

Operation Manual

R-Series V EtherNet/IP™

Magnetostrictive Linear Position Sensors



V
THE NEW GENERATION

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1. Introduction

1.1 Purpose and use of this manual

Before starting the operation of Temposonics® position sensors, read this documentation thoroughly and follow the safety information. Keep this manual for future reference!

The content of this technical documentation and of its appendix 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 danger that might affect the life and health of operating or service personnel or cause material damage are highlighted by the pictogram 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 defined under item 1 and only in conjunction with the third-party devices and components recommended or approved by Temposonics. As a prerequisite of proper and safe operation the product requires correct transport, storage, mounting and commissioning and must be operated with utmost care.

- 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.

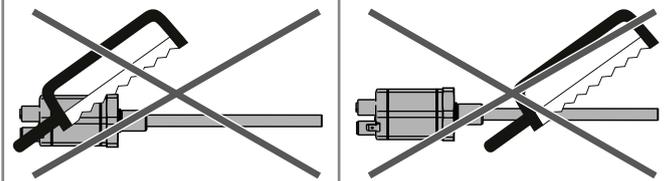
^{1/} The term "qualified technical personnel" characterizes persons who

- are familiar with the safety concepts of automation technology applicable to the particular project and
- are competent in the field of electromagnetic compatibility (EMC) or
- have received adequate training for commissioning and service operations or
- and are familiar with the operation of the device and know the information required for correct operation provided in the product documentation

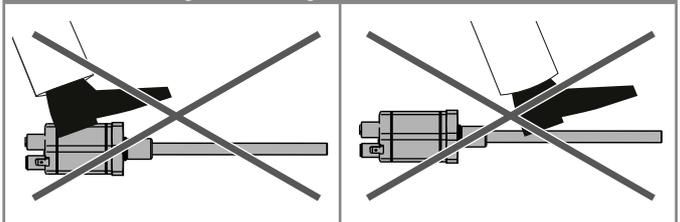
2.2 Foreseeable misuse

Foreseeable misuse	Consequence
Wrong sensor connection	The sensor will not work properly or can be damaged
Operate the sensor out of the operating temperature range	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 damaged/sensor does not respond
Spacers are missing/ installed in a 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 specified by Temposonics	Error in position measurement

Do not alter 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 conditions. 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's 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. Ensure the sensor is operating within the defined limits for supply voltage, environmental conditions, etc.
6. Check the function of the sensor regularly and provide documentation of the checks.
7. Before applying power, 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-hazardous areas.

2.5 Warranty

Temposonics grants a warranty period for the position sensors and supplied accessories relating to material defects and faults that occur despite correct use in accordance with the intended application². The Temposonics obligation is limited to repair or replacement of any defective part of the unit. No warranty can be provided 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 Temposonics 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.

Temposonics explicitly excludes any further warranties. Neither the company's representatives, agents, dealers nor employees are authorized to increase or change the scope of warranty.

2.6 Return

For diagnostic purposes, the sensor can be returned to Temposonics or a repair facility explicitly authorized by Temposonics. Any shipment cost is the responsibility of the sender². For a corresponding form, see chapter "11. Appendix I" on page 56.

^{2/} See also applicable Temposonics terms of sales and delivery on:
www.temposonics.com

3. Identification

3.1 Order code of Temposonics® RP5

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

a	Sensor model																		
R	P	5	Profile																

b	Design																		
G	Magnet slider backlash free (part no. 253 421), suitable for internal linearization																		
L	Block magnet L (part no. 403 448)																		
M	U-magnet OD33 (part no. 251 416-2), suitable for internal linearization																		
N	Magnet slider longer ball-jointed arm (part no. 252 183), suitable for internal linearization																		
O	No position magnet																		
S	Magnet slider joint at top (part no. 252 182), suitable for internal linearization																		
V	Magnet slider joint at front (part no. 252 184), suitable for internal linearization																		

c	Mechanical options																		
A	Standard																		
V	Fluorelastomer seals for the sensor electronics housing																		

d	Stroke length																		
X	X	X	X	M	0025...6350 mm														
Standard stroke length (mm)					Ordering steps														
25... 500 mm					25 mm														
500...2500 mm					50 mm														
2500...5000 mm					100 mm														
5000...6350 mm					250 mm														
X	X	X	X	U	001.0...250.0 in.														
Standard stroke length (in.)					Ordering steps														
1... 20 in.					1.0 in.														
20...100 in.					2.0 in.														
100...200 in.					4.0 in.														
200...250 in.					10.0 in.														

Non-standard stroke lengths are available; must be encoded in 5 mm/0.1 in. increments.

e	Number of magnets																		
X	X	01...20 Position(s) (1...20 magnet(s))																	

f	Connection type																		
D	5	6	2 × M12 female connectors (D-coded), 1 × M8 male connector																
D	5	8	2 × M12 female connectors (D-coded), 1 × M12 male connector (A-coded)																

g	System																		
1	Standard																		

h	Output																		
U	2	0	1	EtherNet/IP™, position and velocity (1...20 magnet(s))															
U	2	1	1	EtherNet/IP™, position and velocity, internal linearization (1...20 magnet(s))															

NOTICE

- For the RP5, the magnet selected in **b** "Design" is included in the scope of delivery. Specify the number of magnets for your application. For multi-position measurements with more than 1 magnet, order the other magnets separately.
- The number of magnets is limited by the stroke length. The minimum allowed distance between magnets (i.e. front face of one to the front face of the next one) is 75 mm (3 in.).
- Use magnets of the same type for multi-position measurement.
- If the option for internal linearization (U211) in **h** "Output" is chosen, select a suitable magnet.

3.2 Order code of Temposonics® RH5

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

a	Sensor model		
R	H	5	Rod

b	Design
B	Base unit (only for replacement)
J	Threaded flange M22×1.5-6g (rod Ø 12.7 mm), stroke length: 25...5900 mm (1...232 in.)
M	Threaded flange M18×1.5-6g (standard)
S	Threaded flange ¾"-16 UNF-3A (standard)
T	Threaded flange ¾"-16 UNF-3A (with raised-face)

c	Mechanical options
A	Standard
B	Bushing on rod end (only for design »M«, »S« & »T«)
M	Thread M4 at rod end (only for design »M«, »S« & »T«)
V	Fluorelastomer seals for the sensor electronics housing

d	Stroke length				
X	X	X	X	M	0025...7620 mm
Standard stroke length (mm)		Ordering steps			
25... 500 mm		5 mm			
500... 750 mm		10 mm			
750...1000 mm		25 mm			
1000...2500 mm		50 mm			
2500...5000 mm		100 mm			
5000...7620 mm		250 mm			
X	X	X	X	U	001.0...300.0 in.
Standard stroke length (in.)		Ordering steps			
1... 20 in.		0.2 in.			
20... 30 in.		0.4 in.			
30... 40 in.		1.0 in.			
40...100 in.		2.0 in.			
100...200 in.		4.0 in.			
200...300 in.		10.0 in.			

Non-standard stroke lengths are available; must be encoded in 5 mm/0.1 in. increments.

e	Number of magnets		
X	X	01...20	Position(s) (1...20 magnet(s))

f	Connection type		
D	5	6	2×M12 female connectors (D-coded), 1×M8 male connector
D	5	8	2×M12 female connectors (D-coded), 1×M12 male connector (A-coded)

g	System
1	Standard

h	Output			
U	2	0	1	EtherNet/IP™, position and velocity (1...20 magnet(s))
U	2	1	1	EtherNet/IP™, position and velocity, internal linearization (1...20 magnet(s))

NOTICE

- Specify number of magnets for your application and order the magnets separately.
- The number of magnets is limited by the stroke length. The minimum allowed distance between magnets (i.e. front face of one to the front face of the next one) is 75 mm (3 in.).
- Use magnets of the same type for multi-position measurement.
- If the option for internal linearization (U211) in **h** "Output" is chosen, select a suitable magnet.

3.3 Order code of Temposonics® RFV

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

a	Sensor model		
R	F	V	Flexible rod

b	Design
B	Base unit
M	Threaded flange M18×1.5-6g (standard)
S	Threaded flange ¾"-16 UNF-3A (standard)

Section **c** is intentionally omitted.

d	Stroke length					
X	X	X	X	X	M	00150...20000 mm
Stroke length (mm)		Ordering steps				
150... 1000 mm		50 mm				
1000... 5000 mm		100 mm				
5000... 10000 mm		250 mm				
10000... 15000 mm		500 mm				
15000... 20000 mm		1000 mm				
X	X	X	X	X	U	0006.0...0787.0 in.
Stroke length (in.)		Ordering steps				
6... 40 in.		2 in.				
40... 197 in.		4 in.				
197... 394 in.		10 in.				
394... 591 in.		20 in.				
591... 787 in.		40 in.				

Non standard stroke lengths are available; must be encoded in 5 mm/0.1 in. increments

e	Number of magnets		
X	X	01...20	Position(s) (1...20 magnet(s))

f	Connection type		
D	5	6	2 × M12 female connectors (D-coded), 1 × M8 male connector
D	5	8	2 × M12 female connectors (D-coded), 1 × M12 male connector (A-coded)

g	System
1	Standard

h	Output			
U	2	0	1	EtherNet/IP™, position and velocity (1...20 magnet(s))

NOTICE

- Specify number of magnets for your application and order the magnets separately.
- The number of magnets is limited by the stroke length. The minimum allowed distance between magnets (i.e. front face of one to the front face of the next one) is 75 mm (3 in.).
- Use magnets of the same type for multi-position measurement.

3.4 Order code of Temposonics® RDV

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

a	Design
R D V	Detached sensor electronics "Classic"

b	Design
C	Threaded flange M18×1.5-6g (A/F 46)
D	Threaded flange ¾"-16 UNF-3A (A/F 46)
M	Threaded flange M18×1.5-6g (A/F 24)
S	Pressure fit flange Ø 26.9 mm f6
T	Threaded flange ¾"-16 UNF-3A (A/F 23)

c	Mechanical options
For side cable entry	
A	PUR cable with M16 connector, 250 mm length
B	PUR cable with M16 connector, 400 mm length
C	PUR cable with M16 connector, 600 mm length
For bottom cable entry	
2	Single wires with flat connector, 65 mm length
4	Single wires with flat connector, 170 mm length
5	Single wires with flat connector, 230 mm length
6	Single wires with flat connector, 350 mm length

d	Stroke length
X X X X M	Flange »S«: 0025...2540 mm Flange »C«, »D«, »M«, »T«: 0025...5080 mm
Stroke length (mm)	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
X X X X U	Flange »S«: 001.0...100.0 in. Flange »C«, »D«, »M«, »T«: 001.0...200.0 in.
Stroke length (in.)	Ordering steps
1... 20 in.	0.2 in.
20... 30 in.	0.4 in.
30... 40 in.	1.0 in.
40... 100 in.	2.0 in.
100... 200 in.	4.0 in.
Non standard stroke lengths are available; must be encoded in 5 mm/0.1 in. increments	

e	Number of magnets
X X	01...20 Position(s) (1...20 magnet(s))

f	Connection type
D 5 6	2× M12 female connectors (D-coded), 1× M8 male connector
D 5 8	2× M12 female connectors (D-coded), 1× M12 male connector (A-coded)

g	System
1	Standard

h	Output
U 2 0 1	EtherNet/IP™, position and velocity (1...20 magnet(s))
U 2 1 1	EtherNet/IP™, position and velocity, internal linearization (1...20 magnet(s))

NOTICE

- Specify number of magnets for your application and order the magnets separately.
- The number of magnets is limited by the stroke length.
The minimum allowed distance between magnets (i.e. front face of one to the front face of the next one) is 75 mm (3 in.).
- Use magnets of the same type for multi-position measurement.
- If the option for internal linearization (U211) in **h** "Output" is chosen, select a suitable magnet.

3.5 Nameplate

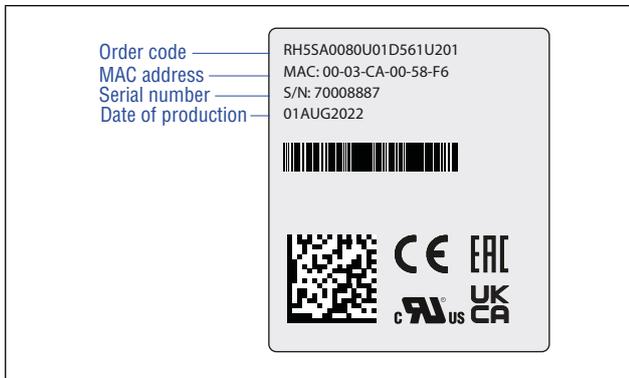


Fig. 1: Example of nameplate of a R-Series V RH5 sensor with EtherNet/IP™ output

3.6 Approvals

- ODVA certified
- CE declaration
- UKCA declaration
- EAC declaration
- UL declaration

3.7 Scope of delivery

RP5 (profile sensor):

- Sensor
- Position magnet (not valid for RP5 with design »0«)
- 2 mounting clamps up to 1250 mm (50 in.) stroke length +
1 mounting clamp for each 500 mm (20 in.) additional stroke length

RH5 (rod sensor):

- RH5-B: Base unit (without flange & rod assembly),
3 × socket screws M4×59
- RH5-J/-M/-S/-T: Sensor, O-ring

RFV (flexible rod sensor):

- RFV-B: Sensor (without flange & rod assembly),
3 × socket screws M4×59
- RFV-M/-S: Sensor, O-ring

RDV (detached sensor electronics):

- RDV-C/-D/-M/-T: Sensor, O-ring
- RDV-S: Sensor, O-ring, back-up ring

4. Product description and commissioning

4.1 Functionality and system design

Product designation

- Position sensor Temposonics® R-Series V

Sensor model

- Temposonics® R-Series V RP5 (profile sensor)
- Temposonics® R-Series V RH5 (rod sensor)
- Temposonics® R-Series V RFV (flexible rod sensor)
- Temposonics® R-Series V RDV (detached sensor electronics)

Stroke length

- Temposonics® R-Series V RP5: 25...6350 mm (1...250 in.)
- Temposonics® R-Series V RH5: 25...7620 mm (1...300 in.)
- Temposonics® R-Series V RFV: 150...20,000 mm (6...787 in.)
- Temposonics® R-Series V RDV: 25...5080 mm (1...200 in.)

Output signal

- EtherNet/IP™

Application

The Temposonics® position sensors are used for measurement and conversion of the length (position) variable in the fields of automated systems and mechanical engineering.

Principle of operation and system construction

The absolute, linear position sensors provided by Temposonics rely on the company's proprietary Temposonics® magnetostrictive technology, which can determine position with a high level of precision and robustness. Each Temposonics® position sensor consists of a ferromagnetic waveguide, a position magnet, a strain pulse converter and supporting electronics. The magnet, connected to the object in motion in the application, generates a magnetic field at its location on the waveguide. A short current pulse is applied to the waveguide. This creates a momentary radial magnetic field and torsional strain on the waveguide. The momentary interaction of the magnetic fields releases a torsional strain pulse that propagates the length of the waveguide. When the ultrasonic wave reaches the end of the waveguide it is converted into an electrical signal. Since the speed of the ultrasonic wave in the waveguide is precisely known, the time required to receive the return signal can be converted into a linear position measurement with both high accuracy and repeatability.

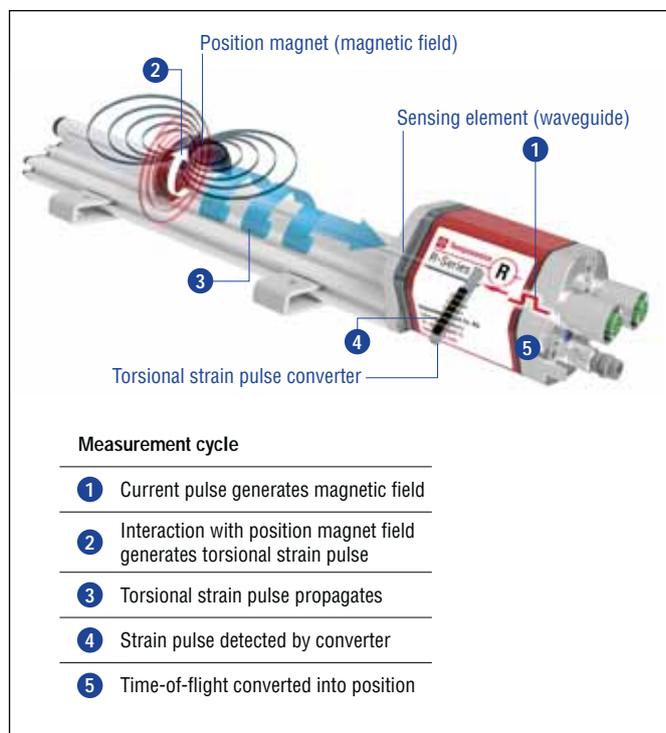


Fig. 2: Time-based magnetostrictive position sensing principle

Modular mechanical and electronic construction

- The sensor rod or profile protects the inner 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 sensor rod or profile and triggers the measurement through the sensor rod wall.
- The sensor can be connected directly to a control system. Its electronics generates a strictly position-proportional signal output between start and end position.

4.2 Installation and design of Temposonics® RP5

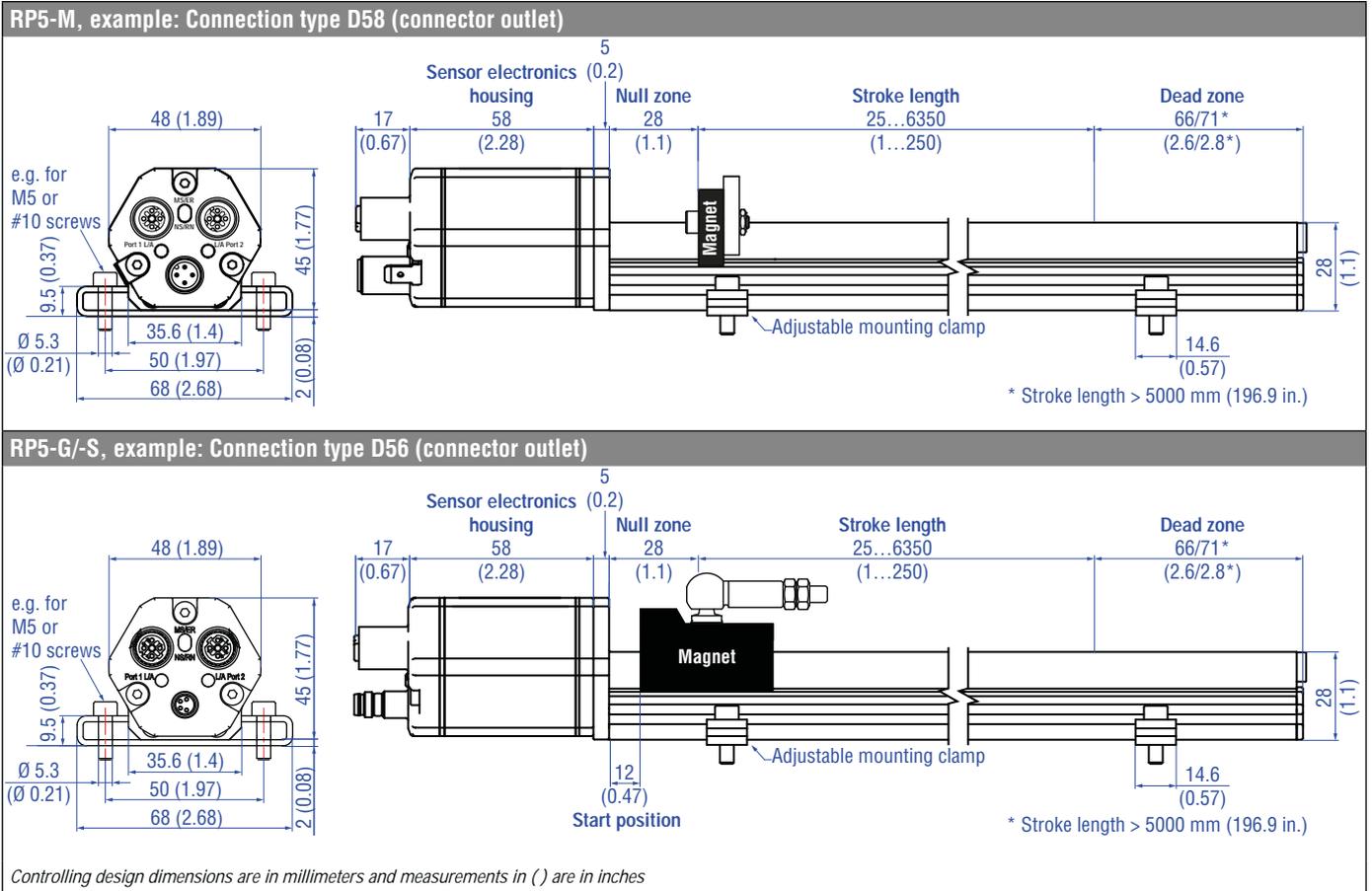


Fig. 3: Temposonics® RP5 with U-magnet and magnet slider

Installation of RP5

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 sensor profile. The sensor is fitted on a flat machine surface using the mounting clamps (Fig. 4). A length-dependent number of these clamps are delivered with the sensor and must be distributed over the profile at regular distances. For fastening use M5×20 screws to DIN 6912 that should be tightened with a fastening torque of 5 Nm.

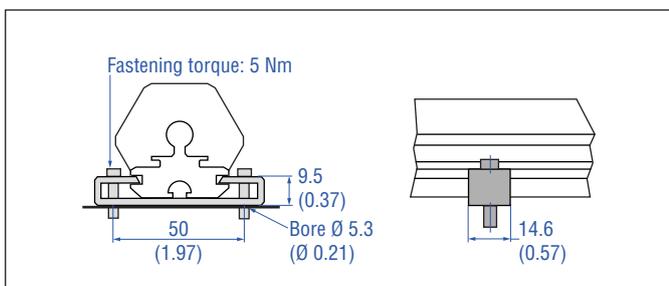


Fig. 4: Mounting clamps (part no. 400 802) with cylinder screw M5×20

Alternative:

If only limited space is available, the profile sensor can be mounted also via the T-rail in the profile bottom using an T-slot nut M5 (part no. 401 602) or a sliding block (Fig. 5).

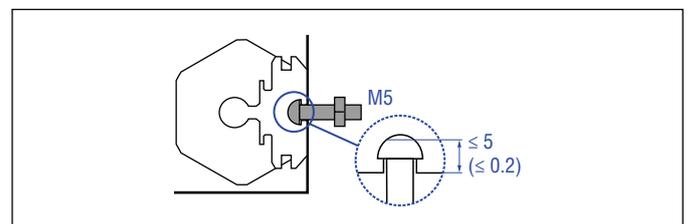


Fig. 5: T-slot nut M5 (part no. 401 602)

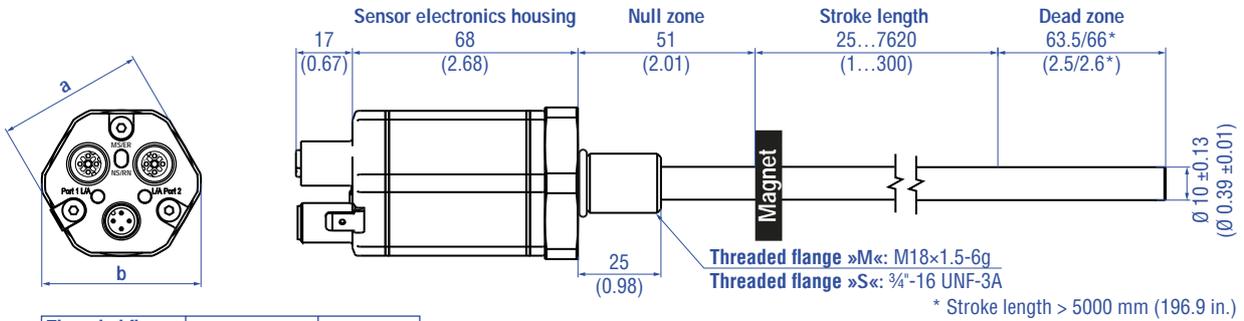
NOTICE

Take care to mount the sensor in an axially parallel position to avoid damage to magnet and sensor.

