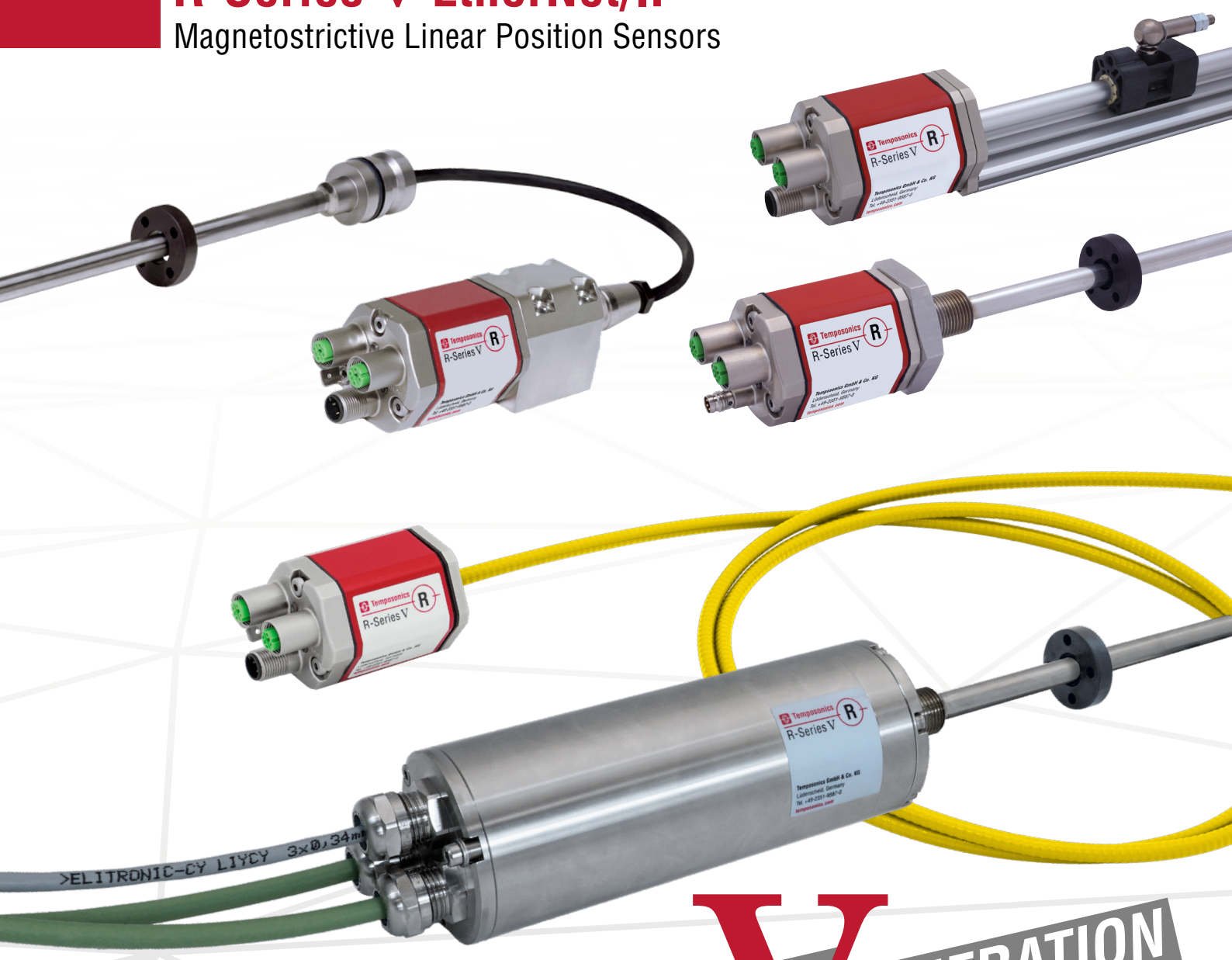
Temposonics
AN AMPHENOL COMPANY

Operation Manual

R-Series V EtherNet/IP™

Magnetostrictive Linear Position Sensors



THE NEW V GENERATION

Table of contents

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

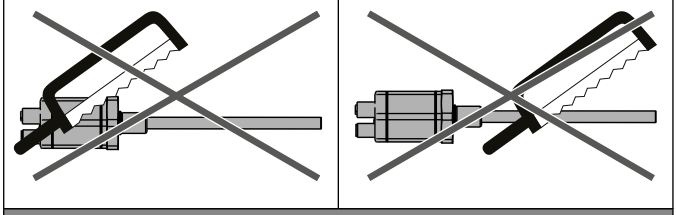
This product may be used only for the applications defined under item 1 and only in conjunction with the third-party devices and components recommended or approved by Temposonics. As a prerequisite of proper and safe operation the product requires correct transport, storage, mounting and commissioning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

1. The sensor systems of all Temposonics® series are intended exclusively for measurement tasks encountered in industrial, commercial and laboratory applications. The sensors are considered as system accessories and must be connected to suitable evaluation electronics, e.g. a PLC, IPC, indicator or other electronic control unit.

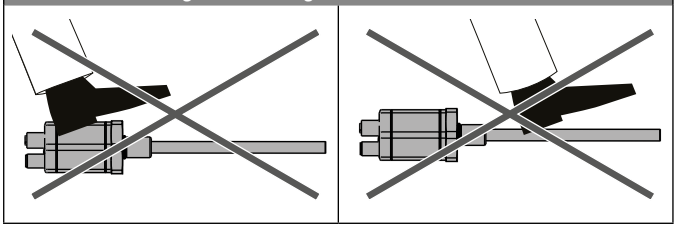
2.2 Foreseeable misuse

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.



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
- are familiar with the operation of the device and know the information required for correct operation provided in the product documentation

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 [2] for the position sensors and supplied accessories relating to material defects and faults that occur despite correct use in accordance with the intended application. 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 sender [2]. For a corresponding form, see chapter "11. Appendix I – Safety declaration" on page 78.

NOTICE

When returning sensors, place protective caps on male and female connectors of the sensor. For pigtail cables, place the cable ends in a static shielding bag for electrostatic discharge (ESD) protection. Fill the outer packaging around the sensor completely to prevent damage during transport.

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 one 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«)
F	Flexible sensing element (only for design »B«, »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 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.
- The internal linearization (U211) in h "Output" is not available with the flexible sensing element F in c "Mechanical options".

3.3 Order code of Temposonics® RM5

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

a	Sensor model
R M 5	Super shield housing

b	Design
B	Base unit (only for replacement/only with connection type D58)
M	Threaded flange M18×1.5-6g (standard)
S	Threaded flange ¾"-16 UNF-3A (standard)

c	Mechanical options
A	Standard

d	Stroke length	
X X X X M	0025…7615 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…7615 mm		250 mm
X X X X U	001.0…299.8 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…299.8 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 8	2 × M12 female connectors (D-coded), 1 × M12 male connector (A-coded) (only for RM5-B)
M X X	2 × XX m/ft. PUR cable (part no. 530 125) for data lines with M12 female connector (part no. 370 830) and 1 × XX m/ft. PVC cable (part no. 530 108) for power supply M01…M10 (1…10 m/1…33 ft.) See “Frequently ordered accessories” for cable & connector specifications
Encode in meters if using metric stroke length Encode in feet if using US customary stroke length	

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 magnet numbers for your sensing application and order 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.

3.4 Order code of Temposonics® RF5

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

a	Sensor model
R F 5	Improved flexible rod

b	Design
B	Base unit (without flange & rod assembly)

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.
- The sensor is without rod assembly. Always insert the flexible sensor rod in a support pipe (e.g. sensor rod HD/HL/HP or HFP profile).

3.5 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 (without flange & rod assembly)
M	Threaded flange M18×1.5-6g (without rod assembly)
S	Threaded flange ¾"-16 UNF-3A (without rod assembly)

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.
- RFV-B/M/S are without rod assembly. Always insert the flexible sensor rod in a support pipe (e.g. sensor rod HD/HL/HP or HFP profile).

3.6 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.

3.7 Nameplate

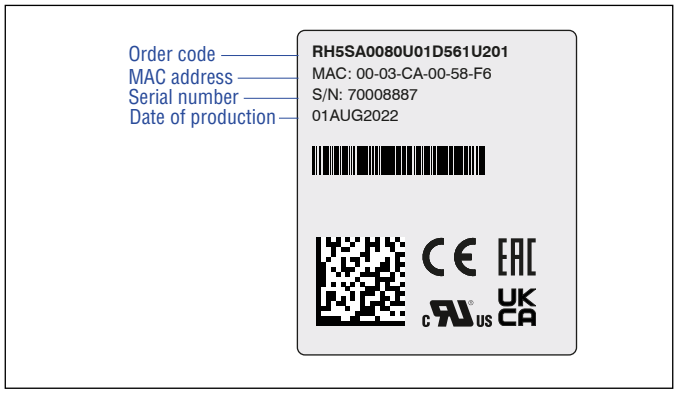


Fig. 1: Example of nameplate of an R-Series V RH5 sensor with EtherNet/IP™ output

3.8 Approvals

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

3.9 Scope of delivery

RP5 (profile sensor):
- Sensor
- Position magnet (not for RP5 with design »O«)
- 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

RM5 (sensor in super shield housing):
- RM5-B: Base unit (without flange & rod assembly),
  3 × socket screws M4×59
- RM5-M/S: Sensor, O-ring

RF5 (improved flexible rod sensor):
- RF5-B: Sensor (without flange & rod assembly),
  3 × socket screws M4×59

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

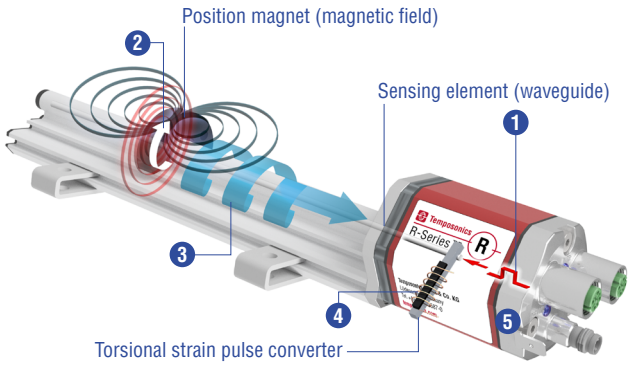
Sensor model
- Temposonics® R-Series V RP5 (profile sensor)
- Temposonics® R-Series V RH5 (rod sensor)
- Temposonics® R-Series V RM5 (sensor in super shield housing)
- Temposonics® R-Series V RF5 (improved flexible rod sensor)
- Temposonics® R-Series V RFV (flexible rod sensor)
- Temposonics® R-Series V RDV (detached sensor electronics)

Stroke length
- Temposonics® R-Serie V RP5: 25… 6350 mm (1…250 in.)
- Temposonics® R-Serie V RH5: 25… 7620 mm (1…300 in.)
- Temposonics® R-Serie V RM5: 25… 7615 mm (1…299.8 in.)
- Temposonics® R-Serie V RF5: 150…20,000 mm (6…787 in.)
- Temposonics® R-Serie V RFV: 150…20,000 mm (6…787 in.)
- Temposonics® R-Serie 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.



Measurement cycle

1	Current pulse generates magnetic field
2	Interaction with position magnet field generates torsional strain pulse
3	Torsional strain pulse propagates
4	Strain pulse detected by converter
5	Time-of-flight converted into position

Fig. 2: Time-of-flight 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

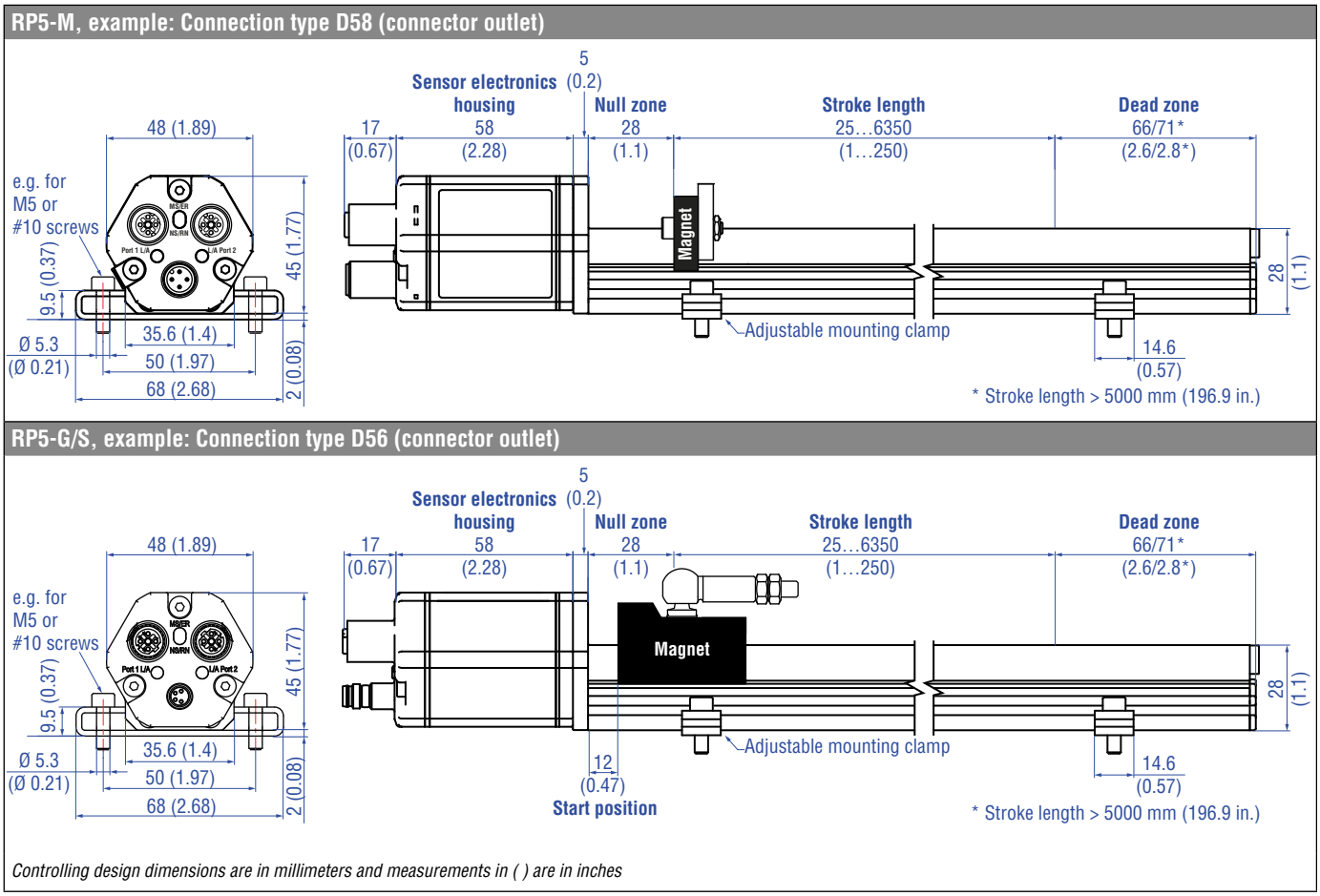


Fig. 3: Temposonics® RP5 with U-magnet/magnet slider

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.

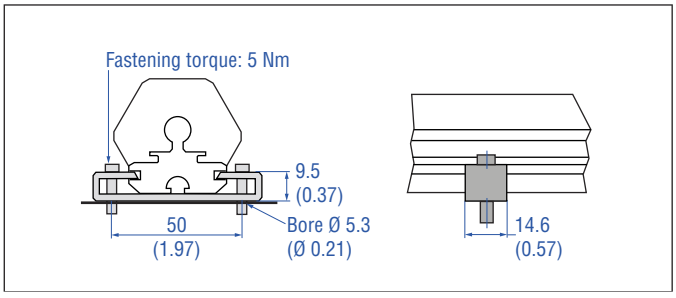


Fig. 4: Mounting clamps (part no. 400 802) with cylinder screw M5×20

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

Alternative:

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

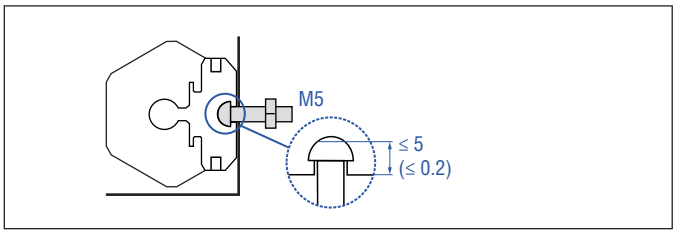


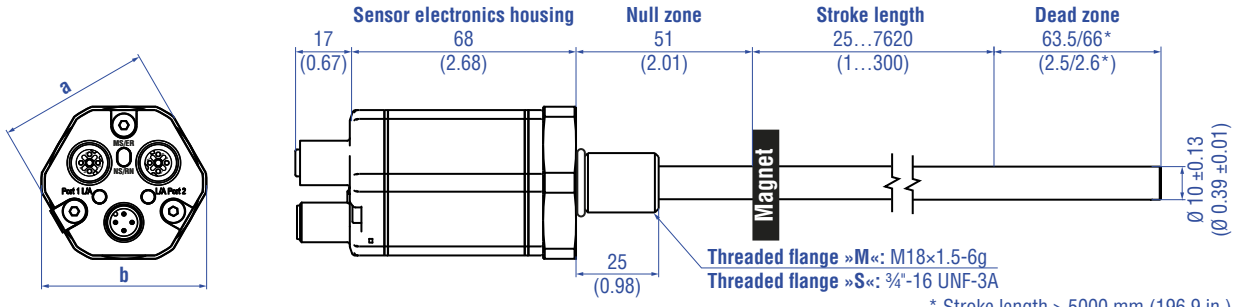
Fig. 5: T-slot nut M5 (part no. 401 602)

NOTICE

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

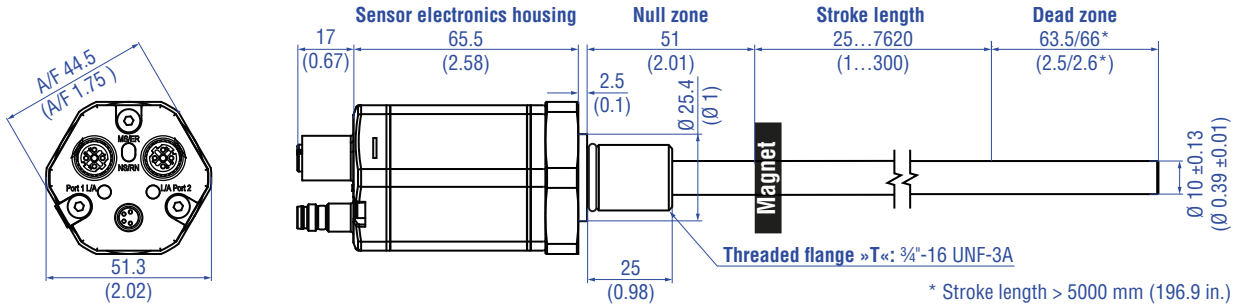
4.3 Installation and design of Temposonics® RH5

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

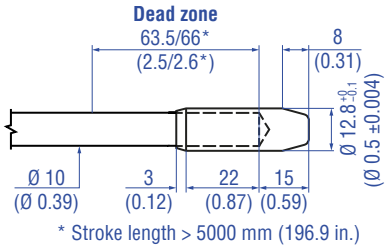


Threaded flange	a	b
»M«	A/F 46 (1.81)	53 (2.09)
»S«	A/F 44.5 (1.75)	51.3 (2.02)

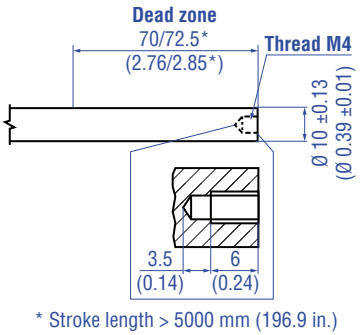
RH5-T-A/F/V – RH5 with threaded flange ¾"-16 UNF-3A with raised-face, example: Connection type D56 (connector outlet)



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

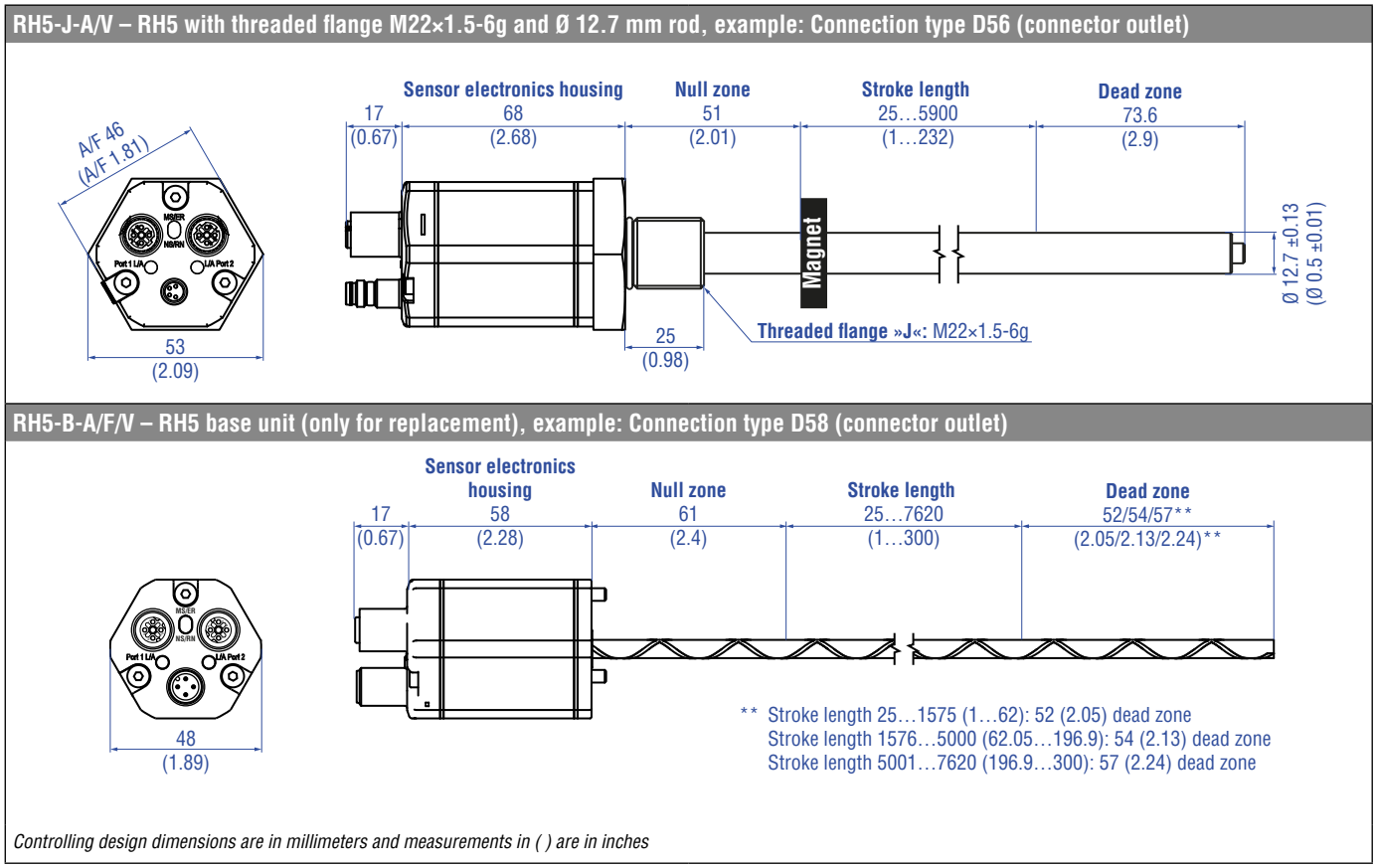


Fig. 7: Temposonics® RH5 with ring magnet, part 2

Installation of RH5 with threaded flange

Fix the sensor rod via threaded flange M18×1.5-6g, M22×1.5-6g or ¾"-16 UNF-3A. Note the fastening torque shown in Fig. 8. Lightly oil the thread before tightening.

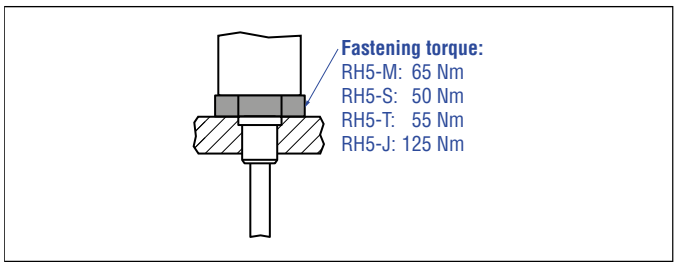


Fig. 8: Mounting example of threaded flange

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 “4.10.1 Replacement of base unit on the RH5/RFV/RF5 model” on page 40.

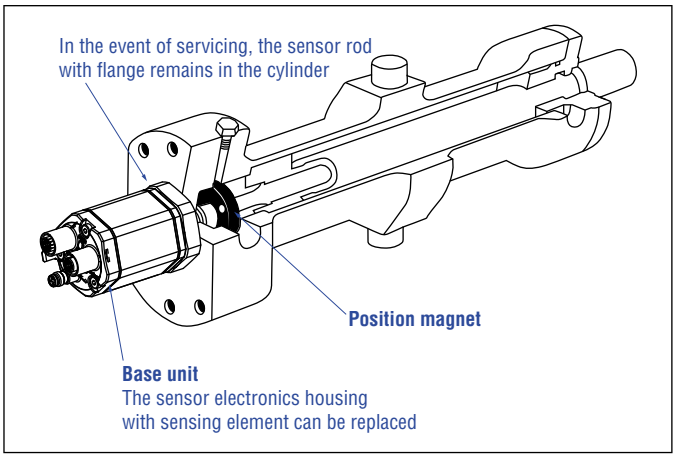


Fig. 9: Sensor in cylinder

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 cap groove.
2. A sealing by using an O-ring in the undercut.
   For threaded flange (¾"-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 flanges 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.

