Temposonics
AN AMPHENOL COMPANY

Operation Manual

R-Serie V EtherCAT®

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 appendices 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

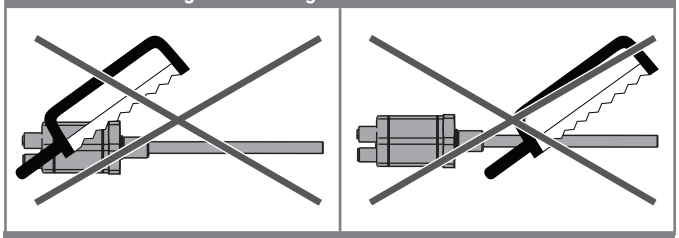
This product may be used only for the applications defined under item 1 and only in conjunction with the third-party devices and components recommended or approved by Temposonics. As a prerequisite of proper and safe operation the product requires correct transport, storage, mounting and commissioning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

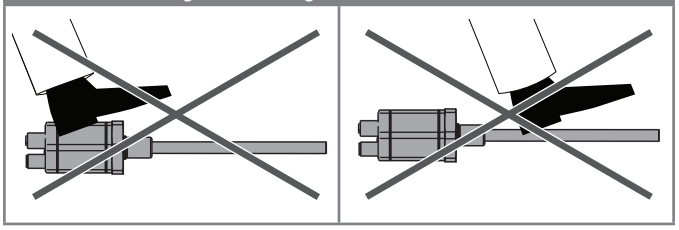
2.2 Foreseeable misuse

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.
➔ 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
- are competent in the field of electromagnetic compatibility (EMC)
- have received adequate training for commissioning and service operations
- are familiar with the operation of the device and know the information required for correct operation provided in the product documentation

2.3 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 "13. Appendix I – Safety declaration"on page 76.

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	1		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…30 position(s) (1…30 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 1 0 1	EtherCAT®, position, velocity and acceleration (1…30 magnet(s))
U 1 1 1	EtherCAT®, position, velocity and acceleration internal linearization (1…30 magnet(s))

NOTICE

- For the RP5, the magnet selected in **b** “Design” is included in the scope of delivery. Specify the number of magnets for your application. For multi-position measurements with more than 1 magnet order the other magnets separately.
- The number of magnets is limited by the stroke length. The minimum allowed distance between magnets (i.e. front face of one to the front face of the next one) is 75 mm (3 in.).
- Use magnets of the same type for multi-position measurement.
- If the option for internal linearization (U111) 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	1		1
a			b	c	d					e		f			g	h			

a	Sensor model
R H 5	Rod

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

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

d	Stroke length	
X X X X M	0025…7620 mm	
Standard stroke length (mm)		**Ordering steps**
25… 500 mm		5 mm
500… 750 mm		10 mm
750…1000 mm		25 mm
1000…2500 mm		50 mm
2500…5000 mm		100 mm
5000…7620 mm		250 mm
X X X X U	001.0…300.0 in.	
Standard stroke length (in.)		**Ordering steps**
1… 20 in.		0.2 in.
20… 30 in.		0.4 in.
30… 40 in.		1.0 in.
40…100 in.		2.0 in.
100…200 in.		4.0 in.
200…300 in.		10.0 in.
Non-standard stroke lengths are available; must be encoded in 5 mm/0.1 in. increments.		

e	Number of magnets
X X	01…30 position(s) (1…30 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 1 0 1	EtherCAT®, position, velocity and acceleration (1…30 magnet(s))
U 1 1 1	EtherCAT®, position, velocity and acceleration internal linearization (1…30 magnet(s))

NOTICE

- Specify the 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 (U111) in h "Output" is chosen, select a suitable magnet.

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	1		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…30 position(s) (1…30 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. 530108) 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 1 0 1	EtherCAT®, position, velocity and acceleration (1…30 magnet(s))
U 1 1 1	EtherCAT®, position, velocity and acceleration internal linearization (1…30 magnet(s))

NOTICE

- Specify the 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 (U111) in **h** “Output” is chosen, select a suitable magnet.

3.4 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	1	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…30 position(s) (1…30 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 1 0 1	EtherCAT®, position, velocity and acceleration (1…30 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 and -S are without rod assembly. Always insert the flexible sensor rod in a support tube (e.g. sensor rod HD/HL/HP or HFP profile).

3.5 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	1		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…30 position(s) (1…30 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 1 0 1	EtherCAT®, position, velocity and acceleration (1…30 magnet(s))
U 1 1 1	EtherCAT®, position, velocity and acceleration internal linearization (1…30 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 (U111) in **h** “Output” is chosen, select a suitable magnet.

3.6 Nameplate

Fig. 1: Example of nameplate of R-Series V RH5 sensor with EtherCAT® output

3.7 Approvals

- ETG certified
- CE declaration
- UKCA declaration
- EAC declaration
- UL declaration

3.8 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

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

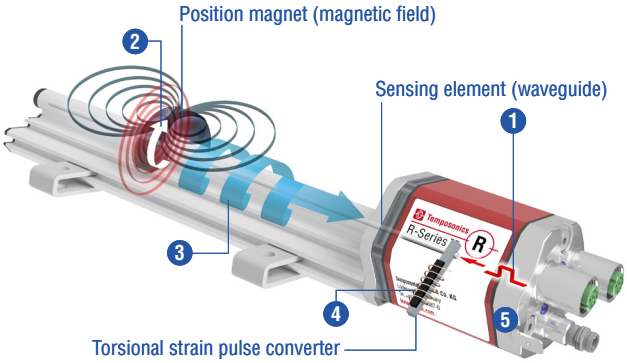
Sensor model
- Temposonics® R-Series V RP5 (profile sensor)
- Temposonics® R-Series V RH5 (rod sensor)
- Temposonics® R-Series V RM5 (sensor in super shield housing)
- Temposonics® R-Series V RFV (flexible rod sensor)
- Temposonics® R-Series V RDV (detached sensor electronics)

Stroke length
- Temposonics® R-Series V RP5: 25…6350 mm (1…250 in.)
- Temposonics® R-Series V RH5: 25…7620 mm (1…300 in.)
- Temposonics® R-Series V RM5: 25…7615 mm (1…299.8)
- Temposonics® R-Series V RFV: 150…20,000 mm (6…787 in.)
- Temposonics® R-Series V RDV: 25…5080 mm (1…200 in.)

Output signal
- EtherCAT®

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 sensing 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