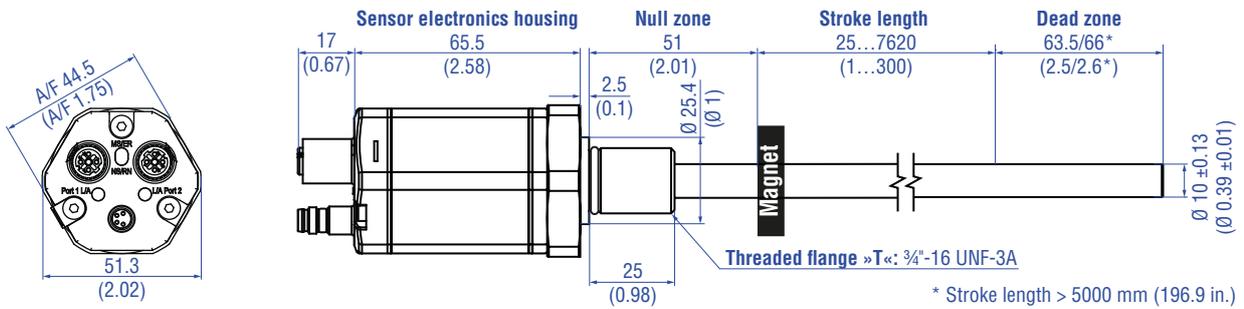
Controlling design dimensions are in millimeters and measurements in () are in inches

4.3 Installation and design of Temposonics® RH5

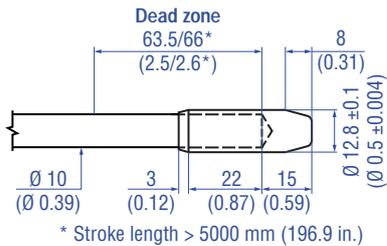
RH5-M/-S-A/-V – RH5 with threaded flange M18×1.5-6g or ¾"-16 UNF-3A, example: Connection type D58 (connector outlet)



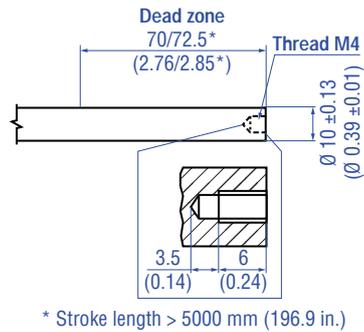
RH5-T-A/-V – RH5 with threaded flange ¾"-16 UNF-3A with raised-face, example: Connection type D56 (connector outlet)



Mechanical option »B«: Bushing on rod end for threaded flange M18×1.5-6g or ¾"-16 UNF-3A



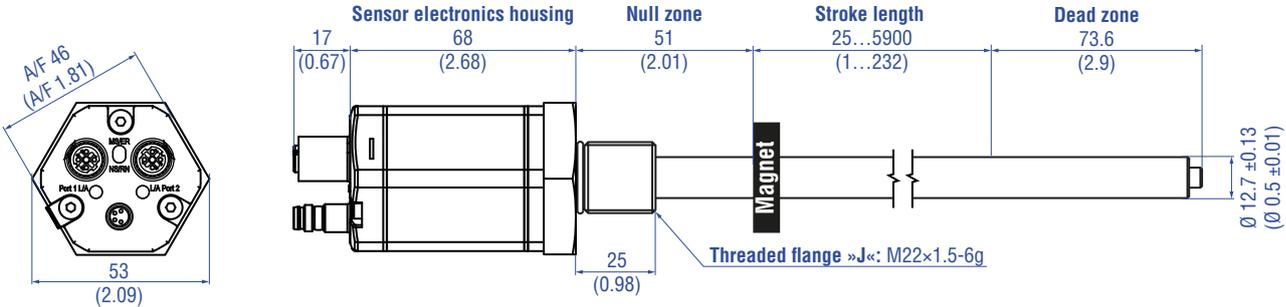
Mechanical option »M«: Thread M4 at rod end for threaded flange M18×1.5-6g or ¾"-16 UNF-3A



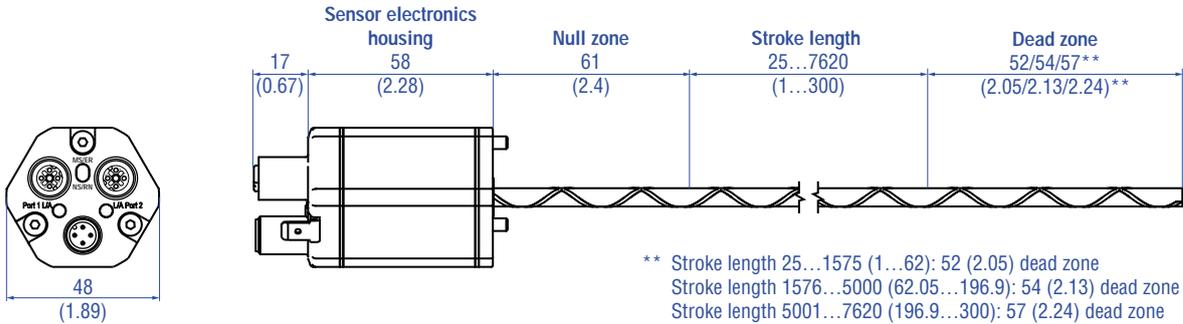
Controlling design dimensions are in millimeters and measurements in () are in inches

Fig. 6: Temposonics® RH5 with ring magnet, part 1

RH5-J-A/-V – RH5 with threaded flange M22×1.5-6g and Ø 12.7 mm rod, example: Connection type D56 (connector outlet)



RH5-B-A/-V – RH5 base unit (only for replacement), example: Connection type D58 (connector outlet)



Controlling design dimensions are in millimeters and measurements in () are in inches

Fig. 7: Temposonics® RH5 with ring magnet, part 2

Installation of RH5 with threaded flange

Fix the sensor rod via threaded flange M18×1.5-6g, M22×1.5-6g or 3/4"-16 UNF-3A.

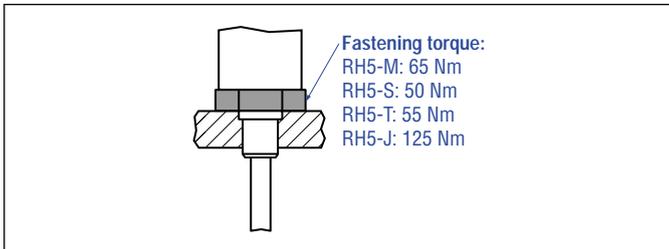


Fig. 8: Mounting example of threaded flange

Installation of a rod-style sensor in a fluid cylinder

The rod-style version has been developed for direct stroke measurement in a fluid cylinder. Mount the sensor via threaded flange or a hex nut.

- Mounted on the face of the piston, the position magnet travels over the rod without touching it and indicates the exact position through the rod wall – independent of the hydraulic fluid.
- The pressure resistant sensor rod is installed into a bore in the piston rod.
- The base unit is mounted by means of three screws. It is the only part that needs to be replaced if servicing is required, i.e. the hydraulic circuit remains closed. For more information see chapter "4.8 Replacement of base unit" on page 29.

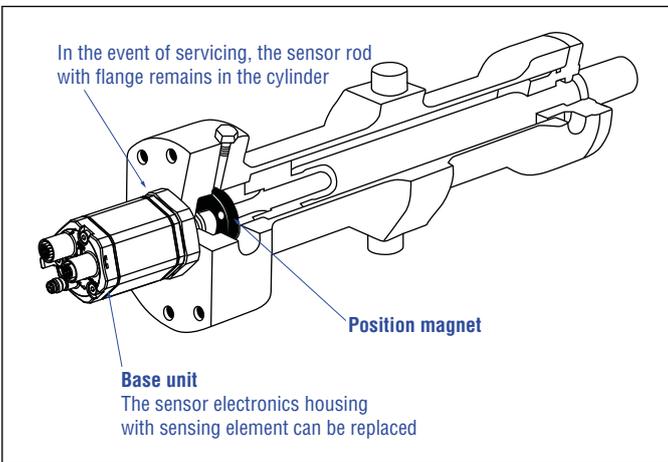


Fig. 9: Sensor in cylinder

Hydraulics sealing

There are two ways to seal the flange contact surface (Fig. 10):

1. A sealing by using an O-ring (e.g. 22.4 × 2.65 mm (0.88 × 0.1 in.), 25.07 × 2.62 mm (0.99 × 0.1 in.)) in a cylinder end groove.
2. A sealing by using an O-ring in the undercut.

For threaded flange (3/4"-16 UNF-3A):

O-ring 16.4 × 2.2 mm (0.65 × 0.09 in.) (part no. 560 315)

For threaded flange (M18×1.5-6g):

O-ring 15.3 × 2.2 mm (0.60 × 0.09 in.) (part no. 401 133)

For threaded flange (M22×1.5-6g):

O-ring 19.2 × 2.2 mm (0.76 × 0.09 in.) (part no. 561 337)

In the case of threaded flange M18×1.5-6g or M22×1.5-6g, provide a screw hole based on ISO 6149-1 (Fig. 11). See ISO 6149-1 for further information.

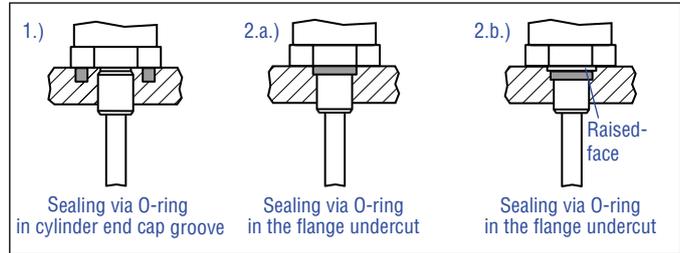


Fig. 10: Possibilities of sealing for threaded flange with flat face 1. + 2.a. (RH5-J-/M-/S) and with raised-face 2.b. (RH5-T)

- Note the fastening torque:

RH5-M: 65 Nm

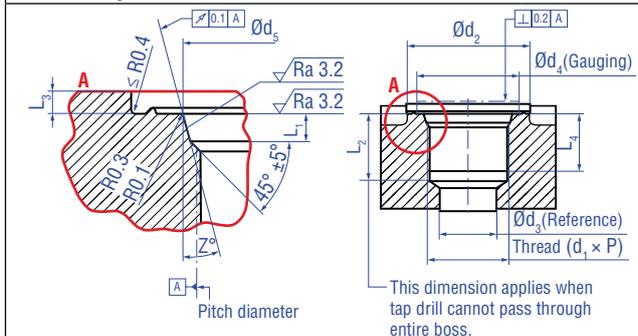
RH5-S: 50 Nm

RH5-T: 55 Nm

RH5-J: 125 Nm

- Seat the flange contact surface completely on the cylinder mounting surface.
- The cylinder manufacturer determines the pressure-resistant gasket (copper gasket, O-ring, etc.).
- The position magnet should not grind on the sensor rod.
- The piston rod drilling (RH5-M/S/T-A/M/V with rod Ø 10 mm: ≥ Ø 13 mm (≥ Ø 0.51 in.); RH5-M/S/T-B with rod Ø 10 mm: ≥ Ø 16 mm (≥ Ø 0.63 in.); RH5-J-A/V with rod Ø 12.7 mm: ≥ Ø 16 mm (≥ Ø 0.63 in.)) depends on the pressure and piston speed.
- Adhere to the information relating to operating pressure.
- Protect the sensor rod against wear.

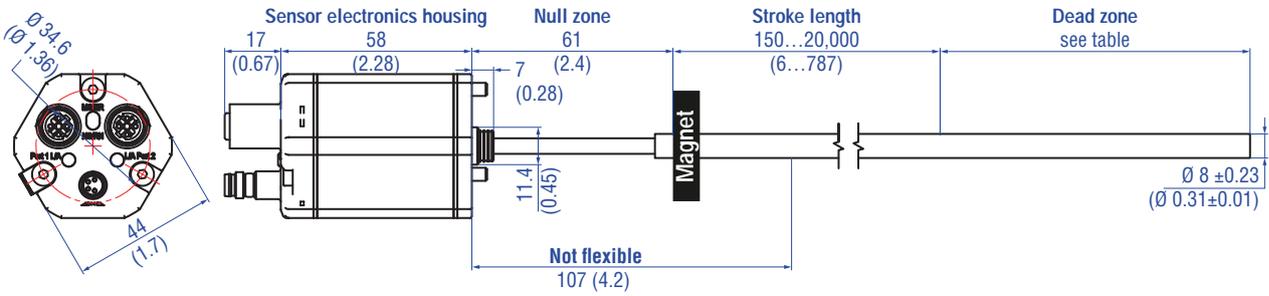
Notice for metric threaded flanges									
Thread (d ₁ ×P)	d ₂	d ₃	d ₄	d ₅ +0.1 0	L ₁ +0.4 0	L ₂	L ₃	L ₄	Z° ±1°
RH5-M-A-/M-/V									
M18×1.5-6g	55	≥ 13	24.5	19.8	2.4	28.5	2	26	15°
RH5-M-B									
M18×1.5-6g	55	≥ 16	24.5	19.8	2.4	28.5	2	26	15°
RH5-J-A-/V									
M22×1.5-6g	55	≥ 16	27.5	23.8	2.4	28.5	2	26	15°



Controlling design dimensions are in millimeters
Fig. 11: Notice for metric threaded flange M18×1.5-6g/M22×1.5-6g based on DIN ISO 6149-1

4.4 Installation and design of Temposonics® RFV

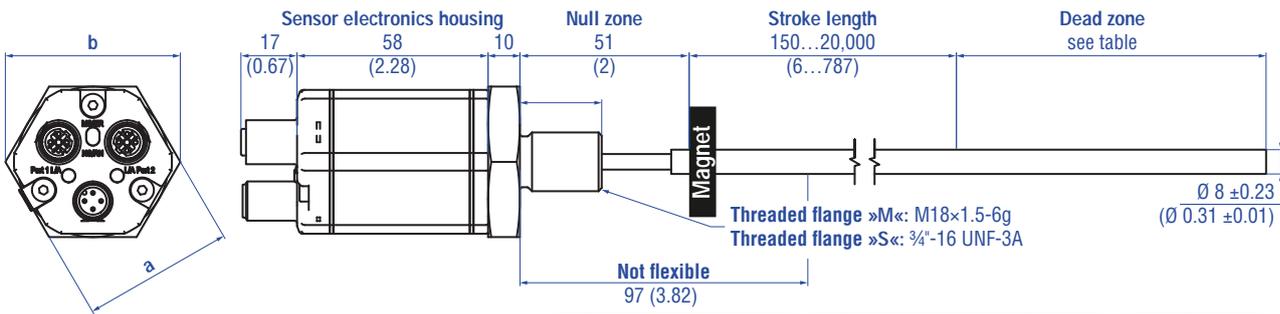
RFV-B – RFV base unit, example: Connection type D56 (connector outlet)



Stroke length	Tolerance of total length	Dead zone
Up to 7620 mm (300.00 in.)	+8 mm (0.31 in.)/-5 mm (0.20 in.)	94 mm (3.70 in.)
Up to 10,000 mm (393.70 in.)	+15 mm (0.59 in.)/-15 mm (0.59 in.)	100 mm (3.94 in.)
Up to 15,000 mm (590.55 in.)	+15 mm (0.59 in.)/-30 mm (1.18 in.)	120 mm (4.72 in.)
Up to 20,000 mm (787.00 in.)	+15 mm (0.59 in.)/-45 mm (1.77 in.)	140 mm (5.51 in.)

Note: Tolerance of total length has no influence on the stroke length.

RFV-M/-S – RFV with threaded flange M18×1.5-6g or ¾"-16 UNF-3A, example: Connection type D58 (connector outlet)



Threaded flange	a	b
»M«	A/F 46 (1.81)	53 (2.09)
»S«	A/F 44.5 (1.75)	51.3 (2.02)

Stroke length	Tolerance of total length	Dead zone
Up to 7620 mm (300.00 in.)	+8 mm (0.31 in.)/-5 mm (0.20 in.)	94 mm (3.70 in.)
Up to 10,000 mm (393.70 in.)	+15 mm (0.59 in.)/-15 mm (0.59 in.)	100 mm (3.94 in.)
Up to 15,000 mm (590.55 in.)	+15 mm (0.59 in.)/-30 mm (1.18 in.)	120 mm (4.72 in.)
Up to 20,000 mm (787.00 in.)	+15 mm (0.59 in.)/-45 mm (1.77 in.)	140 mm (5.51 in.)

Note: Tolerance of total length has no influence on the stroke length.

Controlling design dimensions are in millimeters and measurements in () are in inches

Fig. 12: Temposonics® RFV with ring magnet

Installation of RFV

Note the following information when mounting and handling an RFV sensor:

1. Always insert the flexible sensor rod in a support tube (e.g. pressure rod HD/HL/HP or HFP profile). The support tube has to be made of non-magnetic material and has to have an inside diameter of minimum 9.4 mm (0.37 in.) (Fig. 13). The support tube can be straight or bent.
2. Do never bend beyond the minimum bending radius of 250 mm (9.84 in.).
3. Note the minimum distance to a spatial limitation of 300 mm (11.81 in.), when mounting/dismounting the sensor. The recommended distance is 500 mm (20 in.) (Fig. 15).
4. Note the non-flexible area of the sensor rod from the flange of 107 mm (4.21 in.) (for RFV-B) respectively 97 mm (3.82 in.) (for RFV-M/-S).

NOTICE

Smaller radiuses < 250 mm (9.84 in.) cause damage to the flexible sensor rod.

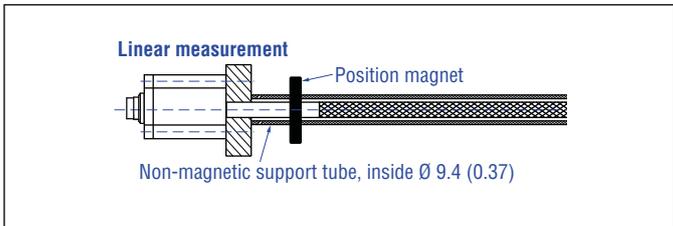


Fig. 13: Sensor with support tube

Controlling design dimensions are in millimeters and measurements in () are in inches

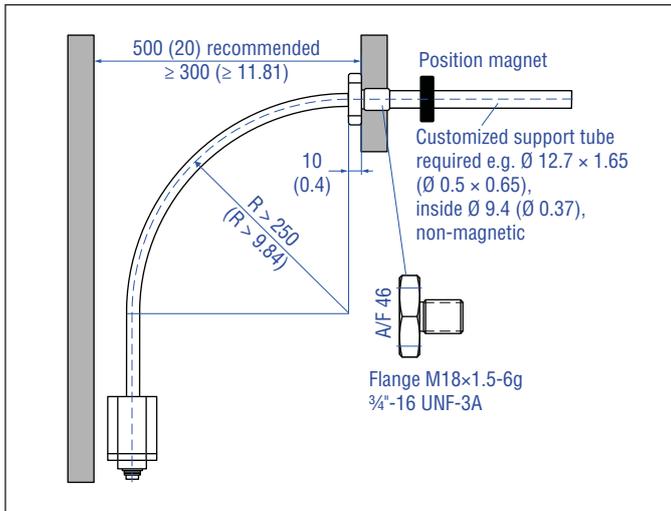


Fig. 14: Clearances for installation and handling

Mounting the RFV

1. RFV-B

- Insert the flexible sensor rod in a support tube.
- Mount the sensor electronics housing by means of 3 non-magnetic socket head screws M4×59. Fastening torque: 1.4 Nm (Fig. 14). Secure the screws, e.g. using Loctite 243, before re-installing.

Recommendation: Seal the sensor via flange.

2. RFV-B with pressure rod HD/HL/HP or HFP profile (see "Frequently ordered accessories")

- Advantage: The flexible sensor rod is inserted in a support tube.
- Mount the sensor electronics housing by means of 3 non-magnetic socket head screws M4×59. Fastening torque: 1.4 Nm (Fig. 14). Secure the screws, e.g. using Loctite 243, before re-installing.
- Installation details: see below

3. RFV-M/-S

- Insert the flexible sensor rod in a support tube.
- Mount the sensor via flange.
- Installation details: see below
- Please note that liquid can enter the sensor between the thread and the flexible rod.

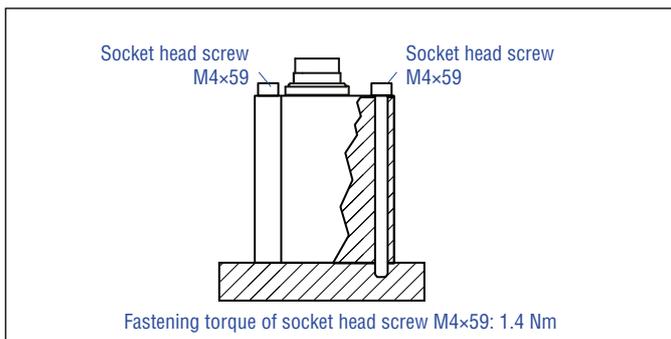


Fig. 15: Mounting with socket head screws M4×59

Installation of RFV with threaded flange »M«, »S«

Fix the sensor rod via threaded flange M18×1.5-6g or 3/4"-16 UNF-3A.

Note the fastening torque of

RFV-M: 65 Nm

RFV-S: 50 Nm

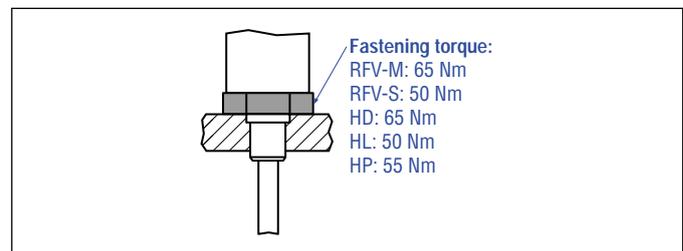


Fig. 16: Mounting example of threaded flange

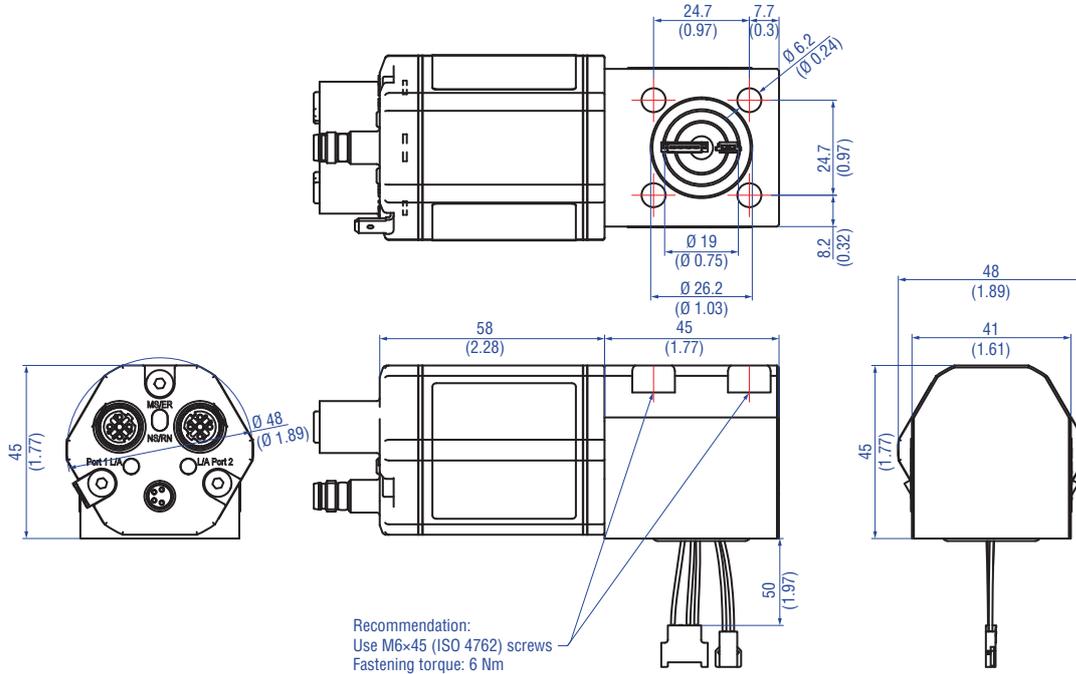
Installation of RFV sensor with pressure rod HD/HL/HP in a fluid cylinder

The rod-style version has been developed for direct stroke measurement in a fluid cylinder. Mount the sensor via threaded flange or a hex nut.