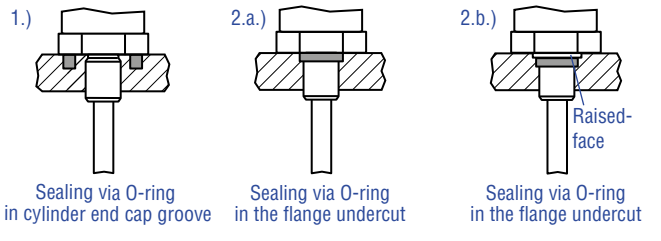
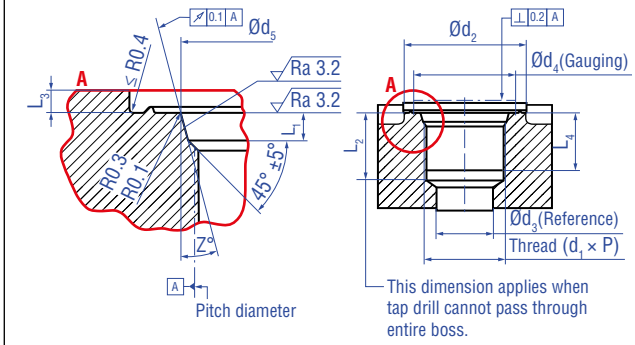


Fig. 10: Possibilities of sealing for threaded flange with flat face 1. + 2.a. (RH5-J/M/S) and with raised-face 2.b. (RH5-T)

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/F/M/V									
M18×1.5	55	≥ 13	24.5	19.8	2.4	28.5	2	26	15°
RH5-M-B									
M18×1.5	55	≥ 16	24.5	19.8	2.4	28.5	2	26	15°
RH5-J-A/V									
M22×1.5	55	≥ 16	27.5	23.8	2.4	28.5	2	26	15°



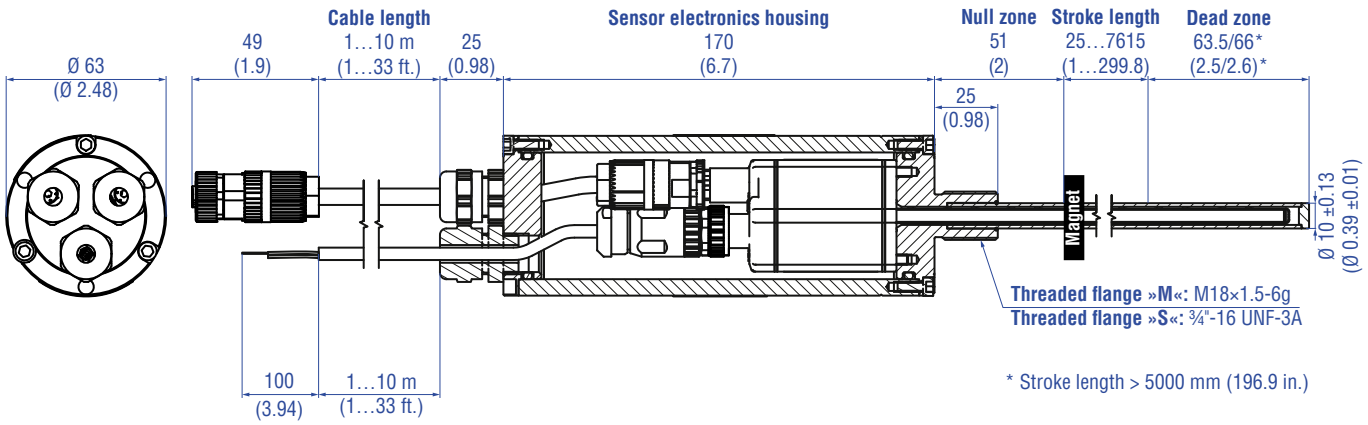
Controlling design dimensions are in millimeters

Fig. 11: Notice for metric threaded flange M18×1.5-6g/M22×1.5-6g based on DIN ISO 6149-1

- 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/F/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.

4.4 Installation and design of Temposonics® RM5

RM5-M/S – RM5 with threaded flange M18×1.5 or ¾"-16 UNF-3A, example: Connection type MXX (cable outlet)



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

Fig. 12: Temposonics® RM5 with ring magnet

Installation of RM5 with threaded flange

Fix the sensor rod via threaded flange M18×1.5-6g or ¾"-16 UNF-3A. Note the fastening torque shown in Fig. 13. Lightly oil the thread before tightening.

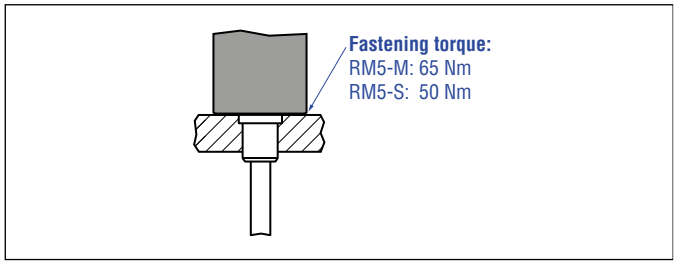


Fig. 13: Mounting example of threaded flange

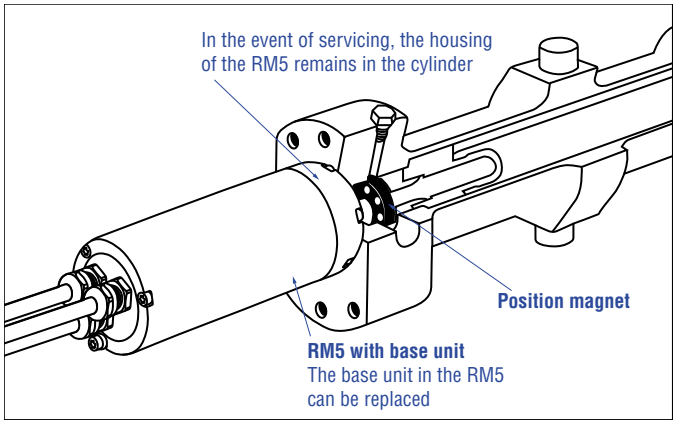


Fig. 14: RM5 sensor in cylinder

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 inside the RM5 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 “4.10.2 Replacement of base unit on the RM5 model” on page 41.

Hydraulics sealing

There are two ways to seal the flange contact surface (Fig. 15):

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 cap groove.
2. A sealing by using an O-ring in the flange undercut.
   For threaded flange (¾"-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)

In the case of threaded flange M18×1.5-6g provide a screw hole based on ISO 6149-1 (Fig. 16). See ISO 6149-1 for further information.

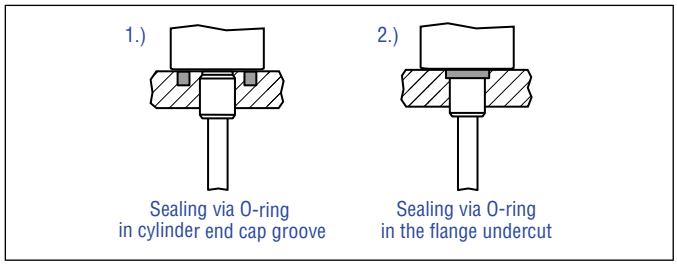
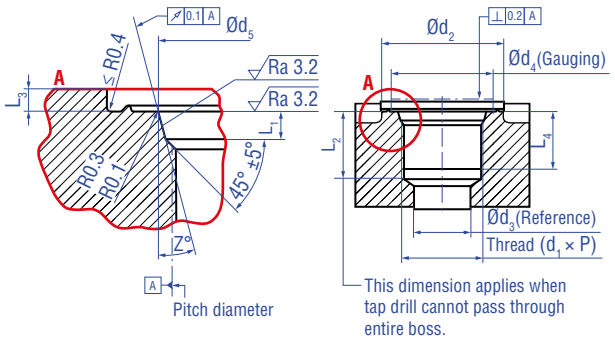


Fig. 15: Possibilities of sealing

- 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
  (RM5-M/S with rod Ø 10 mm: ≥ Ø 13 mm (≥ Ø 0.51 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°
RM5-M									
M18×1.5	55	≥ 13	24.5	19.8	2.4	28.5	2	26	15°

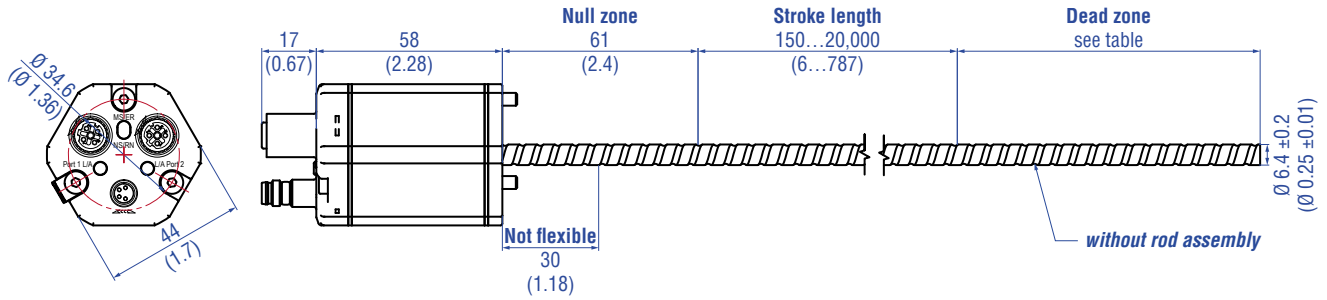


Controlling design dimensions are in millimeters

Fig. 16: Notice for metric threaded flange M18×1.5-6g based on DIN ISO 6149-1

4.5 Installation and design of Temposonics® RF5

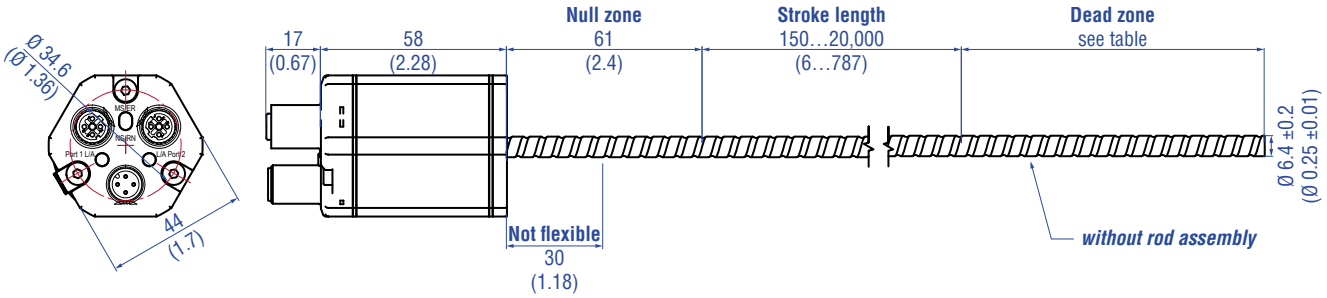
RF5-B – RF5 base unit (without flange & rod assembly), example: Connection type D56 (connector outlet)



Stroke length	Tolerance of total length	Dead zone
Up to 7620 mm (300.00 in.)	±5 mm (0.20 in.)	94 mm (3.70 in.)
Up to 10,000 mm (393.70 in.)	±10 mm (0.39 in.)	100 mm (3.94 in.)
Up to 15,000 mm (590.55 in.)	±15 mm (0.59 in.)	120 mm (4.72 in.)
Up to 20,000 mm (787.00 in.)	±20 mm (0.79 in.)	140 mm (5.51 in.)

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

RF5-B – RF5 base unit (without flange & rod assembly), example: Connection type D58 (connector outlet)



Stroke length	Tolerance of total length	Dead zone
Up to 7620 mm (300.00 in.)	±5 mm (0.20 in.)	94 mm (3.70 in.)
Up to 10,000 mm (393.70 in.)	±10 mm (0.39 in.)	100 mm (3.94 in.)
Up to 15,000 mm (590.55 in.)	±15 mm (0.59 in.)	120 mm (4.72 in.)
Up to 20,000 mm (787.00 in.)	±20 mm (0.79 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. 17: Temposonics® RF5

Installation of RF5

Note the following information when mounting and handling an RF5 sensor:

1. Always insert the flexible sensor rod in a support tube (e.g. sensor 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. 18). The support tube can be straight or bent.
2. Do never bend beyond the minimum bending radius of 100 mm (3.94 in.).
3. Note the minimum distance to a spatial limitation of 150 mm (5.91 in.), when mounting/dismounting the sensor. The recommended distance is 200 mm (7.87 in.) (Fig. 19).
4. Note the non-flexible area of the sensor rod from the flange of 30 mm (1.18 in.) (for RF5-B).

NOTICE

Bending radii < 100 mm (3.94 in.) during handling, installation or operation will damage the flexible sensor rod and thus impair the function of the sensor.

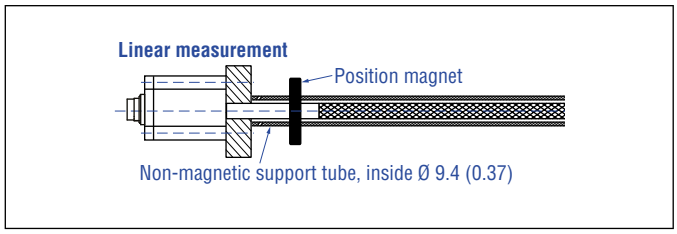


Fig. 18: Sensor with support tube

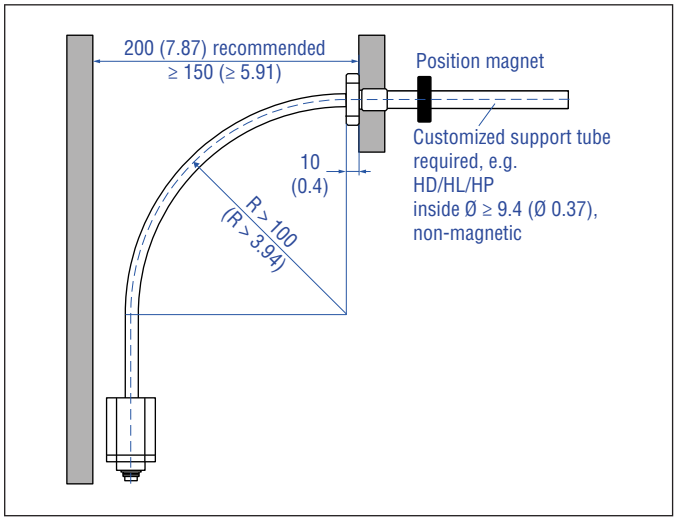


Fig. 19: Clearances for installation and handling

Mounting an RF5 sensor

There are three ways to mount the RF5 sensor:

1. Installation of the RF5-B base unit in a support tube provided by the customer
2. Installation of the RF5-B base unit in a sensor rod HD/HL/HP or HFP profile
3. Installation of the RF5-B base unit with threaded flange M18×1.5-6g or threaded flange ¾"-16 UNF-3A

These installation options are described below.

1. Installation of the RF5-B base unit in a support tube provided by the customer

1. Insert the flexible sensor rod in a support tube.
2. When inserting the flexible sensor rod, hold it close to the flange and insert it slowly into the support tube (Fig. 20). This allows air in the support tube to escape.

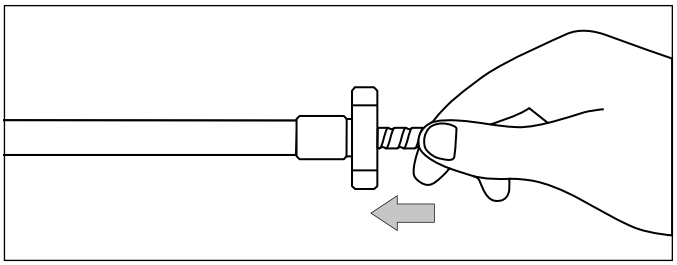


Fig. 20: Hold the flexible sensor rod close to the flange when inserting it

3. Mount the sensor electronics housing using the three M4×59 hexagon socket screws made of non-magnetic material. Tightening torque: 1.4 Nm (Fig. 21). Secure the screws before installation, e.g. with Loctite 243. Remove the three knurled nuts beforehand.

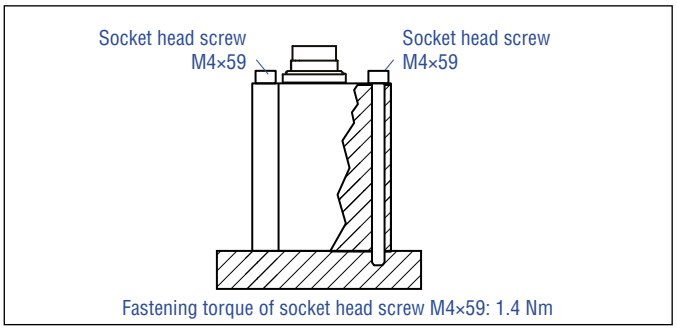


Fig. 21: Mounting with socket head screws M4×59

4. Ensure that the O-ring seal (part no. 562 003) is correctly inserted in the groove on the sensor electronics housing before inserting the base unit into the support tube and attaching the sensor electronics (Fig. 22).

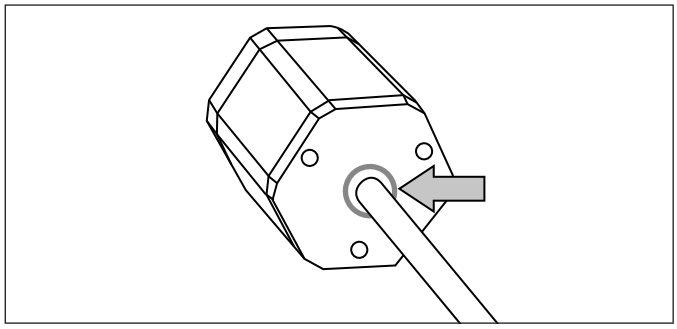


Fig. 22: Correct position of the O-ring in the groove of the sensor electronics housing

2. RF5-B with sensor rod HD/HL/HP or HFP profile (see "4.15 Frequently ordered accessories for Temposonics® RF5")

Using the HD/HL/HP sensor rod or the HFP profile offers you the advantage that the flexible sensor rod is guided in a suitable protective tube.

1. When inserting the flexible sensor rod, hold it close to the flange and insert it slowly into the support tube (Fig. 20). This allows air in the support tube to escape.
2. Mount the sensor electronics housing to the sensor rod or HFP profile using three M4×59 hexagon socket screws made of non-magnetic material: Tightening torque: 1.4 Nm (Fig. 21). Secure the screws before installation, e.g. with Loctite 243. Remove the three knurled nuts beforehand.
3. Ensure that the O-ring seal (part no. 562 003) is correctly inserted in the groove on the sensor electronics before inserting the base unit into the support tube or the HFP profile and attaching the sensor electronics (Fig. 22).

Details on installing the sensor rod HD/HL/HP or the HFP profile follow.

Installation of an RF5 sensor with sensor rod HD/HL/HP in a fluid cylinder

The rod-style version has been developed for direct stroke measurement in a fluid cylinder. Fix the sensor rod via threaded flange M18×1.5-6g or ¾"-16 UNF-3A. Note the fastening torque shown in Fig. 23. Lightly oil the thread before tightening.

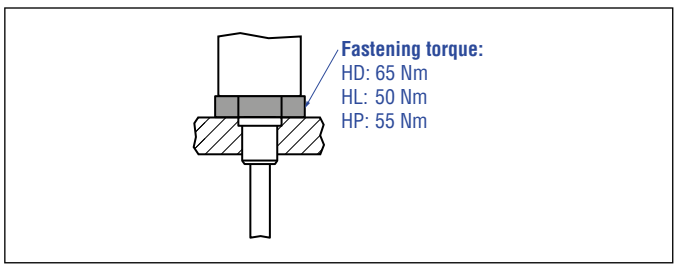


Fig. 23: Mounting example of threaded flange

- 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 "4.10.1 Replacement of base unit on the RH5/RFV/RF5 model" on page 40.
- 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 RF5 sensors with sensor 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.

Hydraulics sealing when using an RF5 sensor in a sensor rod HD/HL/HP

There are two ways to seal the flange contact surface (Fig. 24):

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 cap groove.
2. A sealing by using an O-ring in the flange undercut.
   For threaded flange (¾"-16 UNF-3A) »S«: O-ring 16.4 × 2.2 mm (0.65 × 0.09 in.) (part no. 560 315)
   For threaded flange (M18×1.5-6g) »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. 25). See ISO 6149-1 for further information.

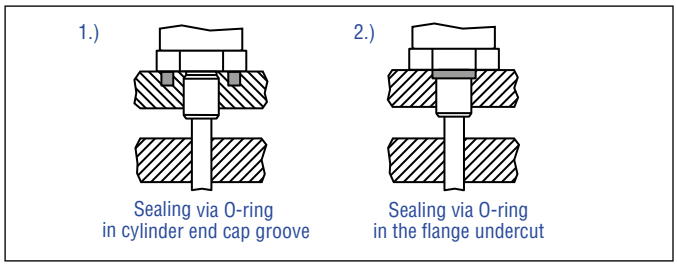
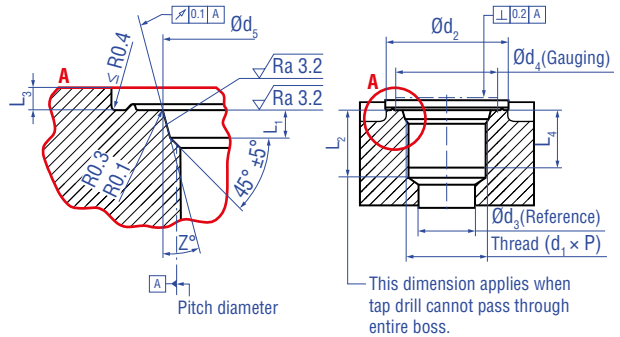


Fig. 24: Possibilities of sealing

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°
Optional sensor rod HD									
M18×1.5	55	≥ 16	24.5	19.8	2.4	28.5	2	26	15°



Controlling design dimensions are in millimeters

Fig. 25: Notice for metric threaded flange M18×1.5-6g based on DIN ISO 6149-1

Installation of RF5 sensor with HFP profile

The RF5 sensor with HFP profile can be installed in any position. The HFP profile 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. 26). 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.

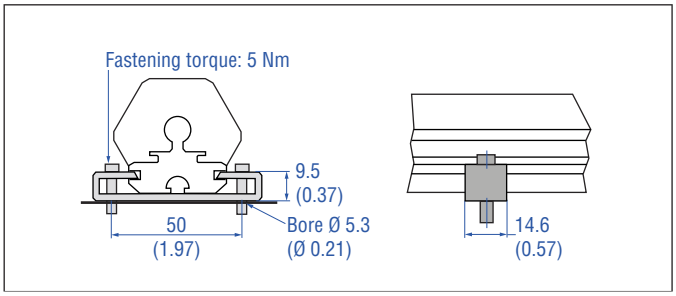


Fig. 26: Mounting clamps (part no. 400 802) with cylinder screw M5×20

3. RF5-B with threaded flange M18×1.5-6g (part no. 404 874) or threaded flange ¾"-16 UNF-3A (part no. 404 875)

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

- Threaded flange M18×1.5-6g (part no. 404 874): 65 Nm
- Threaded flange ¾"-16 UNF-3A (part no. 404 875): 50 Nm

Lightly oil the thread before tightening.

- Insert the flexible sensor rod in a support tube.
- When inserting the flexible sensor rod, hold it close to the flange and insert it slowly into the support tube (Fig. 20). This allows air in the support tube to escape.
- Mount the sensor via flange using the three M4×59 hexagon socket screws made of non-magnetic material. Tightening torque: 1.4 Nm (Fig. 21). Remove the three knurled nuts beforehand.
- Ensure that the O-ring seal (part no. 562 003) is correctly inserted in the groove on the sensor electronics housing before inserting the base unit into the support tube and attaching the sensor electronics (Fig. 22).

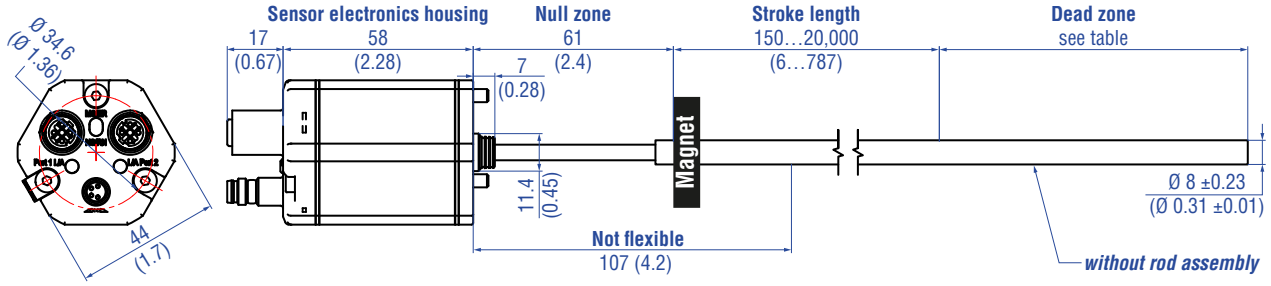
NOTICE

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. 74).
- Embed the flexible sensor element in an appropriately shielded environment, e.g. in a sensor rod HD/HL/HP or HFP profile.