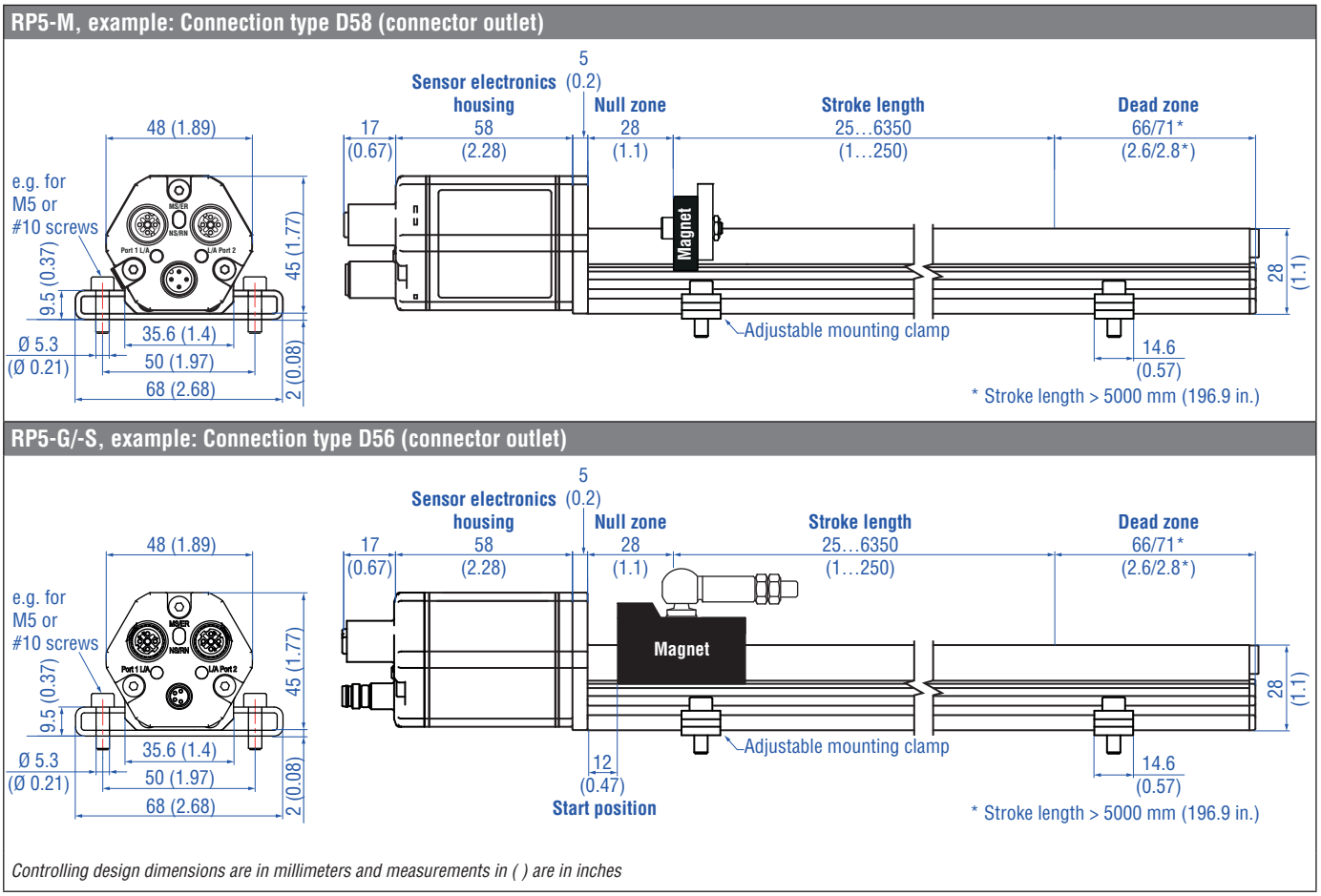


Fig. 3: Temposonics® RP5 with U-magnet und magnet slider

Installation of RP5

The position sensor can be installed in any position. Normally, the sensor is firmly installed and the position magnet is fastened to the mobile machine part. Thus it can travel along the sensor profile. The sensor is fitted on a flat machine surface using the mounting clamps (Fig. 4). A length-dependent number of these clamps are delivered with the sensor and must be distributed over the profile at regular distances. For fastening use M5×20 screws to DIN 6912 that should be tightened with a fastening torque of 5 Nm.

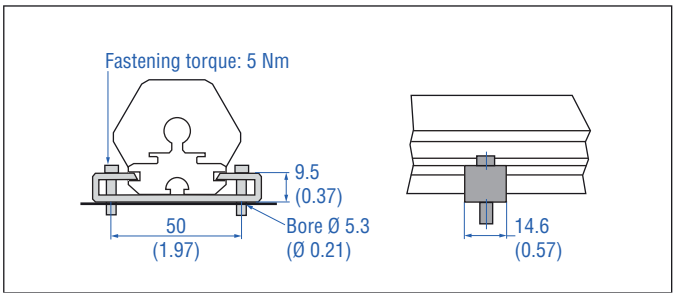


Fig. 4: Mounting clamps (part no. 400 802) with cylinder screw M5×20

Alternative:

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

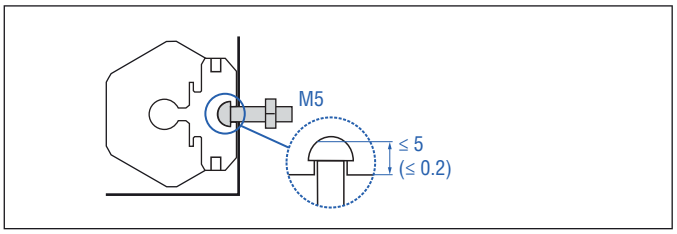


Fig. 5: T-slot nut M5 (part no. 401 602)

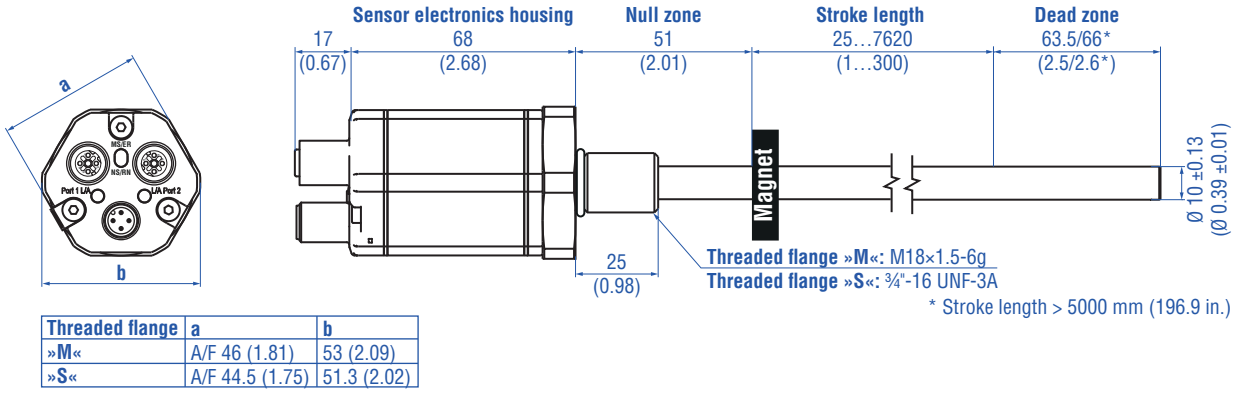
NOTICE

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

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

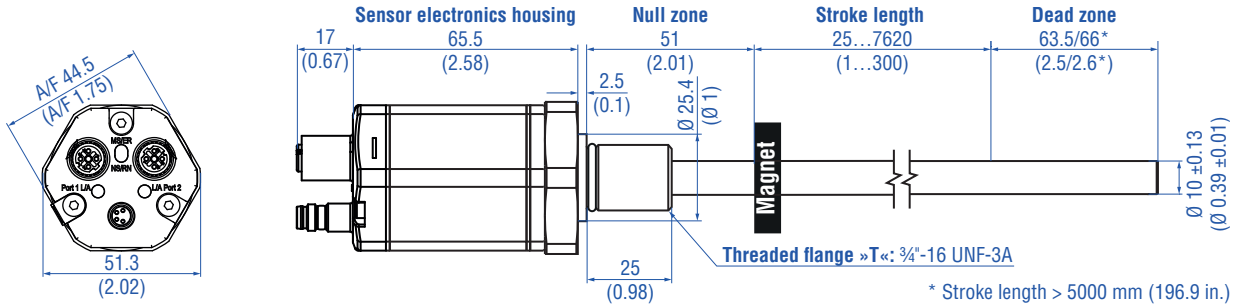
4.3 Installation and design of Temposonics® RH5

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

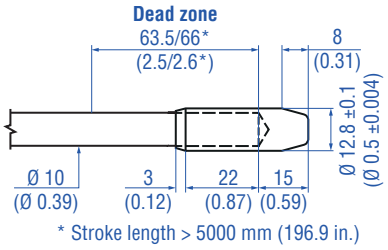


Threaded flange	a	b
»M«	A/F 46 (1.81)	53 (2.09)
»S«	A/F 44.5 (1.75)	51.3 (2.02)

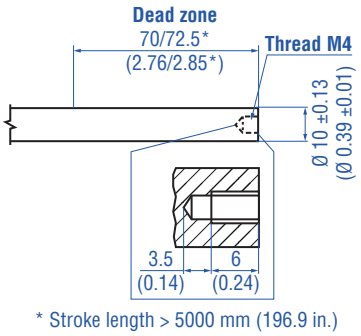
RH5-T-A/-V – RH5 with threaded flange ¾"-16 UNF-3A with raised-face, example: Connection type D56 (connector outlet)