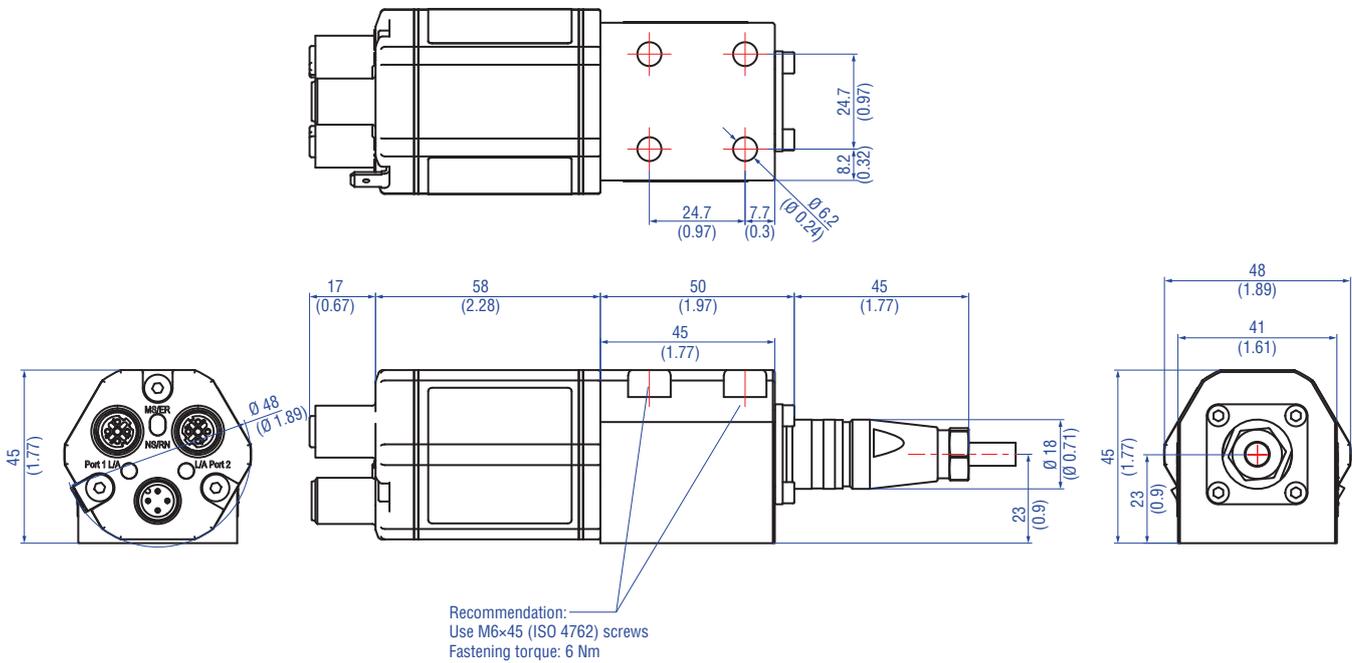
- Mounted on the face of the piston, the position magnet travels over the rod without touching it and indicates the exact position through the rod wall – independent of the hydraulic fluid.
- The pressure resistant sensor rod is installed into a bore in the piston rod.
- The base unit is mounted by means of 3 screws. It is the only part that needs to be replaced if servicing is required, i.e. the hydraulic circuit remains closed. For more information see chapter "4.8 Replacement of base unit" on page 29.
- Note the fastening torque of
 - HD: 65 Nm
 - HL: 50 Nm
 - HP: 55 Nm
- Seat the flange contact surface completely on the cylinder mounting surface.
- The cylinder manufacturer determines the pressure-resistant gasket (copper gasket, O-ring, etc.).
- The position magnet should not grind on the sensor rod.
- The piston rod drilling for RFV sensors with pressure rod (outer diameter 12.7 mm (0.5 in.)) is ≥ 16 mm (≥ 0.63 in.). The borehole depends on the pressure and piston speed.
- Adhere to the information relating to operating pressure.
- Protect the sensor rod against wear.

4.5 Installation and design of Temposonics® RDV

RDV with bottom cable entry, example: Connector D56 (connector outlet)



RDV with side cable entry, example: Connector D58 (connector outlet)

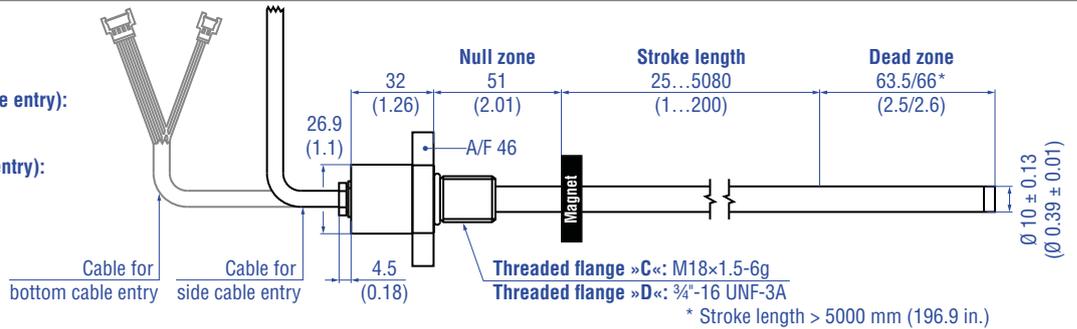


Controlling design dimensions are in millimeters and measurements in () are in inches

Fig. 19: Temposonics® RDV sensor electronics housing

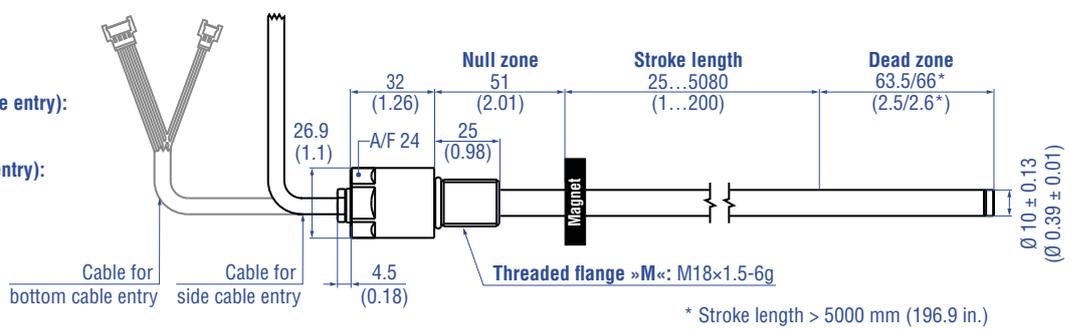
Threaded flange »C« & »D« (for bottom or side cable entry)

PUR cable:
Ø 6 (Ø 0.24)
Bending radius:
> 24 (> 0.94)
Cable length (bottom cable entry):
65/170/230/350
(2.6/6.7/9.1/13.8)
Cable length (side cable entry):
250/400/600
(9.8/15.7/23.6)



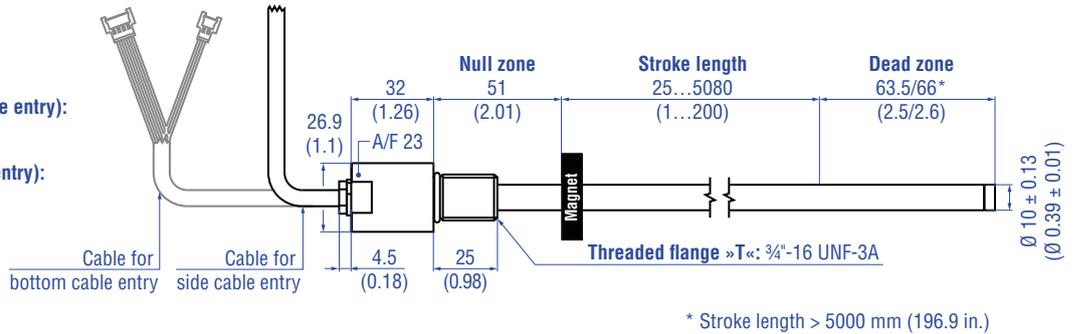
Threaded flange »M« (for bottom or side cable entry)

PUR cable:
Ø 6 (Ø 0.24)
Bending radius:
> 24 (> 0.94)
Cable length (bottom cable entry):
65/170/230/350
(2.6/6.7/9.1/13.8)
Cable length (side cable entry):
250/400/600
(9.8/15.7/23.6)



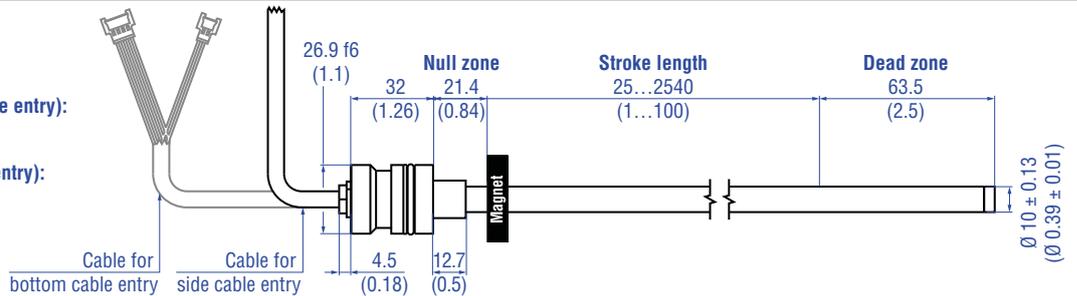
Threaded flange »T« (for bottom or side cable entry)

PUR cable:
Ø 6 (Ø 0.24)
Bending radius:
> 24 (> 0.94)
Cable length (bottom cable entry):
65/170/230/350
(2.6/6.7/9.1/13.8)
Cable length (side cable entry):
250/400/600
(9.8/15.7/23.6)



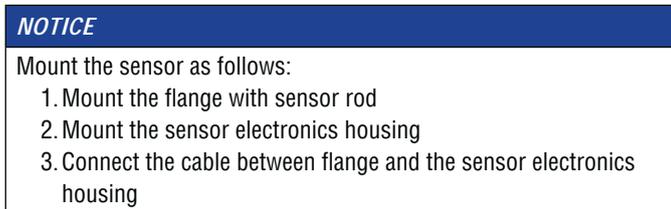
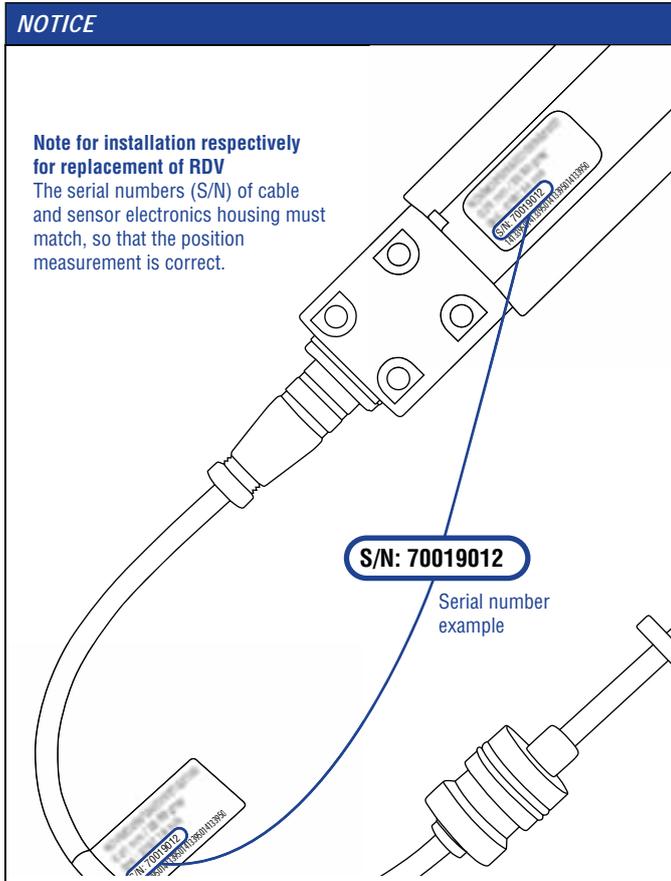
Pressure fit flange »S« (for bottom or side cable entry)

PUR cable:
Ø 6 (Ø 0.24)
Bending radius:
> 24 (> 0.94)
Cable length (bottom cable entry):
65/170/230/350
(2.6/6.7/9.1/13.8)
Cable length (side cable entry):
250/400/600
(9.8/15.7/23.6)



Controlling design dimensions are in millimeters and measurements in () are in inches

Fig. 20: Temposonics® RDV flanges



The steps mentioned above are explained in the following sections.

4.5.1 Installation of RDV with threaded flange

Fix the sensor rod via threaded flange M18×1.5-6g or ¾"-16 UNF-3A.

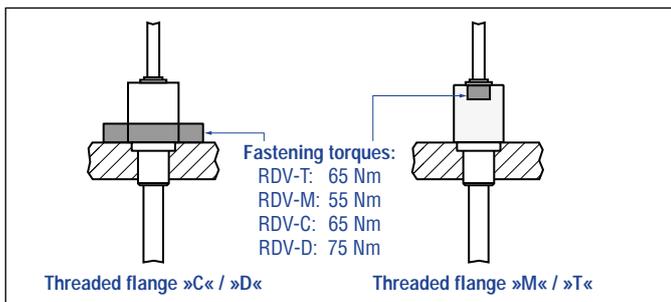


Fig. 21: Mounting example of threaded flange »»C«/»D«, »M«/»T«

Installation of a rod-style sensor in a fluid cylinder

The rod-style version has been developed for direct stroke measurement in a fluid cylinder. Mount the sensor via threaded flange or a hex nut.

- Mounted on the face of the piston, the position magnet travels over the rod without touching it and indicates the exact position through the rod wall – independent of the hydraulic fluid.
- The pressure resistant sensor rod is installed into a bore in the piston rod.

Hydraulics sealing

There are two ways to seal the flange contact (Fig. 22):

1. Sealing via an O-ring (e.g. 22.4 × 2.65 mm, 25.07 × 2.62 mm) in a cylinder end cap groove (**for threaded flange »C«/»D«**)
2. Sealing via an O-ring 16.4 × 2.2 mm (part no. 560 315) in the flange undercut.

For threaded flange (¾"-16 UNF-3A) »D«/»T«: O-ring 16.4 × 2.2 mm (0.65 × 0.09 in.) (part no. 560 315)

For threaded flange (M18×1.5-6g) »C«/»M«: O-ring 15.3 × 2.2 mm (0.60 × 0.09 in.) (part no. 401 133)

In the case of threaded flange M18×1.5-6g provide a screw hole based on ISO 6149-1 (Fig. 23). See ISO 6149-1 for further information.

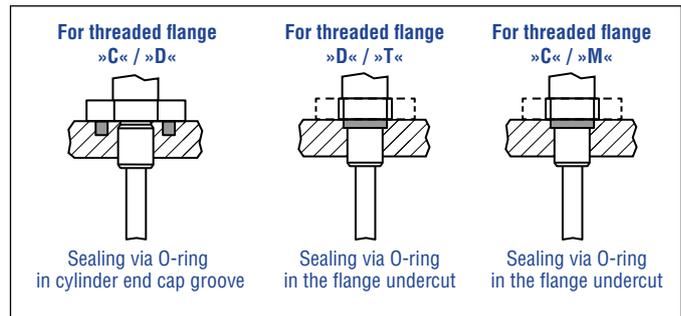


Fig. 22: Possibilities of sealing

- Note the fastening torques:
RDV-T: 65 Nm
RDV-M: 55 Nm
RDV-C: 65 Nm
RDV-D: 75 Nm
- Seat the flange contact surface completely on the cylinder mounting surface.
- The cylinder manufacturer determines the pressure-resistant gasket (copper gasket, O-ring, etc.).
- The position magnet should not grind on the sensor rod.
- The piston rod drilling ($\geq \varnothing 13 \text{ mm}$ ($\geq \varnothing 0.51 \text{ in.}$)) depends on the pressure and piston speed.
- Adhere to the information relating to operating pressure.
- Protect the sensor rod against wear.

Notice for metric threaded flanges									
Thread (d ₁ × P)	d ₂	d ₃	d ₄	d ₅	L ₁	L ₂	L ₃	L ₄	Z°
				+0.1 0	+0.4 0				±1°
RDV-C									
M18×1.5-6g	55	≥ 13	24.5	19.8	2.4	28.5	2	26	15°
RDV-M									
M18×1.5-6g	30	≥ 13	24.5	19.8	2.4	28.5	2	26	15°

Controlling design dimensions are in millimeters

Fig. 23: Notice for metric threaded flange M18×1.5-6g based on DIN ISO 6149-1

4.5.2 Installation of RD4 with pressure fit flange

Cylinder mounting

Install the rod using the pressure fit flange. Seal it off by means of the O-ring and the back-up ring. Block the pressure fit flange using a shoulder screw (Fig. 24). For details of the pressure fit flange »S« see Fig. 25. Also note the mounting examples in Fig. 26 and Fig. 27.

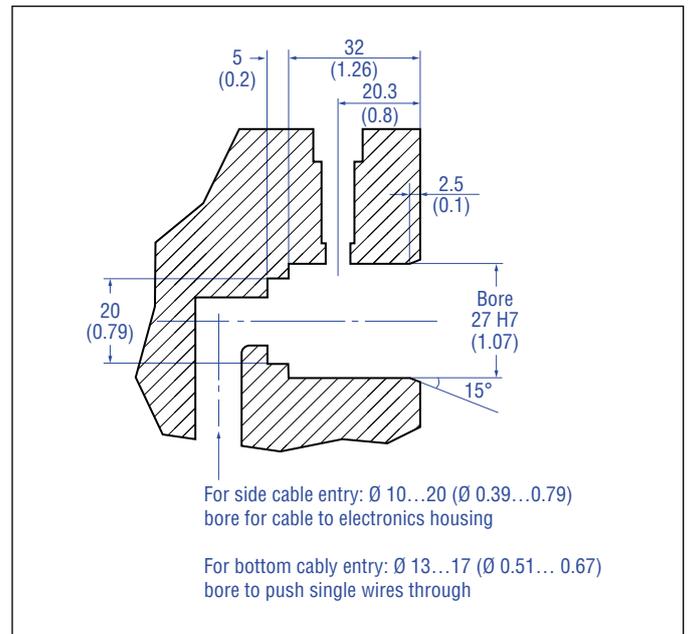


Fig. 24: Example of mounting detail: Shoulder screw 8-M6 (ISO 7379) with internal hexagon

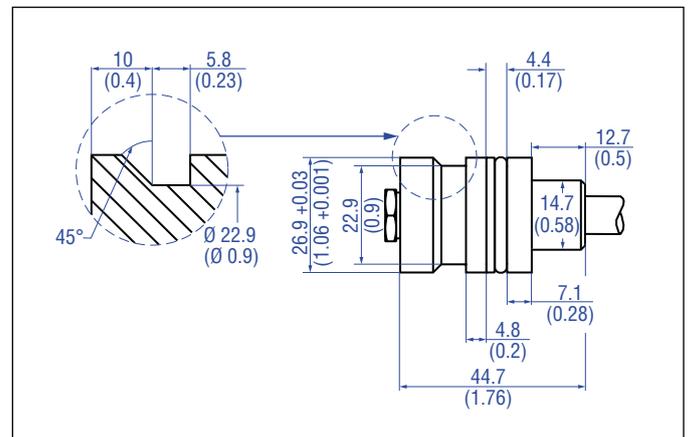


Fig. 25: Pressure fit flange »S« details

Note for cylinder installation:

- The position magnet should not grind on the sensor rod.
- The piston rod drilling ($\geq \text{Ø } 13 \text{ mm}$ ($\geq \text{Ø } 0.51 \text{ in.}$)) depends on the pressure and piston speed.
- Adhere to the information relating to operating pressure.
- Protect the sensor rod against wear.

4.5.4 Installation of RDV's sensor electronics housing

The following section explains the connection of a RDV sensor with bottom cable entry (Fig. 26) and side cable entry (Fig. 27) based on RDV-S. The sensor electronics of RDV sensors with threaded flange are mounted in the same way.

Sensor electronics with bottom cable entry

Connect the rod via the connector to the sensor electronics. Mount the sensor electronics so that you can lead the cables below the bottom of the housing. Thus the sensor system including the connection cables is fully encapsulated and protected against external disturbances (Fig. 26). Note the bending radius of the cable if you run the cable between sensor electronics and rod (see Fig. 20).

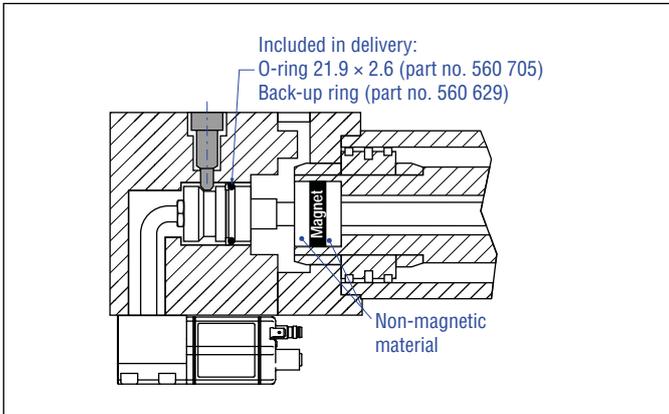


Fig. 26: Mounting example of pressure fit flange »S« and sensor electronics with bottom cable entry

Sensor electronics with side cable entry

Connect the rod via the cable to the sensor electronics on the side. Encapsulate the sensor system including the connection cables (Fig. 27). Note the bending radius of the cable if you run the cable between sensor electronics and rod (see Fig. 27).

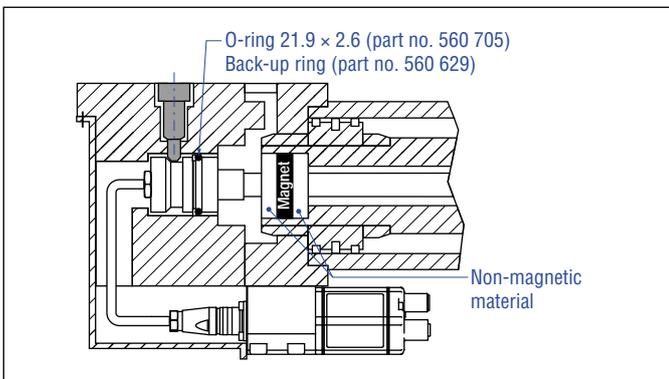


Fig. 27: Mounting example of pressure fit flange »S« and sensor electronics with side cable entry

NOTICE

To fulfill the requirements of EMC standards for emission and immunity the following points are necessary:

- The sensor electronics housing has to be connected to machine ground (Fig. 47).
- The cable between the sensor and the electronics must be integrated into a metallic housing.