4.6 Installation and design of Temposonics® RFV

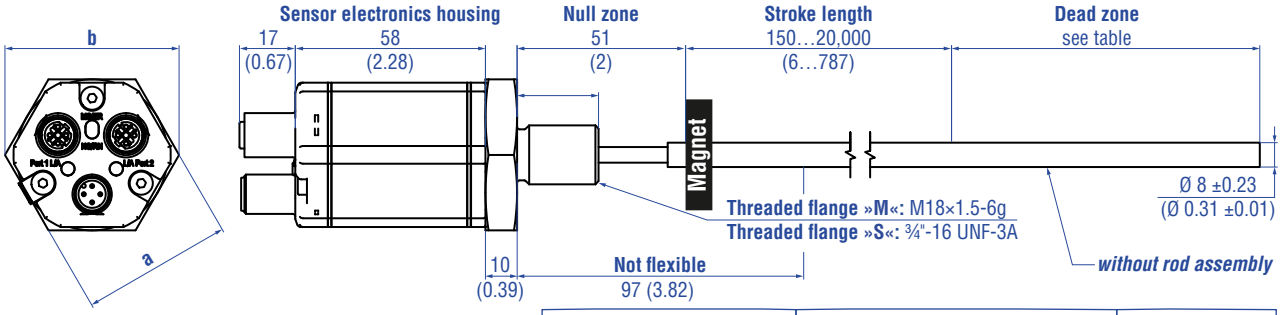
RFV-B – RFV base unit (without flange & rod assembly), example: Connection type D56 (connector outlet)



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 (without rod assembly), 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. 27: 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. sensor 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. 28). 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. 29).
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.

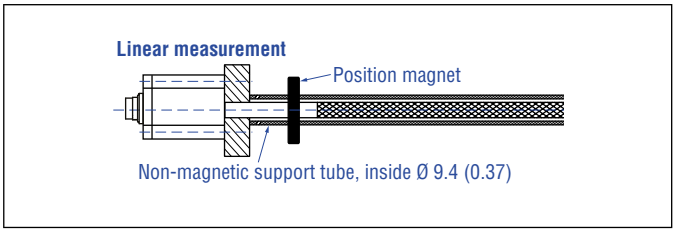


Fig. 28: Sensor with support tube

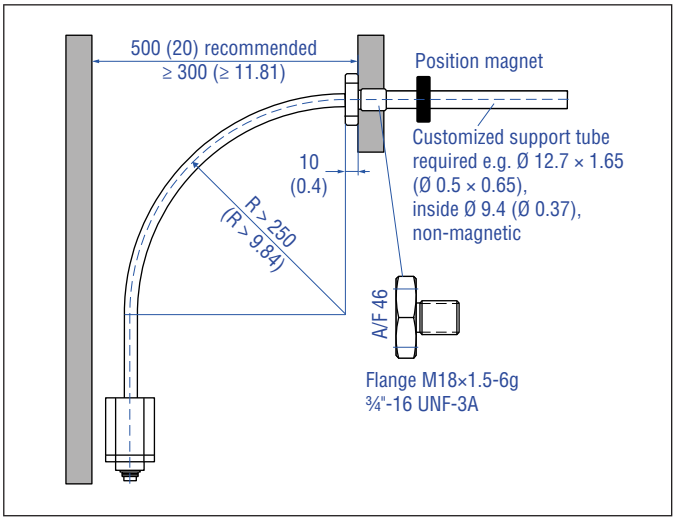


Fig. 29: Clearances for installation and handling

Mounting the RFV

1. RFV-B

- Insert the flexible sensor rod in a support tube.
- Mount the sensor electronics housing by means of three non-magnetic socket head screws M4×59. Fastening torque: 1.4 Nm (Fig. 30). Secure the screws, e.g. using Loctite 243, before re-installing.
  Recommendation: Seal the sensor via flange.

2. RFV-B with sensor 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 three non-magnetic socket head screws M4×59. Fastening torque: 1.4 Nm (Fig. 30). 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.

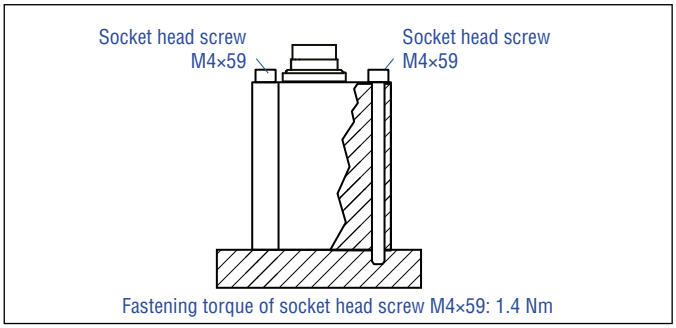


Fig. 30: Mounting with socket head screws M4×59

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. 74).
- Embed the flexible sensor element in an appropriately shielded environment, e.g. in a sensor rod HD/HL/HP or HFP profile.

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

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

Fix the sensor rod via threaded flange M18×1.5-6g or ¾"-16 UNF-3A. Note the fastening torque shown in Fig. 31. Lightly oil the thread before tightening.

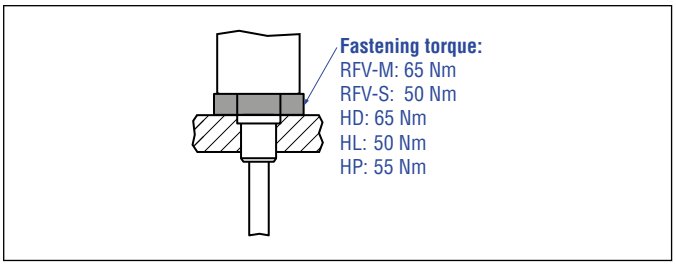


Fig. 31: Mounting example of threaded flange

Installation of RFV sensor with sensor 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 three screws. It is the only part that needs to be replaced if servicing is required, i.e. the hydraulic circuit remains closed. Before inserting the base unit into the sensor rod HD/HL/HP, remove the red sealing at the transition between the sensor electronics housing and the flexible sensor rod (Fig. 32). For more information see chapter “4.10.1 Replacement of base unit on the RH5/RFV/RF5 model” on page 40.
- 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 sensor 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.

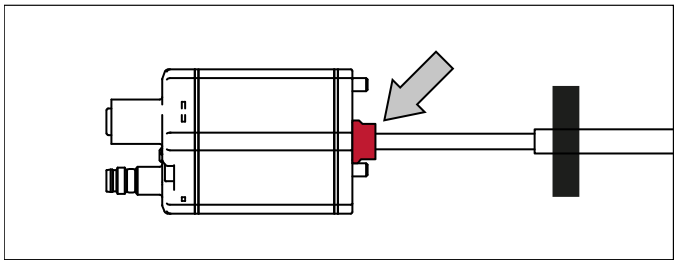


Fig. 32: Remove sealing before inserting into sensor rod HD/HL/HP

Hydraulics sealing when using an RFV sensor in a sensor rod HD/HL/HP

There are two ways to seal the flange contact surface (Fig. 33):

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 cap groove.
2. A sealing by using an O-ring in the flange undercut.
   For threaded flange (¾"-16 UNF-3A) »S«: O-ring 16.4 × 2.2 mm (0.65 × 0.09 in.) (part no. 560 315)
   For threaded flange (M18×1.5-6g) »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. 34). See ISO 6149-1 for further information.

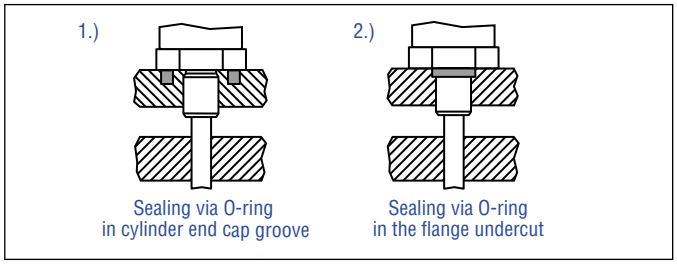
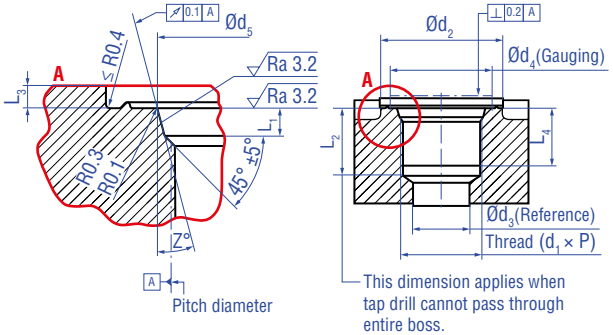


Fig. 33: Possibilities of sealing

For additional information about the accessories HFP profile and sensor rod HD/HL/HP see the accessories catalog document (part number: 551444).

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°
RFV-M/optional sensor rod HD									
M18×1.5	55	≥ 16	24.5	19.8	2.4	28.5	2	26	15°



Controlling design dimensions are in millimeters

Fig. 34: Notice for metric threaded flange M18×1.5-6g based on DIN ISO 6149-1

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

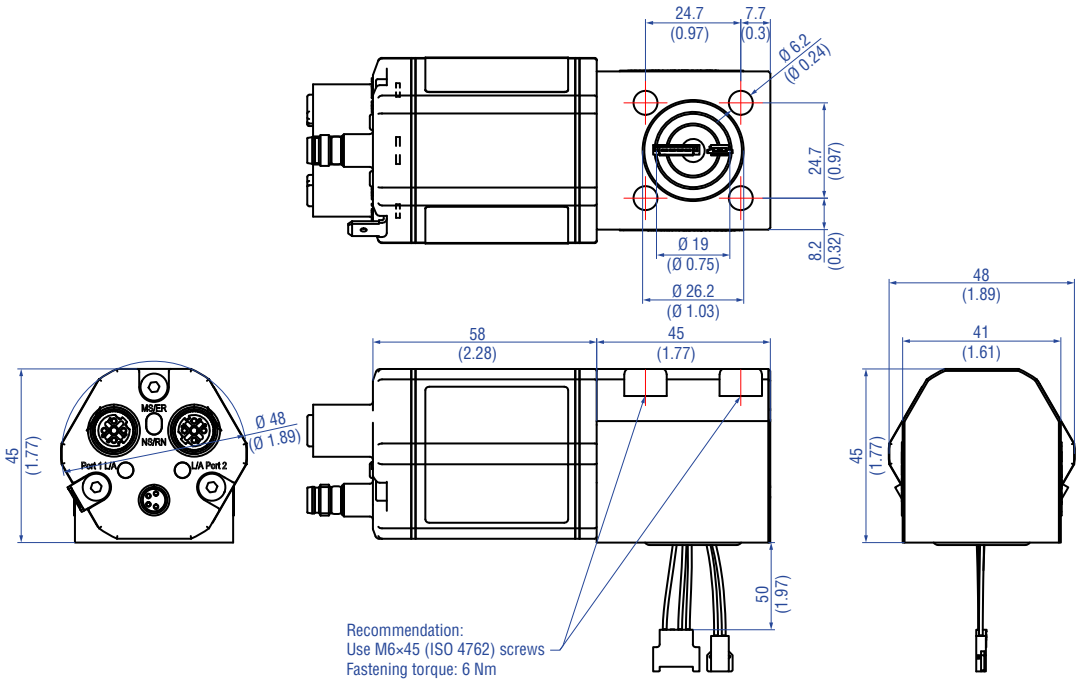
Replacing an R-Series 2004 RF-C with an R-Series V RFV-B

If you are replacing the R-Series 2004 RF-C base unit with the R-Series V RFV-B base unit, note the following points:

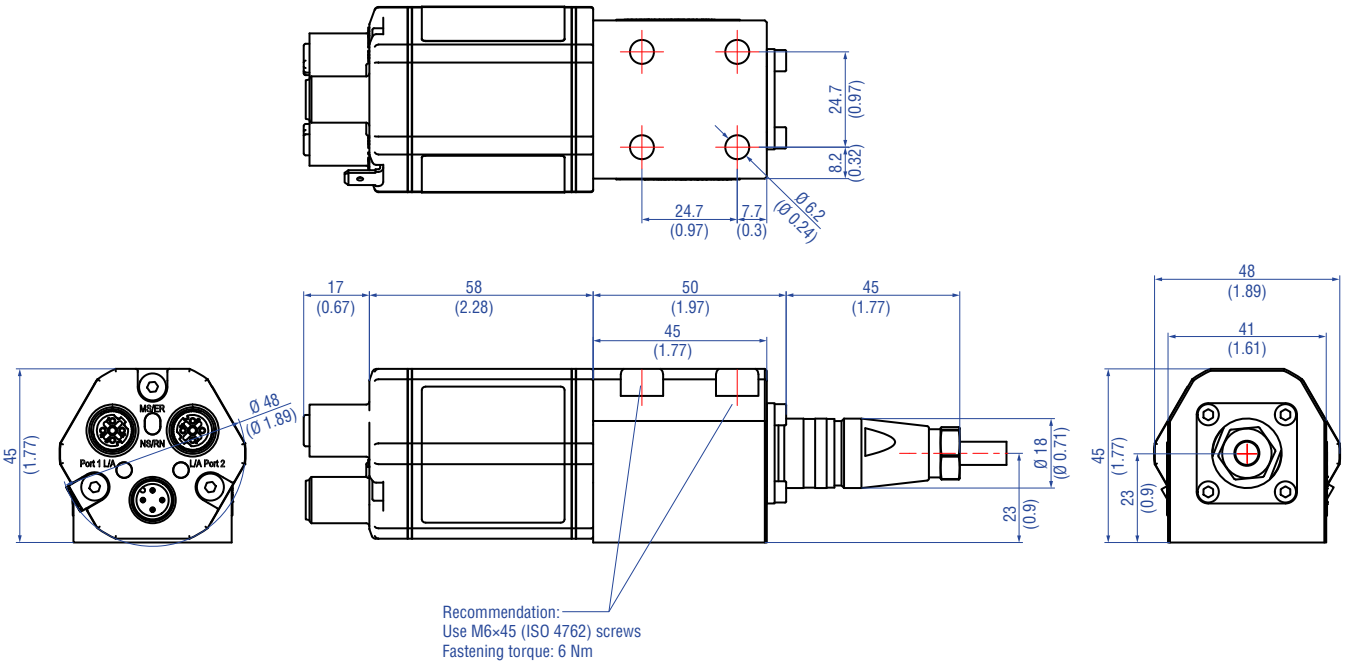
- The R-Series 2004 RF-C base unit is attached to the system with two screws. The R-Series V RFV-B base unit is mounted to the machine with three screws.
- Therefore, we recommend using the adapter plate kit 255198. The adapter plate is used to mount the base unit RFV-B with three screws to the existing hole pattern with two screws.
    - Fasten the adapter plate to the existing hole pattern using the two M4×6 (A/F 2.5) socket head screws with a fastening torque of 1.4 Nm. Ensure that the O-ring is correctly seated between the system and the adapter plate. Secure the screws with Loctite 243.
    - Place the RFV-B base unit on the adapter plate.
    - Attach the ground lug to one screw of the base unit.
    - Screw the RFV-B base unit to the adapter plate using the three M4×59 hexagon socket head (A/F 2.5) with a fastening torque of 1.4 Nm. Ensure that the O-ring is correctly seated between the base unit and the adapter plate. Secure the screws with Loctite 243.
- The adapter plate has a thickness of 5 mm. Order the RFV-B base unit with the addition H003 to compensate for the thickness of the adapter plate: RFV-B-xxxxxx-…-H003

4.7 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)

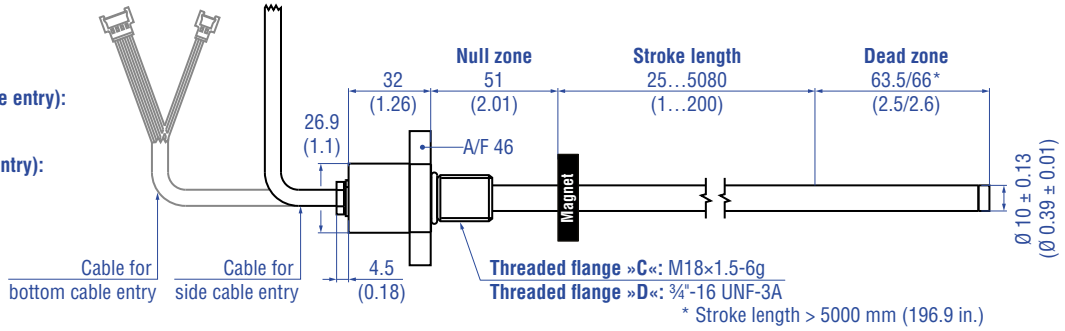


Controlling design dimensions are in millimeters and measurements in ( ) are in inches

Fig. 35: Temposonics® RDV sensor electronics housing

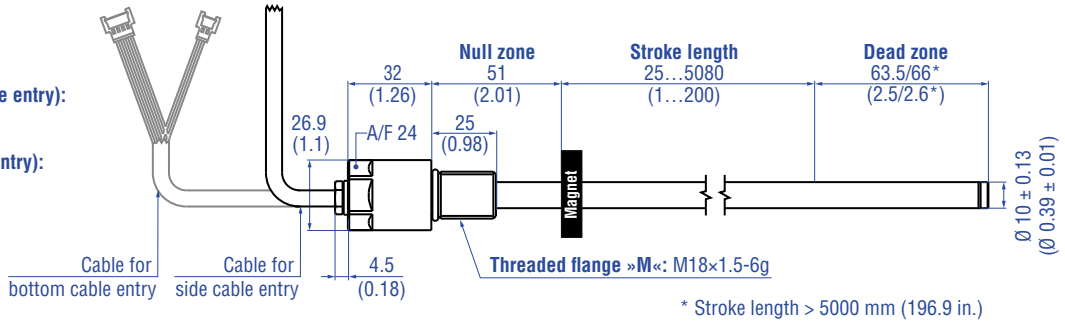
Threaded flange »C« & »D« (for bottom or side cable entry)

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)



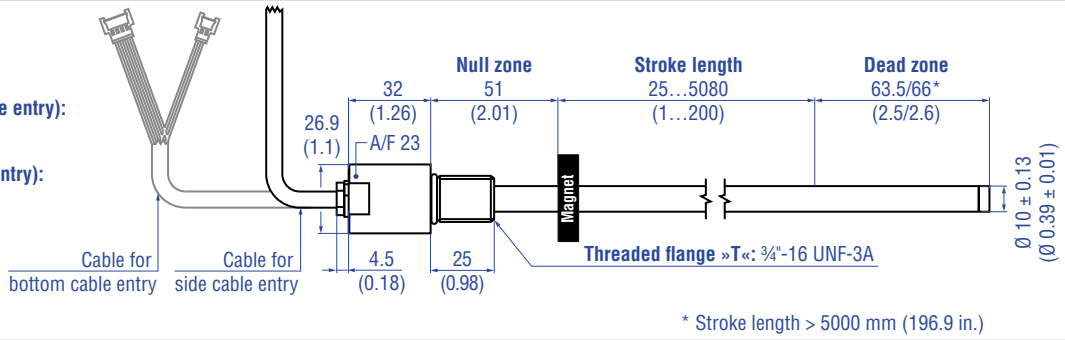
Threaded flange »M« (for bottom or side cable entry)

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)



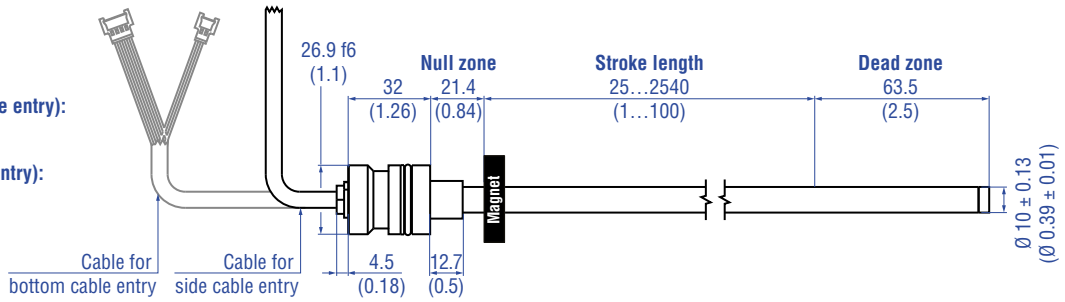
Threaded flange »T« (for bottom or side cable entry)

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)

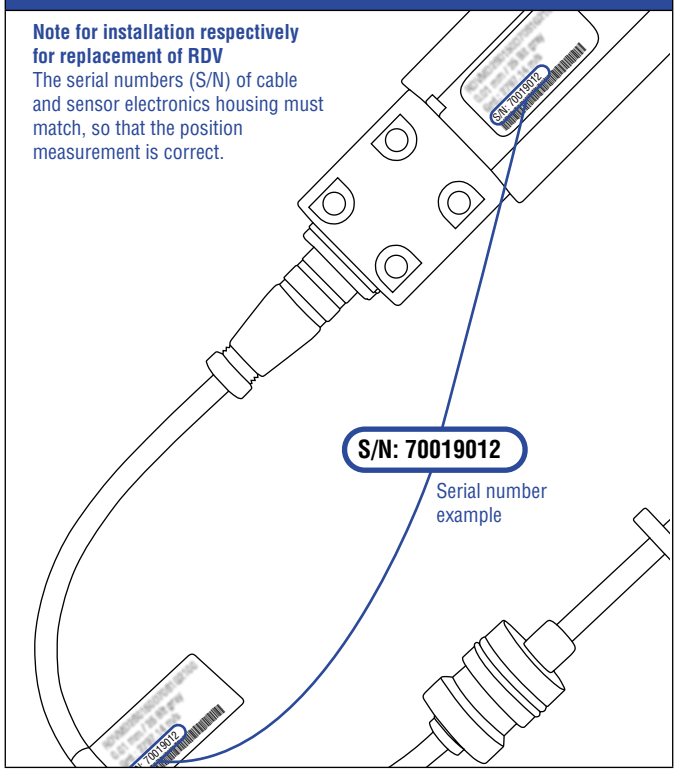


Controlling design dimensions are in millimeters and measurements in ( ) are in inches

Fig. 36: Temposonics® RDV flanges

NOTICE

Note for installation respectively for replacement of RDV
The serial numbers (S/N) of cable and sensor electronics housing must match, so that the position measurement is correct.



NOTICE

Mount the sensor as follows:
1. Mount the flange with sensor rod
2. Mount the sensor electronics housing
3. Connect the cable between flange and the sensor electronics housing

The steps mentioned above are explained in the following sections.

4.7.1 Installation of RDV with threaded flange

Fix the sensor rod via threaded flange M18×1.5-6g or ¾"-16 UNF-3A. Note the fastening torque shown in Fig. 37. Lightly oil the thread before tightening.

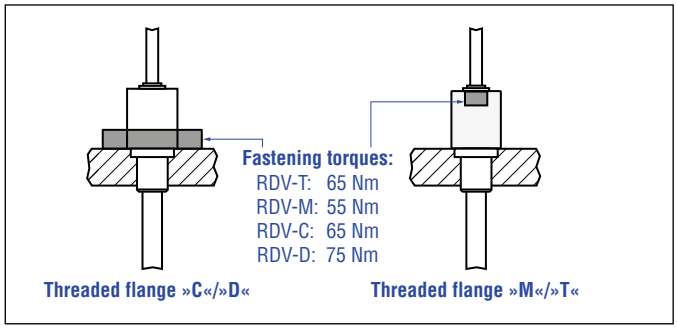


Fig. 37: Mounting example of threaded flange »C«/»D«, »M«/»T«

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. 38):

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. 39). See ISO 6149-1 for further information.

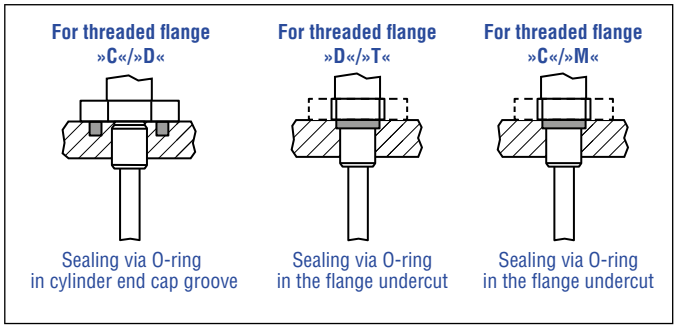
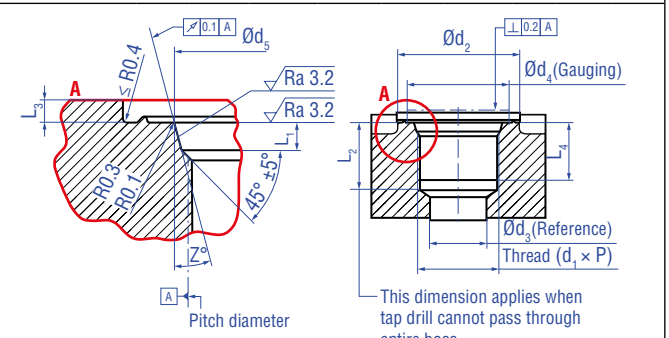


Fig. 38: Possibilities of sealing

- 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 (≥ Ø 13 mm (≥ Ø 0.51 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°
RDV-C									
M18×1.5	55	≥ 13	24.5	19.8	2.4	28.5	2	26	15°
RDV-M									
M18×1.5	30	≥ 13	24.5	19.8	2.4	28.5	2	26	15°



Controlling design dimensions are in millimeters

Fig. 39: Notice for metric threaded flange M18×1.5-6g based on DIN ISO 6149-1

4.7.2 Installation of RDV 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. 40). For details of the pressure fit flange »S« see Fig. 41. Also note the mounting examples in Fig. 42 and Fig. 43.