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



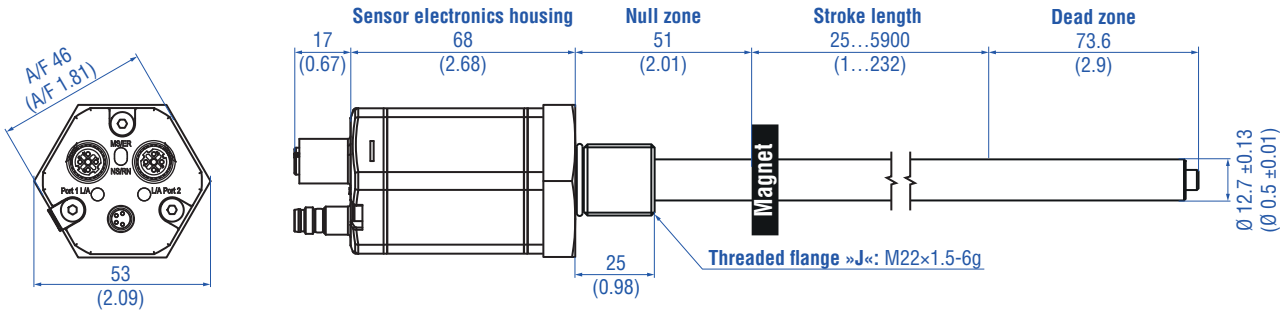
Mechanical option »M«: Thread M4 at rod end for threaded flange M18×1.5-6g or ¾"-16 UNF-3A



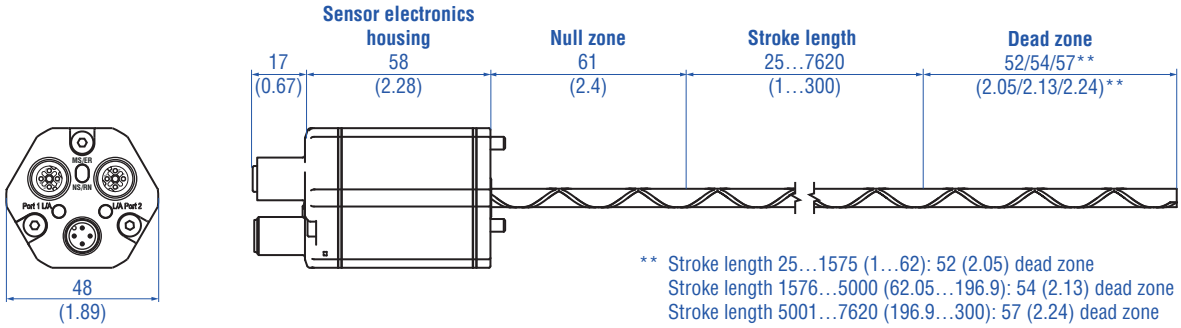
Controlling design dimensions are in millimeters and measurements in ( ) are in inches

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

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



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



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

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

Installation of RH5 with threaded flange

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

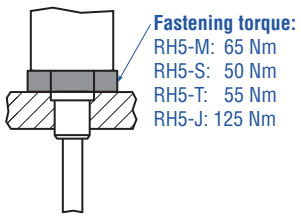


Fig. 8: Mounting example of threaded flange

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 “4.9.1. Replacement of base unit on the RH5/RFV model”on page 35.

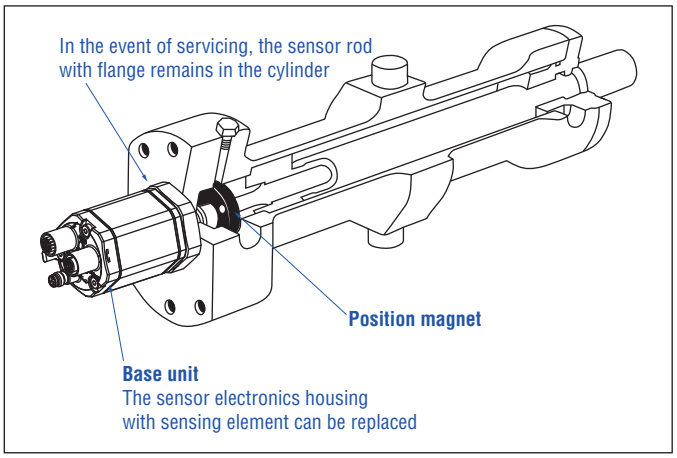


Fig. 9: Sensor in cylinder

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.

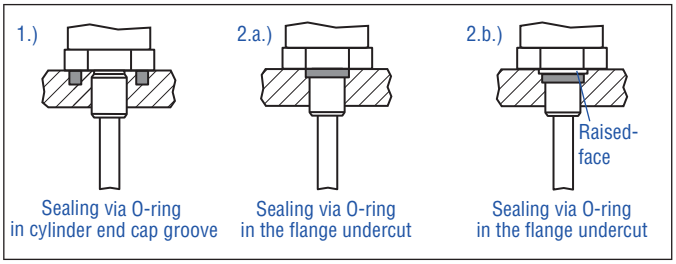
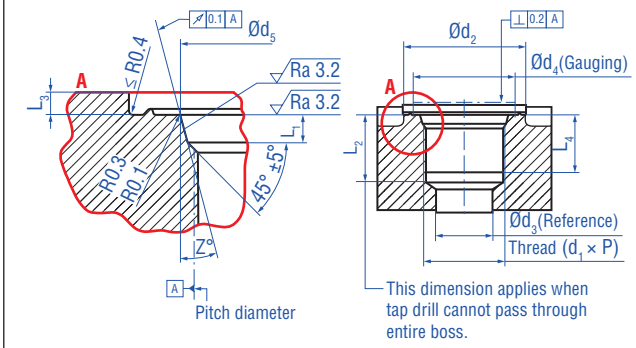


Fig. 10: Possibilities of sealing for threaded flange with flat face 1. + 2.a. (RH5-J/-M/-S) and with raised-face 2.b. (RH5-T)

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

Notice for metric threaded flanges

Thread (d_1×P)	d_2	d_3	d_4	d_5 +0.1 0	L_1 +0.4 0	L_2	L_3	L_4	Z° ±1°
RH5-M-A/M/V									
M18×1.5	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°

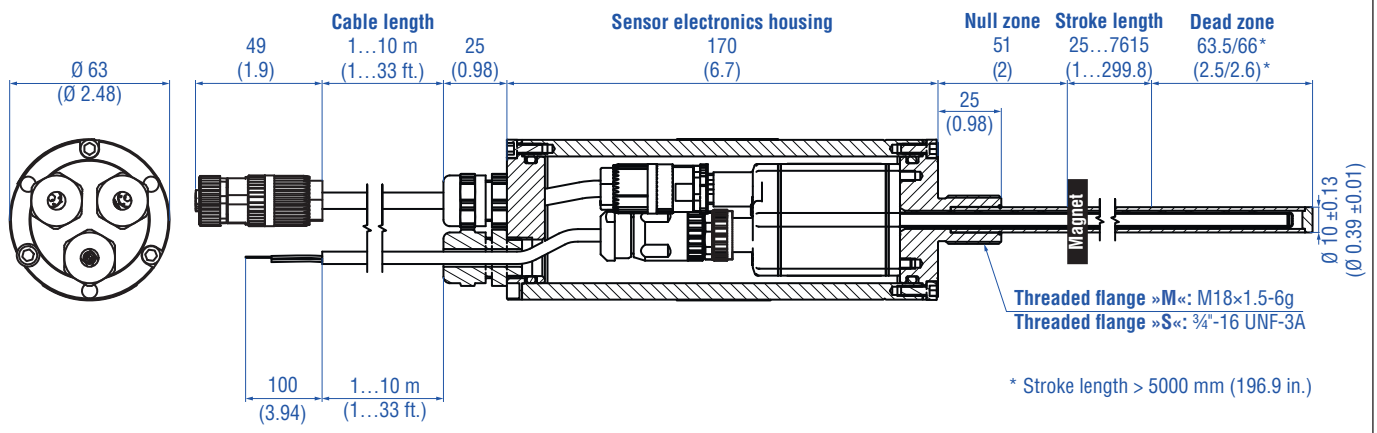


Controlling design dimensions are in millimeters

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

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 threaded before tightening.

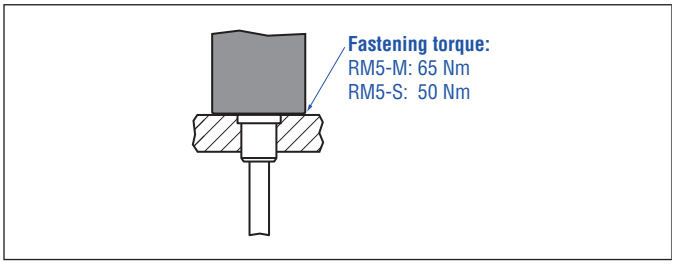


Fig. 13: Mounting example of threaded flange

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 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 “4.9.2. Replacement of base unit on the RM5 model”on page 36.