Connect the flange to the sensor electronics housing via the molex connectors for bottom cable entry respectively via the 6 pin cable for side cable entry.

4.5.3 Mounting of sensor electronics housing

Mount the sensor electronics housing with 4 × M6×45 (ISO 4762) screws via the mounting block. Note the fastening torque of 6 Nm.

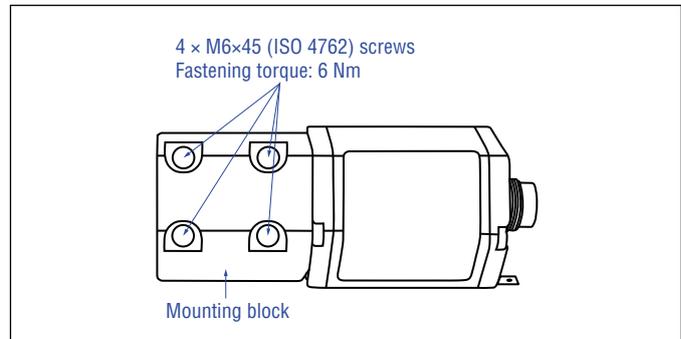


Fig. 28: Mounting of RDV sensor electronics housing (example of bottom cable entry)

4.6 Magnet installation

Typical use of magnets

Magnet	Typical sensors	Benefits
	Ring magnets Rod model (RH5, RFV, RDV)	<ul style="list-style-type: none"> Rotationally symmetrical magnetic field
	U-magnets Profile & rod models (RP5, RH5, RFV, RDV)	<ul style="list-style-type: none"> Height tolerances can be compensated, because the magnet can be lifted off
	Block magnets Profile & rod models (RP5, RH5, RFV, RDV)	<ul style="list-style-type: none"> Height tolerances can be compensated, because the magnet can be lifted off
	Magnet sliders Profile models (RP5)	<ul style="list-style-type: none"> The magnet is guided by the profile The distance between the magnet and the waveguide is strictly defined Easy coupling via the ball joint

Fig. 29: Typical use of magnets

Mounting ring magnets, U-magnets & block magnets

Install the magnet using non-magnetic material for mounting device, screws, spacers etc.. The magnet must not grind on the sensor rod. Alignment errors are compensated via the air gap.

- Permissible surface pressure: Max. 40 N/mm² (only for ring magnets and U-magnets)
- Fastening torque for M4 screws: 1 Nm; use washers, if necessary
- Minimum distance between position magnet and any magnetic material has to be 15 mm (0.6 in.) (Fig. 32)
- If no other option exists and magnetic material is used, observe the specified dimensions (Fig. 32)

NOTICE

- Mount ring magnets and U-magnets concentrically.
- Mount block magnets centrally over the sensor rod or the sensor profile.
- The maximum permissible air gap must not be exceeded (Fig. 30/ Fig. 31). Take care to mount the primary sensor axis in parallel to the magnet path in order to avoid damage to the carriage, magnet and sensor rod/sensor profile.

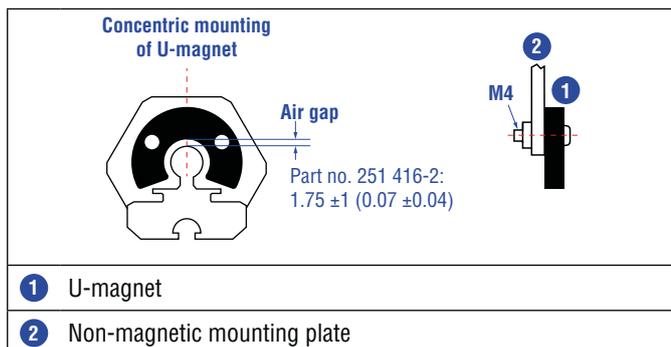


Fig. 30: Mounting of U-magnet (part no. 251 416-2)

Controlling design dimensions are in millimeters and measurements in () are in inches

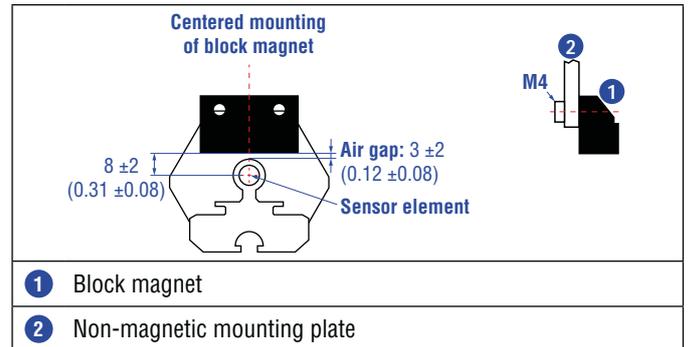


Fig. 31: Mounting of block magnet (part no. 403 448)

Magnet mounting with magnetic material

When using magnetic material the dimensions of Fig. 32 must be observed.

- A.** If the position magnet aligns with the drilled piston rod
- B.** If the position magnet is set further into the drilled piston rod, install another non-magnetic spacer (e.g. part no. 400 633) above the magnet.

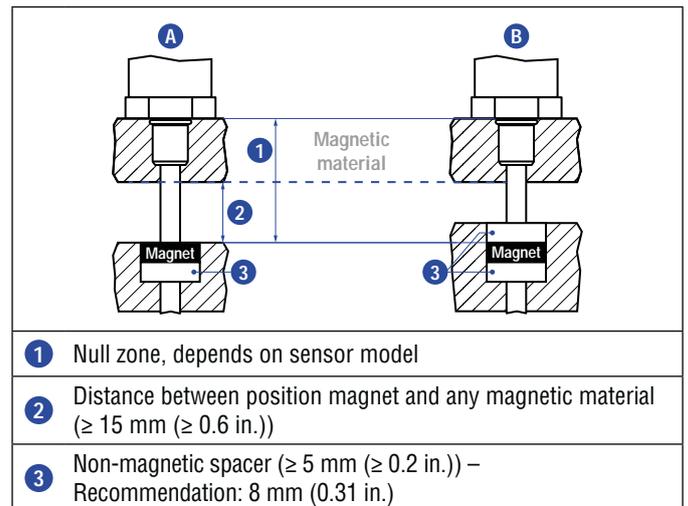


Fig. 32: Installation with magnetic material

Rod sensors with stroke lengths ≥ 1 meter (3.3 ft.)

Support horizontally installed rod sensors with a stroke length of 1 meter and more (3.3 ft.) mechanically. Without using a support, the sensor rod bends over and the rod and the position magnet may be damaged. A false measurement result is also possible. Longer rods require evenly distributed mechanical support over the entire length (e.g. part no. 561 481). Use an U-magnet (Fig. 33) for measurement.

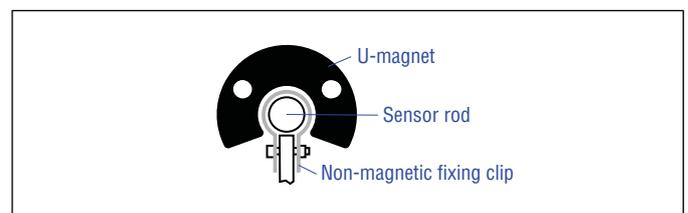


Fig. 33: Example of sensor support with the fixing clip (part no. 561 481)

Start- and end positions of the position magnets

Consider the start and end positions of the position magnets during the installation. To ensure that the entire stroke length is electrically usable, the position magnet must be mechanically mounted as follows.

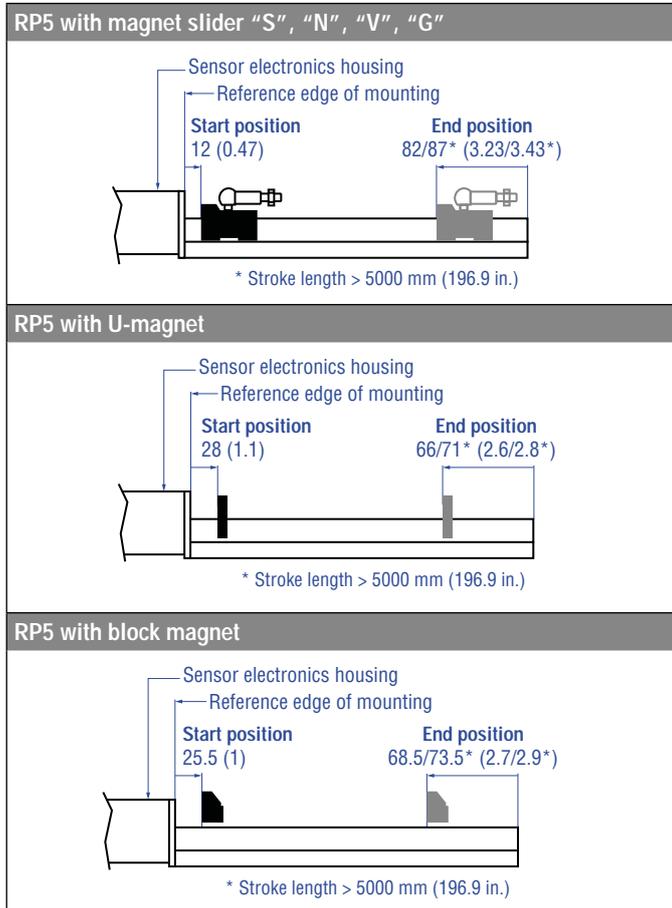


Fig. 34: Start- and end positions of magnets for RP5

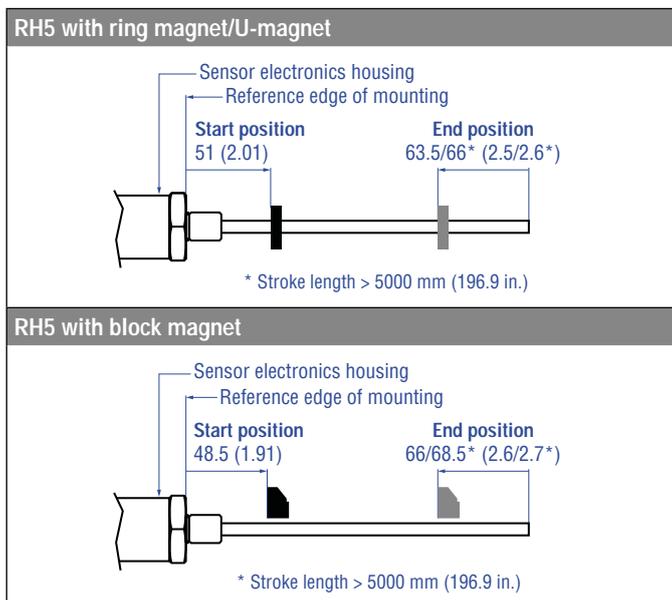


Fig. 35: Start- and end positions of magnets for RH5

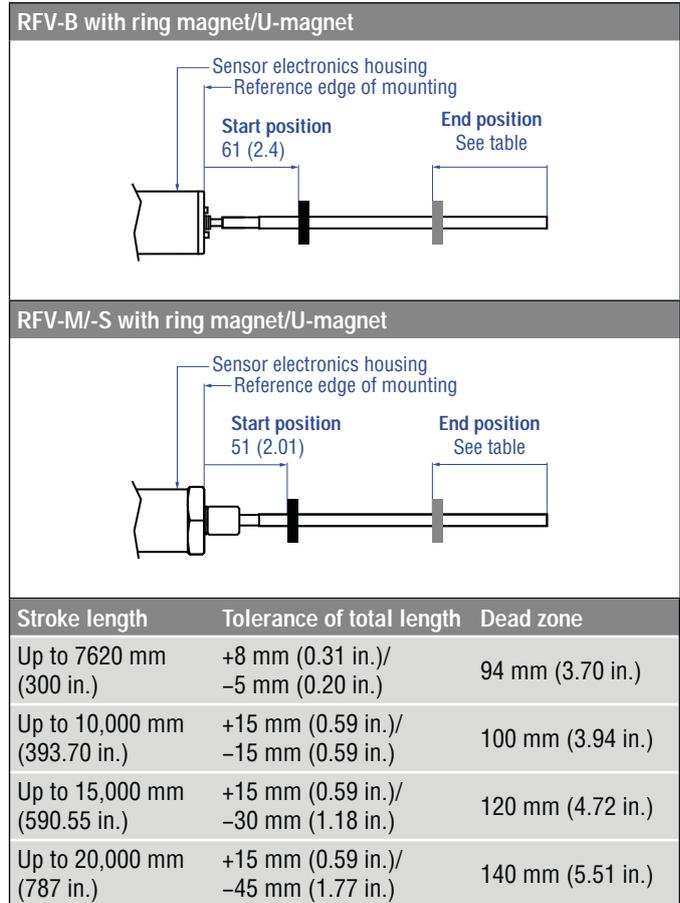


Fig. 36: Start- and end positions of magnets for RFV with ring- and U-magnets

Controlling design dimensions are in millimeters and measurements in () are in inches

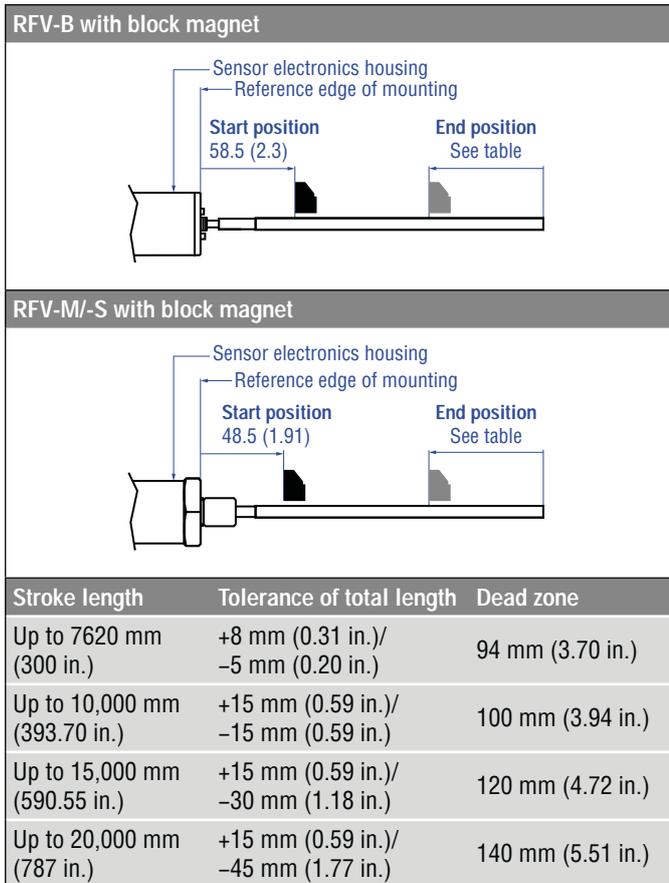


Fig. 37: Start- and end positions of magnets for RFV with block magnets

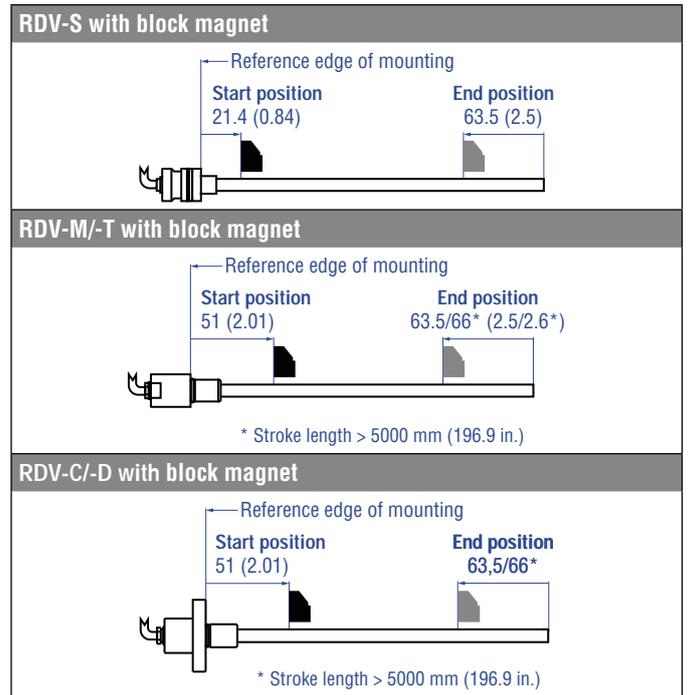


Fig. 39: Start- and end positions of magnets for RDV with block magnets

NOTICE
On all sensors, the areas left and right of the active stroke length are provided for null and dead zone. These zones should not be used for measurement, however the active stroke length can be exceeded.

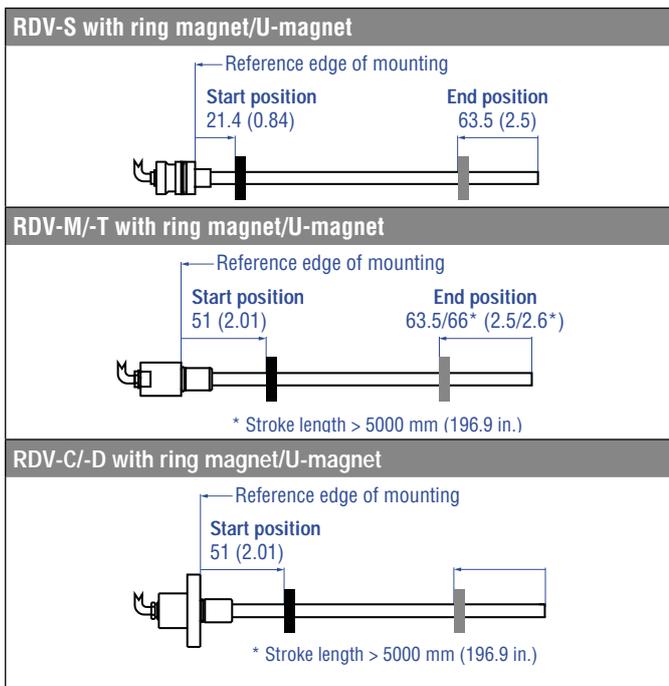


Fig. 38: Start- and end positions of magnets for RDV with ring- and U-magnets

Controlling design dimensions are in millimeters and measurements in () are in inches

Multi-position measurement

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

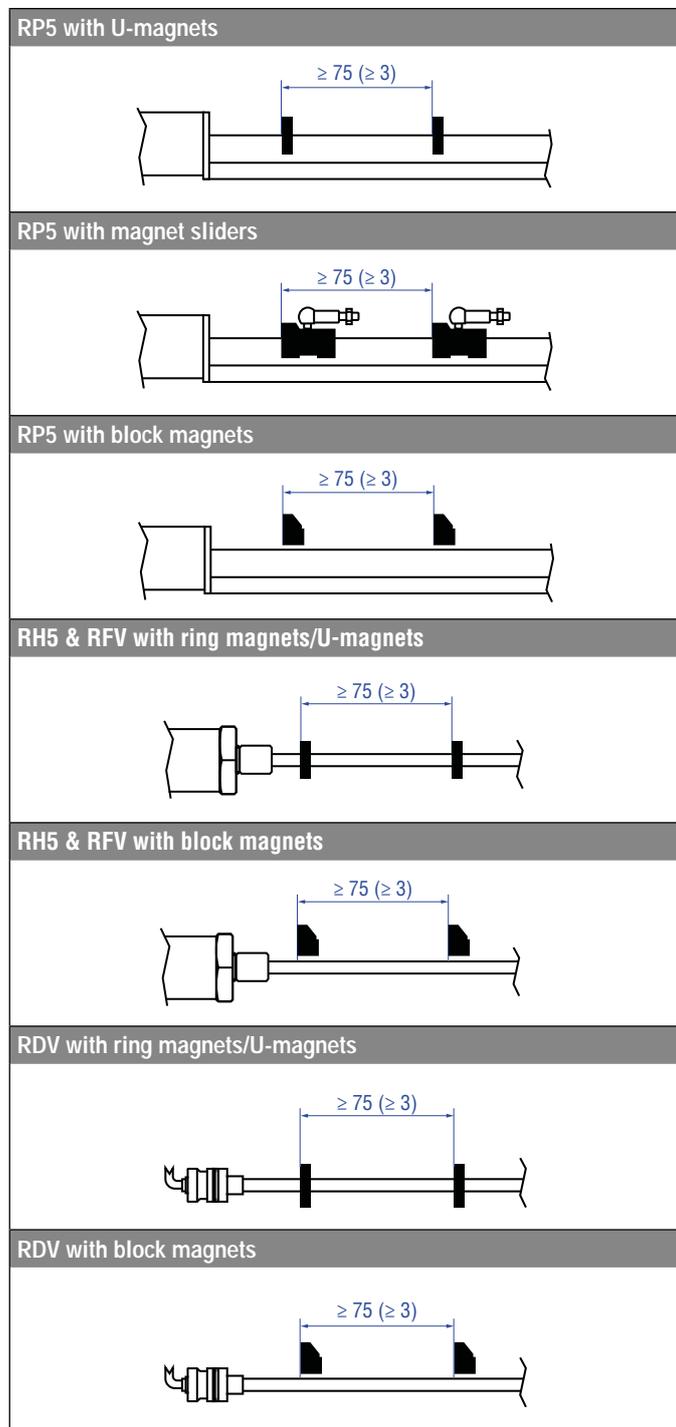


Fig. 40: Minimum distance for multi-position measurement

NOTICE
 Use magnets of the same type for multi-position measurement. Do not fall below the minimum distance between the magnets of 75 mm (3 in.) for multi-position measurement. Contact Temposonics if you need a magnet distance < 75 mm (3 in.).

Controlling design dimensions are in millimeters and measurements in () are in inches

4.7 Alignment of the magnet with the option "Internal linearization"

The internal linearization offers improved linearity of the sensor. The option must be specified in the order code of the sensor. The internal linearization is set for the sensor during production. A sensor with internal linearization is delivered with the magnet with which the sensor was squared during production. In order to achieve the best possible result, Temposonics recommends to operate the sensor with the supplied magnet.

For the internal linearization, the following magnets can be used:

- Ring magnet OD33 (part no. 253 620), for RH5 & RDV only
- U-magnet OD33 (part no. 254 226)
- Ring magnet OD25.4 (part no. 253 621), for RH5 & RDV only
- Magnet slider S (part no. 252 182), for RP5 only
- Magnet slider N (part no. 252 183), for RP5 only
- Magnet slider V (part no. 252 184), for RP5 only
- Magnet slider G (part no. 253 421), for RP5 only

The ring magnet and U-magnet will be marked for the internal linearization. During the installation, the magnets have to be aligned to the sensor electronics housing or the flange of the RDV (see Fig. 41, Fig. 42, Fig. 43 and Fig. 44).

For RH5 EtherNet/IP™ sensors with ring magnet/U-magnet applies:

- Install the magnet until the marking on the magnet points to the sensor electronics housing.
- The marking on the magnet points to the same direction as the elongated status LED in the lid of the sensor electronics housing.

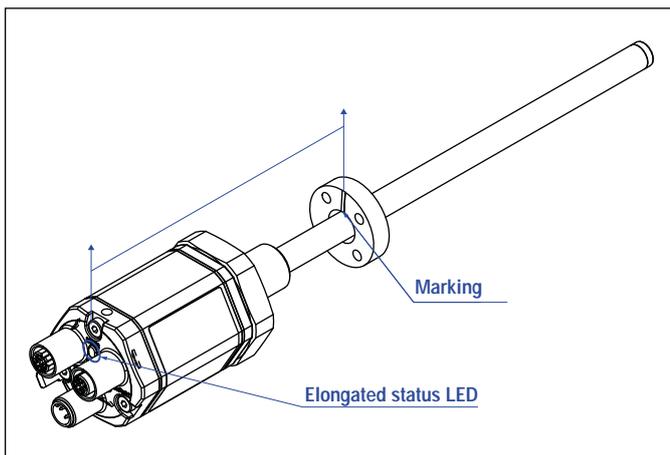


Fig. 41: Magnet alignment of ring magnet for RH5 EtherNet/IP™ with internal linearization

For RP5 EtherNet/IP™ sensors with U-magnet applies:

- Install the magnet until the marking on the magnet points to the sensor electronics housing.
- The marking on the magnet points to the same direction as the elongated status LED in the lid of the sensor electronics housing.