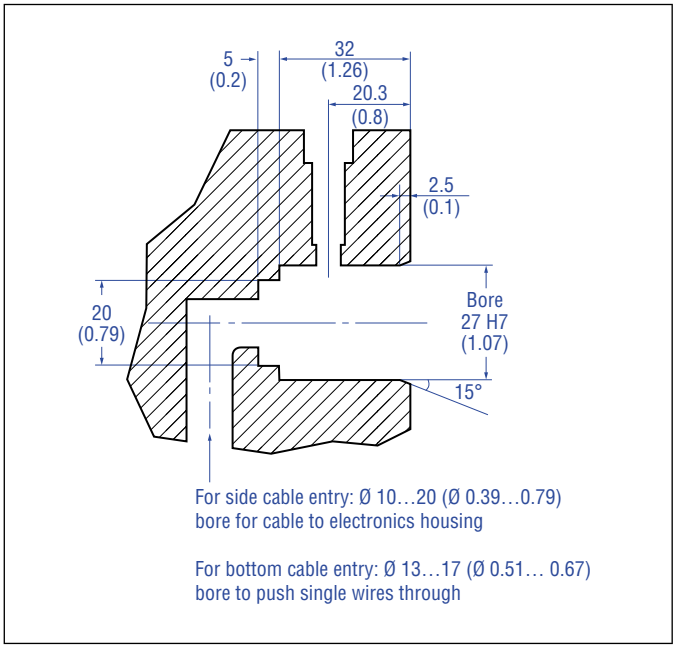


Fig. 40: Example of mounting detail: Shoulder screw 8-M6 (ISO 7379) with internal hexagon

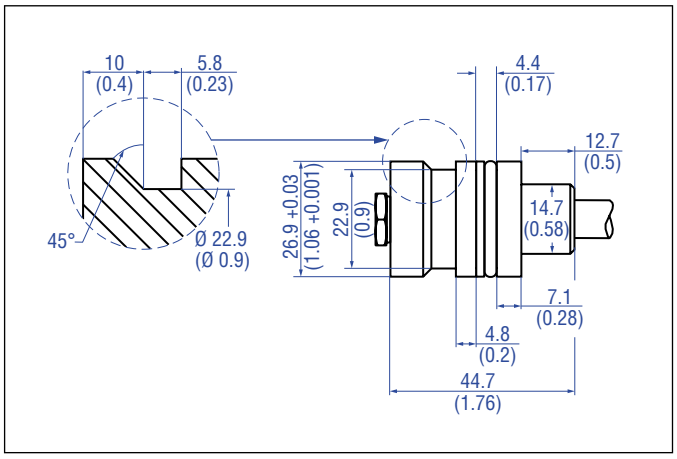


Fig. 41: Pressure fit flange »S« details

Note for cylinder installation:

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

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

4.7.3 Installation of RDV's sensor electronics housing

The following section explains the connection of an RDV sensor with bottom cable entry (Fig. 42) and side cable entry (Fig. 43) 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. 42). Note the bending radius of the cable if you run the cable between sensor electronics and rod (see Fig. 36).

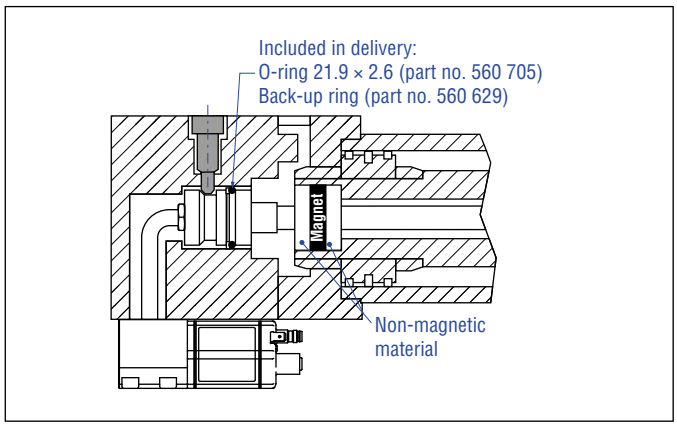


Fig. 42: Mounting example of pressure fit flange »S« and sensor electronics with bottom cable entry

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. 43). Note the bending radius of the cable if you run the cable between sensor electronics and rod (see Fig. 43).

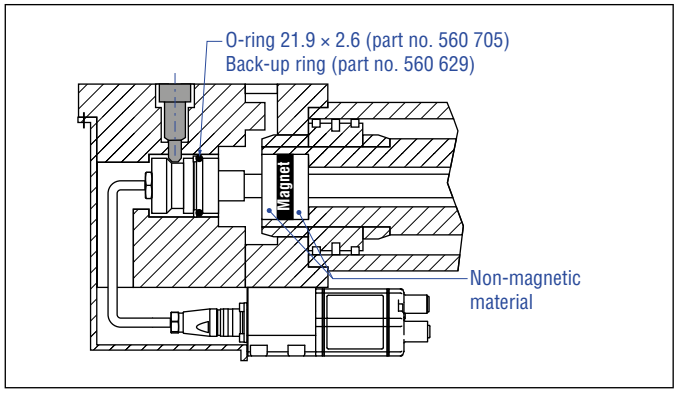


Fig. 43: Mounting example of pressure fit flange »S« and sensor electronics with side cable entry

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. 74).
- 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.

4.7.4 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.

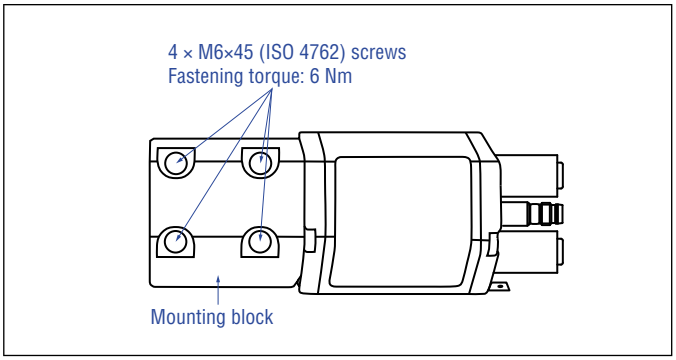


Fig. 44: Mounting of RDV sensor electronics housing (example of bottom cable entry)

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

4.8 Magnet installation

Typical use of magnets

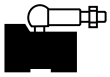
Magnet	Typical sensors	Benefits
Ring magnets 	**Rod model** (RH5, RM5, RF5, RFV, RDV)	• Rotationally symmetrical magnetic field
U-magnets 	**Profile & rod models** (RP5, RH5, RM5, RF5, RFV, RDV)	• Height tolerances can be compensated, because the magnet can be lifted off
Block magnets 	**Profile & rod models** (RP5, RH5, RM5, RF5, RFV, RDV)	• Height tolerances can be compensated, because the magnet can be lifted off
Magnet sliders 	**Profile models** (RP5)	• 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. 45: Typical use of magnets

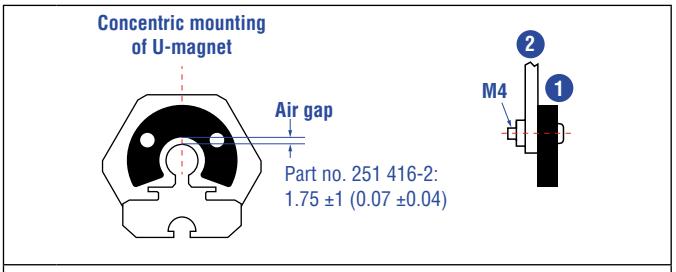
Mounting ring magnets, U-magnets & block magnets

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. 48)
- If no other option exists and magnetic material is used, observe the specified dimensions (Fig. 48)

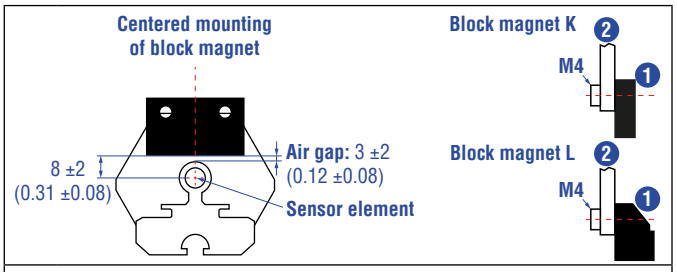
NOTICE

- Mount ring magnets and U-magnets concentrically.
- Mount block magnets centrically over the sensor rod or the sensor profile.
- The maximum permissible air gap must not be exceeded (Fig. 46/ Fig. 47). 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.



1	U-magnet
2	Non-magnetic mounting plate

Fig. 46: Mounting of U-magnet (part no. 251 416-2)



1	Block magnet
2	Non-magnetic mounting plate

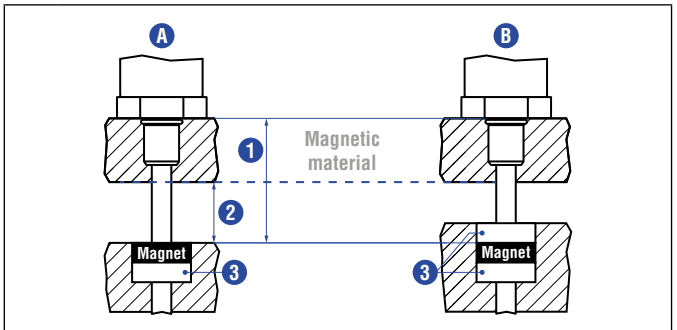
Fig. 47: Mounting of block magnet K (part no. 251 298-2) and block magnet L (part no. 403 448)

Magnet mounting with magnetic material

When using magnetic material the dimensions of Fig. 48 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.



1	Null zone, depends on sensor model
2	Distance between position magnet and any magnetic material (≥ 15 mm (≥ 0.6 in.))
3	Non-magnetic spacer (≥ 5 mm (≥ 0.2 in.)) – Recommendation: 8 mm (0.31 in.)

Fig. 48: Installation with magnetic material

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

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. 49) for measurement.

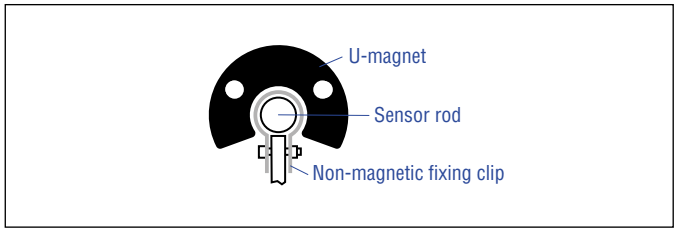
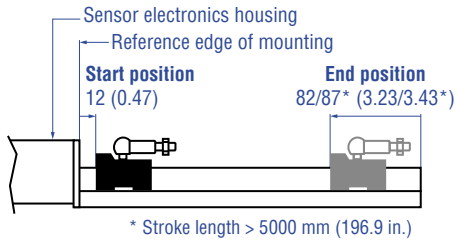


Fig. 49: Example of sensor support with the fixing clip (part no. 561 481)

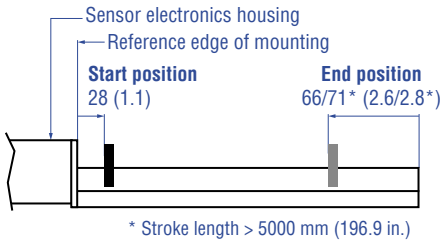
Start- and end positions of the position magnets

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.

RP5 with magnet slider "S", "N", "V", "G"



RP5 with U-magnet



RP5 with block magnet

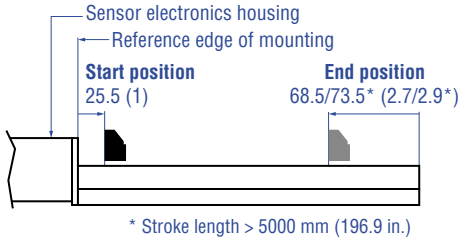
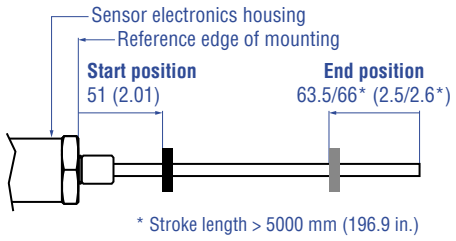


Fig. 50: Start- and end positions of magnets for RP5

RH5 with ring magnet/U-magnet



RH5 with block magnet

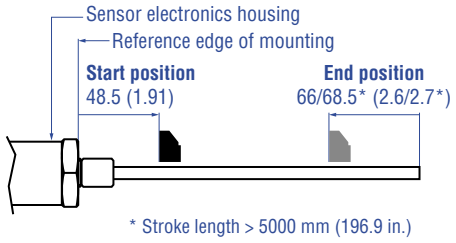
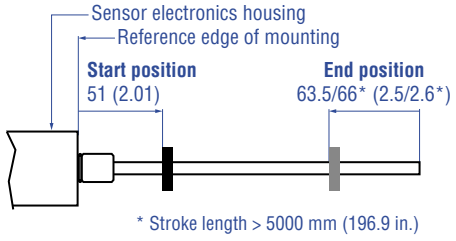


Fig. 51: Start- and end positions of magnets for RH5

RM5 with ring magnet/U-magnet



RM5 with block magnet

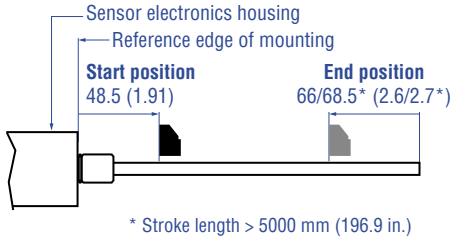
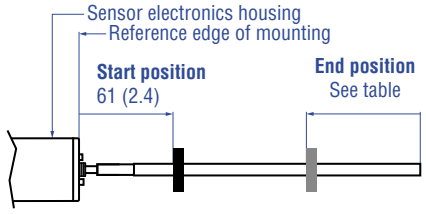


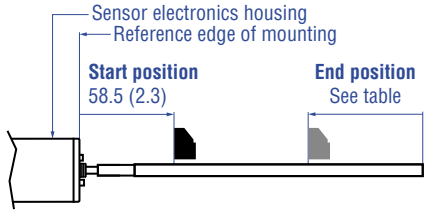
Fig. 52: Start- and end positions of magnets for RM5

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

RF5-B with ring magnet/U-magnet



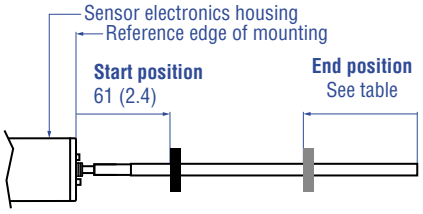
RF5-B with block magnet



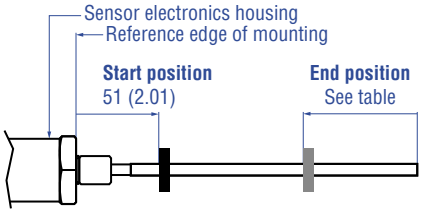
Stroke length	Tolerance of total length	Dead zone
Up to 7620 mm (300 in.)	±5 mm (0.20 in.)	94 mm (3.7 in.)
Up to 10,000 mm (393.7 in.)	±10 mm (0.39 in.)	100 mm (3.94 in.)
Up to 15,000 mm (590.55 in.)	±15 mm (0.59 in.)	120 mm (4.72 in.)
Up to 20,000 mm (787 in.)	±20 mm (0.79 in.)	140 mm (5.51 in.)

Fig. 53: Start- and end positions of magnets for RF5

RFV-B with ring magnet/U-magnet



RFV-M/S with ring magnet/U-magnet

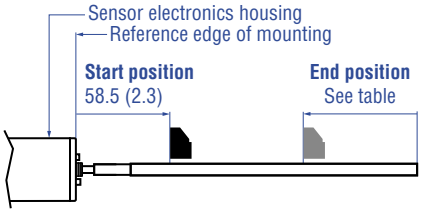


Stroke length	Tolerance of total length	Dead zone
Up to 7620 mm (300 in.)	+8 mm (0.31 in.)/ –5 mm (0.2 in.)	94 mm (3.7 in.)
Up to 10,000 mm (393.7 in.)	+15 mm (0.59 in.)/ –15 mm (0.59 in.)	100 mm (3.94 in.)
Up to 15,000 mm (590.55 in.)	+15 mm (0.59 in.)/ –30 mm (1.18 in.)	120 mm (4.72 in.)
Up to 20,000 mm (787 in.)	+15 mm (0.59 in.)/ –45 mm (1.77 in.)	140 mm (5.51 in.)

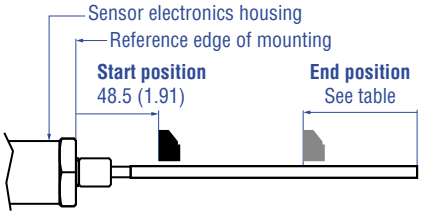
Fig. 54: Start- and end positions of magnets for RFV with ring- and U-magnets

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

RFV-B with block magnet



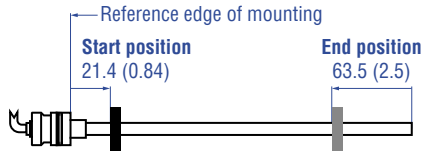
RFV-M/S with block magnet



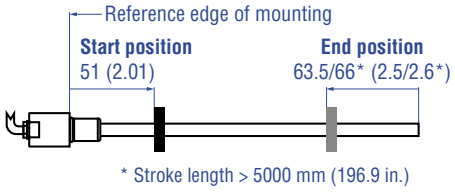
Stroke length	Tolerance of total length	Dead zone
Up to 7620 mm (300 in.)	+8 mm (0.31 in.)/ –5 mm (0.2 in.)	94 mm (3.7 in.)
Up to 10,000 mm (393.7 in.)	+15 mm (0.59 in.)/ –15 mm (0.59 in.)	100 mm (3.94 in.)
Up to 15,000 mm (590.55 in.)	+15 mm (0.59 in.)/ –30 mm (1.18 in.)	120 mm (4.72 in.)
Up to 20,000 mm (787 in.)	+15 mm (0.59 in.)/ –45 mm (1.77 in.)	140 mm (5.51 in.)

Fig. 55: Start- and end positions of magnets RFV with block magnets

RDV-S with ring magnet/U-magnet



RDV-M/T with ring magnet/U-magnet



RDV-C/D with ring magnet/U-magnet

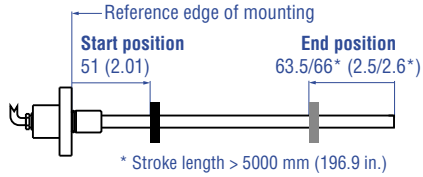
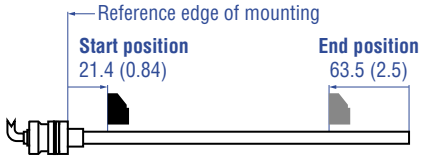
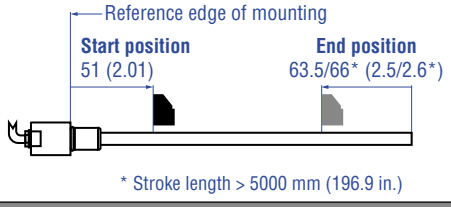


Fig. 56: Start- and end positions of magnets RDV with ring- and U-magnets

RDV-S with block magnet



RDV-M/T with block magnet



RDV-C/D with block magnet

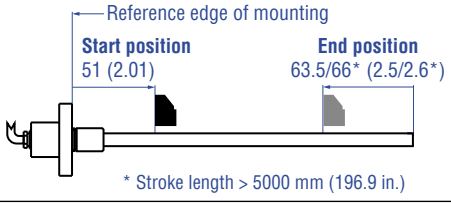


Fig. 57: Start- and end positions of magnets RDV with block magnets

NOTICE

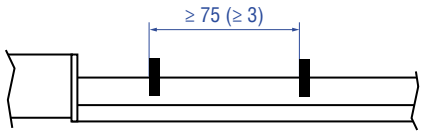
On all sensors, the areas left and right of the active stroke length are provided for null and dead zone. These zones should not be used for measurement, however the active stroke length can be exceeded.

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

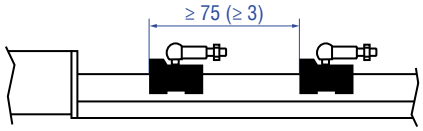
Multi-position measurement

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

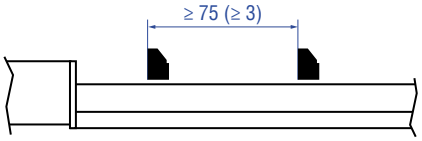
RP5 with U-magnets



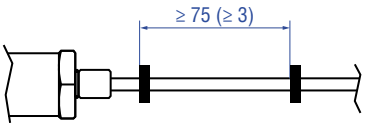
RP5 with magnet sliders



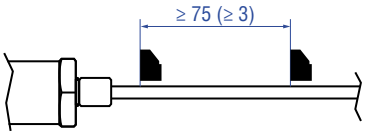
RP5 with block magnets



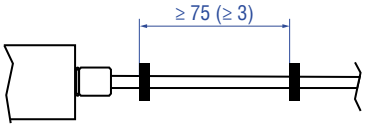
RH5/RF5/RFV with ring magnets/U-magnets



RH5/RF5/RFV with block magnets



RM5 with ring magnets/U-magnets



RM5 with block magnets

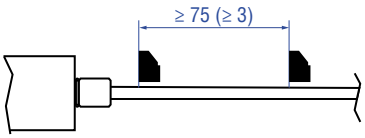
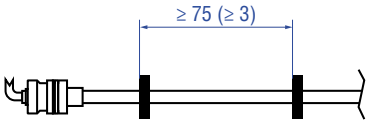


Fig. 58: Minimum distance for multi-position measurement (RH5, RP5, RF5, RFV, RM5)

RDV with ring magnets/U-magnets



RDV with block magnets

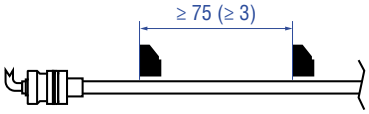


Fig. 59: Minimum distance for multi-position measurement (RDV)

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

4.9 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, RM5 and RDV only
- U-magnet OD33 (part no. 254 226)
- Ring magnet OD25.4 (part no. 253 621), for RH5, RM5 and 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. 60, Fig. 61, Fig. 62, Fig. 63 and Fig. 64).

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.

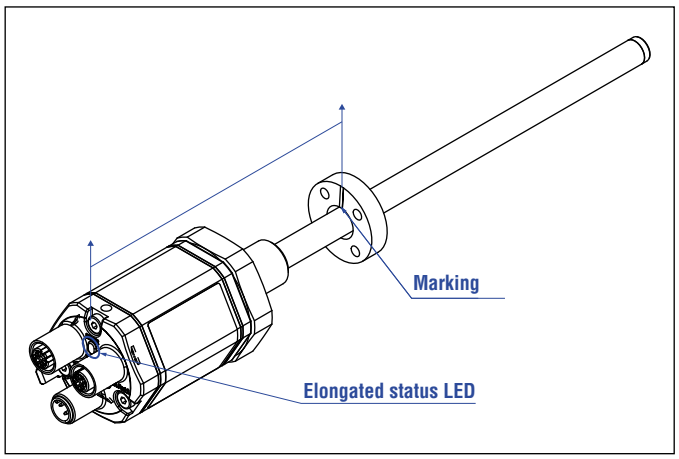


Fig. 60: Magnet alignment of ring magnet for RH5 EtherNet/IP™ with internal linearization

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.

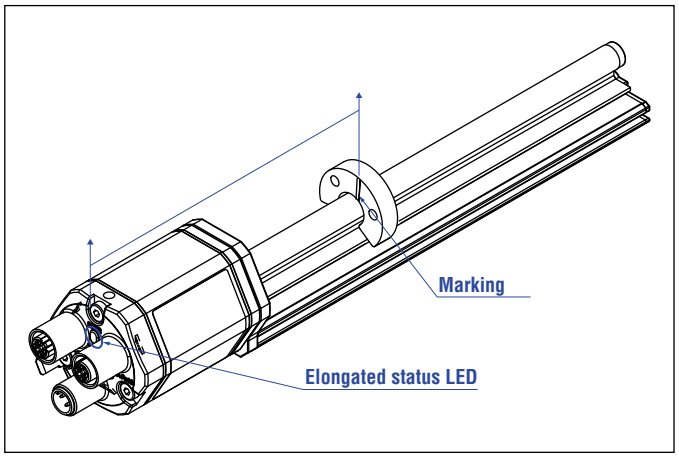


Fig. 61: Magnet alignment of U-magnet for RP5 EtherNet/IP™ with internal linearization

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.