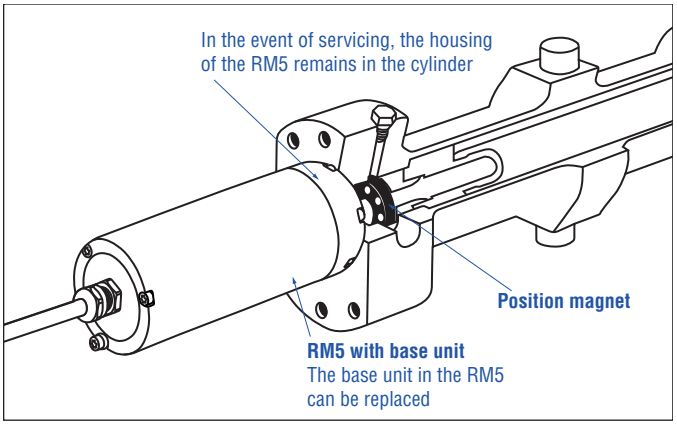


Fig. 14: RM5 sensor in cylinder

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.

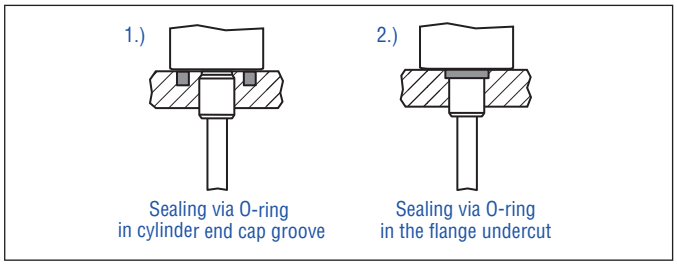
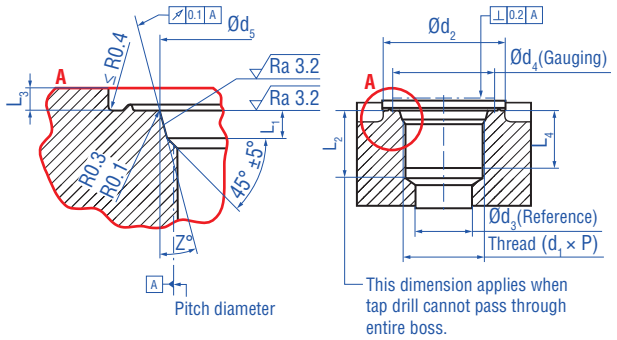


Fig. 15: Possibilities of sealing

- Note the fastening torque:
  RM5-M: 65 Nm
  RM5-S: 50 Nm
- Seat the flange contact surface completely on the cylinder mounting surface.
- The cylinder manufacturer determines the pressure-resistant gasket (copper gasket, O-ring, etc.).
- The position magnet should not grind on the sensor rod.
- The piston rod drilling
  (≥ 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°

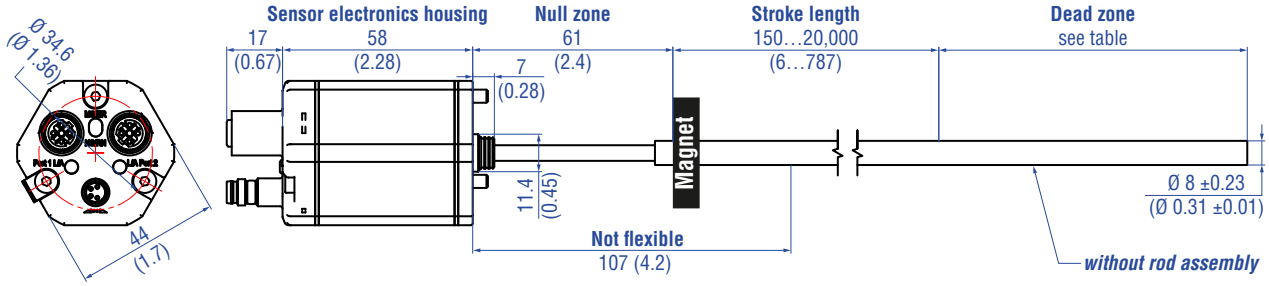


Controlling design dimensions are in millimeters

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

4.5 Installation and design of Temposonics® RFV

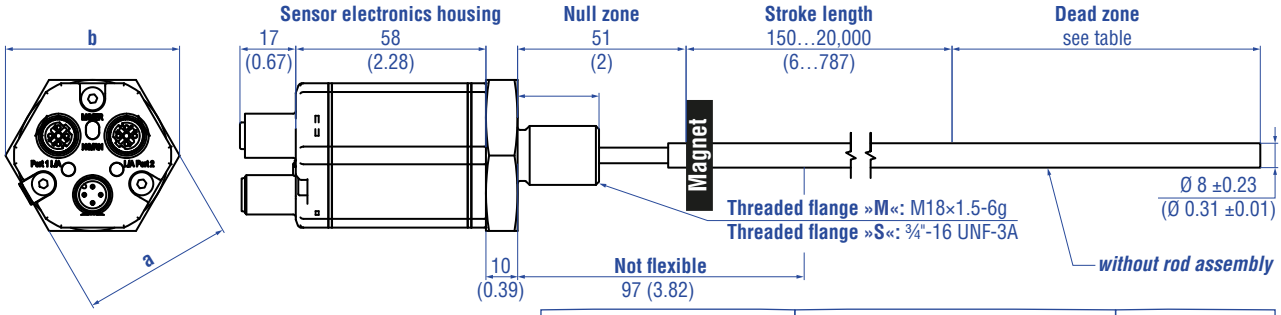
RFV-B – RFV base unit (without flange & rod assembly), example: Connection type D56 (connector outlet)



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. 17: Temposonics® RFV with ring magnet

Installation of Temposonics® 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. 18). 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. 19).
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.

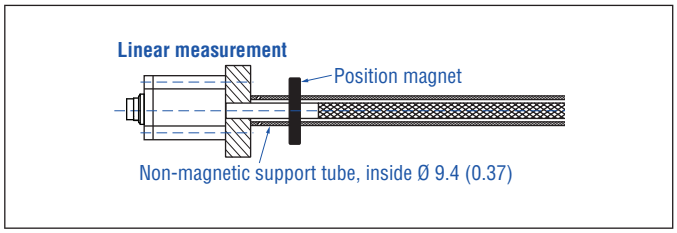


Fig. 18: Sensor with support tube

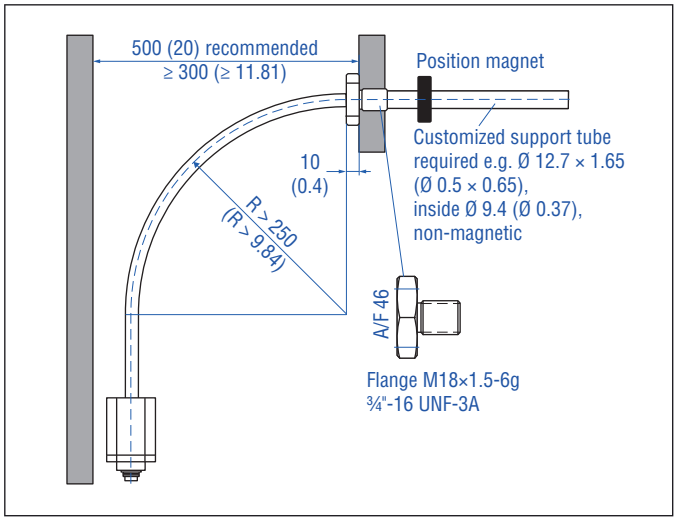


Fig. 19: Clearances for installation and handling

Mounting the RFV

1. RFV-B

- Insert the flexible sensor rod in a support tube.
- Mount the sensor electronics housing by means of 3 non-magnetic socket head screws M4×59. Fastening torque: 1.4 Nm (Fig. 19). 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 3 non-magnetic socket head screws M4×59. Fastening torque: 1.4 Nm (Fig. 20). 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.