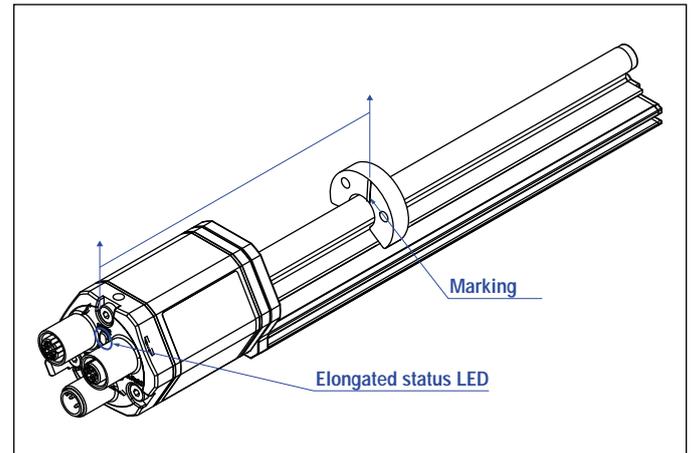


Fig. 42: Magnet alignment of U-magnet for RP5 EtherNet/IP™ with internal linearization

For RP5 EtherNet/IP™ sensors with magnet slider applies:

- ① Install the magnet sliders "S", "N" and "G" until the additional hole in the magnet points towards the sensor electronics housing.
- ② Install the magnet slider "V" until the joint points to the end of the profile.

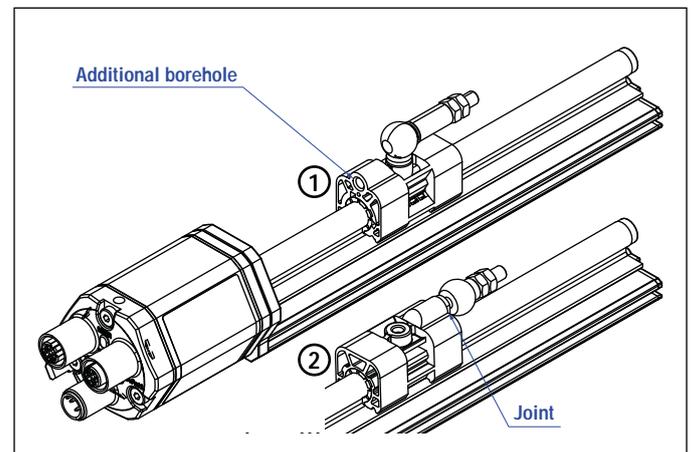


Fig. 43: Magnet alignment of magnet slider for RP5 EtherNet/IP™ with internal linearization

For RDV EtherNet/IP™ sensors with ring magnet/U-magnet applies:

- Install the magnet so that the marking on the magnet faces the sensor flange.
- The marking on the magnet points in the same direction as the marking on the sensor flange.

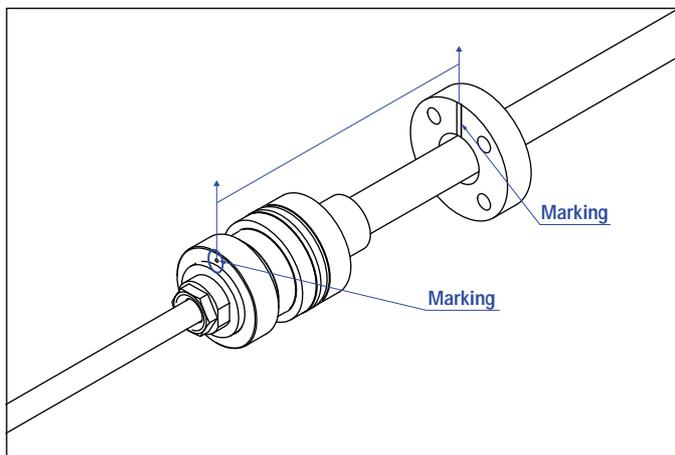


Fig. 44: Magnet alignment of magnet slider for RDV EtherNet/IP™ with internal linearization using the example of a "S" flange

The internal linearization of the sensor is carried out under the following conditions:

- Supply voltage +24 VDC \pm 0.5
- Operating time > 30 min
- No shock and no vibration
- Eccentricity of the position magnet to central axis of the sensor < 0.1 mm

NOTICE

The generated linearization might deviate from the linearity tolerances regarding different environmental conditions. In addition, the use of a different position magnet or more position magnets may cause differences.

4.8 Replacement of base unit

The base unit of the sensor model RH5 (RH5-B) is replaceable as shown in Fig. 45 and Fig. 46 for the sensor designs »M«, »S« and »T«. The sensor can be replaced without interrupting the hydraulic circuit. This also applies to the RFV-B sensor, which is installed in the optional HD, HL and HP pressure rod.

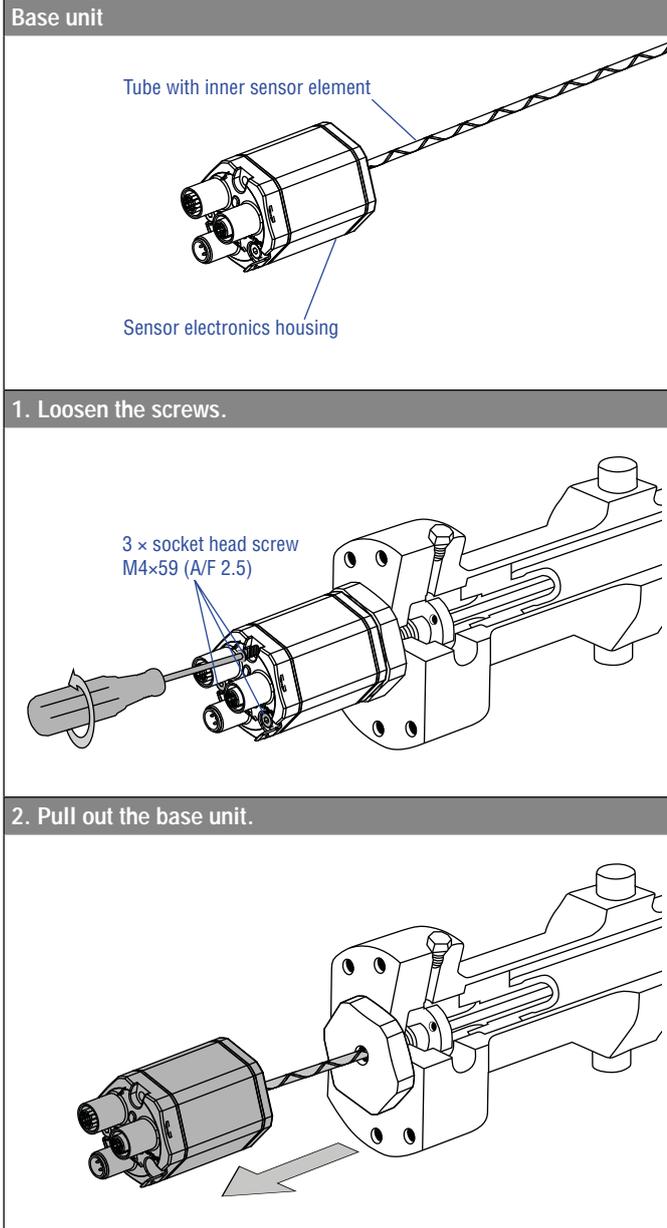


Fig. 45: Replacement of the base unit (e.g. RH5 sensor), part 1

3. Insert the new base unit.
Mount the ground lug on a screw.
Tighten the screws.

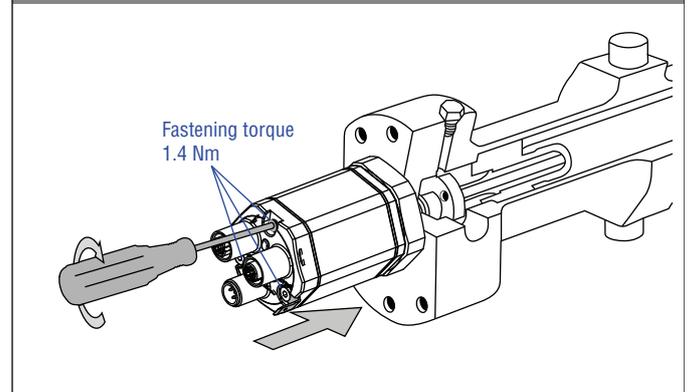


Fig. 46: Replacement of the base unit (e.g. RH5 sensor), part 2

NOTICE

- When replacing the base unit, make sure that no humidity enters the sensor tube. This may damage the sensor.
- Secure the base unit screws, e.g. using Loctite 243, before re-installing.
- If the R-Series V replaces a predecessor model of the R-Series, the plastic tube in the sensor rod must be removed.
- Make sure the O-ring is correctly fitted between the flange and the base unit.

4.9 Electrical connection

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

NOTICE

1. Do not mount the sensors in the area of strong magnetic or electric noise fields.
2. Never connect/disconnect the sensor when voltage is applied.

Instructions for connection

- Use low-resistant twisted pair and shielded cables. Connect the shield to ground externally via the controller equipment.
- Keep control and signal cables 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 shielding to the connector housing.
- Keep the connection surface at both shielding ends as large as possible. Connect the cable clamps to function as a ground.
- Keep all non-shielded leads as short as possible.
- Keep the earth connection 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 shielding.
Recommendation:
Install potential compensating leads with large cross section, or use cables with separate double shielding, and connect only one end of the shield.
- Use only stabilized power supplies in compliance with the specified electrical ratings.

Grounding of profile and rod sensors

Connect the sensor electronics housing to machine ground. Ground R-Series V sensors via ground lug as shown in Fig. 47. In addition you can ground the sensor types RH5 and RFV via thread.

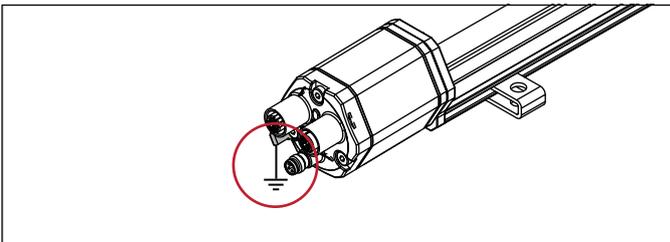


Fig. 47: Grounding via ground lug on the example of an RP5 sensor

Connector wiring

Connect the sensor directly to the control system, indicator or other evaluating systems as follows:

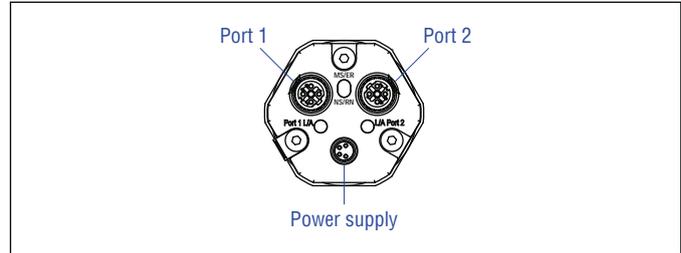


Fig. 48: Location of connections

D56		
Port 1 – Signal		
M12 female connector (D-coded)	Pin	Function
<p>View on sensor</p>	1	Tx (+)
	2	Rx (+)
	3	Tx (-)
	4	Rx (-)
Port 2 – Signal		
M12 female connector (D-coded)	Pin	Function
<p>View on sensor</p>	1	Tx (+)
	2	Rx (+)
	3	Tx (-)
	4	Rx (-)
Power supply		
M8 male connector	Pin	Function
<p>View on sensor</p>	1	+12...30 VDC (±20 %)
	2	Not connected
	3	DC Ground (0 V)
	4	Not connected

Fig. 49: Connector wiring D56

D58		
Port 1 – Signal		
M12 female connector (D-coded)	Pin	Function
 <p>View on sensor</p>	1	Tx (+)
	2	Rx (+)
	3	Tx (-)
	4	Rx (-)
Port 2 – Signal		
M12 female connector (D-coded)	Pin	Function
 <p>View on sensor</p>	1	Tx (+)
	2	Rx (+)
	3	Tx (-)
	4	Rx (-)
Power supply		
M12 male connector (A-coded)	Pin	Function
 <p>View on sensor</p>	1	+12...30 VDC (±20 %)
	2	Not connected
	3	DC Ground (0 V)
	4	Not connected

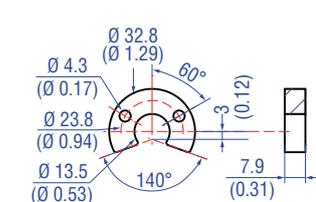
Fig. 50: Connector wiring D58

4.10 Frequently ordered accessories for RP5 design – Additional options see [Accessories Catalog](#) 551444

Position magnets

<p>Magnet slider S, joint at top Part no. 252 182</p> <p>Material: GRP, magnet hard ferrite Weight: Approx. 35 g Operating temperature: -40...+85 °C (-40...+185 °F)</p>	<p>Magnet slider V, joint at front Part no. 252 184</p> <p>Material: GRP, magnet hard ferrite Weight: Approx. 35 g Operating temperature: -40...+85 °C (-40...+185 °F)</p>	<p>Magnet slider N, longer ball-joint arm Part no. 252 183</p> <p>Material: GRP, magnet hard ferrite Weight: Approx. 35 g Operating temperature: -40...+85 °C (-40...+185 °F)</p>	<p>Magnet slider G, backlash free Part no. 253 421</p> <p>Material: GRP, magnet hard ferrite Weight: Approx. 25 g Operating temperature: -40...+85 °C (-40...+185 °F)</p>

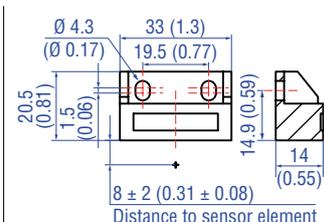
Position magnets



U-magnet OD33
Part no. 251 416-2

Material: PA ferrite GF20
Weight: Approx. 11 g
Surface pressure: Max. 40 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
-40...+105 °C (-40...+221 °F)

Marked version for sensors with internal linearization: Part no. 254 226

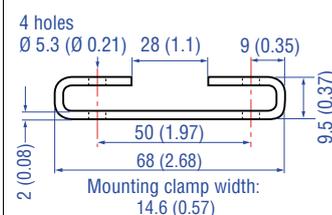


Block magnet L
Part no. 403 448

Material: Plastic carrier with hard ferrite magnet
Weight: Approx. 20 g
Fastening torque for M4 screws: 1 Nm
Operating temperature:
-40...+75 °C (-40...+167 °F)

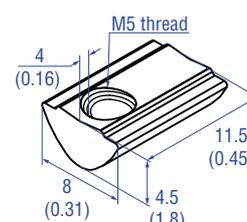
This magnet may influence the sensor performance specifications for some applications.

Mounting accessories



Mounting clamp
Part no. 400 802

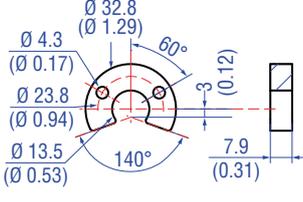
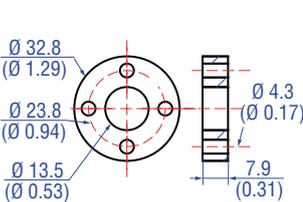
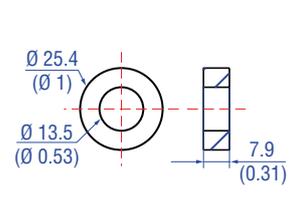
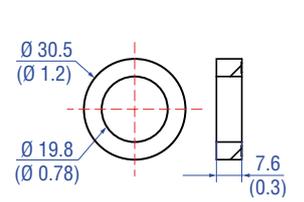
Material: Stainless steel (AISI 304)

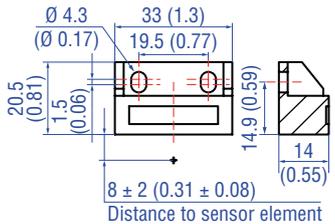
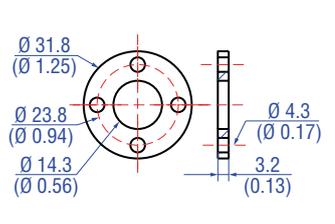
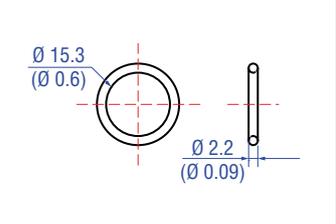
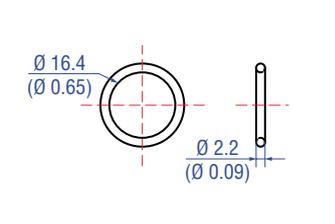


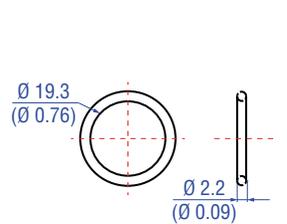
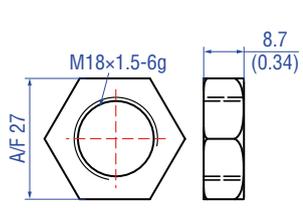
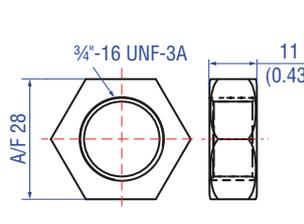
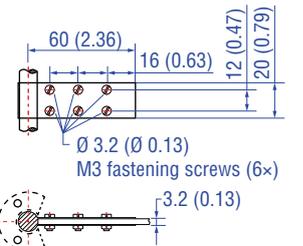
T-nut
Part no. 401 602

Fastening torque for M5 screw: 4.5 Nm

4.11 Frequently ordered accessories for RH5 design – Additional options see [Accessories Catalog](#) 551444

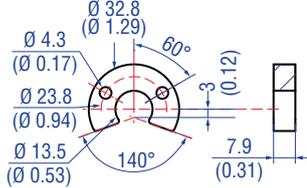
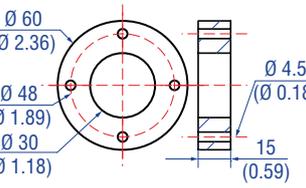
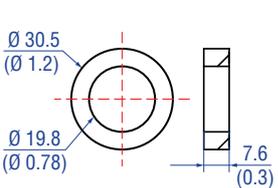
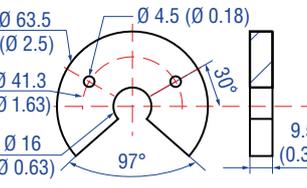
Position magnets			
			
U-magnet OD33 Part no. 251 416-2	Ring magnet OD33 Part no. 201 542-2	Ring magnet OD25.4 Part no. 400 533	Ring magnet Part no. 402 316
Material: PA ferrite GF20 Weight: Approx. 11 g Surface pressure: Max. 40 N/mm ² Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F) Marked version for sensors with internal linearization: Part no. 254 226	Material: PA ferrite GF20 Weight: Approx. 14 g Surface pressure: Max. 40 N/mm ² Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F) Marked version for sensors with internal linearization: Part no. 253 620	Material: PA ferrite Weight: Approx. 10 g Surface pressure: Max. 40 N/mm ² Operating temperature: -40...+105 °C (-40...+221 °F) Marked version for sensors with internal linearization: Part no. 253 621	Material: PA ferrite coated Weight: Approx. 13 g Surface pressure: Max. 20 N/mm ² Operating temperature: -40...+100 °C (-40...+212 °F)

Position magnet	Magnet spacer	O-rings	
			
Block magnet L Part no. 403 448	Magnet spacer Part no. 400 633	O-ring for threaded flange M18x1.5-6g Part no. 401 133	O-ring for threaded flange 3/4-16 UNF-3A Part no. 560 315
Material: Plastic carrier with hard ferrite magnet Weight: Approx. 20 g Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+75 °C (-40...+167 °F) This magnet may influence the sensor performance specifications for some applications.	Material: Aluminum Weight: Approx. 5 g Surface pressure: Max. 20 N/mm ² Fastening torque for M4 screws: 1 Nm	Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)	Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)

O-ring	Mounting accessories		
			
O-ring for threaded flange M22x1.5-6g Part no. 561 337	Hex jam nut M18x1.5-6g Part no. 500 018	Hex jam nut 3/4-16 UNF-3A Part no. 500 015	Fixing clip Part no. 561 481
Material: FPM Durometer: 75 Shore A Operating temperature: -20...+200 °C (-6...+392 °F)	Material: Steel, zinc plated	Material: Steel, zinc plated	Application: Used to secure sensor rods (Ø 10 mm (Ø 0.39 in.)) when using an U-magnet or block magnet Material: Brass, non-magnetic

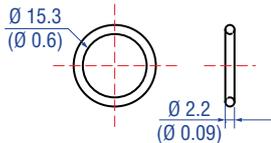
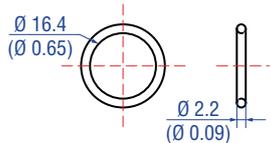
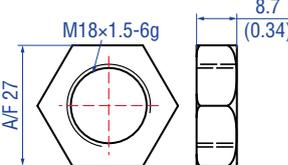
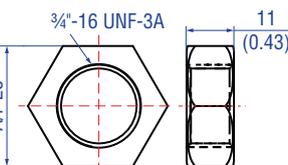
4.12 Frequently ordered accessories for RFV design – Additional options see [Accessories Catalog](#) 551444

Position magnets

			
<p>U-magnet OD33 Part no. 251 416-2</p> <p>Material: PA ferrite GF20 Weight: Approx. 11 g Surface pressure: Max. 40 N/mm² Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p>Ring magnet OD60 Part no. MT0162</p> <p>Material: AlCuMgPb, magnets compound-filled Weight: Approx. 90 g Surface pressure: Max. 20 N/mm² Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+75 °C (-40...+167 °F)</p>	<p>Ring magnet Part no. 402 316</p> <p>Material: PA ferrite coated Weight: Approx. 13 g Surface pressure: Max. 20 N/mm² Operating temperature: -40...+100 °C (-40...+212 °F)</p>	<p>U-magnet OD63.5 Part no. 201 553</p> <p>Material: PA 66-GF30, magnets compound-filled Weight: Approx. 26 g Surface pressure: 20 N/mm² Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+75 °C (-40...+167 °F)</p>

O-rings

Mounting accessories

			
<p>O-ring for threaded flange M18x1.5-6g Part no. 401 133</p> <p>Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)</p>	<p>O-ring for threaded flange ¾"-16 UNF-3A Part no. 560 315</p> <p>Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)</p>	<p>Hex jam nut M18x1.5-6g Part no. 500 018</p> <p>Material: Steel, zinc plated</p>	<p>Hex jam nut ¾"-16 UNF-3A Part no. 500 015</p> <p>Material: Steel, zinc plated</p>

Mounting accessories

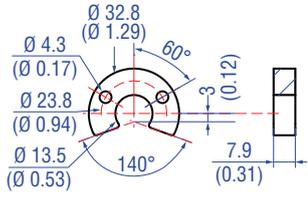
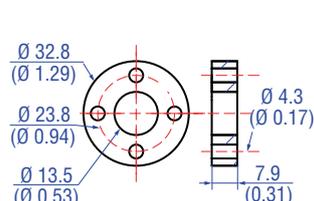
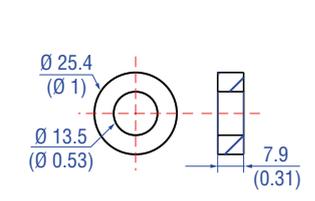
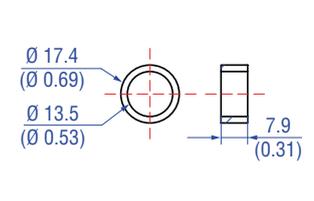
	
