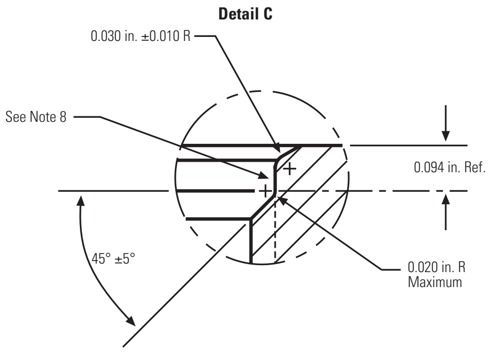
C Y L I N D E R   P O R T   D E T A I L S

PORT DETAIL (PD) FOR TEMPOSONICS RH SENSORS WITH HOUSING STYLE S:

NOTES:

1. Dimensions and tolerances based on ANSI Y14.5-1982.
2. MTS has extracted all pertinent information from MS33649 to generate this document.
3. PD must be square with surface B within 0.005 FIM across 2.250 dia minimum.
4. PD must be concentric with 2.250 dia within 0.030 FIM and with 0.769 dia within 0.005 FIM.
5. Surface texture ANSI B46.1-1978
6. Use O-ring MTS part number 560315 for correct sealing.
7. The thread design shall have sufficient threads to meet strength requirements of material used.
8. Finish counter-bore shall be free from longitudinal and spiral tool marks. Annular tool marks up to 32 microinches maximum will be permissible.

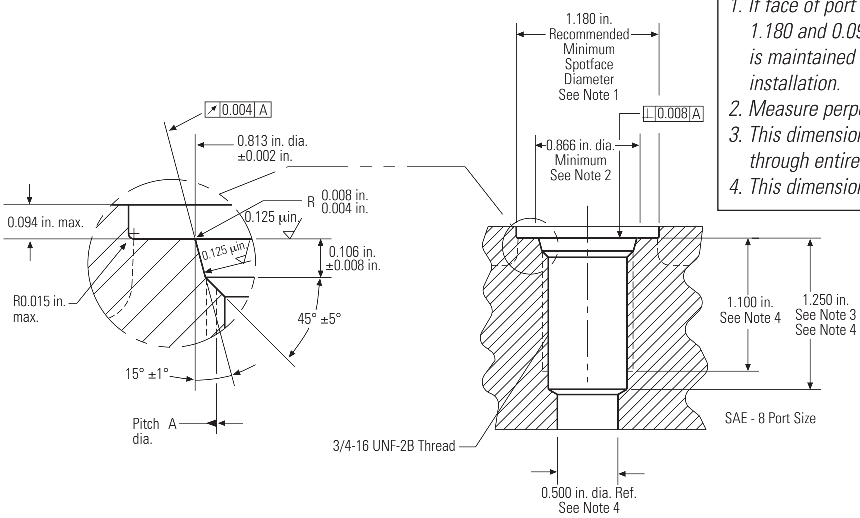




PORT DETAIL (SAE J1926/1) FOR TEMPOSONICS RH SENSORS WITH HOUSING STYLE T:

NOTES:

1. If face of port is on a machined surface, dimensions 1.180 and 0.094 need not apply as long as R0.008/0.004 is maintained to avoid damage to the O-ring during installation.
2. Measure perpendicularity to A at this diameter.
3. This dimension applies when tap drill cannot pass through entire boss.
4. This dimension does not conform to SAE J1926/1.



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