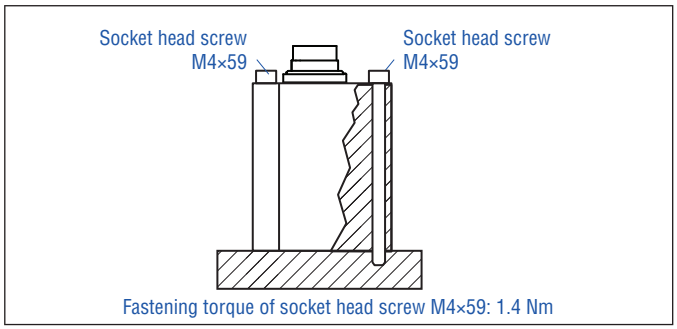


Fig. 20: Mounting with socket head screws M4×59

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

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. 60).
- Embed the flexible sensor element in an appropriately shielded environment, e.g. in a sensor rod HD/HL/HP.

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. 21. Lightly oil the threaded before tightening.

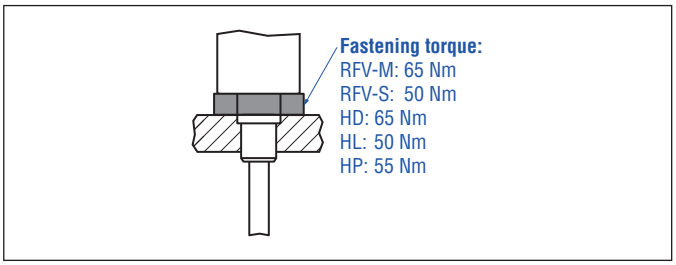


Fig. 21: Mounting example of threaded flange

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 3 screws. It is the only part that needs to be replaced if servicing is required, i.e. the hydraulic circuit remains closed. For more information see chapter “4.9.1. Replacement of base unit on the RH5/RFV model”on page 35.
- 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.

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. 22):

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

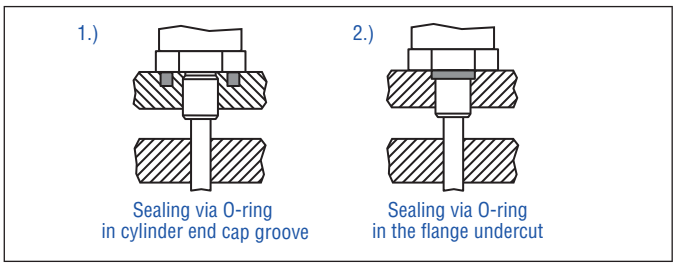


Fig. 22: Possibilities of sealing

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°

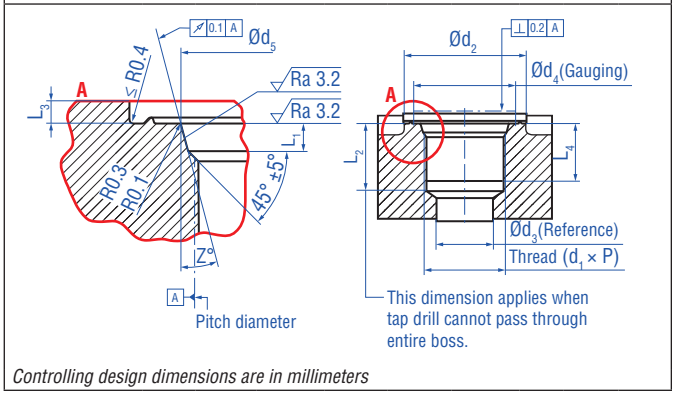


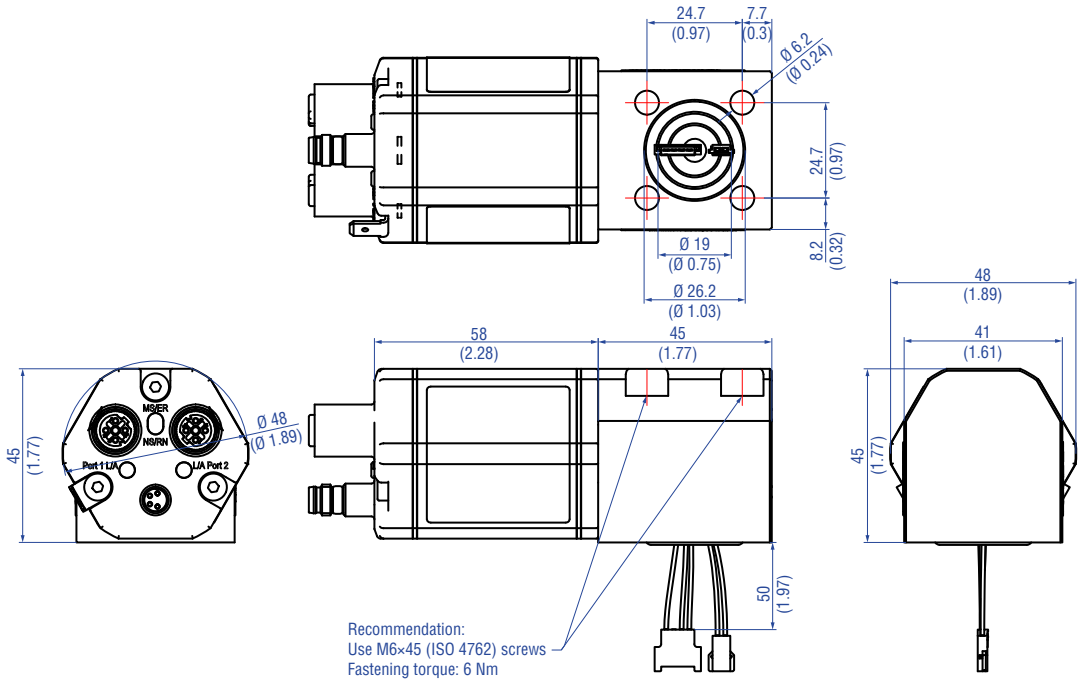
Fig. 23: Notice for metric threaded flange M18×1.5-6g based on DIN ISO 6149-1

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:

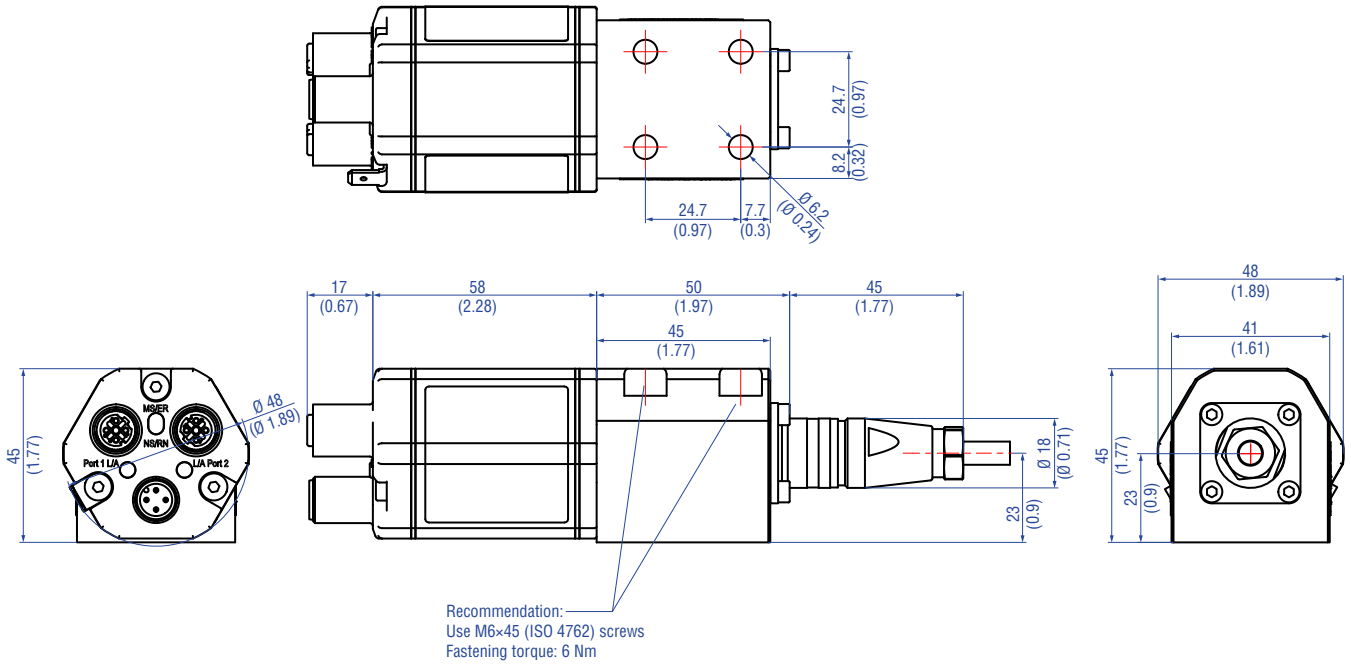
- The R-Series 2004 RF-C base unit is attached to the system with two screws. The R-Series V RFV-B base unit is mounted to the machine with three screws.
- Therefore, we recommend using the adapter plate kit 255198. The adapter plate is used to mount the base unit RFV-B with three screws to the existing 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-xx-xxx-1-xxxx-H003