<p>Threaded flange M18x1.5-6g Part no. 404 874</p> <p>Material: Stainless steel 1.4305 (AISI 303)</p>	<p>Threaded flange ¾"-16 UNF-3A Part no. 404 875</p> <p>Material: Stainless steel 1.4305 (AISI 303)</p>

Mounting accessories

		
<p>Pressure rod with threaded flange with flat-face (M18x1.5-6g) and O-ring HD [length mm: XXXX] M HD [length in.: XXX.X] U</p>	<p>Pressure rod with threaded flange with flat-face (3/4\" data-bbox="331 241 547 309"> </p>	<p>Profile with flange HFP [length mm: XXXXX] M HFP [length in.: XXXX.X] U</p>
<p>Pressure rod Ø: 12.7 mm (0.5 in.) Length: 100...7500 mm (4...295 in.) Operating pressure: 350 bar (5076 psi) Material flange: Stainless steel 1.4305 (AISI 303) Material rod: Stainless steel 1.4301 (AISI 304)</p>	<p>Pressure rod Ø: 12.7 mm (0.5 in.) Length: 100...7500 mm (4...295 in.) Operating pressure: 350 bar (5076 psi) Material flange: Stainless steel 1.4305 (AISI 303) Material rod: Stainless steel 1.4301 (AISI 304)</p>	<p>Length: Max. 20 000 mm (max. 787 in.) Ingress protection: IP30 Material: Aluminum</p>

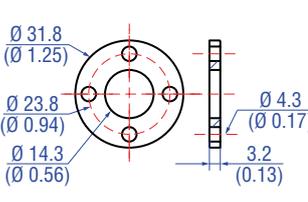
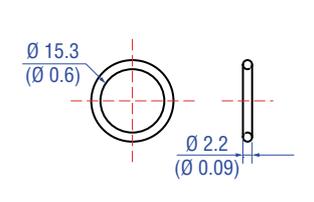
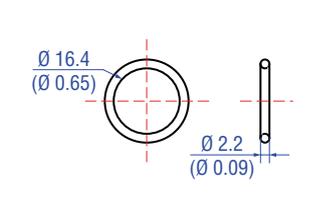
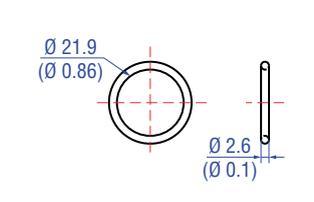
4.13 Frequently ordered accessories for RDV design – Additional options see [Accessories Catalog](#)  551444

Position magnets

			
<p>U-magnet OD33 Part no. 251 416-2</p>	<p>Ring magnet OD33 Part no. 201 542-2</p>	<p>Ring magnet OD25.4 Part no. 400 533</p>	<p>Ring magnet OD17.4 Part no. 401 032</p>
<p>Material: PA ferrite GF20 Weight: Approx. 11 g Surface pressure: Max. 40 N/mm² Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p> <p>Marked version for sensors with internal linearization: Part no. 254 226</p>	<p>Material: PA ferrite GF20 Weight: Approx. 14 g Surface pressure: Max. 40 N/mm² Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p> <p>Marked version for sensors with internal linearization: Part no. 253 620</p>	<p>Material: PA ferrite Weight: Approx. 10 g Surface pressure: Max. 40 N/mm² Operating temperature: -40...+105 °C (-40...+221 °F)</p> <p>Marked version for sensors with internal linearization: Part no. 253 621</p>	<p>Material: PA neobond Weight: Approx. 5 g Surface pressure: Max. 20 N/mm² Operating temperature: -40...+105 °C (-40...+221 °F)</p>

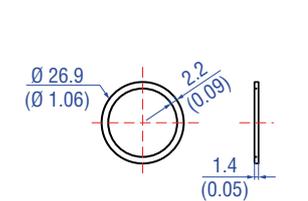
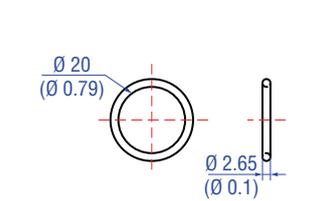
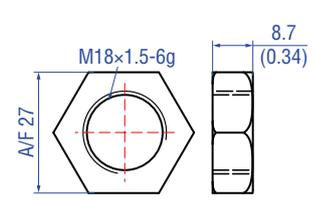
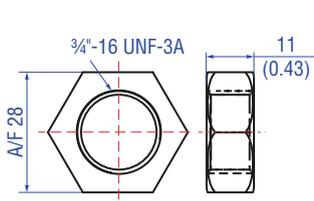
Magnet spacer

O-rings

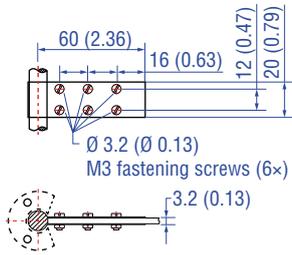
			
<p>Magnet spacer Part no. 400 633</p>	<p>O-ring for threaded flange M18×1.5-6g Part no. 401 133</p>	<p>O-ring for threaded flange ¾"-16 UNF-3A Part no. 560 315</p>	<p>O-ring for pressure fit flange Ø 26.9 mm Part no. 560 705</p>
<p>Material: Aluminum Weight: Approx. 5 g Surface pressure: Max. 20 N/mm² Fastening torque for M4 screws: 1 Nm</p>	<p>Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)</p>	<p>Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)</p>	<p>Material: Nitrile rubber Operating temperature: -53...+107 °C (-65...+225 °F)</p>

O-rings

Mounting accessories

			
<p>Back-up ring for pressure fit flange Ø 26.9 mm Part no. 560 629</p>	<p>O-ring for mounting block with bottom entry Part no. 561 435</p>	<p>Hex jam nut M18×1.5-6g Part no. 500 018</p>	<p>Hex jam nut ¾"-16 UNF-3A Part no. 500 015</p>
<p>Material: Polymyte Durometer: 90 Shore A</p>	<p>Material: FKM Durometer: 80± 5 Shore A Operating temperature: -15...+200 °C (5...+392 °F)</p>	<p>Material: Steel, zinc plated</p>	<p>Material: Steel, zinc plated</p>

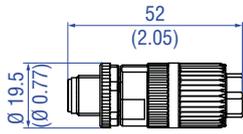
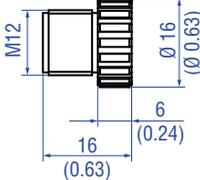
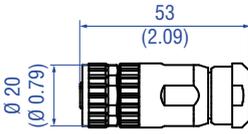
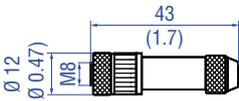
Mounting accessory



Fixing clip Part no. 561 481

Application: Used to secure sensor rods ($\varnothing 10$ mm ($\varnothing 0.39$ in.)) when using an U-magnet or block magnet
Material: Brass, non-magnetic

4.14 Frequently ordered accessories for EtherNet/IP™ output

Cable connectors* – Signal		Cable connectors* – Power	
			
M12 D-coded male connector (4 pin), straight Part no. 370 523	M12 connector end cap Part no. 370 537	M12 A-coded female connector (4 pin/5 pin), straight Part no. 370 677	M8 female connector (4 pin), straight Part no. 370 504
Material: Zinc nickel-plated Termination: Insulation-displacement Cable Ø: 5.5...7.2 mm (0.2...0.28 in.) Wire: 24 AWG – 22 AWG Operating temperature: –25...+85 °C (–13...+185 °F) Ingress protection: IP65 / IP67 (correctly fitted) Fastening torque: 0.6 Nm	Female connectors M12 should be covered by this protective cap Material: Brass nickel-plated Ingress protection: IP67 (correctly fitted) Fastening torque: 0.39...0.49 Nm	Material: GD-Zn, Ni Termination: Screw Contact insert: CuZn Cable Ø: 4...8 mm (0.16...0.31 in.) Wire: 1.5 mm ² Operating temperature: –30...+85 °C (–22...+185 °F) Ingress protection: IP67 (correctly fitted) Fastening torque: 0.6 Nm	Material: CuZn nickel plated Termination: Solder Cable Ø: 3.5...5 mm (0.14...0.28 in.) Wire: 0.25 mm ² Operating temperature: –40...+85 °C (–40...+185 °F) Ingress protection: IP67 (correctly fitted) Fastening torque: 0.5 Nm
Cables		Cable sets	
			
PUR signal cable Part no. 530 125	PVC power cable Part no. 530 108	Signal cable with M12 D-coded male connector (4 pin), straight – M12 D-coded, male connector (4 pin), straight Part no. 530 064	Signal cable with M12 D-coded male connector (4 pin), straight – RJ45 male connector, straight Part no. 530 065
Material: PUR jacket; green Features: Cat 5, highly flexible, halogen free, suitable for drag chains, mostly oil & flame resistant Cable Ø: 6.5 mm (0.26 in.) Cross section: 2 × 2 × 0.35 mm ² (22 AWG) Bending radius: 5 × D (fixed installation) Operating temperature: –20...+60 °C (–4...+140 °F)	Material: PVC jacket; gray Features: Shielded, flexible, mostly flame resistant Cable Ø: 4.9 mm (0.19 in.) Cross section: 3 × 0.34 mm ² Bending radius: 5 × D (fixed installation) Operating temperature: –30...+80 °C (–22...+176 °F)	Material: PUR jacket; green Features: Cat 5e Cable length: 5 m (16.4 ft) Cable Ø: 6.5 mm (0.26 in.) Ingress protection: IP65, IP67, IP68 (correctly fitted) Operating temperature: –30...+70 °C (–22...+158 °F)	Material: PUR jacket; green Features: Cat 5e Cable length: 5 m (16.4 ft) Cable Ø: 6.5 mm (0.26 in.) Ingress protection M12 connector: IP67 (correctly fitted) Ingress protection RJ45 connector: IP20 (correctly fitted) Operating temperature: –30...+70 °C (–22...+158 °F)

*/ Follow the manufacturer's mounting instructions
 Controlling design dimensions are in millimeters and measurements in () are in inches
 Color of connectors and cable jacket may change. Colors of the cores and technical properties remain unchanged.

Cable sets		Programming tools	
			
<p>Power cable with M8 female connector (4 pin), straight – pigtail Part no. 530 066 (5 m (16.4 ft.)) Part no. 530 096 (10 m (32.8 ft.)) Part no. 530 093 (15 m (49.2 ft.))</p>	<p>Power cable with M12 A-coded female connector (5 pin), straight – pigtail Part no. 370 673</p>	<p>TempoLink® kit for Tempsonics® R-Series V Part no. TL-1-0-EM08 (D56) Part no. TL-1-0-EM12 (D58)</p>	<p>TempoGate® smart assistant for Tempsonics® R-Series V Part no. TG-C-0-Dxx (xx indicates the number of R-Series V sensors that can be connected (even numbers only))</p>
<p>Material: PUR jacket; gray Features: Shielded Cable Ø: 5 mm (0.2 in.) Operating temperature: –40...+90 °C (–40...+194 °F)</p>	<p>Material: PUR jacket; black Features: Shielded Cable length: 5 m (16.4 ft) Ingress protection: IP67 (correctly fitted) Operating temperature: –25...+80 °C (–13...+176 °F)</p>	<ul style="list-style-type: none"> • Connect wirelessly via Wi-Fi enabled device or via USB with the diagnostic tool • Simple connectivity to the sensor via 24 VDC power line (permissible cable length: 30 m) • User friendly interface for mobile devices and desktop computers • See data sheet “TempoLink® smart assistant” (document part no.: 552070) for further information 	<ul style="list-style-type: none"> • OPC UA server for diagnostics of the R-Series V • For installation in the control cabinet • Connection via LAN and Wi-Fi • See data sheet “TempoGate® smart assistant” document part no.: 552110 for further information

Color of connectors and cable jacket may change. Colors of the cores and technical properties remain unchanged.

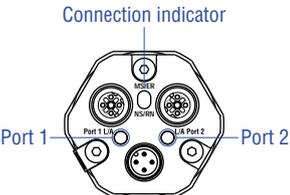
5. Operation

5.1 Initial start-up

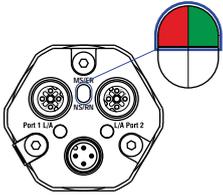
The position sensor R-Series V EtherNet/IP™ transfers position and velocity values via the EtherNet/IP™ output. EtherNet/IP™ is the abbreviation for Ethernet Industrial Protocol. This industrial interface is managed by the Open DeviceNet Vendor Association (ODVA). The sensor and the corresponding EDS (Electronic Data Sheet) file are certified by the ODVA. The R-Series V supports the Device Level Ring (DLR) technology and CIP (Common Industrial Protocol) Sync.

5.2 LED Status

EtherNet/IP™ LED status

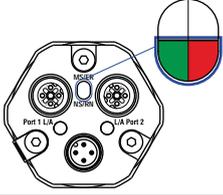


Module status LED



Green	Red	Information
● ON	○ OFF	IP address configured
● Flashing	○ OFF	IP address not configured
○ OFF	● Flashing	Duplicate of IP address recognized

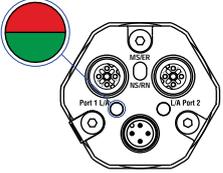
Network status LED



Green	Red	Information
● ON	○ OFF	Connection established
● Flashing	○ OFF	No connection
○ OFF	● ON	Unrecoverable error
○ OFF	● Flashing	Recoverable error

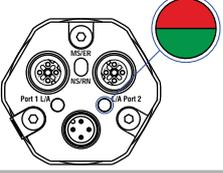
Fig. 51: LED status display, part 1

Port 1 L/A (IN)



Green	Red	Information
● ON	○ OFF	LINK activity on port 1
● Flickers	○ OFF	Data transfer on port 1
○ OFF	● ON	No magnet / wrong quantity of magnets

Port 2 L/A (OUT)



Green	Red	Information
● ON	○ OFF	LINK activity on port 2
● Flickers	○ OFF	Data transfer on port 2

NOTICE

Observe during commissioning

1. Before initial switch-on, check carefully if the sensor has been connected correctly.
2. Position the magnet in the measuring range of the sensor during first commissioning and after replacement of the magnet.
3. Ensure that the sensor control system cannot react in an uncontrolled way when switching on.
4. Ensure that the sensor is ready and in operation mode after switching on. The connection indicator LEDs will show green for on and red for off.

Fig. 52: LED status display, part 2

6. Programming and configuration

6.1 IP address Configuration

An example of configuring a Temposonics 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 an Temposonics 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 Temposonics EtherNet/IP™ EDS file (download at www.temposonics.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.

6.2 Setting the IP address of the sensor

Each sensor comes from the factory with DHCP mode 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 static, 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.

6.2.1 Open the BOOTP/DHCP Server software.

- ▶ The 'BOOTP/DHCP Server' window opens.

6.2.2 To add your sensor to the 'Relation List', click the **New** button in the 'Relation List' pane.

- ▶ The 'New Entry' window opens.

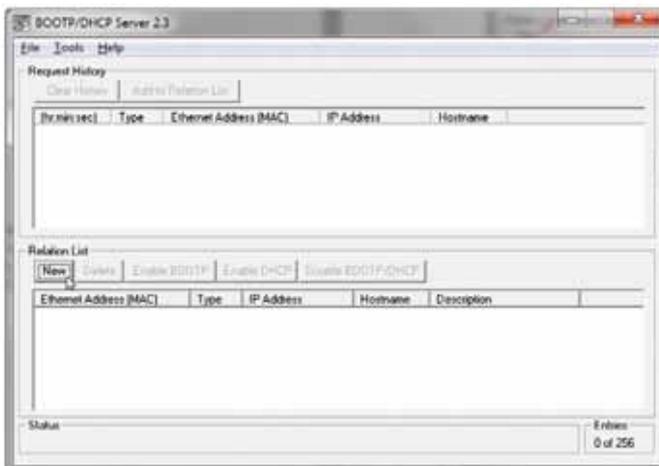


Fig. 53: Create new relation list entry

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.

6.2.3 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**.

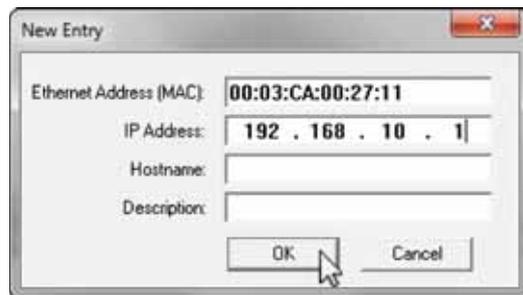


Fig. 54: Enter MAC ID and unique IP address

6.2.4 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 6.2.2 to 6.2.4. Otherwise, continue to step 6.2.5.

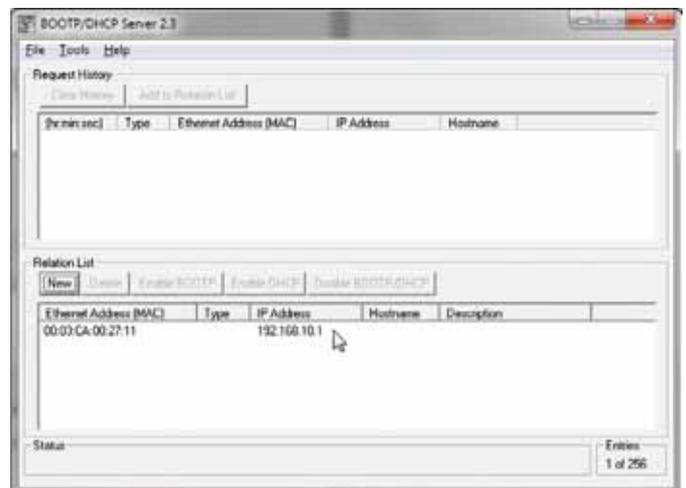


Fig. 55: Populated relation list

- 6.2.5 Apply power to the sensor. The sensor should take around 10 to 15 seconds to begin to broadcast its MAC ID.
- 6.2.6 Verify that your IP address and MAC ID appear in the 'Request History' box.

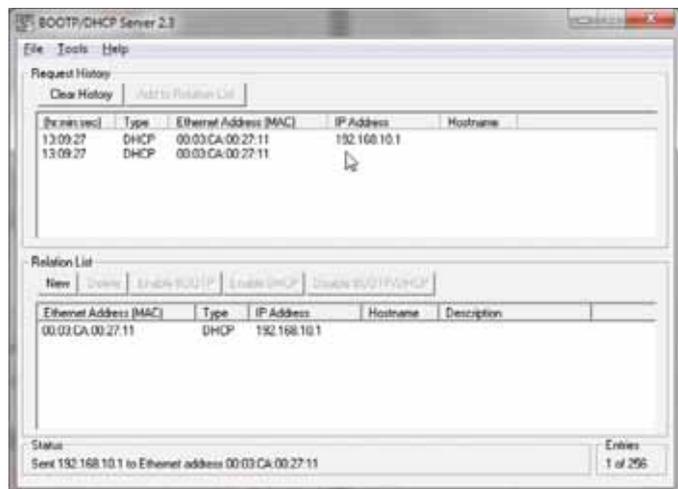


Fig. 56: Request History shows MAC ID and IP address

- 6.2.9 Exit the BOOT/DHCP Server software. If installing the Temposonics EtherNet/IP™ EDS file (download at www.temposonics.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.

NOTICE

Step 6.2.7 will make your sensors unique IP address static. It will disable BOOTP and DHCP, and the IP address will be stored in the EEPROM of the sensor.

- 6.2.7 Click to select your sensor in the 'Relation List' box and click the disable BOOTP/DHCP button.
- 6.2.8 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 static IP address. If needed, repeat step 6.2.7 until the disable command is successful.

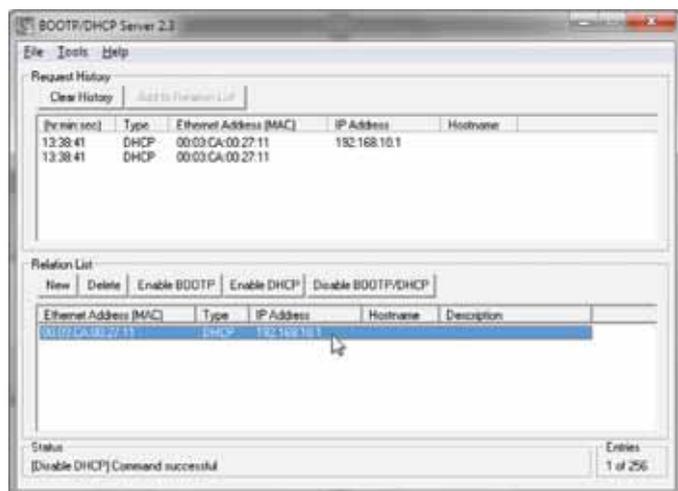


Fig. 57: Sensor shows the static IP address

7. Integration in RSLogix 5000

7.1 Install the Temposonics EtherNet/IP™ EDS file

The EDS file for the R-Series V EtherNet/IP™ sensor is available at www.temposonics.com. It provides full backwards compatibility to the previous generation of R-Series EtherNet/IP™ sensors.

7.1.1 Open the RSLogix 5000 software interface.

7.1.2 Click the Tools menu and select “EDS Hardware Installation Tool”.

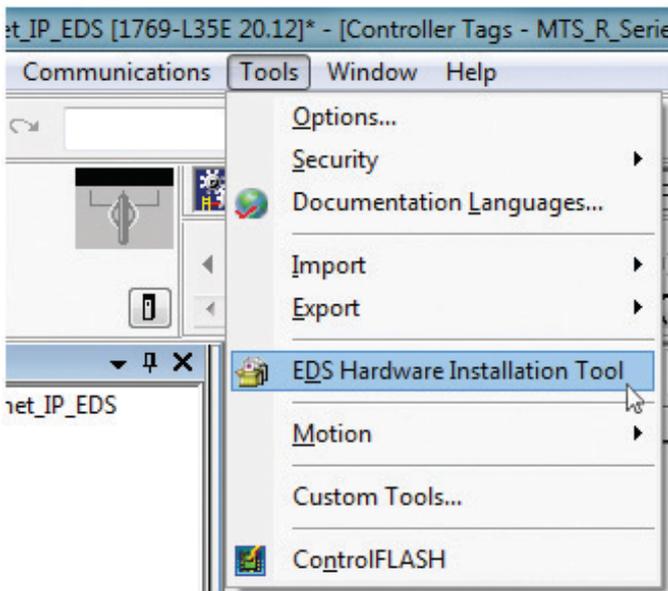


Fig. 58: Select the “EDS Hardware Installation Tool”

7.1.3 The ‘EDS Wizard’ window opens, click Next, in the ‘Options’ window select Register an EDS file(s) and click “Next”.