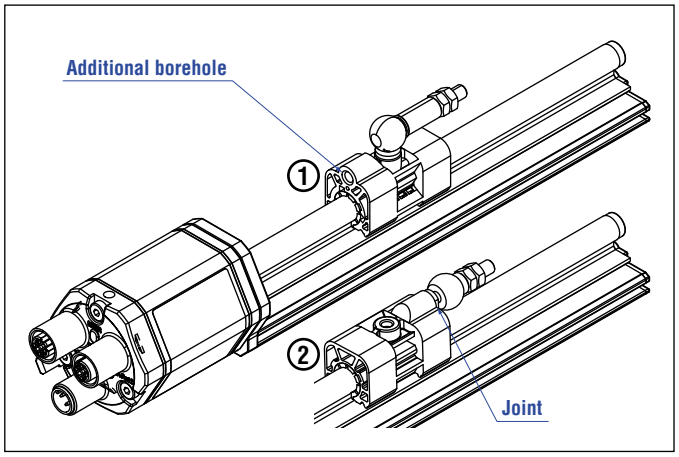


Fig. 62: Magnet alignment of magnet slider for RP5 EtherNet/IP™ with internal linearization

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.

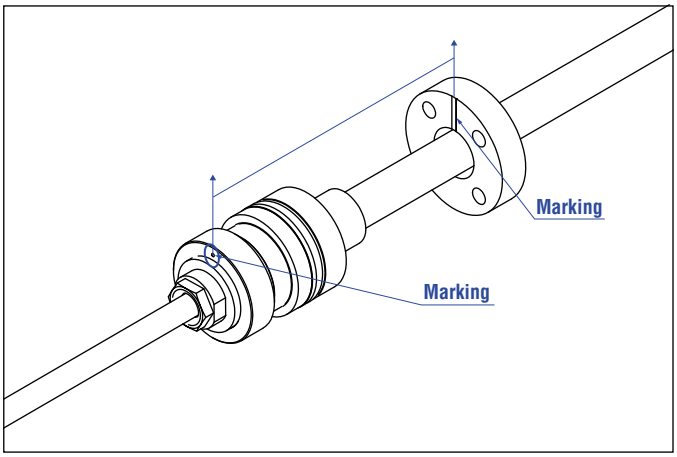


Fig. 63: Magnet alignment of ring magnet for RDV EtherNet/IP™ with internal linearization using the example of a »S« flange

For RM5 EtherNet/IP™ sensors with ring magnet/U-magnet applies:

- Install the magnet so that the marking on the magnet faces the super shield housing.
- The line on the magnet points in the same direction as the marking on the super shield housing.

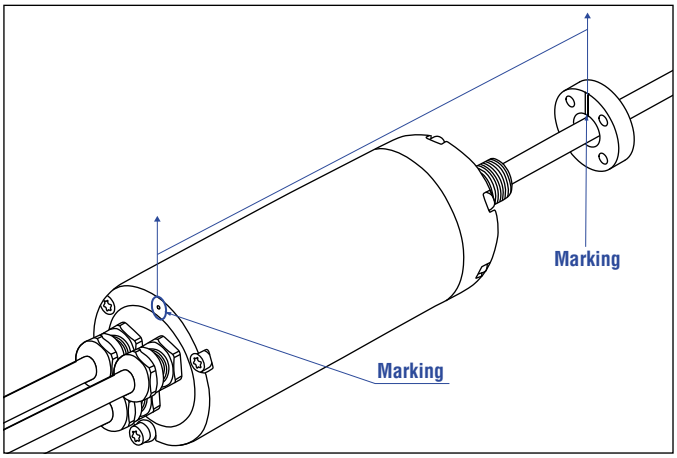


Fig. 64: Magnet alignment of ring magnet for RM5 EtherNet/IP™ with internal linearization

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

- Supply voltage +24 VDC ± 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

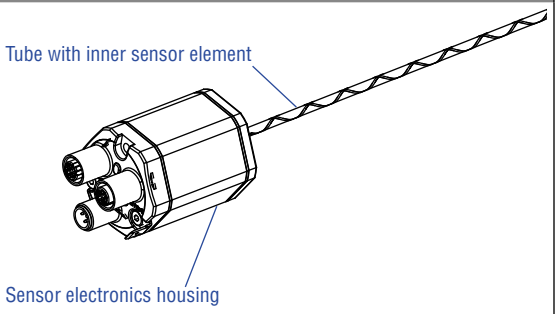
The generated linearization might deviate from the linearity tolerances regarding different environmental conditions. In addition, the use of a different position magnet or more position magnets may cause differences.

4.10 Replacement of base unit

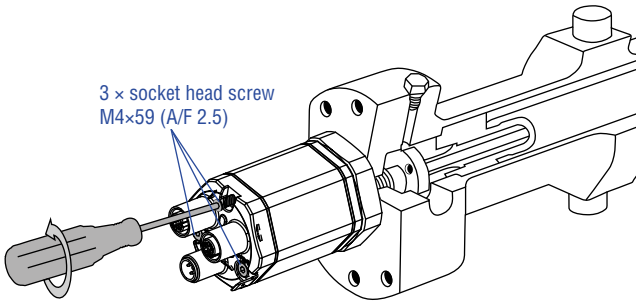
4.10.1 Replacement of base unit on the RH5/RFV/RF5 model

The base unit of the sensor model RH5 (RH5-B) is replaceable as shown in Fig. 65 and Fig. 66 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/RF5-B sensor, which is installed in the optional HD, HL and HP sensor rod.

Base unit



1. Loosen the screws.



2. Pull out the base unit.

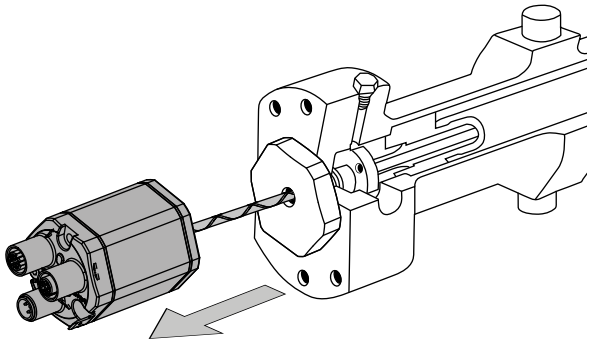


Fig. 65: Replacement of the base unit (e.g. RH5 sensor), part 1

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

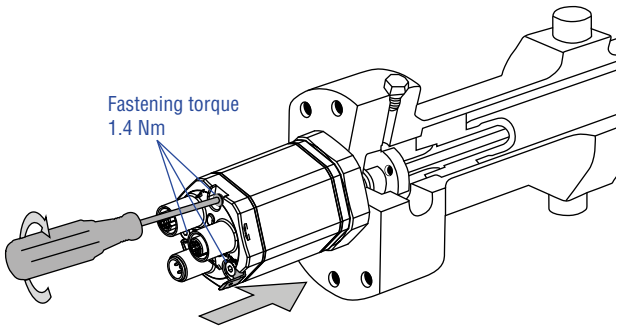


Fig. 66: Replacement of the base unit (e.g. RH5 sensor), part 2

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 (part no. 562 003) is correctly fitted between the flange and the base unit.
- The O-ring is secured with an adhesive strip. Remove the adhesive strip before tightening before reinstalling the base unit (see illustration “Remove adhesive strips”).

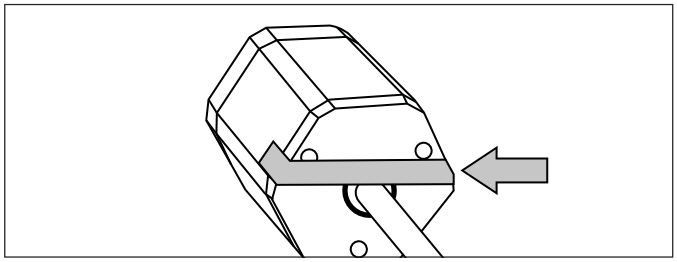


Fig. 67: Remove adhesive strips

Remove the transport cap at the end of the flexible sensor element before installing an RH5-B-F (Fig. 67). Slowly push the flexible sensor element into the sensor rod so that the air inside the rod can escape. Observe the minimum bending radius of 100 mm and the instructions for handling and installing an RF5 in chapter 4.5.

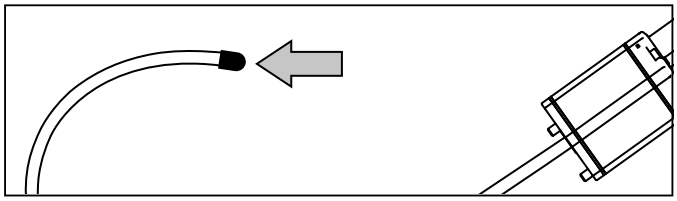


Fig. 68: Remove the transport cap from the RH5-B-F before installation

4.10.2 Replacement of base unit on the RM5 model

A base unit RM5-B is installed in the super shield housing of the RM5 (Fig. 69). The base unit can be replaced without interrupting the hydraulic circuit.

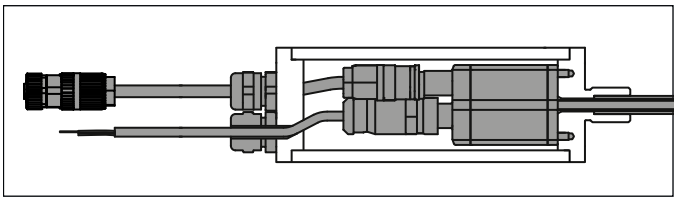
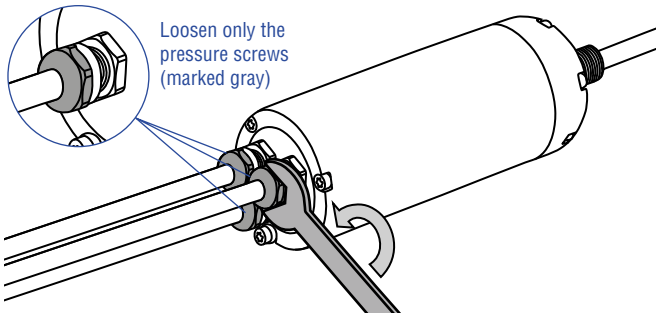
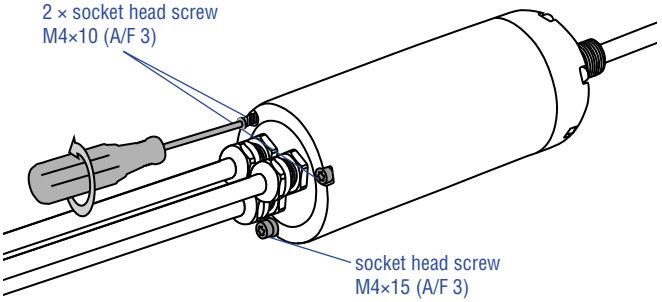


Fig. 69: Base unit in the super shield housing of the RM5

1. Loosen the pressure screws of the cable glands.



2. Loosen the screws in the cover of the super shield housing.



**3. Pull the cover off the super shield housing.
While doing so, push the cables through the cable glands.**

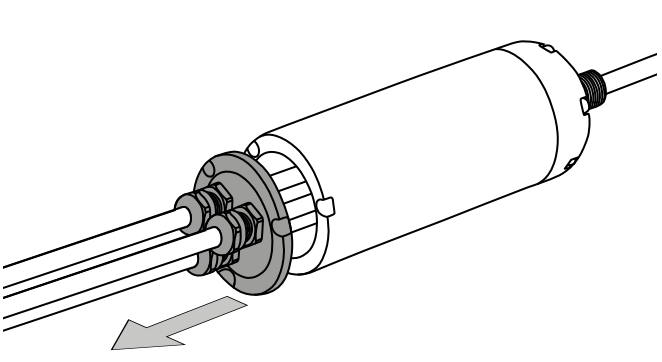
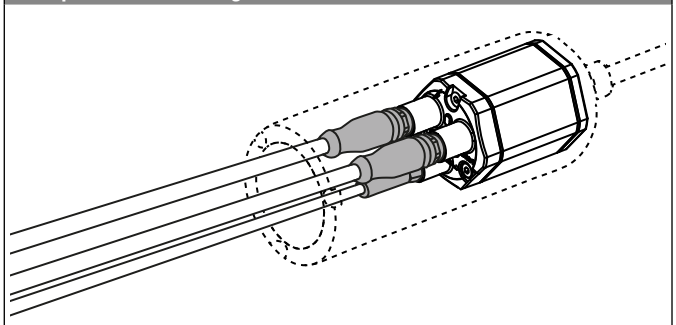
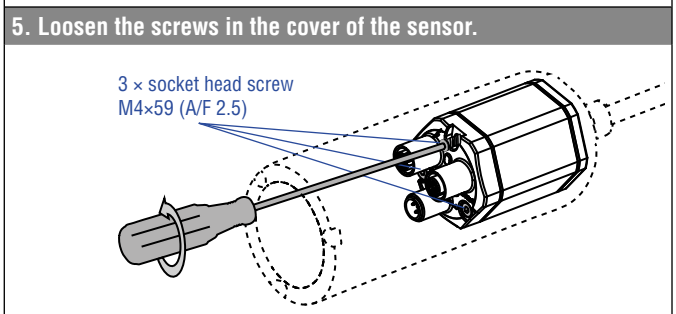


Fig. 70: Replacement of the base unit on model RM5, part 1

4. Disconnect the connectors from the base unit inside the super shield housing.



5. Loosen the screws in the cover of the sensor.



6. Pull out the base unit.

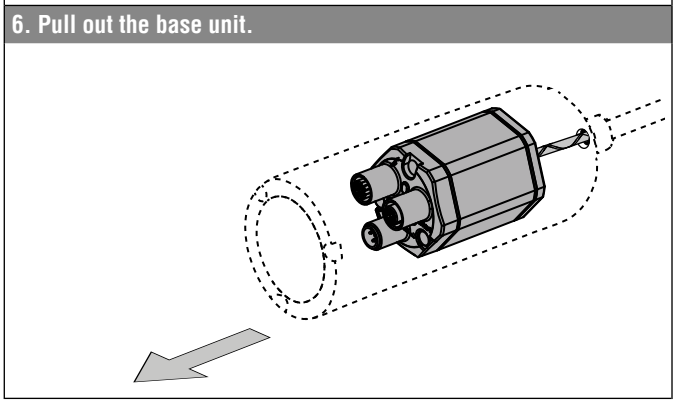
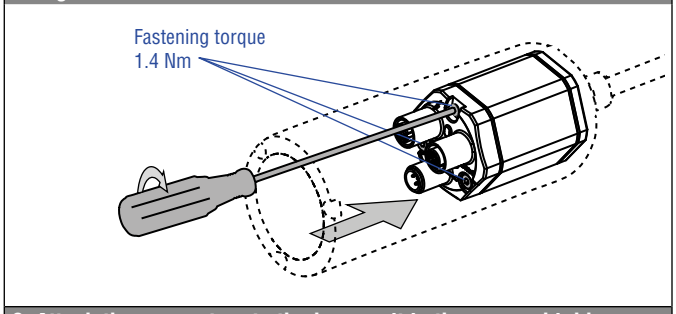


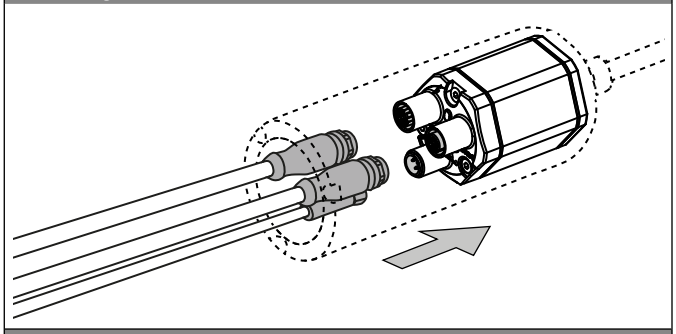
Fig. 71: Replacement of the base unit on model RM5, part 2

Continued on next page

7. Insert the new base unit.
Screw the base unit tight.
Secure the screws of the base unit before re-installing, e.g. with Loctite 243.



8. Attach the connectors to the base unit in the super shield housing.



9. Place the lid on the super shield housing.
Screw the lid tight.
Secure the screws of the lid before reassembly, e.g. with Loctite 243.

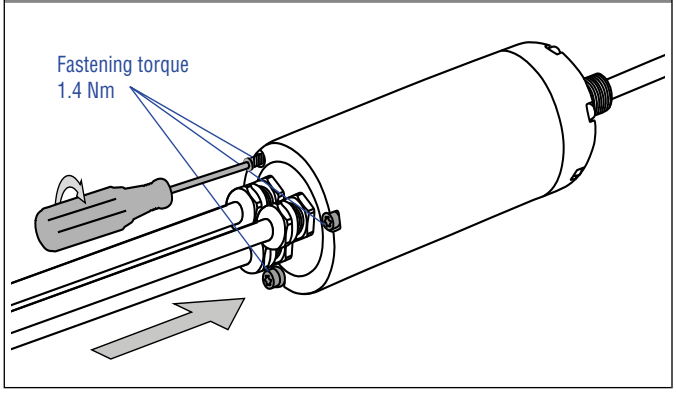


Fig. 72: Replacement of the base unit on model RM5, part 3

10. Carefully pull the excess cables out of the super shield housing. Tighten the pressure screw (marked gray) of the cable glands until the sealing insert and pressure screw are at the same height.
Secure the cable glands before reassembly, e.g. with Loctite 243.

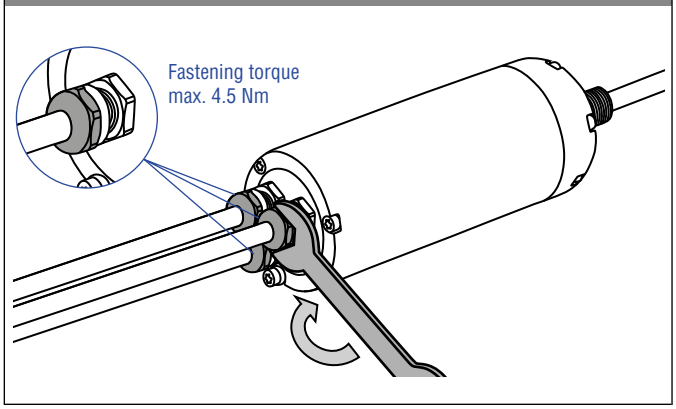


Fig. 73: Replacement of the base unit on model RM5, part 4

NOTICE

When replacing the base unit, make sure that no humidity enters the sensor tube. This may damage the sensor.

4.11 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. 74. Note the installation example for grounding an RM5 sensor in Fig. 75. In addition you can ground the sensor types RH5, RM5, RF5 and RFV via thread.

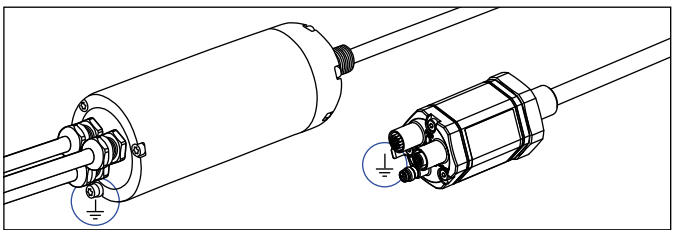


Fig. 74: Grounding via ground lug on the example of an RM5 sensor (left)/RH5 sensor (right)

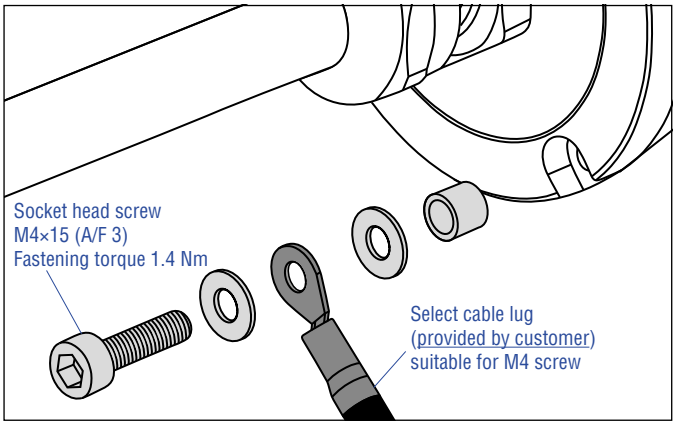


Fig. 75: Installation example for grounding of RM5 sensor

NOTICE

Secure the socket head screw before reassembly, e.g. with Loctite 243.

Connector wiring

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

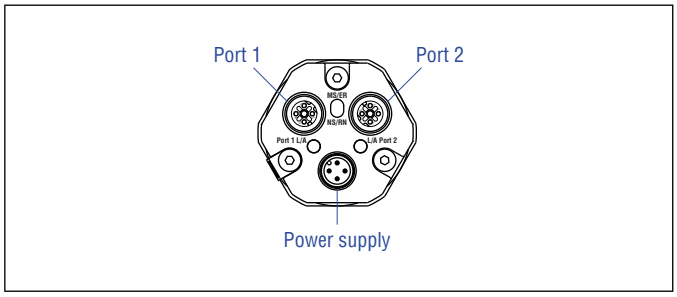


Fig. 78: Location of connections

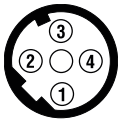
D56		
Port 1 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
 View on sensor	1	Tx (+)
	2	Rx (+)
	3	Tx (–)
	4	Rx (–)
Port 2 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
 View on sensor	1	Tx (+)
	2	Rx (+)
	3	Tx (–)
	4	Rx (–)
Power supply		
M8 male connector	**Pin**	**Function**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

Fig. 76: Connector wiring D56

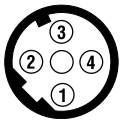
D58		
Port 1 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
 View on sensor	1	Tx (+)
	2	Rx (+)
	3	Tx (–)
	4	Rx (–)
Port 2 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
 View on sensor	1	Tx (+)
	2	Rx (+)
	3	Tx (–)
	4	Rx (–)
Power supply		
M12 male connector (A-coded)	**Pin**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

Fig. 77: Connector wiring D58

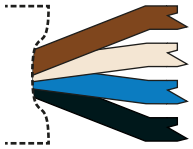
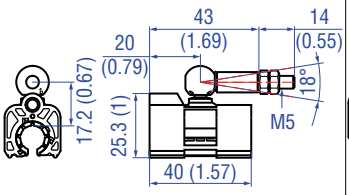
MXX		
Port 1 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
 View on sensor	1	Tx (+)
	2	Rx (+)
	3	Tx (–)
	4	Rx (–)
Port 2 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
 View on sensor	1	Tx (+)
	2	Rx (+)
	3	Tx (–)
	4	Rx (–)
Power supply		
Cable	**Color**	**Function**
	BN	+12…30 VDC (±20 %)
	WH	Not connected
	BU	DC Ground (0 V)
	BK	Not connected

Fig. 79: Connector wiring MXX

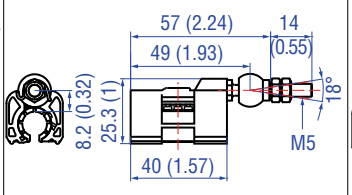
4.12 Frequently ordered accessories for Temposonics® RP5 – Additional options see Accessories Catalog 551444

Position magnets



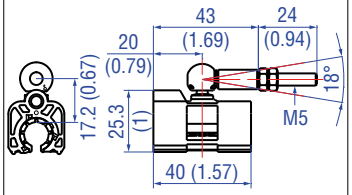
Magnet slider S,
joint at top
Part no. 252 182

Material: GRP, magnet hard ferrite
Weight: Approx. 35 g
Operating temperature:
–40…+85 °C (–40…+185 °F)



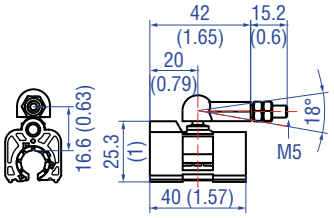
Magnet slider V,
joint at front
Part no. 252 184

Material: GRP, magnet hard ferrite
Weight: Approx. 35 g
Operating temperature:
–40…+85 °C (–40…+185 °F)



Magnet slider N
longer ball-joint arm
Part no. 252 183

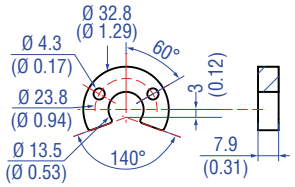
Material: GRP, magnet hard ferrite
Weight: Approx. 35 g
Operating temperature:
–40…+85 °C (–40…+185 °F)



Magnet slider G,
backlash free
Part no. 253 421

Material: GRP, magnet hard ferrite
Weight: Approx. 25 g
Operating temperature:
–40…+85 °C (–40…+185 °F)

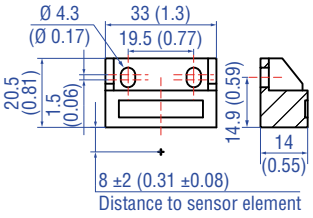
Position magnets



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…+120 °C (–40…+248 °F)

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

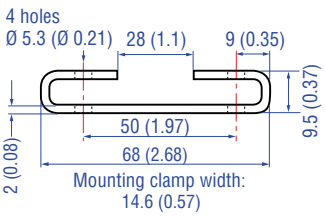


Block magnet L
Part no. 403 448

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

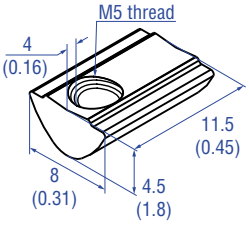
This magnet may influence the sensor performance specifications for some applications.