4.6 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)

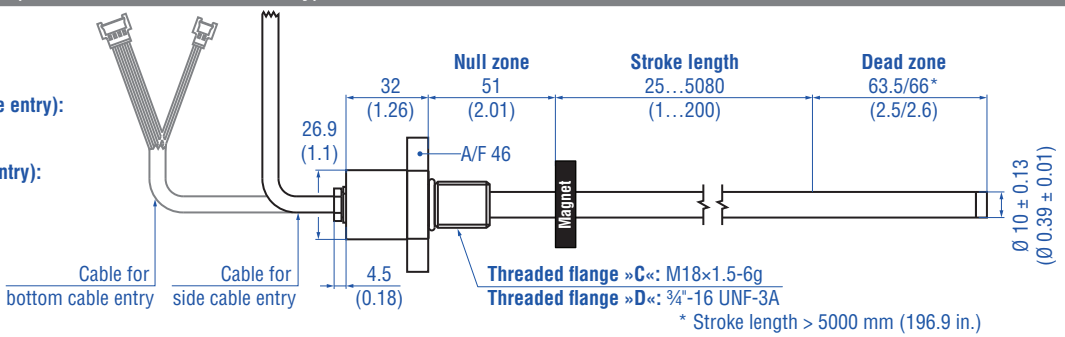


Controlling design dimensions are in millimeters and measurements in ( ) are in inches

Fig. 24: Temposonics® RDV sensor electronics housing

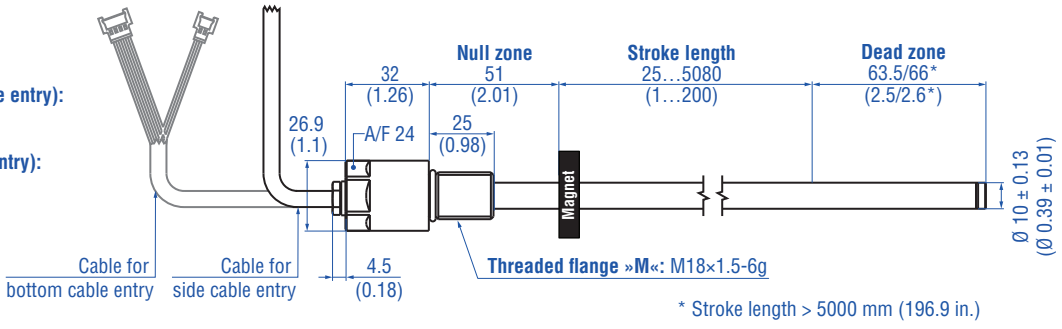
Threaded flange »C« & »D« (for bottom or side cable entry)

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)



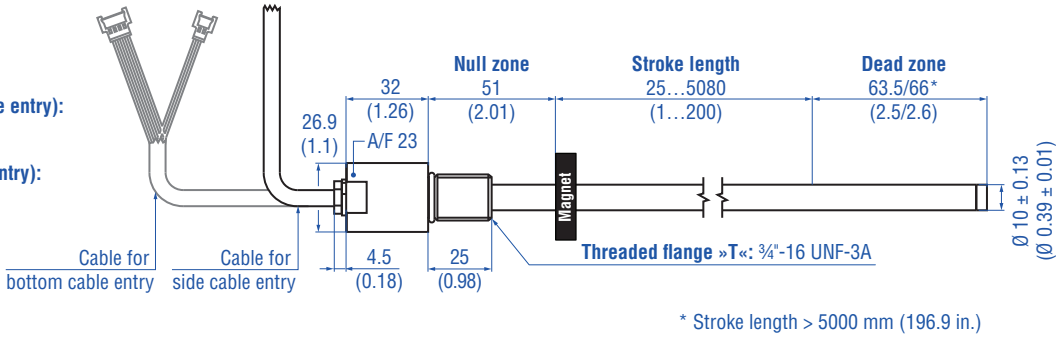
Threaded flange »M« (for bottom or side cable entry)

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)



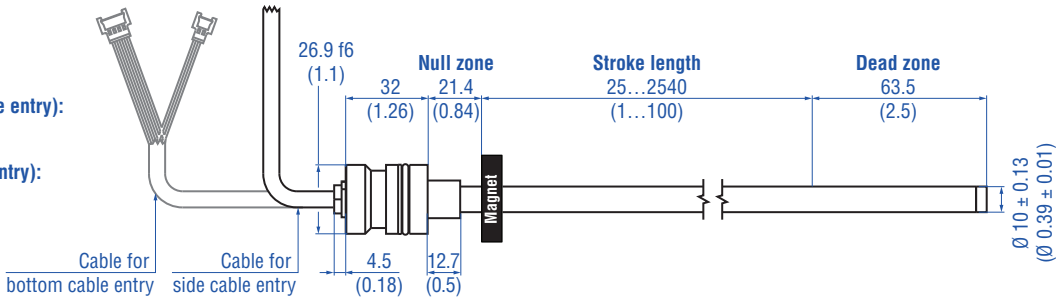
Threaded flange »T« (for bottom or side cable entry)

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)

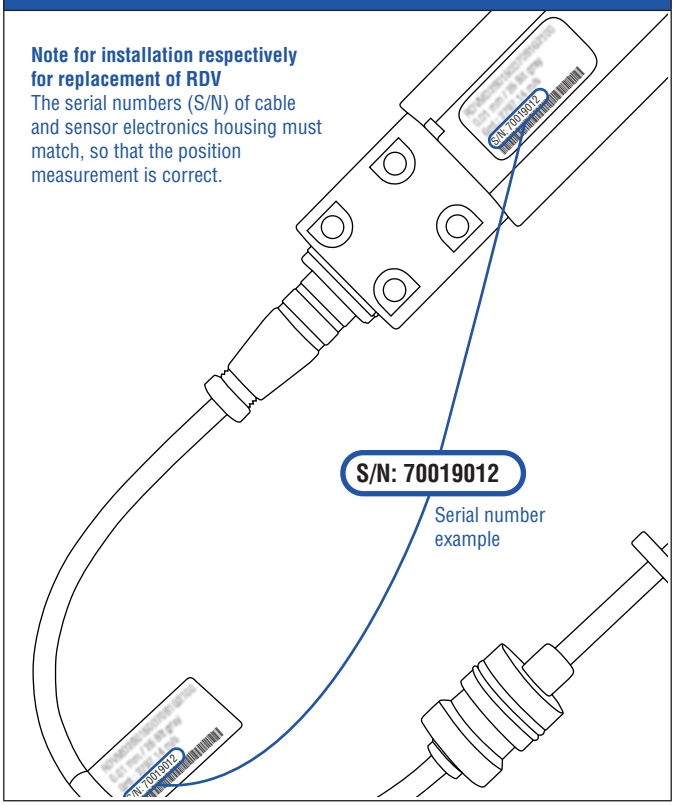
PUR cable:
Ø 6 (Ø 0.24)
Bending radius:
> 24 (> 0.94)
Cable length (bottom cable entry):
65/170/230/350
(2.6/6.7/9.1/13.8)
Cable length (side cable entry):
250/400/600
(9.8/15.7/23.6)



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

Fig. 25: Temposonics® RDV flanges

NOTICE



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 will be explained in the following sections.

4.6.1. 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. 26. Lightly oil the threaded before tightening.