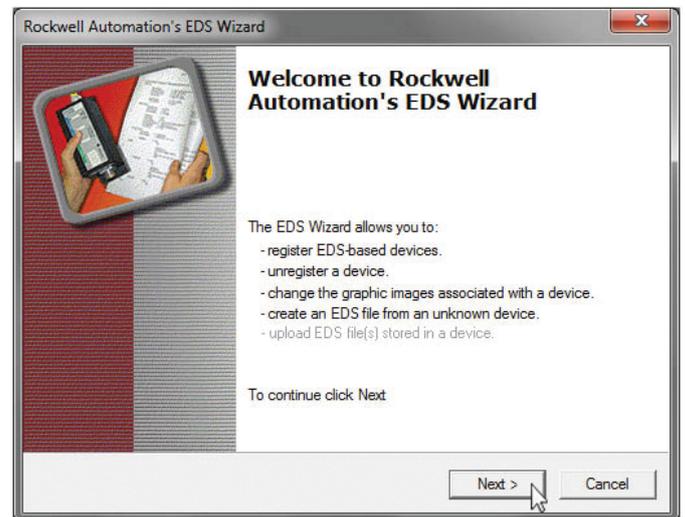


Fig. 59: EDS wizard launch screen

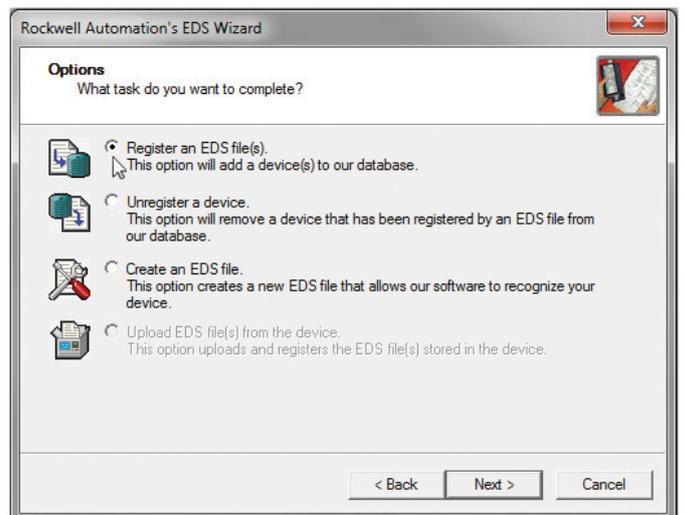


Fig. 60: Register an EDS file

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

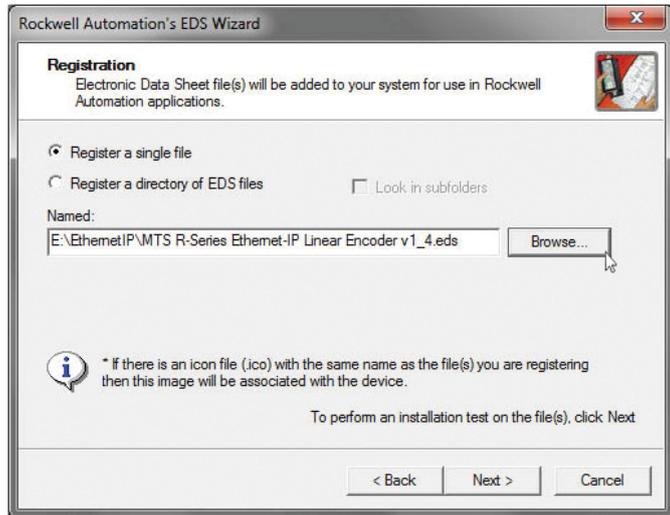


Fig. 61: Enter the path to the EDS file

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

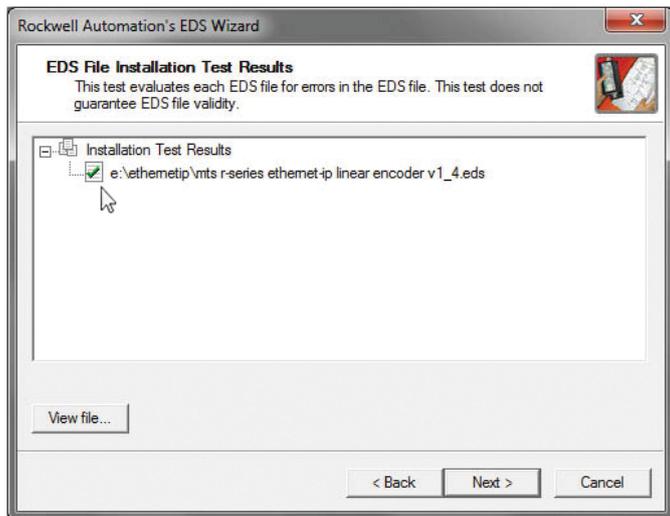


Fig. 62: Confirmation of path to the EDS file

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

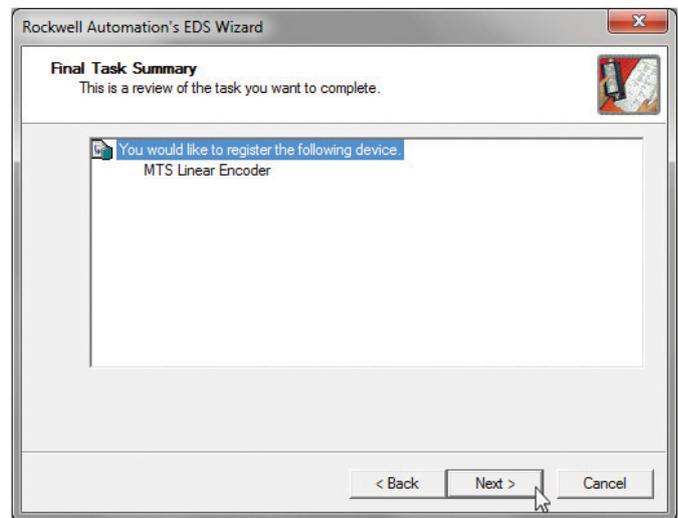


Fig. 63: Confirmation of EDS file origin

7.1.7 Click "Finish".

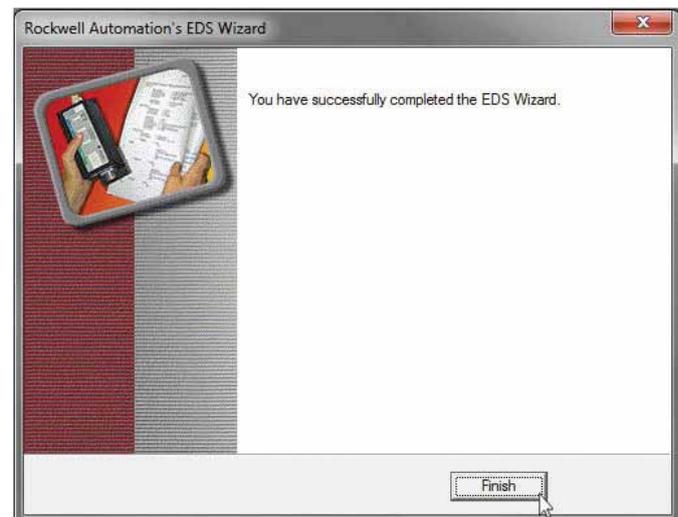


Fig. 64: EDS Installation Complete

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”.

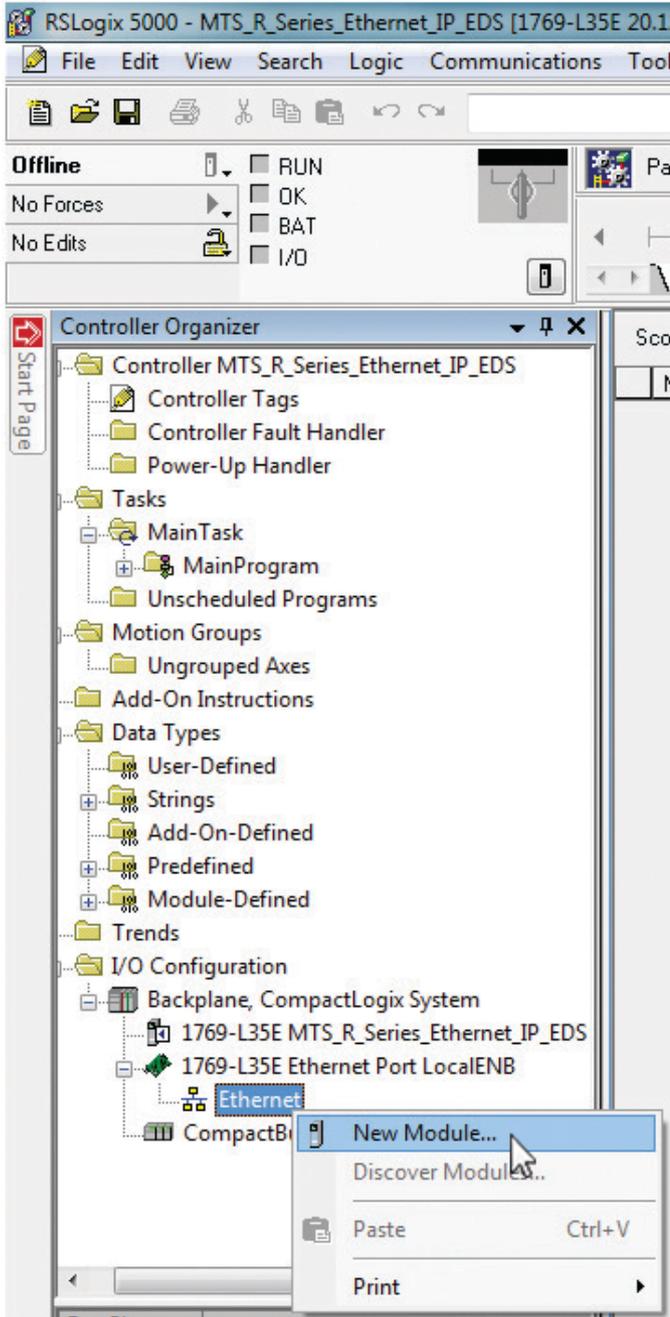


Fig. 65: Add a new module to the RSLogix 5000 IO tree

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

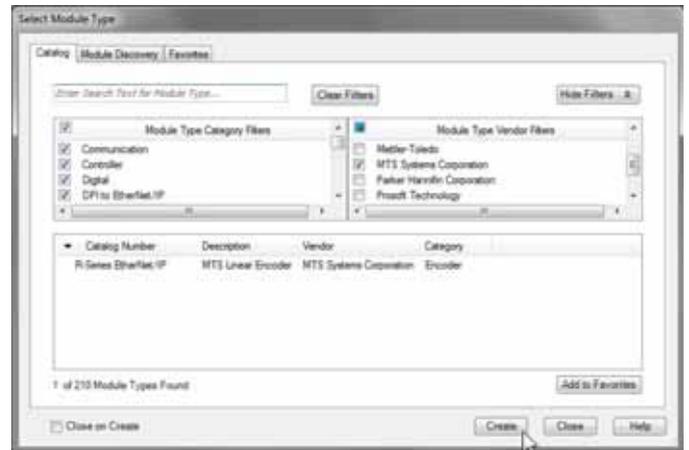


Fig. 66: Create new module tree

7.2.3 In the New Module window, enter a name in the ‘Name’ field, select the IP address radio button and enter the static IP address that is assigned to the sensor. Click “OK” and close the new module window.

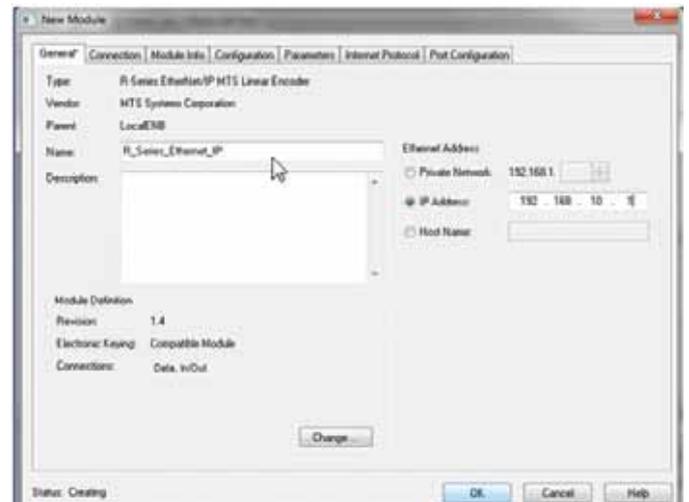


Fig. 67: Confirm the new module settings

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

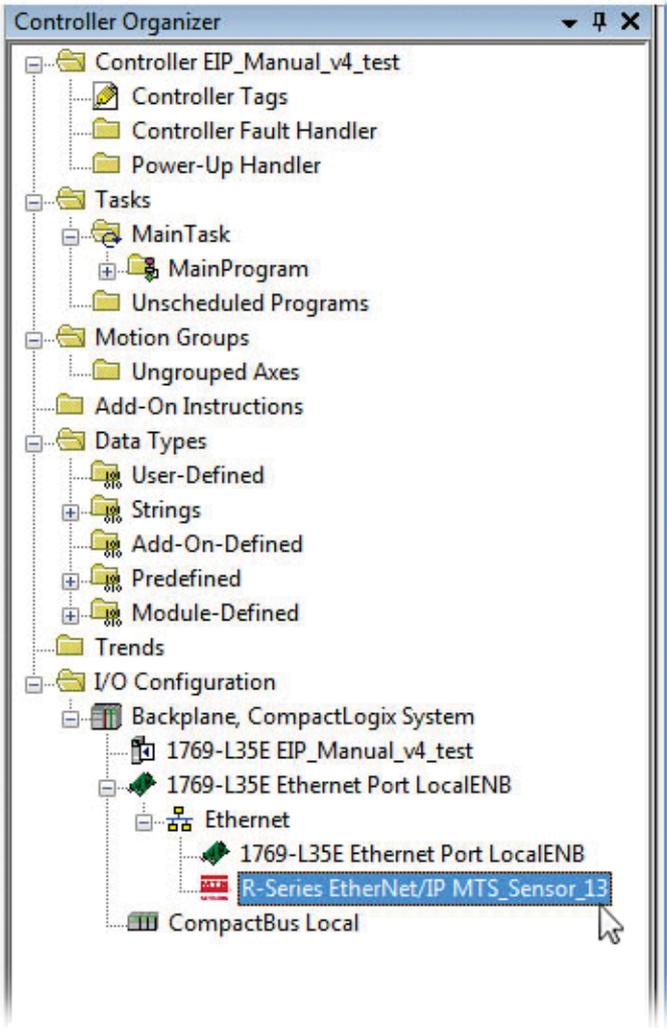
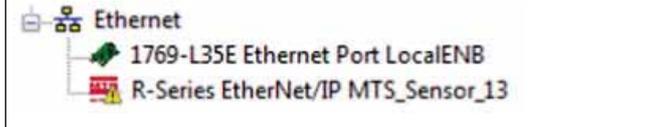


Fig. 68: New module on the network

The Temposonics (previously MTS Sensors) 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 without using EDS file

Before you begin, you will need the sensors static IP address you recorded in from step 6.2.7.

- 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.

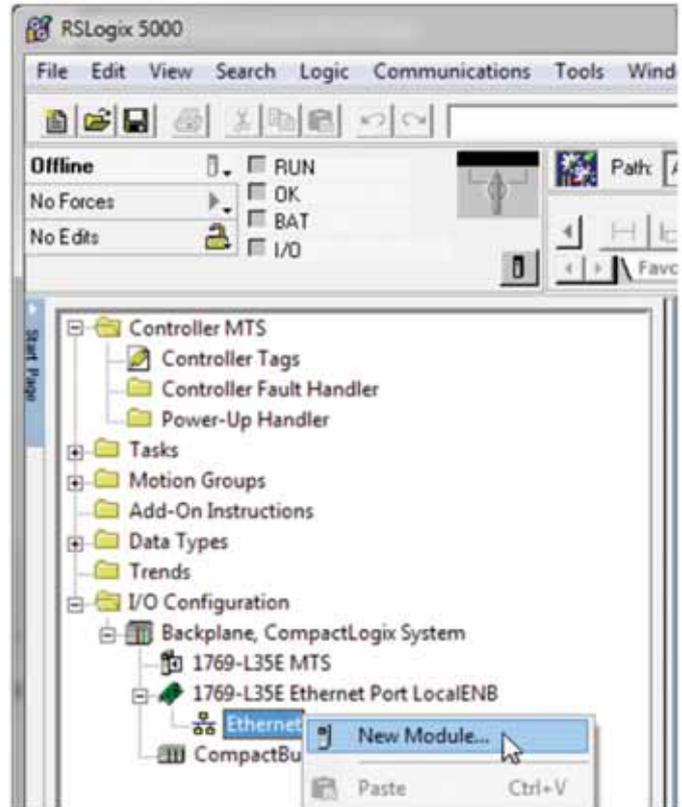


Fig. 69: Add a new module to the RSLogix 5000 I/O tree

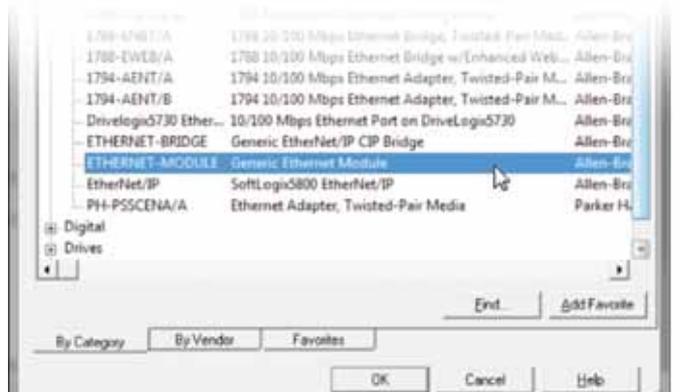


Fig. 70: Add a new Generic module tree

7.3.4 In the 'New Module' window (Fig. 71) perform step 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 step 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 static IP address you assigned to the sensor in chapter 6.1.
- 7.3.4.4 To set the “Connection Parameters” enter the following connection parameters field information:

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.

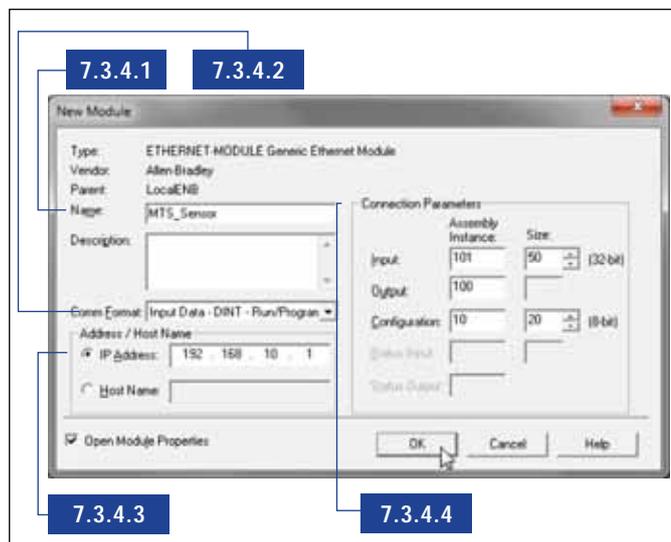


Fig. 71: New Module window

7.4 Set Module RPI

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

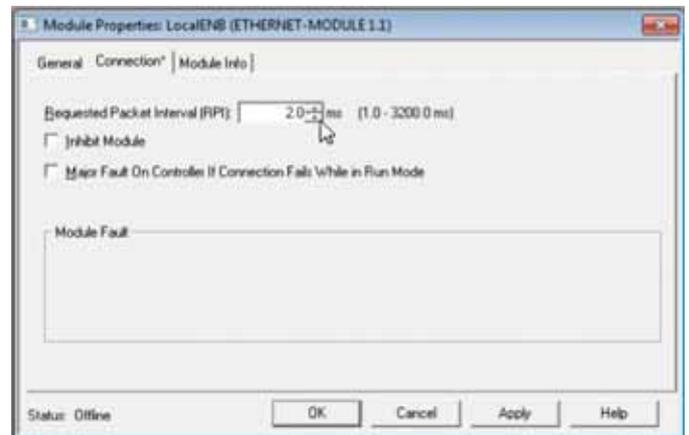


Fig. 72: New module properties

NOTICE

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.

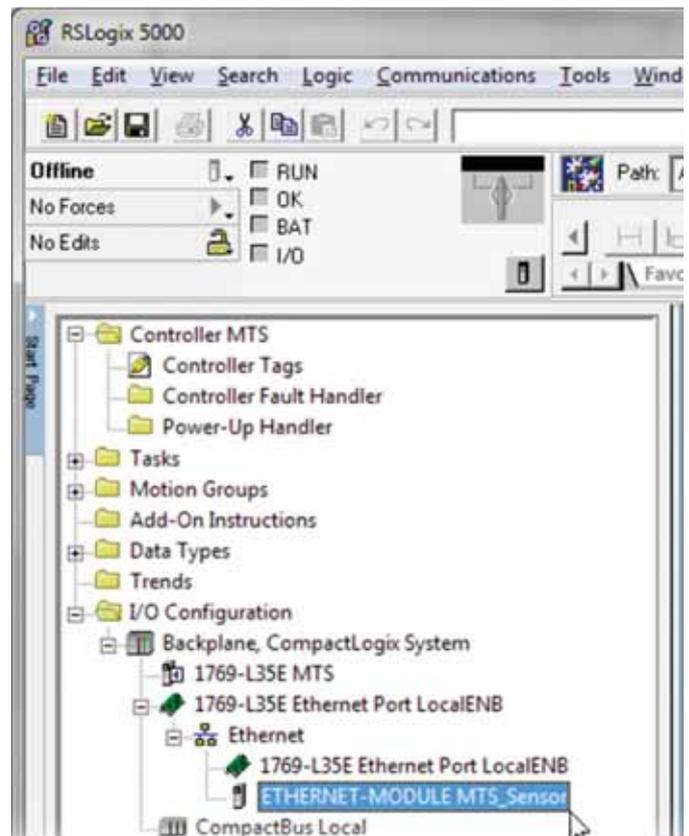


Fig. 73: New generic module has been added to the network

7.6 Verify Generic Ethernet Module

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 (Fig. 74). The description column fields will be blank by default.

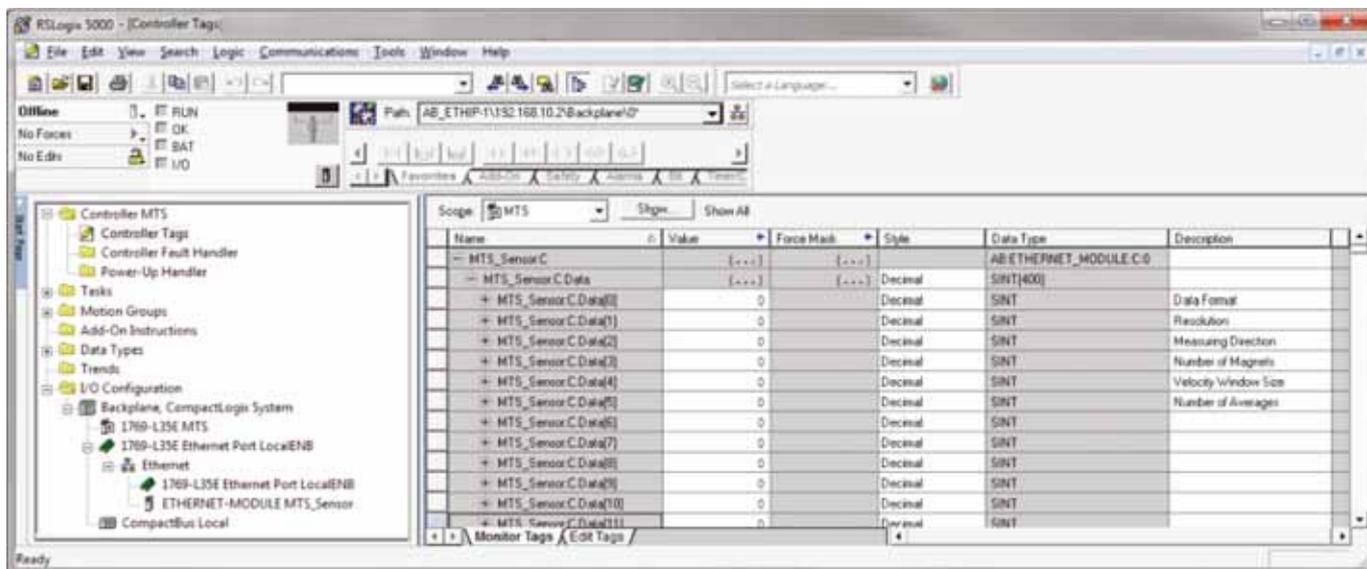


Fig. 74: Device control tags

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.