Mounting accessories



Mounting clamp
Part no. 400 802

Material: Stainless steel (AISI 304)



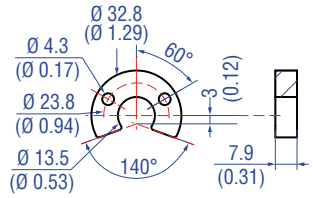
T-nut
Part no. 401 602

Fastening torque for M5 screw: 4.5 Nm

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

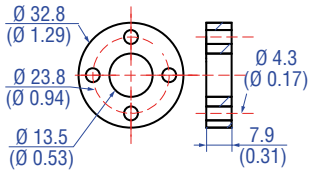
4.13 Frequently ordered accessories for Temposonics® RH5 – Additional options see Accessories Catalog 551444

Position magnets



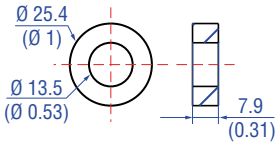
U-magnet OD33
Part no. 251 416-2

Material: PA ferrite GF20
Weight: Approx. 11 g
Surface pressure: Max. 40 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40…+120 °C (–40…+248 °F)
Marked version for sensors with internal linearization: Part no. 254 226



Ring magnet OD33
Part no. 201 542-2

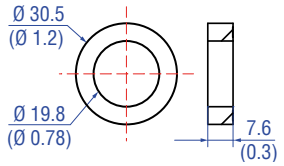
Material: PA ferrite GF20
Weight: Approx. 14 g
Surface pressure: Max. 40 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40...+120 °C (–40...+248 °F)
Marked version for sensors with internal linearization: Part no. 253 620



Ring magnet OD25.4
Part no. 400 533

Material: PA ferrite
Weight: Approx. 10 g
Surface pressure: Max. 40 N/mm²
Operating temperature:
–40…+120 °C (–40…+248 °F)

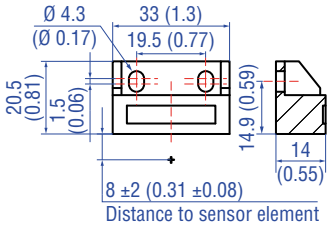
Marked version for sensors with internal linearization: Part no. 253 621



Ring magnet
Part no. 402 316

Material: PA ferrite coated
Weight: Approx. 13 g
Surface pressure: Max. 20 N/mm²
Operating temperature:
–40…+100 °C (–40…+212 °F)

Position magnet

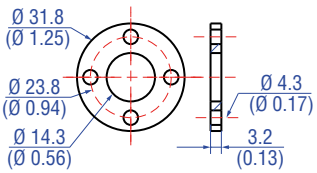


Block magnet L
Part no. 403 448

Material: Plastic carrier with neodymium 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.

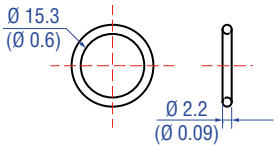
Magnet spacer



Magnet spacer
Part no. 400 633

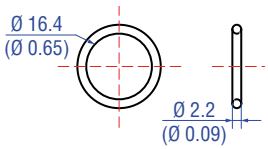
Material: Aluminum
Weight: Approx. 5 g
Surface pressure: Max. 20 N/mm²
Fastening torque for M4 screws: 1 Nm

O-rings



O-ring for threaded flange
M18×1.5-6g
Part no. 401 133

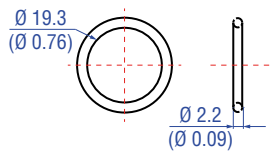
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)



O-ring for threaded flange
¾"-16 UNF-3A
Part no. 560 315

Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)

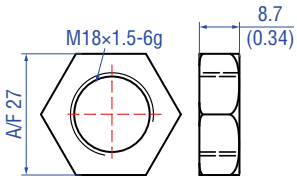
O-ring



O-ring for threaded flange
M22×1.5-6g
Part no. 561 337

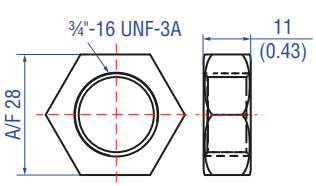
Material: FPM
Durometer: 75 Shore A
Operating temperature:
–20…+200 °C (–6…+392 °F)

Mounting accessories



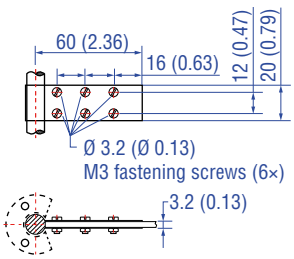
Hex jam nut M18×1.5-6g
Part no. 500 018

Material: Steel, zinc plated



Hex jam nut ¾"-16 UNF-3A
Part no. 500 015

Material: Steel, zinc plated



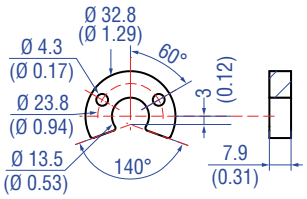
Fixing clip
Part no. 561 481

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

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

4.14 Frequently ordered accessories for Temposonics® RM5 – Additional options see Accessories Catalog 551444

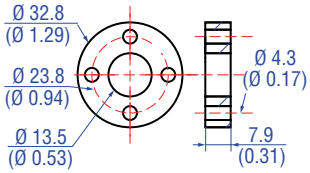
Position magnets



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…+120 °C (–40…+248 °F)

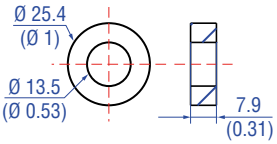
Marked version for sensors with internal linearization: Part no. 254 226



Ring magnet OD33
Part no. 201 542-2

Material: PA ferrite GF20
Weight: Approx. 14 g
Surface pressure: Max. 40 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40...+120 °C (–40...+248 °F)

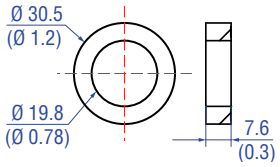
Marked version for sensors with internal linearization: Part no. 253 620



Ring magnet OD25.4
Part no. 400 533

Material: PA ferrite
Weight: Approx. 10 g
Surface pressure: Max. 40 N/mm²
Operating temperature:
–40…+120 °C (–40…+248 °F)

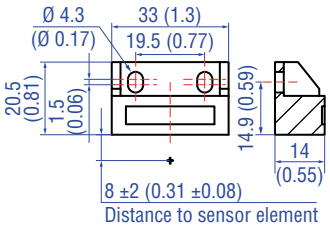
Marked version for sensors with internal linearization: Part no. 253 621



Ring magnet
Part no. 402 316

Material: PA ferrite coated
Weight: Approx. 13 g
Surface pressure: Max. 20 N/mm²
Operating temperature:
–40…+100 °C (–40…+212 °F)

Position magnet

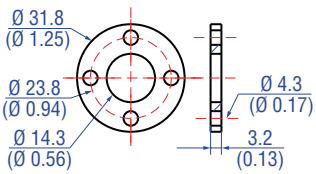


Block magnet L
Part no. 403 448

Material: Plastic carrier with neodymium 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.

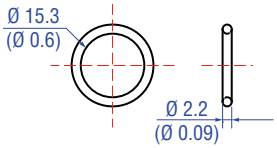
Magnet spacer



Magnet spacer
Part no. 400 633

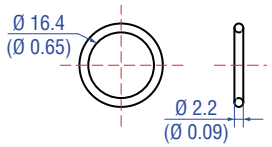
Material: Aluminum
Weight: Approx. 5 g
Surface pressure: Max. 20 N/mm²
Fastening torque for M4 screws: 1 Nm

O-rings



O-ring for threaded flange
M18×1.5-6g
Part no. 401 133

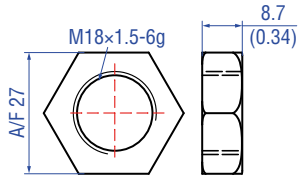
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)



O-ring for threaded flange
¾"-16 UNF-3A
Part no. 560 315

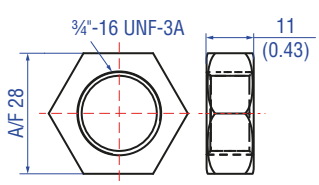
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)

Mounting accessories



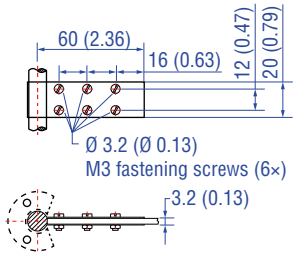
Hex jam nut M18×1.5-6g
Part no. 500 018

Material: Steel, zinc plated



Hex jam nut ¾"-16 UNF-3A
Part no. 500 015

Material: Steel, zinc plated

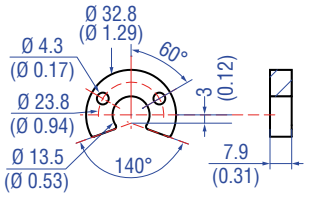


Fixing clip
Part no. 561 481

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

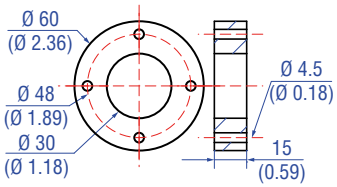
4.15 Frequently ordered accessories for Temposonics® RF5 – Additional options see Accessories Catalog 551444

Position magnets



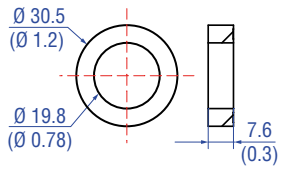
U-magnet OD33
Part no. 251 416-2

Material: PA ferrite GF20
Weight: Approx. 11 g
Surface pressure: Max. 40 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40…+120 °C (–40…+248 °F)



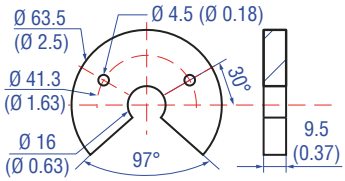
Ring magnet OD60
Part no. MT0162

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)



Ring magnet
Part no. 402 316

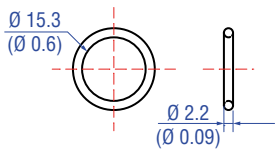
Material: PA ferrite coated
Weight: Approx. 13 g
Surface pressure: Max. 20 N/mm²
Operating temperature:
–40…+100 °C (–40…+212 °F)



U-magnet OD63.5
Part no. 201 553

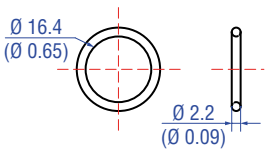
Material: PA 66-GF30,
magnets compound-filled
Weight: Approx. 26 g
Surface pressure: 20 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40…+75 °C (–40…+167 °F)

O-rings



O-ring for threaded flange
M18×1.5-6g
Part no. 401 133

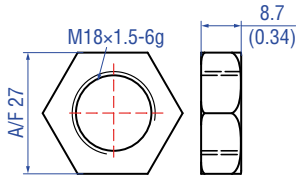
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)



O-ring for threaded flange
¾"-16 UNF-3A
Part no. 560 315

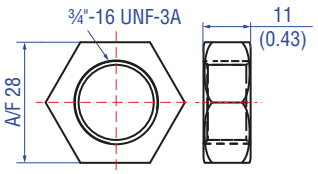
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)

Mounting accessories



Hex jam nut M18×1.5-6g
Part no. 500 018

Material: Steel, zinc plated



Hex jam nut ¾"-16 UNF-3A
Part no. 500 015

Material: Steel, zinc plated

Mounting accessories

Threaded flange M18×1.5-6g
Part no. 404 874

Material: Stainless steel 1.4305
(AISI 303)
Order O-rings separately:
O-ring 15×2: Part no. 560 853
O-ring 15.3×2.2: Part no. 401 133

Threaded flange ¾"-16 UNF-3A
Part no. 404 875

Material: Stainless steel 1.4305
(AISI 303)
Order O-rings separately:
O-ring 15×2: Part no. 560 853
O-ring 16.4×2.2: Part no. 560 315

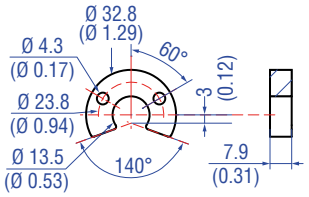
Controlling design dimensions are in millimeters and measurements in ( ) are in inches

Mounting accessories

			
Sensor rod with threaded flange with flat-face (M18×1.5-6g) and O-ring **HD [length mm: XXXX] M** **HD [length in.: XXX.X] U**	**Sensor rod with threaded flange with flat-face (¾"-16 UNF-3A) and O-ring** **HL [length mm: XXXX] M** **HL [length in.: XXX.X] U**	**Sensor rod with threaded flange with raised-face (¾"-16 UNF-3A) and O-ring** **HP [length mm: XXXX] M** **HP [length in.: XXX.X] U**	**Profile with flange** **HFP [length mm: XXXXX] M** **HFP [length in.: XXXX.X] U**
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)	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)	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)	Length: Max. 20,000 mm (max. 787 in.) Ingress protection: IP30 Material: Aluminum

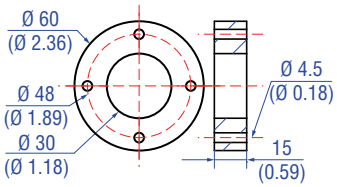
4.16 Frequently ordered accessories for Temposonics® RFV – Additional options see Accessories Catalog 551444

Position magnets



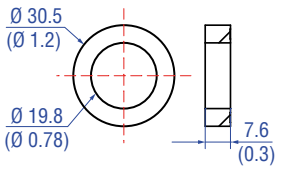
U-magnet OD33
Part no. 251 416-2

Material: PA ferrite GF20
Weight: Approx. 11 g
Surface pressure: Max. 40 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40…+120 °C (–40…+248 °F)



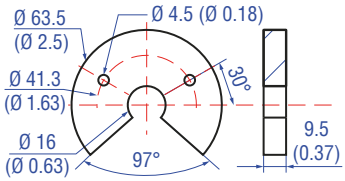
Ring magnet OD60
Part no. MT0162

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)



Ring magnet
Part no. 402 316

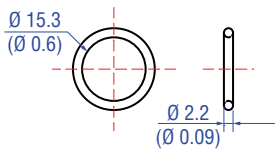
Material: PA ferrite coated
Weight: Approx. 13 g
Surface pressure: Max. 20 N/mm²
Operating temperature:
–40…+100 °C (–40…+212 °F)



U-magnet OD63.5
Part no. 201 553

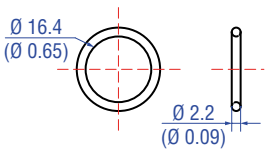
Material: PA 66-GF30,
magnets compound-filled
Weight: Approx. 26 g
Surface pressure: 20 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40…+75 °C (–40…+167 °F)

O-rings



O-ring for threaded flange
M18×1.5-6g
Part no. 401 133

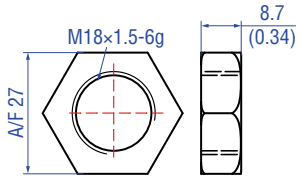
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)



O-ring for threaded flange
¾"-16 UNF-3A
Part no. 560 315

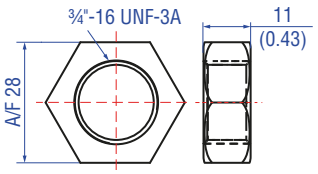
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)

Mounting accessories



Hex jam nut M18×1.5-6g
Part no. 500 018

Material: Steel, zinc plated



Hex jam nut ¾"-16 UNF-3A
Part no. 500 015

Material: Steel, zinc plated

Mounting accessories

Threaded flange M18×1.5-6g
Part no. 404 874

Material: Stainless steel 1.4305
(AISI 303)
Order O-rings separately:
O-ring 15×2: Part no. 560 853
O-ring 15.3×2.2: Part no. 401 133

Threaded flange ¾"-16 UNF-3A
Part no. 404 875

Material: Stainless steel 1.4305
(AISI 303)
Order O-rings separately:
O-ring 15×2: Part no. 560 853
O-ring 16.4×2.2: Part no. 560 315

Adapter plate
Part no. 255 198

Adapter plate for mounting an
RFV-B as replacement for an RF-C.
Order the RFV-B with the addition
H003

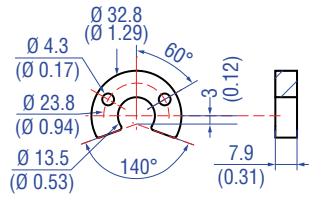
Controlling design dimensions are in millimeters and measurements in ( ) are in inches

Mounting accessories

			
Sensor rod with threaded flange with flat-face (M18×1.5-6g) and O-ring **HD [length mm: XXXX] M** **HD [length in.: XXX.X] U**	**Sensor rod with threaded flange with flat-face (¾"-16 UNF-3A) and O-ring** **HL [length mm: XXXX] M** **HL [length in.: XXX.X] U**	**Sensor rod with threaded flange with raised-face (¾"-16 UNF-3A) and O-ring** **HP [length mm: XXXX] M** **HP [length in.: XXX.X] U**	**Profile with flange** **HFP [length mm: XXXXX] M** **HFP [length in.: XXXX.X] U**
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)	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)	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)	Length: Max. 20,000 mm (max. 787 in.) Ingress protection: IP30 Material: Aluminum

4.17 Frequently ordered accessories for Temposonics® RDV – Additional options see Accessories Catalog 551444

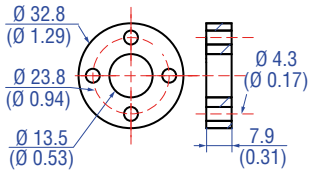
Position magnets



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…+120 °C (–40…+248 °F)

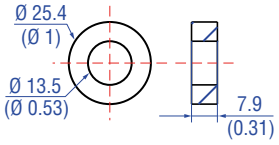
Marked version for sensors with internal linearization: Part no. 254 226



Ring magnet OD33
Part no. 201 542-2

Material: PA ferrite GF20
Weight: Approx. 14 g
Surface pressure: Max. 40 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40...+120 °C (–40...+248 °F)

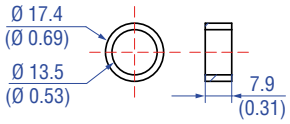
Marked version for sensors with internal linearization: Part no. 253 620



Ring magnet OD25.4
Part no. 400 533

Material: PA ferrite
Weight: Approx. 10 g
Surface pressure: Max. 40 N/mm²
Operating temperature:
–40…+120 °C (–40…+248 °F)

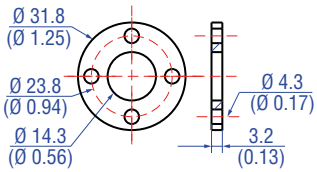
Marked version for sensors with internal linearization: Part no. 253 621



Ring magnet OD17.4
Part no. 401 032

Material: PA neobond
Weight: Approx. 5 g
Surface pressure: Max. 20 N/mm²
Operating temperature:
–40…+105 °C (–40…+221 °F)

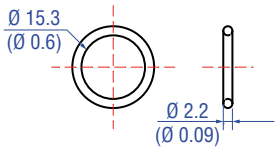
Magnet spacer



Magnet spacer
Part no. 400 633

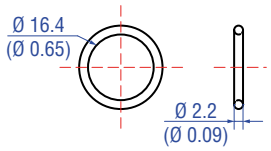
Material: Aluminum
Weight: Approx. 5 g
Surface pressure: Max. 20 N/mm²
Fastening torque for M4 screws: 1 Nm

O-rings



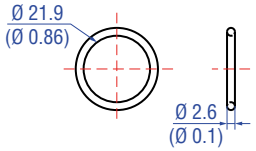
O-ring for threaded flange
M18×1.5-6g
Part no. 401 133

Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)



O-ring for threaded flange
¾"-16 UNF-3A
Part no. 560 315

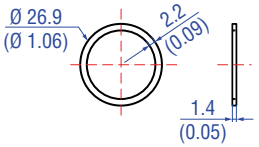
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)



O-ring for pressure fit flange Ø 26.9 mm
Part no. 560 705

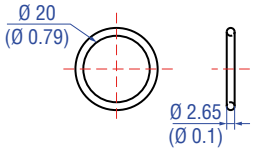
Material: Nitrile rubber
Operating temperature:
–53…+107 °C (–65…+225 °F)

O-rings



Back-up ring for pressure fit flange
Ø 26.9 mm
Part no. 560 629

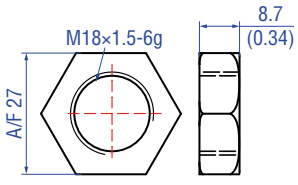
Material: Polymyte
Durometer: 90 Shore A



O-ring for mounting block with bottom entry
Part no. 561 435

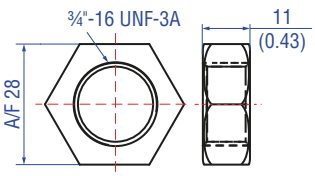
Material: FKM
Durometer: 80± 5 Shore A
Operating temperature:
–15…+200 °C (5…+392 °F)

Mounting accessories



Hex jam nut M18×1.5-6g
Part no. 500 018

Material: Steel, zinc plated

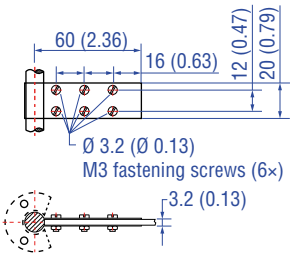


Hex jam nut ¾"-16 UNF-3A
Part no. 500 015

Material: Steel, zinc plated

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

Mounting accessories



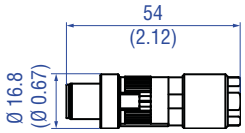
Fixing clip
Part no. 561 481

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

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

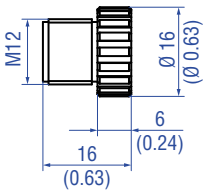
4.18 Frequently ordered accessories for EtherNet/IP™ output – Additional options see Accessories Catalog 551444

Cable connectors* – Signal



M12 D-coded male connector (4 pin), straight
Part no. 370 523

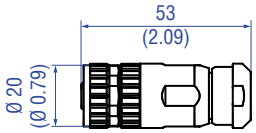
Material: Zinc nickel-plated
Termination: Insulation-displacement
Cable Ø: 6…7.2 mm (0.2…0.28 in.)
Wire: 24 AWG – 22 AWG
Operating temperature:
–25…+85 °C (–13…+185 °F)
Ingress protection: IP65 / IP67 (correctly fitted)
Fastening torque: 0.6 Nm



M12 connector end cap
Part no. 370 537

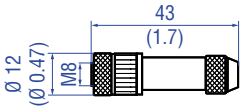
Female connectors M12 should be covered by this protective cap
Material: Brass nickel-plated
Ingress protection: IP67 (correctly fitted)
Fastening torque: 0.39…0.49 Nm

Cable connectors* – Power



M12 A-coded female connector (4 pin/5 pin), straight
Part no. 370 677

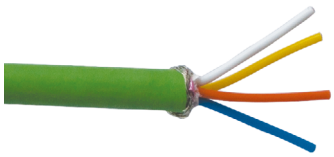
Material: GD-Zn, Ni
Termination: Screw
Contact insert: CuZn
Cable Ø: 4…8 mm (0.16…0.31 in.)
Wire: max. 1.5 mm² (16 AWG)
Operating temperature:
–30…+85 °C (–22…+185 °F)
Ingress protection: IP67 (correctly fitted)
Fastening torque: 0.6 Nm



M8 female connector (4 pin), straight
Part no. 370 504

Material: CuZn nickel plated
Termination: Solder
Cable Ø: 3.5…5 mm (0.14…0.28 in.)
Wire: 0.25 mm²
Operating temperature:
–40…+85 °C (–40…+185 °F)
Ingress protection: IP67 (correctly fitted)
Fastening torque: 0.5 Nm

Cables



PUR signal cable
Part no. 530 125

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 mm² (22 AWG)
Bending radius: 6 × D (fixed installation)
Operating temperature:
–20…+60 °C (–4…+140 °F)

PVC power cable
Part no. 530 108

Material: PVC jacket; gray
Features: Shielded, flexible, mostly flame resistant
Cable Ø: 4.9 mm (0.19 in.)
Cross section: 3 × 0.34 mm²
Bending radius: 5 × D (fixed installation)
Operating temperature:
–30…+80 °C (–22…+176 °F)

Cable sets

Signal cable with M12 D-coded male connector (4 pin), straight – M12 D-coded, male connector (4 pin), straight
Part no. 530 064

Material: PUR jacket; green
Feature: 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)

Signal cable with M12 D-coded male connector (4 pin), straight – RJ45 male connector, straight
Part no. 530 065

Material: PUR jacket; green
Feature: 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. Color codes for the individual wires and technical properties remain unchanged.

Cable sets		Programming tools	
			
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.))**	**Power cable with M12 A-coded female connector (5 pin), straight – pigtail** **Part no. 370 673**	**TempoLink® kit for Temposonics® R-Series V** **Part no. TL-1-0-EM08 (D56)** **Part no. TL-1-0-EM12 (D58)**	**TempoGate® smart assistant for Temposonics® R-Series V** **Part no. TG-C-0-D*xx*** (*xx* indicates the number of R-Series V sensors that can be connected (even numbers only))
Material: PUR jacket; gray Feature: Shielded Cable Ø: 5 mm (0.2 in.) Operating temperature: –40…+90 °C (–40…+194 °F)	Material: PUR jacket; black Feature: Shielded Cable length: 5 m (16.4 ft) Ingress protection: IP67 (correctly fitted) Operating temperature: –25…+80 °C (–13…+176 °F)	• 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	• 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. Color codes for the individual wires and technical properties remain unchanged.

5. Commissioning

5.1 Initial start-up

The R-Series V EtherNet/IP™ position sensor transmits position and velocity values via the EtherNet/IP™ output. EtherNet/IP™ was developed by Rockwell Automation and the Open Device-Net Vendor Association (ODVA) and is a standard for transmissions in Industrial Ethernet. The specification and maintenance of EtherNet/IP™ is managed by ODVA. The sensor and the corresponding EDS file are certified by the ODVA.

The R-Series V EtherNet/IP™ supports Device Level Ring (DLR). DLR technology enables the creation of a fault-tolerant network so that reliable operation can be achieved in a ring topology.