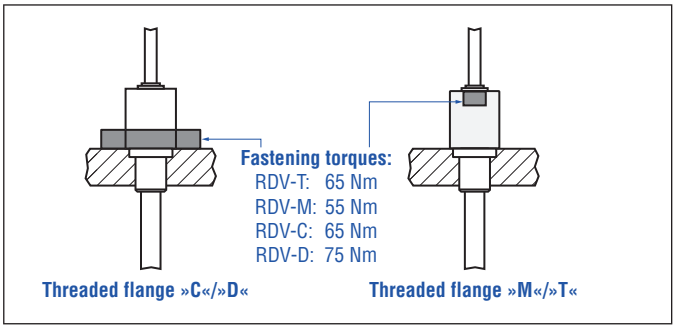


Fig. 26: Mounting example of threaded flange »C«/»D«, »M«/»T«

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

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. 27):

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

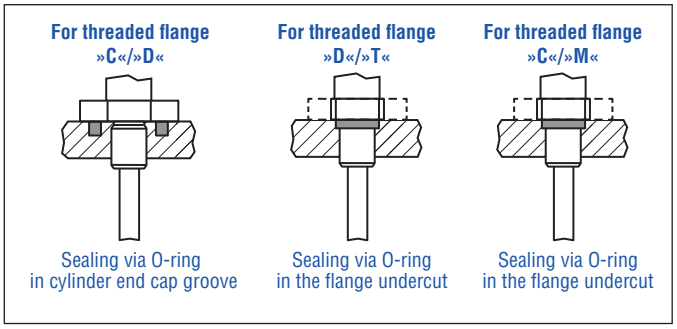
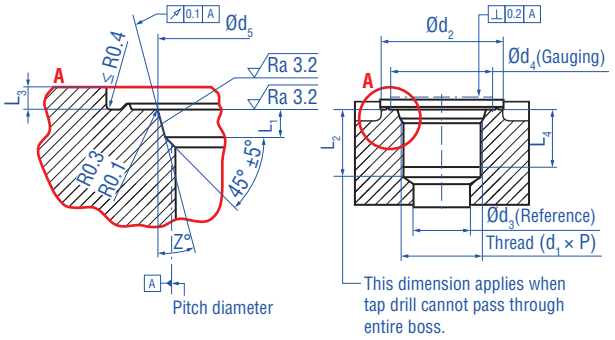


Fig. 27: Possibilities of sealing

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

4.6.2. 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. 29). For details of the pressure fit flange »S« see Fig. 30. Also note the mounting examples in Fig. 31 and Fig. 32.

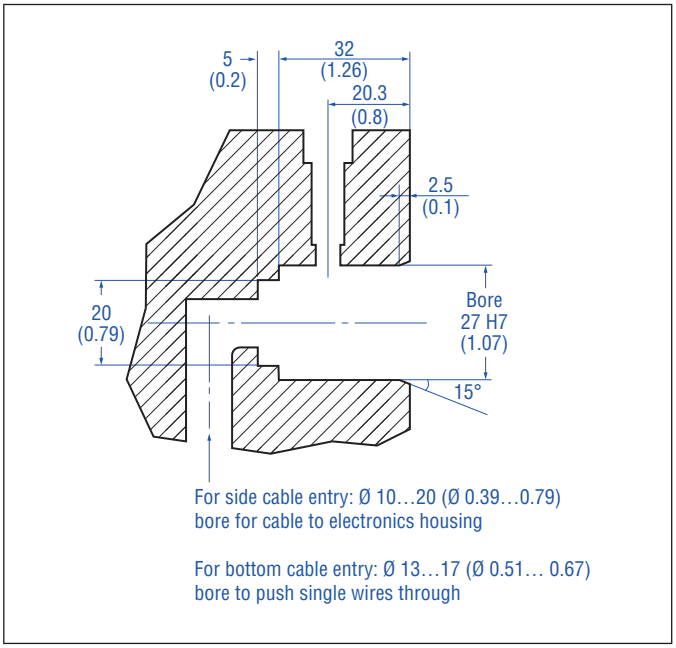


Fig. 29: Example of mounting detail: Shoulder screw 8-M6 (ISO 7379) with internal hexagon

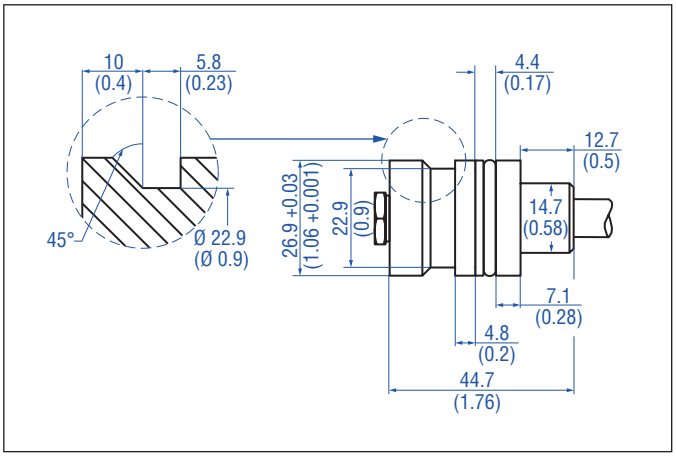


Fig. 30: Pressure fit flange »S« details

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

4.6.3. Installation of RDV's sensor electronics housing

The following section explains the connection of an RDV sensor with bottom cable entry (Fig. 31) and side cable entry (Fig. 32) 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. 31). Note the bending radius of the cable if you run the cable between sensor electronics and rod (see Fig. 25).

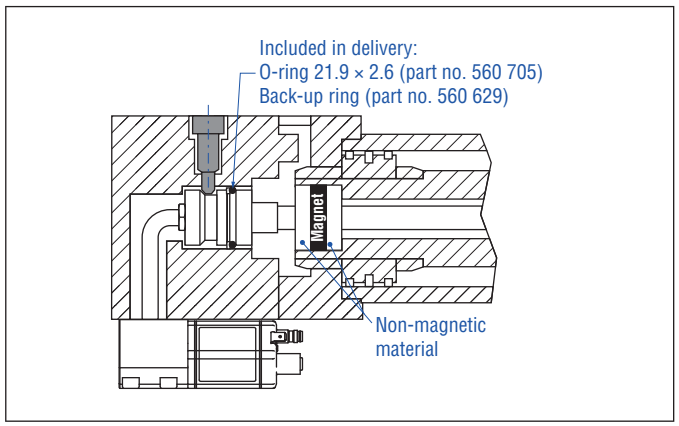


Fig. 31: Mounting example of pressure fit flange »S« and sensor electronics with bottom cable entry

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. 32). Note the bending radius of the cable if you run the cable between sensor electronics and rod (see Fig. 25).

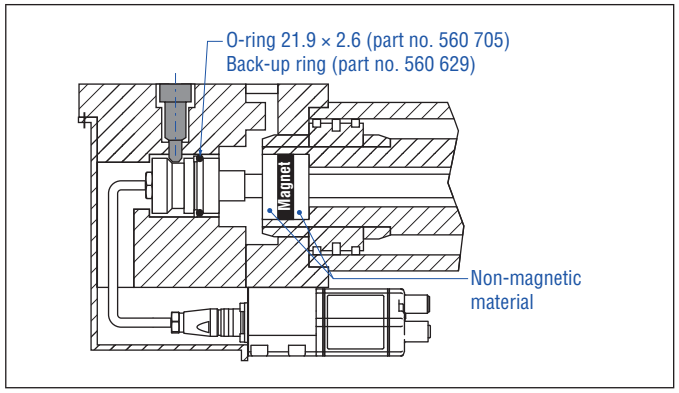


Fig. 32: Mounting example of pressure fit flange »S« and sensor electronics with side cable entry

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. 60).
- 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.

4.6.4. 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.