Name	Description	Values	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	(default value) First 4 bytes are status. Then repeating for each magnet: 4 bytes signed position, 4 bytes signed velocity. The 4 status bytes are defined as follows: <ul style="list-style-type: none"> • Lower byte (bits 0 – 7) = Status <ul style="list-style-type: none"> • 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 • Upper byte (bits 24 – 31) = Number of magnets found on the sensor
Data Byte [1]	Resolution	0	0.001 mm (default value, also the same as value = 1)
		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) (default value)
		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	1...1000	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 (default value: 1, no smoothing).
Data Byte [5]	Number of averages	0...100	A simple moving average that can be used to filter the position data in noisy environments (default value: 1, no averaging).

7.7 Controller tags input data

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

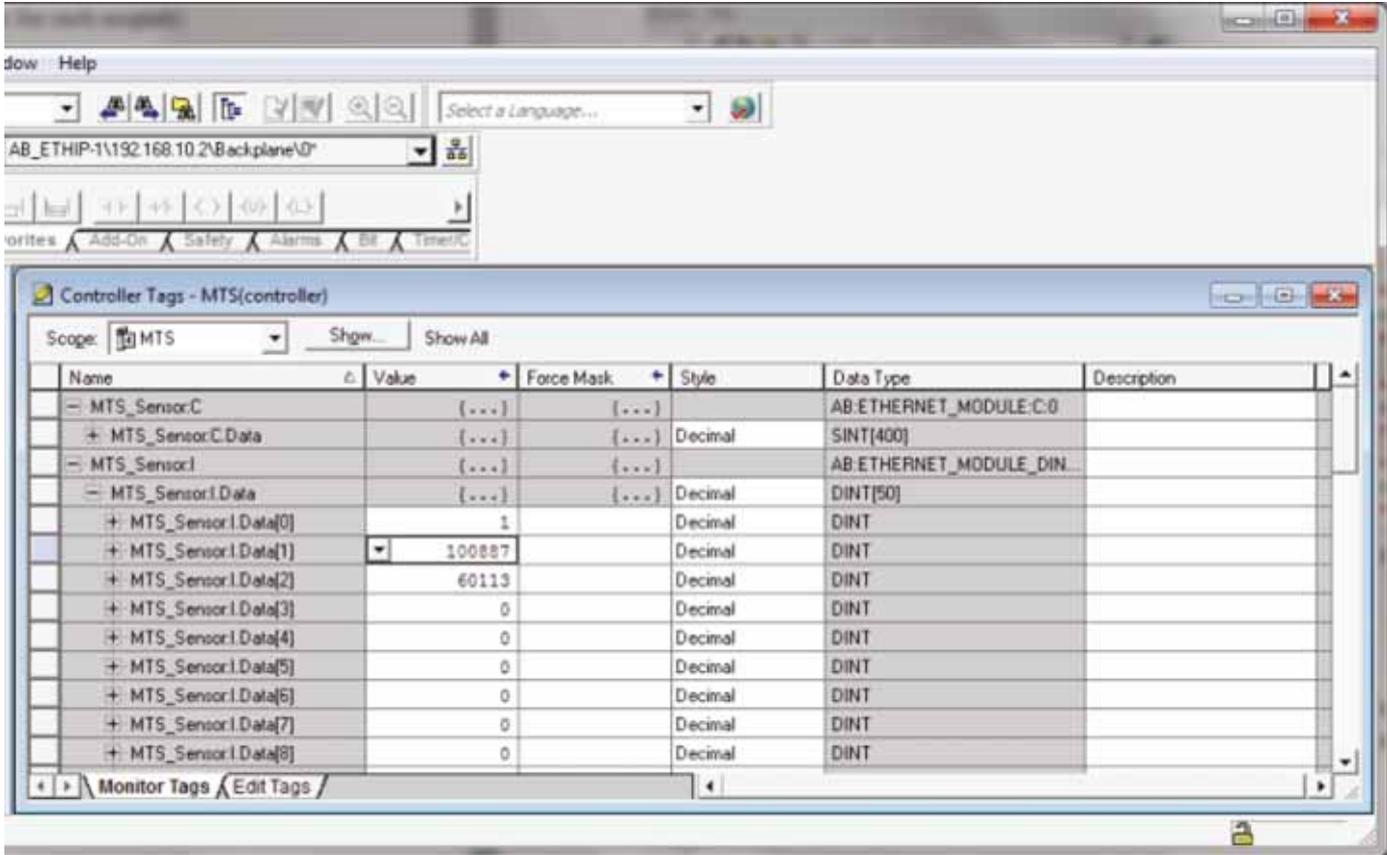


Fig. 75: Controller tags

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

7.7.1 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.

7.7.2 Magnet Data

The remaining data is laid out according to the data format selected in the configuration. The screenshot on page 32 in section 7.8 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.

$$\text{Position} = 100887 \times 0.001 \text{ mm} = 100.887 \text{ mm}$$

Magnet data – Velocity

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

$$\text{Velocity} = 60113 \times 0.001 \text{ mm} = 60.113 \text{ mm}$$

7.7.3 Configuration complete

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

8. Maintenance and troubleshooting

8.1 Error conditions, troubleshooting

See chapter "5. Operation" on page 40.

8.2 Maintenance

The sensor is maintenance-free.

8.3 Repair

Repairs of the sensor may be performed only by Temposonics or a repair facility explicitly authorized by Temposonics.

8.4 List of spare parts

No spare parts are available for this sensor.

8.5 Transport and storage

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

9. Removal from service / dismantling

The product contains electronic components and must be disposed of in accordance with the local regulations.

10. Technical data

10.1 Technical data Temposonics® RP5

Output				
Interface	EtherNet/IP™			
Data protocol	Encoder CIP device profile with CIP Sync™ and DLR capabilities			
Data transmission rate	100 MBit/s (maximum)			
Measured value	Position, velocity / option: Simultaneous multi-position and multi-velocity measurements up to 20 magnets			
Measurement parameters				
Resolution: Position	1...500 µm (selectable)			
Cycle time	Stroke length	up to 2000 mm	up to 4800 mm	up to 6350 mm
	Cycle time	1.0 ms	2.0 ms	3.0 ms
Linearity deviation ³	Stroke length	up to 500 mm	greater than 500 mm	
	Linearity deviation	≤ ±50 µm	< 0.01 % F.S.	
	Optional internal linearity: Linearity tolerance (Applies for the first magnet for multi-position measurement)			
	Stroke length	25...300 mm	300...600 mm	600...1200 mm
	typical	± 15 µm	± 20 µm	± 25 µm
	maximum	± 25 µm	± 30 µm	± 50 µm
Repeatability	< ±0.001 % F.S. (minimum ±2.5 µm) typical			
Hysteresis	< 4 µm, typical 2 µm			
Operating conditions				
Operating temperature	-40...+85 °C (-40...+185 °F)			
Humidity	90 % relative humidity, no condensation			
Ingress protection	IP67 (connectors correctly fitted)			
Shock test	150 g / 11 ms, IEC standard 60068-2-27			
Vibration test	30 g / 10...2000 Hz, IEC standard 60068-2-6 (excluding resonant frequencies)			
EMC test	Electromagnetic emission according to EN 61000-6-3 Electromagnetic immunity according to EN 61000-6-2 The RP5 sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TR CU 020/2011			
Magnet movement velocity	Magnet slider: Max. 10 m/s; U-magnet: Any; block magnet: Any			
Design/Material				
Sensor electronics housing	Aluminum (painted), zinc die cast			
Sensor profile	Aluminum			
RoHS compliance	The used materials are compliant with the requirements of EU directive 2011/65/EU and EU regulation 2015/863 as well as UKSI 2022 No. 622			
Stroke length	25...6350 mm (1...250 in.)			
Mechanical mounting				
Mounting position	Any			
Mounting instruction	Please consult the technical drawings on page 11			
Electrical connection				
Connection type	2 × M12 female connectors (5 pin), 1 × M8 male connector (4 pin), 2 × M12 female connectors (5 pin), 1 × M12 male connector (4 pin)			
Operating voltage	12...30 VDC ±20 % (9.6...36 VDC) ⁴			
Power consumption	Less than 4 W typical			
Dielectric strength	500 VDC (DC ground to machine ground)			
Polarity protection	Up to -36 VDC			
Overvoltage protection	Up to 36 VDC			

^{3/} With position magnet # 252 182

^{4/} Power supply must be able to provide current of 1 A for power up process

10.2 Technical data Temposonics® RH5

Output				
Interface	EtherNet/IP™			
Data protocol	Encoder CIP device profile with CIP Sync™ and DLR capabilities			
Data transmission rate	100 MBit/s (maximum)			
Measured value	Position, velocity / option: Simultaneous multi-position and multi-velocity measurements up to 20 magnets			
Measurement parameters				
Resolution: Position	1...500 µm (selectable)			
Cycle time	Stroke length	up to 2000 mm	up to 4800 mm	up to 7620 mm
	Cycle time	1.0 ms	2.0 ms	3.0 ms
Linearity deviation ⁵	Stroke length	500 mm	greater than 500 mm	
	Linearity deviation	50 µm	< 0.01 % F.S.	
	Optional internal linearity: Linearity tolerance (Applies for the first magnet for multi-position measurement)			
	Stroke length	25...300 mm	300...600 mm	600...1200 mm
	typical	± 15 µm	± 20 µm	± 25 µm
	maximum	± 25 µm	± 30 µm	± 50 µm
Repeatability	< ±0.001 % F.S. (minimum ±2.5 µm) typical			
Hysteresis	< 4 µm, typical 2 µm			
Operating conditions				
Operating temperature	-40...+85 °C (-40...+185 °F)			
Humidity	90 % relative humidity, no condensation			
Ingress protection	IP67 (connectors correctly fitted)			
Shock test	150 g / 11 ms, IEC standard 60068-2-27			
Vibration test	30 g / 10...2000 Hz, IEC 60068-2-6 (excluding resonant frequencies)			
EMC test	Electromagnetic emission according to EN 61000-6-3			
	Electromagnetic immunity according to EN 61000-6-2			
	The RH5 sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TR CU 020/2011			
Operating pressure	350 bar (5076 psi) / 700 bar (10153 psi) peak (at 10 × 1 min) for sensor rod			
Magnet movement velocity	Any			
Design/Material				
Sensor electronics housing	Aluminum (painted), zinc die cast			
Sensor flange	Stainless steel 1.4305 (AISI 303) / RH5-J: Stainless steel 1.4305 (AISI 303)			
Sensor rod	Stainless steel 1.4306 (AISI 304L) / RH5-J: Stainless steel 1.4301 (AISI 304)			
RoHS compliance	The used materials are compliant with the requirements of EU directive 2011/65/EU and EU regulation 2015/863 as well as UKSI 2022 No. 622			
Stroke length	25...7620 mm (1...300 in.)			
Mechanical mounting				
Mounting position	Any			
Mounting instruction	Please consult the technical drawings on page 12 and page 13			
Electrical connection				
Connection type	2 × M12 female connectors (5 pin), 1 × M8 male connector (4 pin), 2 × M12 female connectors (5 pin), 1 × M12 male connector (4 pin)			
Operating voltage	12...30 VDC ±20 % (9.6...36 VDC) ⁶			
Power consumption	Less than 4 W typical			
Dielectric strength	500 VDC (DC ground to machine ground)			
Polarity protection	Up to -36 VDC			
Overvoltage protection	Up to 36 VDC			

5/ With position magnet # 251 416-2

6/ Power supply must be able to provide current of 1 A for power up process

10.3 Technical data Temposonics® RFV

Output					
Interface	EtherNet/IP™				
Data protocol	Encoder CIP device profile with CIP Sync™ and DLR capabilities				
Data transmission rate	100 MBit/s (maximum)				
Measured value	Position, velocity/option: Simultaneous multi-position and multi-velocity measurements up to 20 magnets				
Measurement parameters					
Resolution: Position	1...500 µm (selectable)				
Cycle time	Stroke length	≤ 2000 mm	≤ 4675 mm	≤ 10,000 mm	≤ 20,000 mm
	Cycle time	1.0 ms	2.0 ms	4.0 ms	8.0 ms
Linearity deviation ⁷	< ±0.02 % F.S. (minimum ±100 µm)				
Repeatability	< ±0.001 % F.S. (minimum ±2.5 µm) typical				
Hysteresis	< 4 µm typical				
Temperature coefficient	< 15 ppm/K typical				
Operating conditions					
Operating temperature	-40...+85 °C (-40...+185 °F)				
Humidity	90 % relative humidity, no condensation				
Ingress protection	IP30 (IP65 rating only for professional mounted guide pipe and if mating connectors are correctly fitted)				
Shock test	100 g/6 ms, IEC standard 60068-2-27				
Vibration test	5 g/10...2000 Hz, IEC standard 60068-2-6 (excluding resonant frequencies)				
EMC test	Electromagnetic emission according to EN 61000-6-3				
	Electromagnetic immunity according to EN 61000-6-2				
	The RFV sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TR CU 020/2011 under the condition of an EMC-compliant installation. ⁸				
Magnet movement velocity	Any				
Design/Material					
Sensor electronics housing	Aluminum (painted), zinc die cast				
Sensor flange	Stainless steel 1.4305 (AISI 303)				
Sensor rod	Stainless steel conduct with PTFE coating				
RoHS compliance	The used materials are compliant with the requirements of EU directive 2011/65/EU and EU regulation 2015/863 as well as UKSI 2022 No. 622				
Stroke length	150...20,000 mm (6...787 in.)				
Mechanical mounting					
Mounting position	Any				
Mounting instruction	Please consult the technical drawings on page 15				
Electrical connection					
Connection type	2 × M12 female connectors (5 pin), 1 × M8 male connector (4 pin) or 2 × M12 female connectors (5 pin), 1 × M12 male connector (4 pin)				
Operating voltage	+12...30 VDC ±20 % (9.6...36 VDC)				
Power consumption	Less than 4 W typical				
Dielectric strength	500 VDC (DC ground to machine ground)				
Polarity protection	Up to -36 VDC				
Overvoltage protection	Up to 36 VDC				

^{7/} With position magnet # 251 416-2

^{8/} The flexible sensor element must be mounted in an appropriately shielded environment.

10.4 Technical data Temposonics® RDV

Output				
Interface	EtherNet/IP™			
Data protocol	Encoder CIP device profile with CIP Sync™ and DLR capabilities			
Data transmission rate	100 MBit/s (maximum)			
Measured value	Position, velocity/option: Simultaneous multi-position and multi-velocity measurements up to 20 magnets			
Measurement parameters				
Resolution: Position	1...500 µm (selectable)			
Cycle time	Stroke length	≤ 2000 mm	≤ 4800 mm	5080 mm
	Cycle time	1.0 ms	2.0 ms	3.0 ms
Linearity deviation ^{9, 10}	Stroke length	≤ 500 mm	> 500 mm	
	Linearity deviation	≤ ±50 µm	< 0.01 % F.S.	
	Optional internal linearity: Linearity tolerance (Applies for the first magnet for multi-position measurement)			
	Stroke length	25...300 mm	300...600 mm	600...1200 mm
	typical	± 15 µm	± 20 µm	± 25 µm
	maximum	± 25 µm	± 30 µm	± 50 µm
Repeatability	< ±0.001 % F.S. (minimum ±2.5 µm) typical			
Hysteresis	< 4 µm typical			
Temperature coefficient	< 15 ppm/K typical			
Operating conditions				
Operating temperature	-40...+85 °C (-40...+185 °F)			
Humidity	90 % relative humidity, no condensation			
Ingress protection	Sensor electronics IP67 (with professional mounted housing and connectors) Measuring rod with connecting cable for side cable entry IP65 Measuring rod with single wires and flat connector with bottom cable entry IP30			
Shock test	100 g/11 ms, IEC standard 60068-2-27			
Vibration test	10 g/10...2000 Hz, IEC standard 60068-2-6 (excluding resonant frequencies)			
EMC test	Electromagnetic emission according to EN 61000-6-3 Electromagnetic immunity according to EN 61000-6-2 The RDV sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TR CU 020/2011 under the condition of an EMC-compliant installation. ¹¹			
Operating pressure	350 bar (5076 psi)/700 bar (10,153 psi) peak (at 10 × 1 min) for sensor rod			
Magnet movement velocity	Any			
Design/Material				
Sensor electronics housing	Aluminum (painted), zinc die cast			
Sensor rod with flange	Stainless steel 1.4301 (AISI 304)			
RoHS compliance	The used materials are compliant with the requirements of EU directive 2011/65/EU and EU regulation 2015/863 as well as UKSI 2022 No. 622			
Stroke length	25...2540 mm (1...100 in.) for pressure-fit flange »S« 25...5080 mm (1...200 in.) for all threaded flanges			
Mechanical mounting				
Mounting position	Any			
Mounting instruction	Please consult the technical drawings on page 18 and page 19			
Electrical connection				
Connection type	2 × M12 female connectors (5 pin), 1 × M12 male connector (4 pin) 2 × M12 female connectors (5 pin), 1 × M8 male connector (4 pin)			
Operating voltage	+12...30 VDC ±20 % (9.6...36 VDC)			
Power consumption	Less than 4 W typical			
Dielectric strength	500 VDC (DC ground to machine ground)			
Polarity protection	Up to -36 VDC			
Overvoltage protection	Up to 36 VDC			

^{9/} With position magnet # 251 416-2

^{10/} For rod style »S« the linearity deviation can be higher in the first 30 mm (1.2 in.) of stroke length

^{11/} The cable between the sensor element and the electronic housing must be mounted in an appropriately shielded environment.

11. Appendix I

Safety declaration

Dear Customer,

If you return one or several sensors for checking 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 people handling these items will not be in danger.

Temposonics order number: _____

Sensor type(s): _____

Serial number(s): _____

Sensor length(s): _____

The sensor has been in contact with the following materials:

Do not 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 Temposonics to determine measures to be taken before
shipment.

Short description of malfunction:

Corporate information

Company: _____

Address: _____

Contact partner

Phone: _____

Fax: _____

Email: _____

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 is excluded.

Stamp

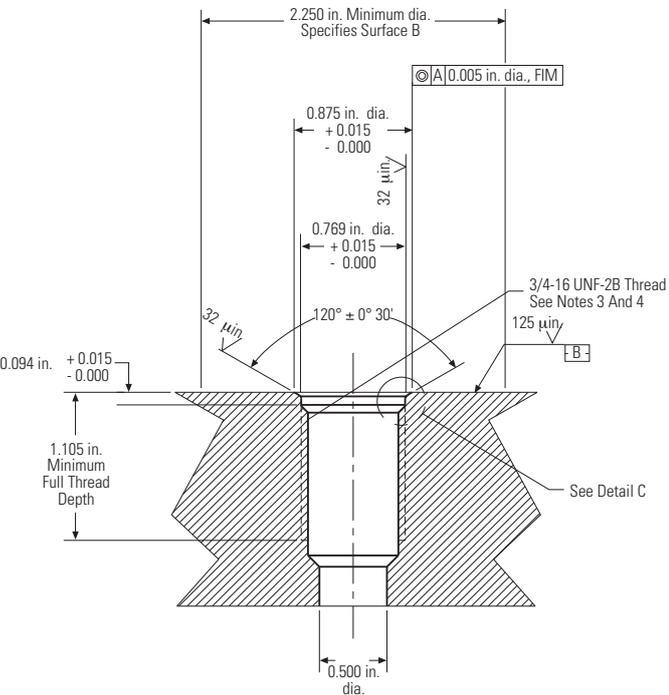
Signature

Date

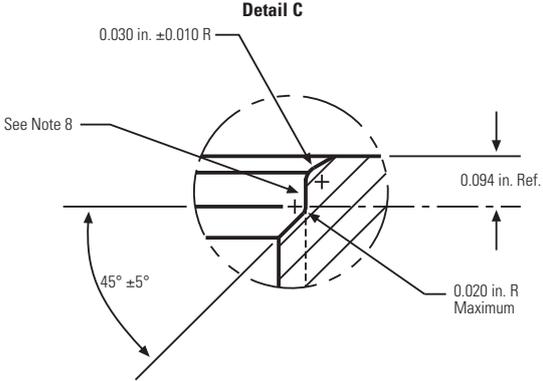
12. Appendix II

CYLINDER PORT DETAILS

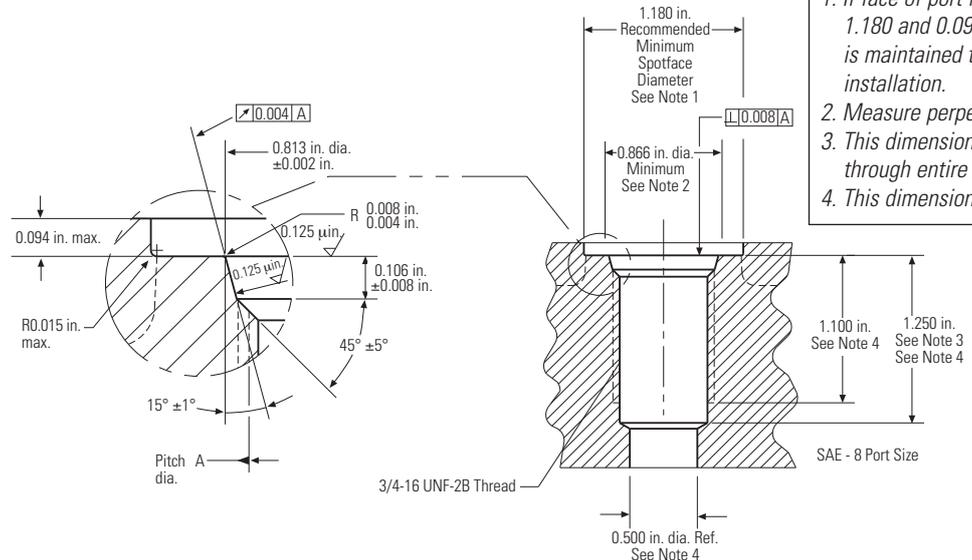
PORT DETAIL (PD) FOR RH5-S:



- NOTES:**
1. Dimensions and tolerances based on ANSI Y14.5-1982.
 2. Temposonics 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 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 (PD) FOR RH5-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.

13. Glossary

C

CIP Sync

Synchronization services in CIP (Common Industrial Protocol) provide the increased control coordination to achieve real-time synchronization between distributed devices and systems. CIP Sync™ is compliant with IEEE-1588™ standard and allows synchronization accuracy between two devices of fewer than 100 nanoseconds.

D

DLR

The Device Level Ring (DLR) protocol provides a means for detecting, managing and recovering from faults in a ring-based network.

E

EDS

The properties and functions of an EtherNet/IP™ device are described in an EDS file (Electronic Data Sheet). The XML-based EDS file contains all relevant data that are important for the implementation of the device in the controller as well as for data exchange during operation. The EDS file of the R-Series V EtherNet/IP™ is available on the homepage www.temposonics.com.

EtherNet/IP™

EtherNet/IP™ (Ethernet Industrial Protocol) is an Industrial Ethernet interface and is managed by the Open DeviceNet Vendor Association (ODVA). The R-Series V EtherNet/IP™ and its corresponding EDS file are certified by the ODVA.

I

Internal Linearization

The internal linearization offers an improved linearity for an overall higher accuracy of the position measurement. The internal linearization is set for the sensor during production

M

Measuring Direction

When moving the position magnet, the position and velocity values increase in the measuring direction.

- Forward: Values increasing from sensor electronics housing to rod end/profile end
- Reverse: Values decreasing from sensor electronics housing to rod end/profile end

Multi-position measurement

During the measurement cycle, the positions of every magnet on the sensor are simultaneously reported. The velocity is continuously calculated based on these changing position values as the magnets are moved.

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