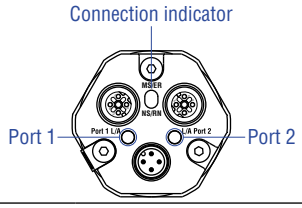
EtherNet/IP™ typically achieves cycle times of around 10 ms. The R-Series V EtherNet/IP™ supports the protocol extension CIP-Sync™ (Common Industrial Protocol). This enables synchronization of the devices in the network and therefore shorter cycle times. A master clock serves as the basis, which synchronizes the network with an accuracy of a few nanoseconds. The time offset between communication partners is determined and taken into account. The data is provided with an exact time stamp and the time of measurement is triggered for position detection. The time required for evaluating and transmission of the position values can be compensated retrospectively due to the time stamp of the measurement.

5.2 LED status

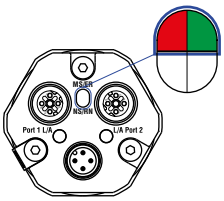
A diagnostic display on the lid of the sensor informs about the current status of the sensor. The R-Series V EtherNet/IP™ is equipped with three LEDs:

- LED for status indication (condition indicator)
- LED for activity of the Ethernet connection at port 1 (link activity)
- LED for activity of the Ethernet connection at port 2 (link activity)

EtherNet/IP™ LED status

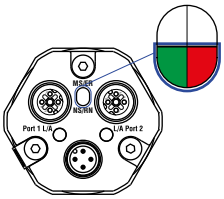


Module status LED



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

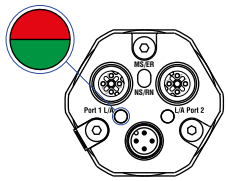
Network status LED



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

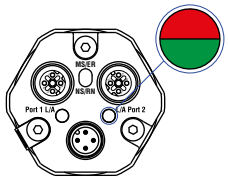
Fig. 80: LED status display, part 1

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

Fig. 81: LED status display, part 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 controller, to which the sensor is connected, does not react in an uncontrolled way.
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.

5.3 Topologies and hubs

EtherNet/IP™ supports various topologies when building up a network. Thus, the usage of linear, star, ring and tree topologies are supported. A hub is integrated in devices like the R-Series V EtherNet/IP™ sensors. With integrated hubs, a power failure will cause a communication interruption to the subsequent devices. This can be avoided for example by extending a line structure to a ring structure.

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 a 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.

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 a 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.

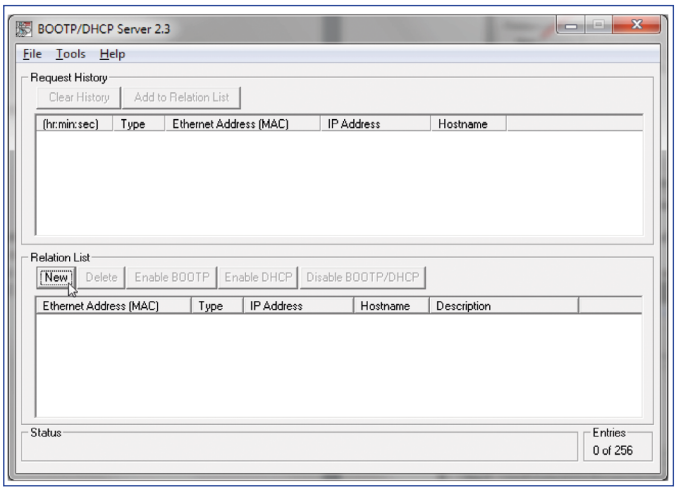


Fig. 82: Create new relation list entry

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 an unique **IP address** you will use for the sensor, **record the IP address** and click **OK**.

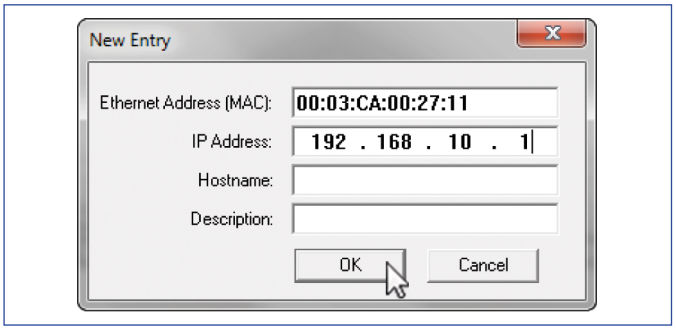


Fig. 83: Enter MAC ID and unique IP address

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 with step 6.2.5.

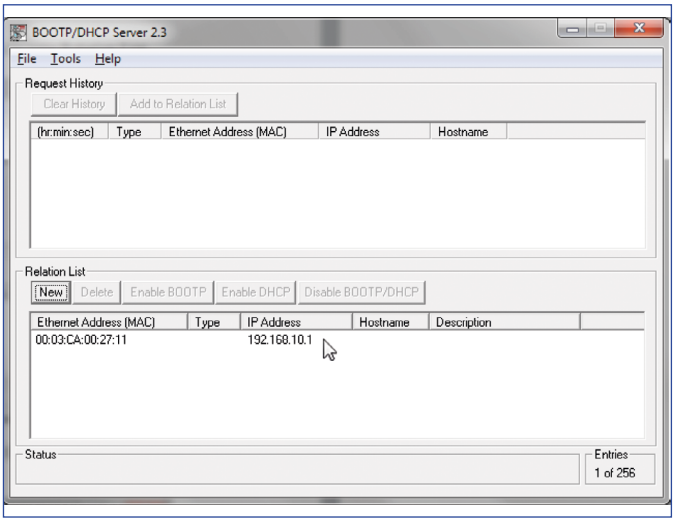


Fig. 84: Populated relation list

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.

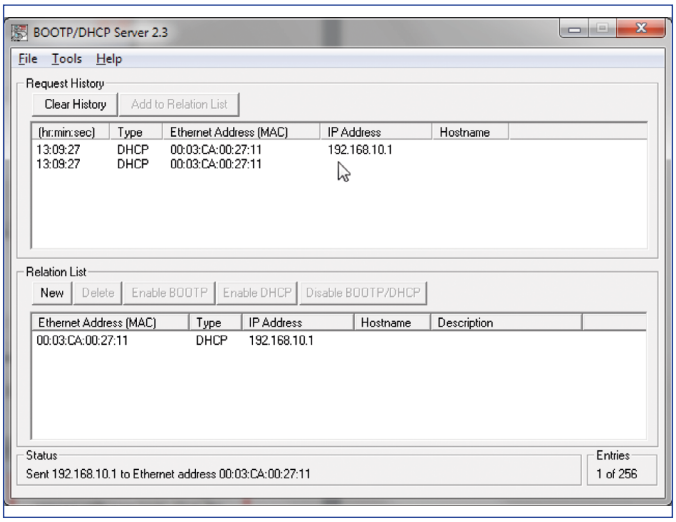


Fig. 85: Request history shows MAC ID and IP address

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.

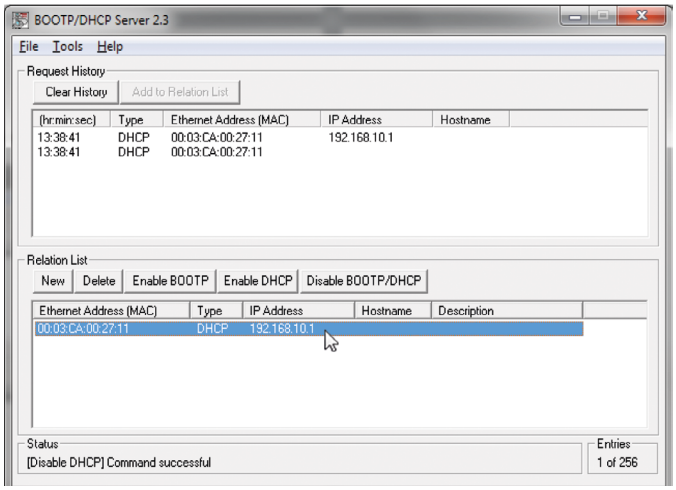


Fig. 86: Sensor shows the static IP address

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.

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”.

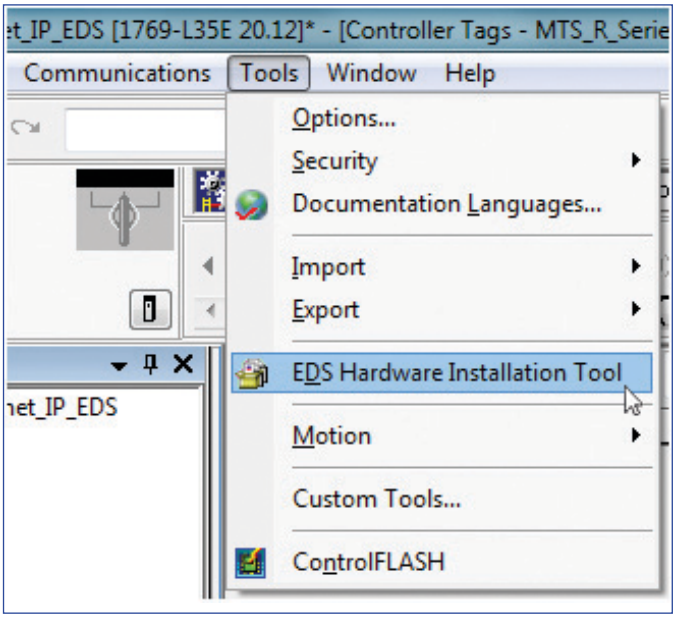


Fig. 87: Select the “EDS Hardware Installation Tool”

7.1.3 The “EDS Wizard” window opens. Click **Next**. Select “Register an EDS file(s)” in the “Options” window and click **Next** (Fig. 89).

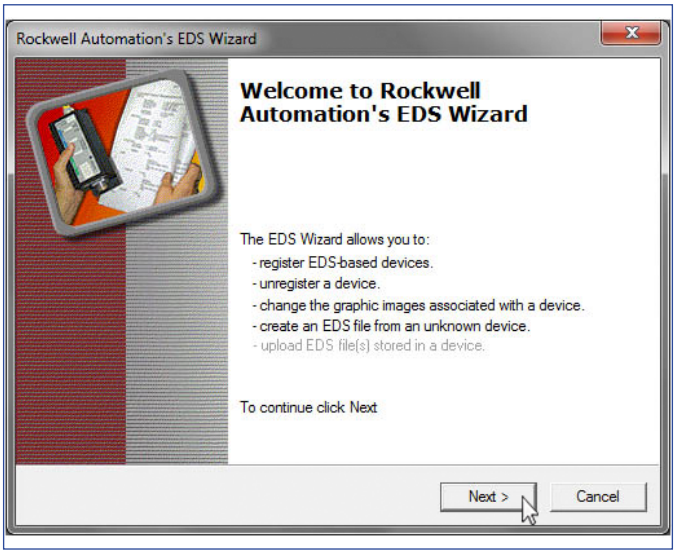


Fig. 88: EDS wizard launch screen

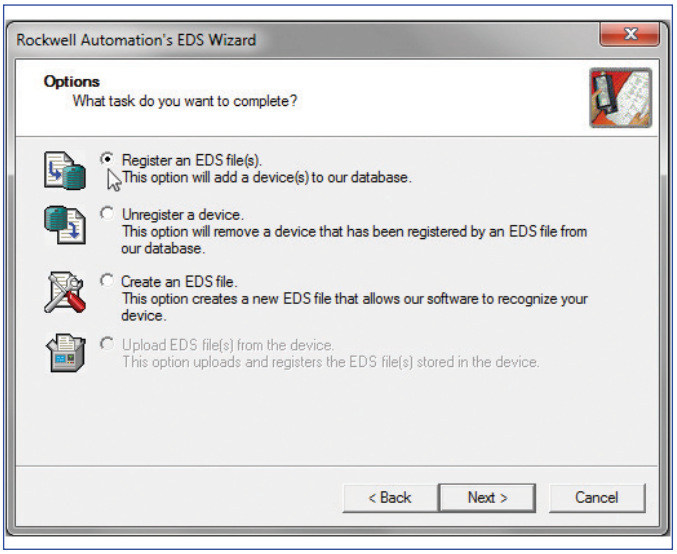


Fig. 89: Register an EDS file

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**.

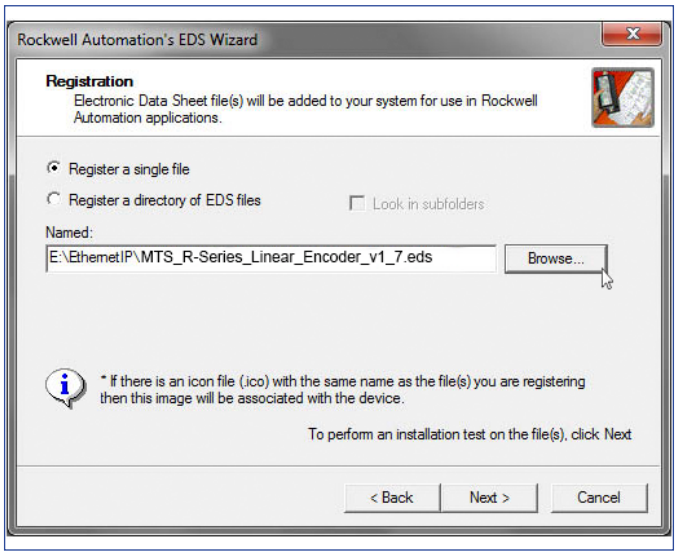


Fig. 90: Enter the path to the EDS file

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

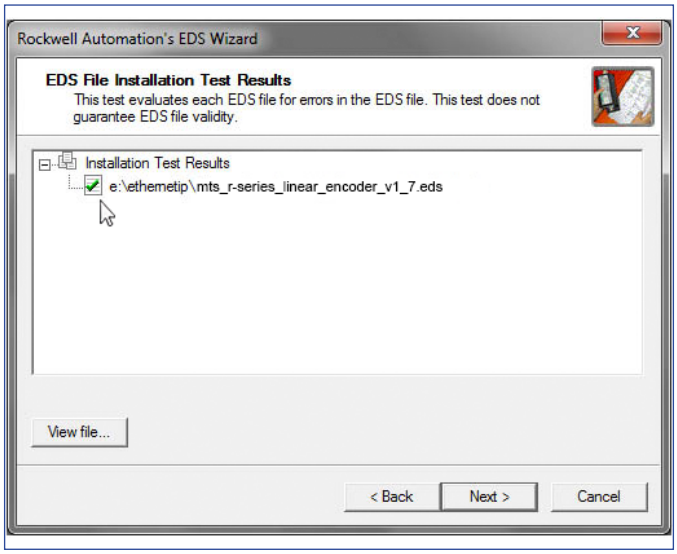


Fig. 91: Confirmation of path to the EDS file

7.1.6 The “Final Task Summary” window opens, click **Next**.

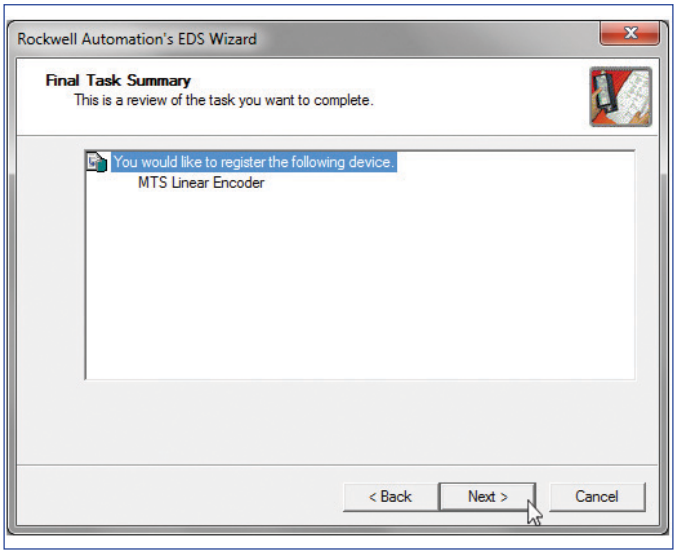


Fig. 92: Confirmation of EDS file origin (Temposonics was previously MTS Sensors)

7.1.7 Click **Finish**.

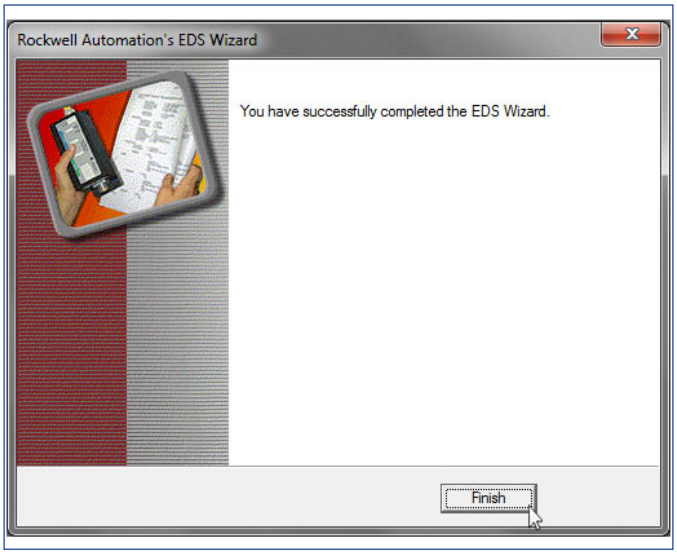


Fig. 93: EDS installation completed

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”.

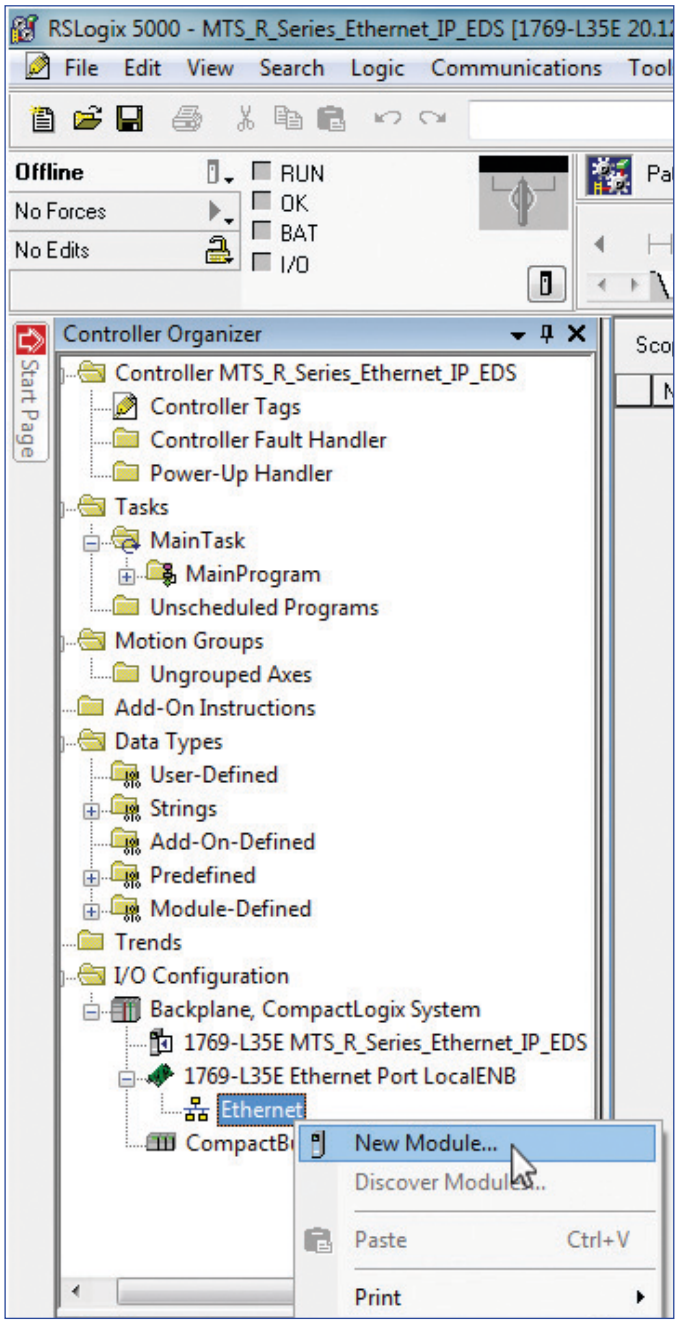


Fig. 94: Add a new module to the RSLogix 5000 IO tree

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

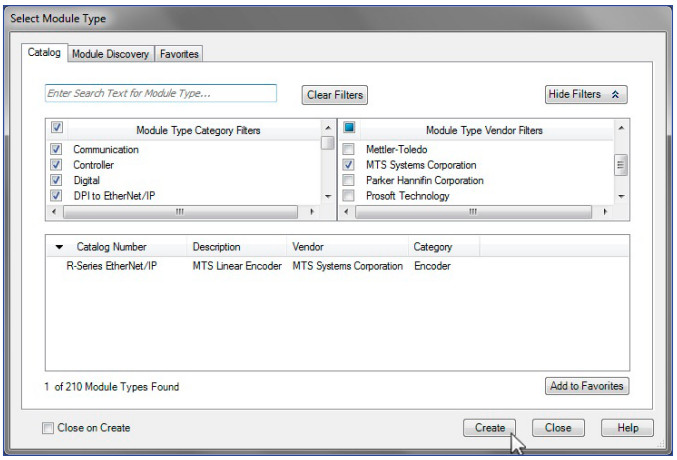


Fig. 95: Create new module tree

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.

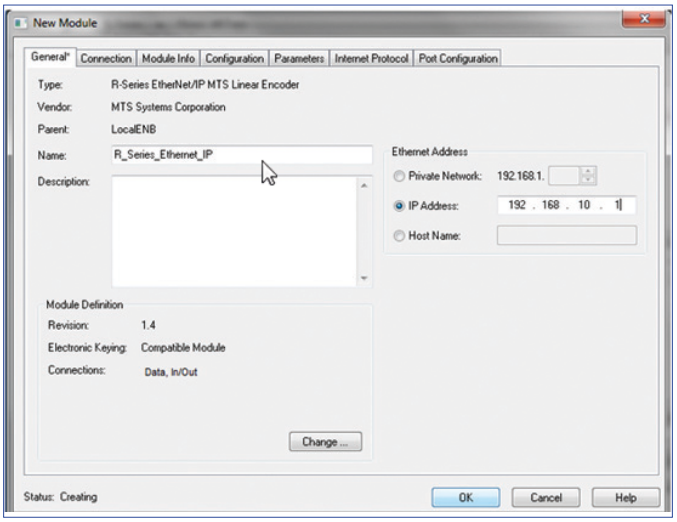


Fig. 96: Confirm the new module settings

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

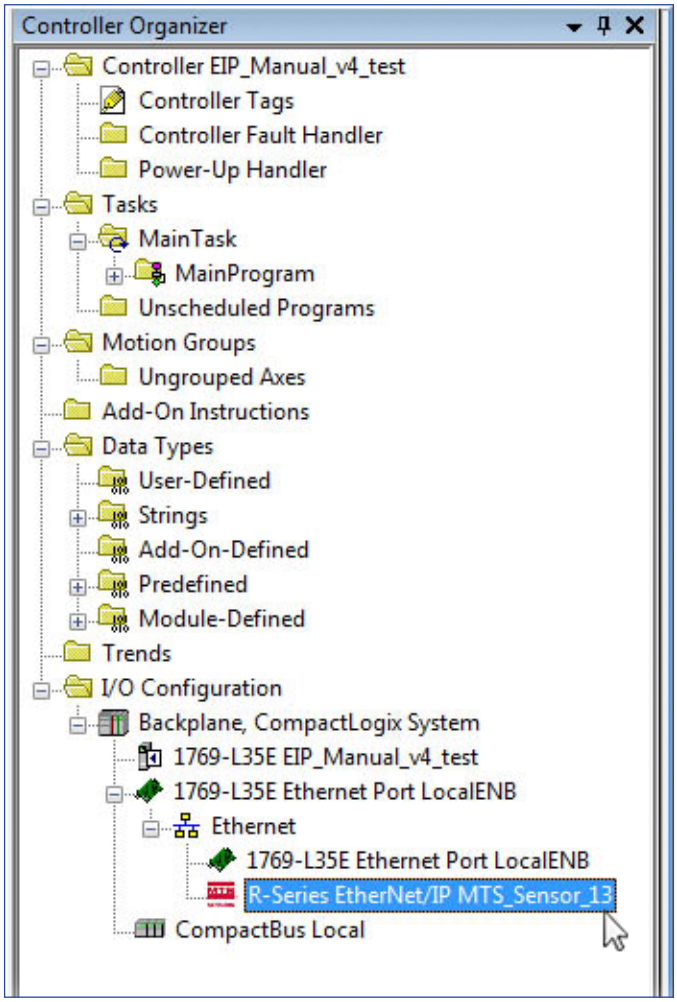
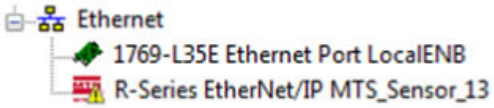


Fig. 97: New module on the network

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 5000 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.

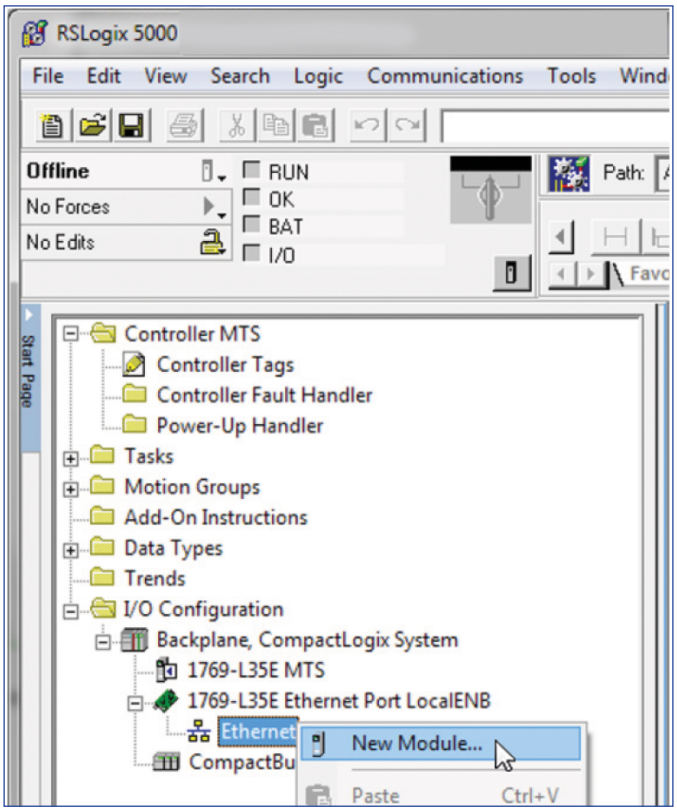


Fig. 98: Add a new module to the RSLogix 5000 IO tree

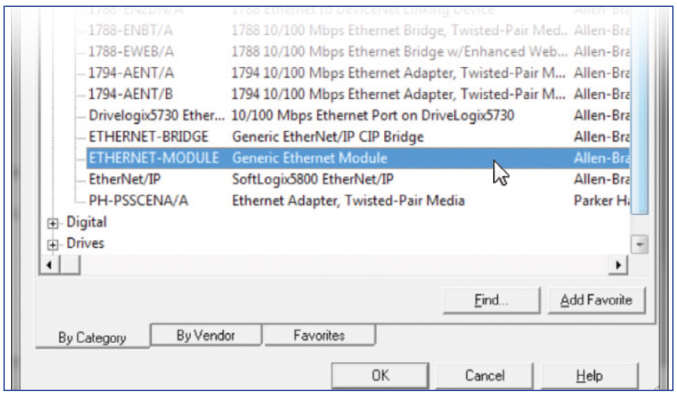


Fig. 99: Add a new generic module tree

7.3.4 In the “New Module” window (Fig. 100) perform step 7.3.4.1 – 7.3.4.4 to configure the new generic ethernet module to the R-Series V 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, select the entry “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 6.2.

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	–
Confguration assembly	10	20

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

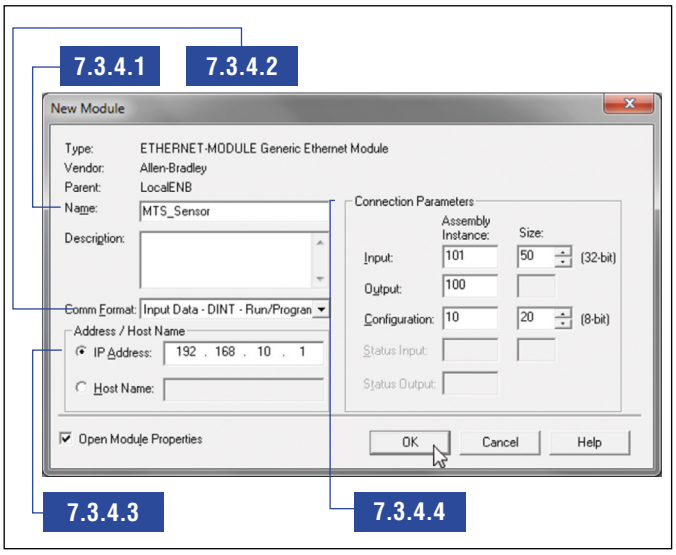


Fig. 100: NewModulewindow

7.4 Set Module RPI

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).

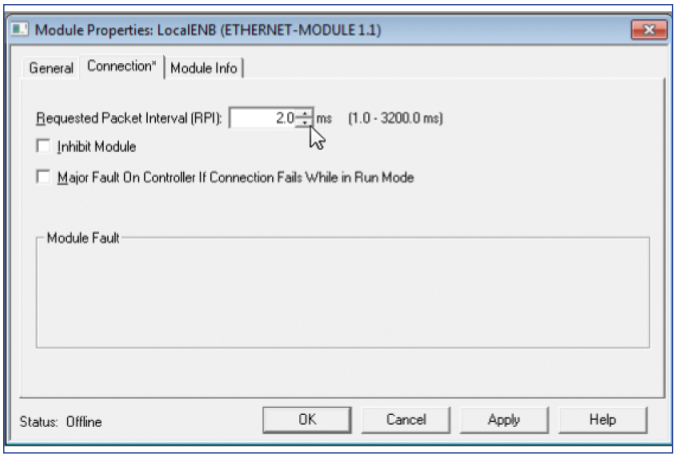


Fig. 101: Modulepropertieswindow

NOTICE

RPI limitations are:
- 2 ms up to 4800 mm stroke
- 4 ms up to 7620 mm stroke

7.5 Verify Generic EtherNet Module

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

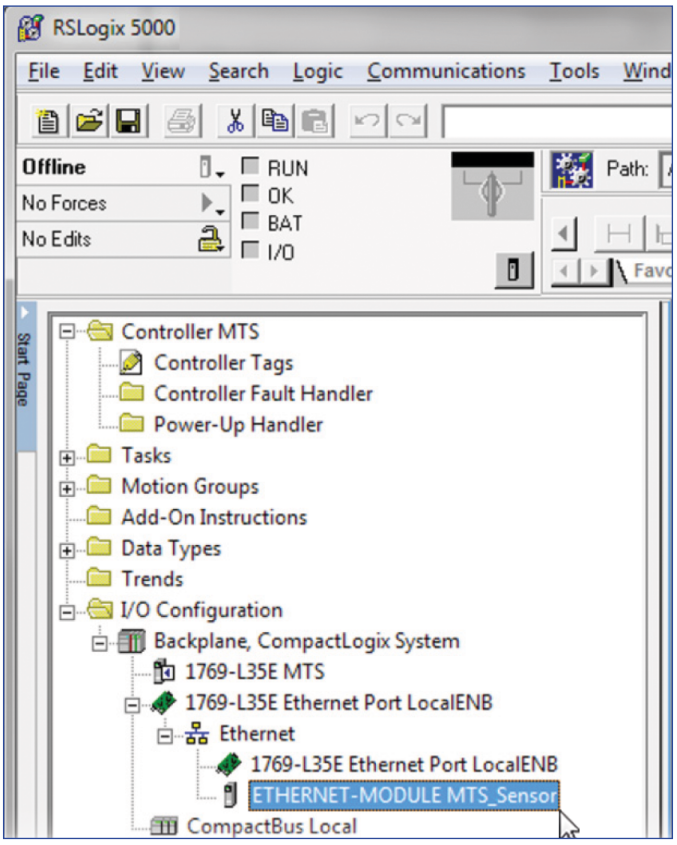


Fig. 102: New generic module has been added to the network

7.6 Controller tags configuration data

7.6.1 In the “I/O Configuration tree”, click to open the “Controller Tags” directory. The controller tag table displays in the left pane (Fig. 103). The description column fields will be blank by default.

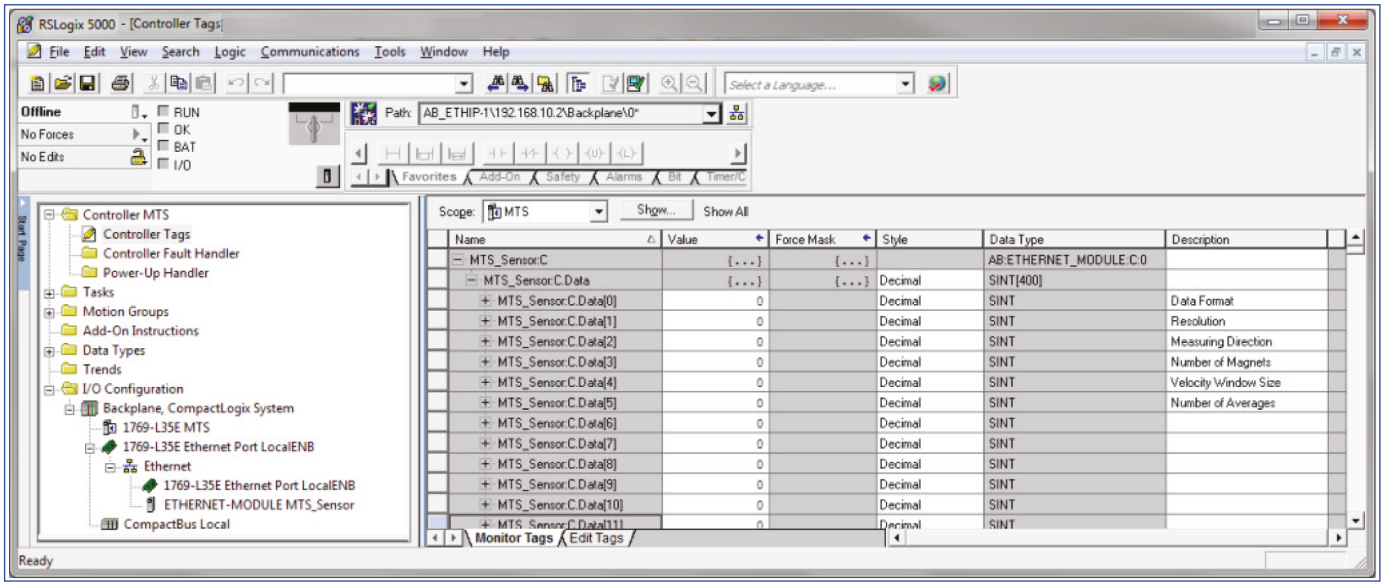


Fig. 103: Devicecontroltags

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:
			• Lower byte (bits 0 – 7) = Status
			  • Bit 0 = Magnet missing (0 = magnet not missing, 1 = magnet missing)
			  • Bit 1 = CPU Watchdog (0 = not triggered, 1 = triggered)
			  • Bits 2 – 7 = Not used
			• Middle 2 bytes (bits 8 – 23) = Unused
			• 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 (values increasing from sensor electronics housing to rod end/profile end) (default value)
		1	Reverse (values decreasing from sensor electronics housing to rod end/profile end)
Data Byte [3]	Number of magnets	0	Used to detect missing magnets on the sensor. If “Value” = 0, the sensor determines the number of magnets present on the sensor at the startup. This number is used as a reference for detecting missing magnets. A missing magnet is displayed in the status (see Data format) and via the LEDs on the lid of the sensor (“5.2 LED status” on page 57).
Data Byte [4]	Velocity window size	1…1000	Setting of the number of position values for determining the velocity of the position magnet. The larger the number the more accurate the velocity and the slower the sensor reacts to a change in the velocity. (default value: 1).
Data Byte [5]	Number of averages	0…100	Setting the number of position values for calculation the filter of the output value. The filter is used to smooth the measured position value before output and can be helpful in a noisy environment. (default value: 1, no filter).

7.7 Controller tags input data

Fig. 104 illustrates an example of “Controller Tags” information based on the factory default configuration:

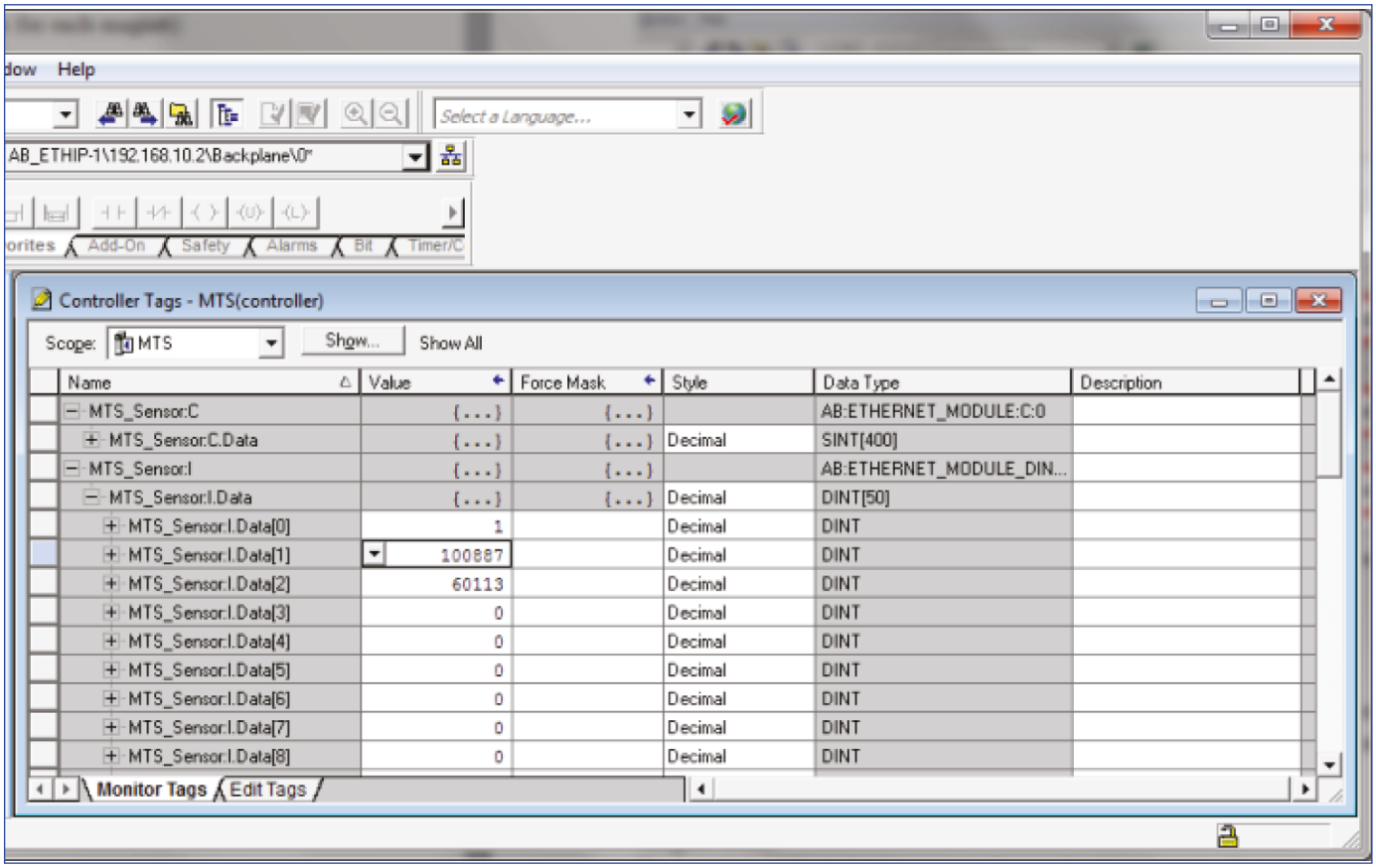


Fig. 104: Controllertags

“Controller Tags” information examples based on the factory default configuration are as follows:

- **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.
- **Magnet Data**
  The remaining data is laid out according to the data format selected in the configuration. Fig. 104 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 the position:
    Position = 100887 × 0.001 mm = 100.887 mm
  - Magnet data – Velocity
    The velocity data for magnet one in this example is 60113. The velocity resolution is always 0.001 mm/s.
    Velocity = 60113 × 0.001 mm = 60.113 mm/s

8. Maintenance and troubleshooting

8.1 Error conditions, troubleshooting

See chapter “5. Commissioning” on page 57.

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. For return see chapter “2.6 Return” on page 5.

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 of 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: ≤ 2000 mm / ≤ 4800 mm / ≤ 6350 mm Cycle time: 1.0 ms / 2.0 ms / 3.0 ms
Linearity deviation [3]	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	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 with amendments
Stroke length	25…6350 mm (1…250 in.)
Mechanical mounting	
Mounting position	Any
Mounting instruction	Please consult the technical drawings on page 14
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); the RP5 sensors must be power supplied via an external Class 2 power source in accordance with the UL approval
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

10.2 Technical data of 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 [4]	Stroke length	≤ 2000 mm	≤ 4800 mm	≤ 7620 mm
	Cycle time	1.0 ms	2.0 ms	3.0 ms
Linearity deviation [5]	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	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) / RH5-J: 15 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 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 (5,076 psi)/700 bar (10,153 psi) peak (at 10 × 1 min) for sensor rod, RH5-J: 800 bar (11,603 psi)			
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 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 with amendments			
Stroke length	25…7620 mm (1…300 in.)			
Mechanical mounting				
Mounting position	Any			
Mounting instruction	Please consult the technical drawings on page 15 and page 16			

Technical data “Electrical connection” on page 72

4/ These values refer to a single position measurement
5/ With position magnet # 251 416-2

Electrical connection	
Connection type	2 × M12 female connectors (5 pin), 1 × M12 male connector (4 pin) or 2 × M12 female connectors (5 pin), 1 × M8 male connector (4 pin)
Operating voltage	+12…30 VDC ±20 % (9.6…36 VDC); the RH5 sensors must be power supplied via an external Class 2 power source in accordance with the UL approval
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

10.3 Technical data of Temposonics® RM5

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	≤ 7615 mm
	Cycle time	1.0 ms	2.0 ms	3.0 ms
Linearity deviation [6]	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	100 % relative humidity, no condensation			
Ingress protection	IP68 (3 m/180 d)/IP69			
Shock test	100 g/6 ms, IEC standard 60068-2-27			
Vibration test	10 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 RM5 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 (10,153 psi) peak (at 10 × 1 min) for sensor rod			
Magnet movement velocity	Any			
Design/Material				
Sensor electronics housing	Stainless steel 1.4404 (AISI 316L)			
Sensor flange	Stainless steel 1.4404 (AISI 316L)			
Sensor rod	Stainless steel 1.4404 (AISI 316L)			
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 with amendments			
Stroke length	25…7615 mm (1…299.8 in.)			
Mechanical mounting				
Mounting position	Any			
Mounting instruction	Please consult the technical drawings on page 18			
Electrical connection				
Connection type	2 × cable with M12 female connector (D-coded), 1 × cable			
Operating voltage	+12…30 VDC ±20 % (9.6…36 VDC); the RM5 sensors must be power supplied via an external Class 2 power source in accordance with the UL approval			
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			

6/ With position magnet # 251 416-2

10.4 Technical data of Temposonics® RF5

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 [7]	Stroke length	≤ 715 mm	≤ 2000 mm	≤ 4675 mm	≤ 10,000 mm	≤ 20,000 mm
	Cycle time	500 µs	1000 µs	2000 µs	4000 µs	8000 µs
Linearity deviation [8]	< ±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	IP68 (3 d/3 m) (connectors and flange correctly fitted)					
Shock test	100 g/6 ms, IEC standard 60068-2-27 (when guided in a support pipe, e.g. sensor rod HD/HL/HP)					
Vibration test	5 g/10…2000 Hz, IEC standard 60068-2-6 (excluding resonant frequencies) (when guided in a support pipe, e.g. sensor rod HD/HL/HP)					
EMC test	Electromagnetic emission according to EN 61000-6-3 Electromagnetic immunity according to EN 61000-6-2 With EMC-compliant installation, the RF5 sensors fulfill the requirements of EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TR ZU 020/2011. [9]					
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 PU 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 with amendments					
Stroke length	150…20,000 mm (6…787 in.)					
Mechanical mounting						
Mounting position	Any					
Mounting instruction	Please consult the technical drawings on page 20					
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); the RF5 sensors must be power supplied via an external Class 2 power source in accordance with the UL approval					
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/ These values refer to a single position measurement
8/ With position magnet # 251 416-2
9/ The flexible sensor element must be mounted in an appropriately shielded environment

10.5 Technical data of 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 [10]	< ±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 With EMC-compliant installation, the RFV sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TR CU 020/2011. [11]				
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 conduit 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 with amendments				
Stroke length	150…20,000 mm (6…787 in.)				
Mechanical mounting					
Mounting position	Any				
Mounting instruction	Please consult the technical drawings on page 24				
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); the RFV sensors must be power supplied via an external Class 2 power source in accordance with the UL approval				
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				

10/ With position magnet # 251 416-2
11/ The flexible sensor element must be mounted in an appropriately shielded environment

10.6 Technical data of 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 [12, 13]	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 With EMC-compliant installation, the RDV sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TR CU 020/2011. [14]			
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 with amendments			
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 28 and page 29			

Technical data “Electrical connection” on page 77

12/ With position magnet # 251 416-2
13/ For rod style »S« the linearity deviation can be higher in the first 30 mm (1.2 in.) of stroke length
14/ The cable between the sensor element and the sensor electronics housing must be mounted in an appropriately shielded environment

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); the RDV sensors must be power supplied via an external Class 2 power source in accordance with the UL approval
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

Temposonics
AN AMPHENOL COMPANY

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 code: _____ Sensor model(s): _____

Serial number(s): _____ Stroke 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 _____

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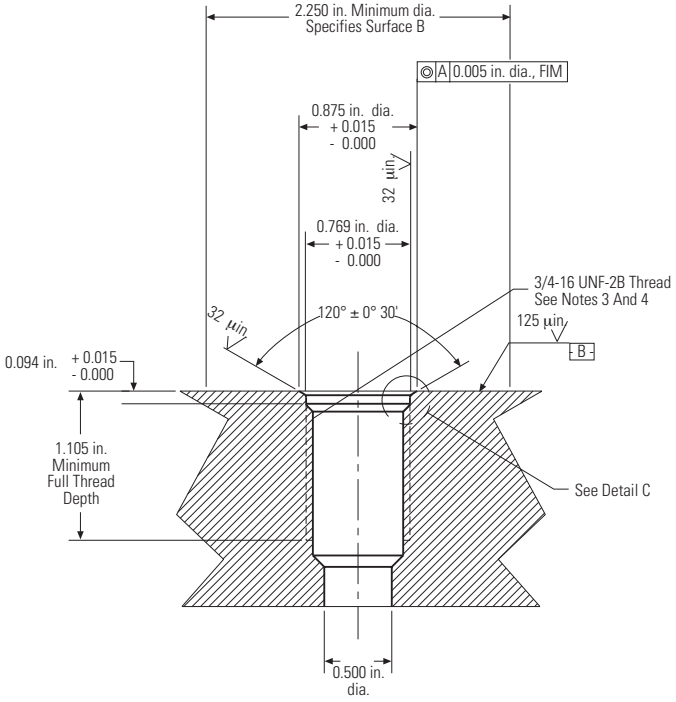
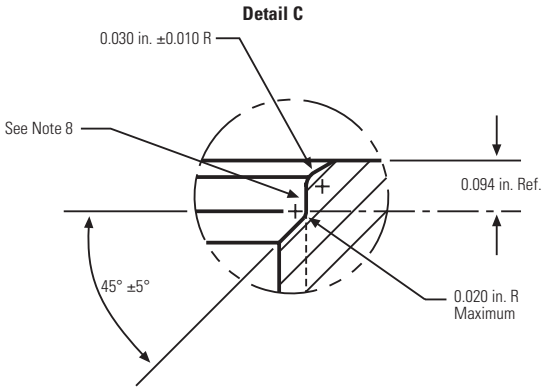
12. Appendix II – Cylinder port details

PORT DETAIL (PD) FOR RH5-S:

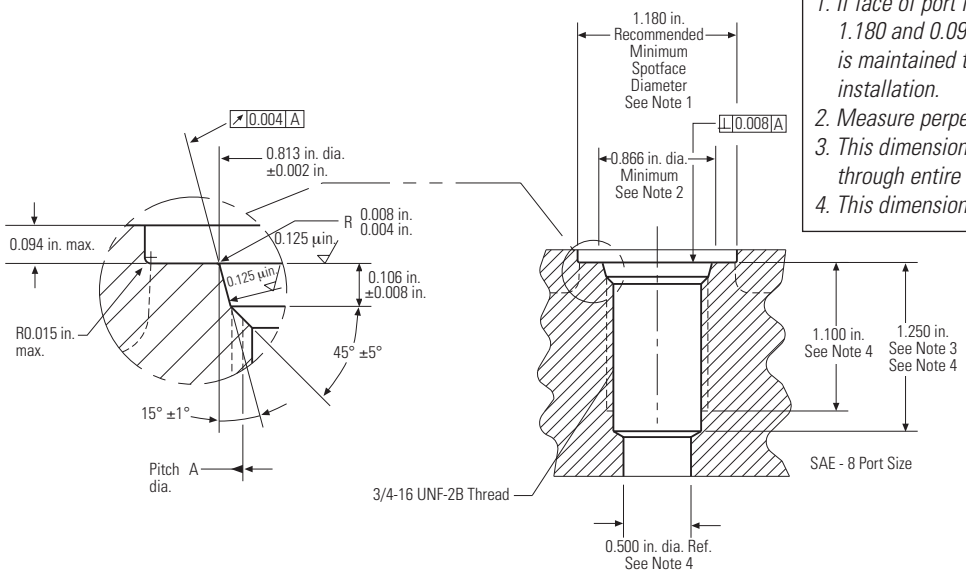


NOTES:

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 (**C**ommon **I**ndustrial **P**rotcol) 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 **D**evice **L**evel **R**ing (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 (**E**lectronic **D**ata **S**heet). 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 I**ndustrial **P**rotocol) is an Industrial Ethernet interface and is managed by the **O**pen **D**eviceNet **V**endor **A**ssociation (ODVA). The R-Series V EtherNet/IP™ and its corresponding EDS file are certitified 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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