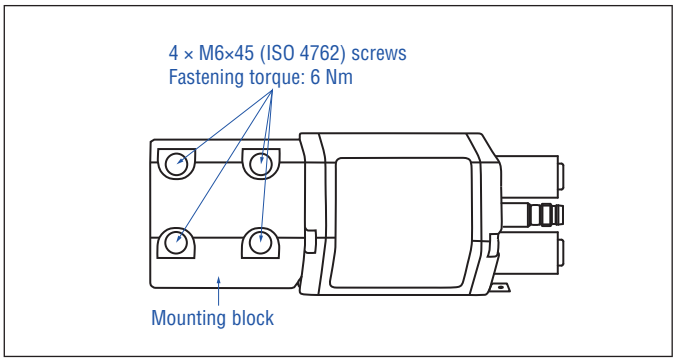


Fig. 33: Mounting of RDV sensor electronics housing (example of bottom cable entry)

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

4.7 Magnet installation

Typical use of magnets

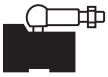
Magnet	Typical sensors	Benefits
Ring magnets 	**Rod model** (RH5, RM5, RFV, RDV)	• Rotationally symmetrical magnetic field
U-magnets 	**Profile & rod models** (RP5, RH5, RM5, RFV, RDV)	• Height tolerances can be compensated, because the magnet can be lifted off
Block magnets 	**Profile & rod models** (RP5, RH5, RM5, 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. 34: Typical use of magnets

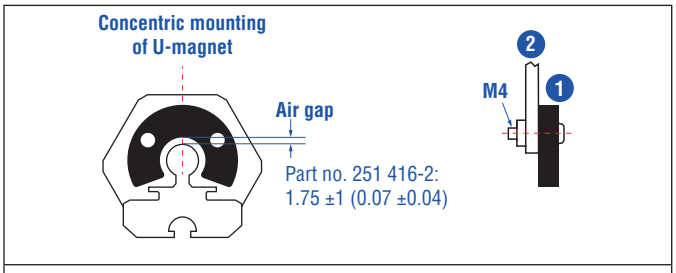
Mounting ring magnets, U-magnets & block magnets

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. 37)
- If no other option exists and magnetic material is used, observe the specified dimensions (Fig. 37)

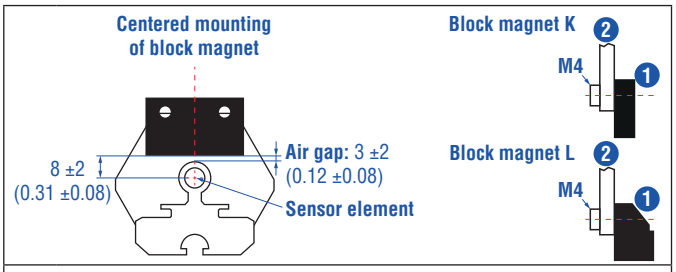
NOTICE

- 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. 35/Fig. 36).
- 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. 35: Mounting of U-magnet (part no. 251 416-2)



1	Block magnet
2	Non-magnetic mounting plate

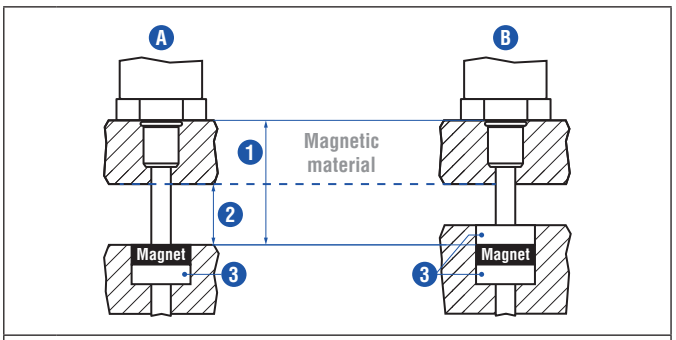
Fig. 36: Mounting of block magnet (part no. 403 448)

Magnet mounting with magnetic material

When using magnetic material the dimensions of Fig. 37 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. 37: 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. 38) for measurement.

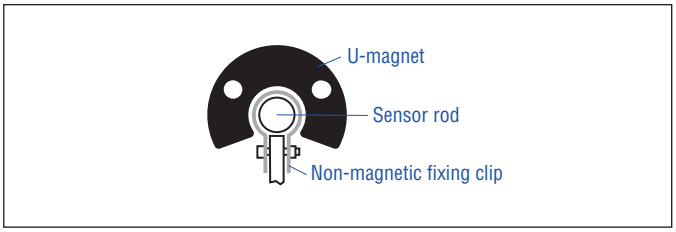
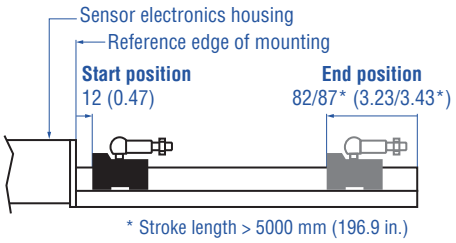


Fig. 38: Example of sensor support with the fixing clip (part no. 561 481)

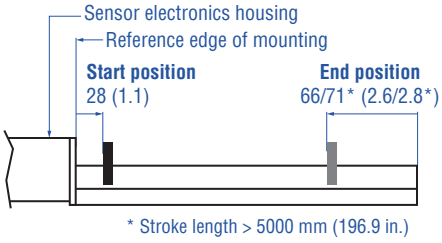
Start- and end positions of the position magnets

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

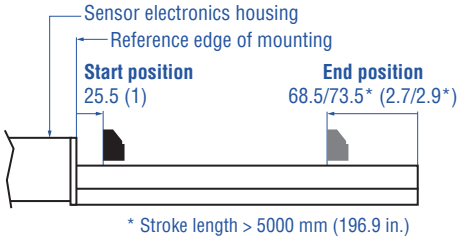
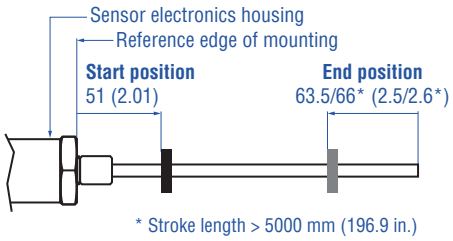


Fig. 39: Start- and end positions of magnets for RP5

RH5 with ring magnet/U-magnet



RH5 with block magnet

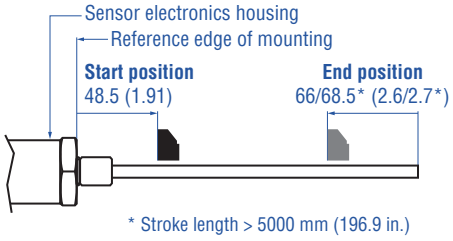
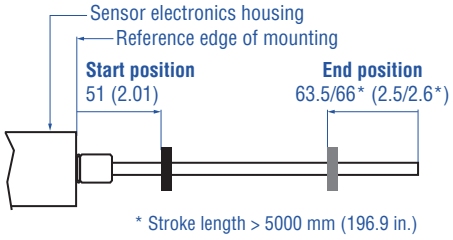


Fig. 40: Start- and end positions of magnets for RH5

RM5 with ring magnet/U-magnet



RM5 with block magnet

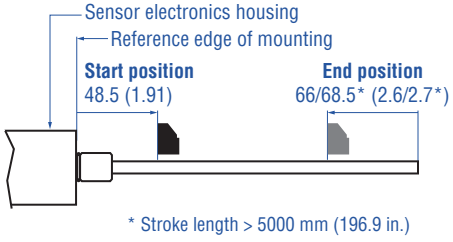
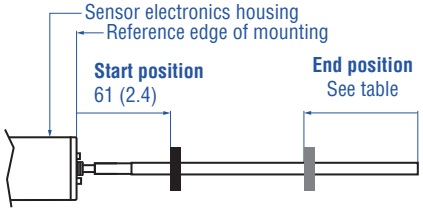


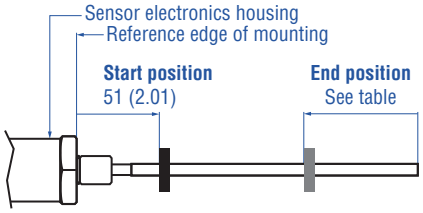
Fig. 41: Start- and end positions of magnets for RM5

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

RFV-B with ring magnet/U-magnet



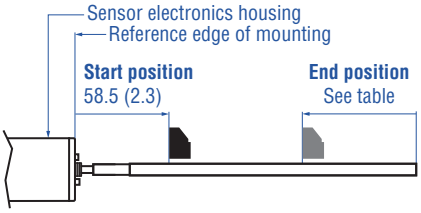
RFV-M/-S with ring magnet/U-magnet



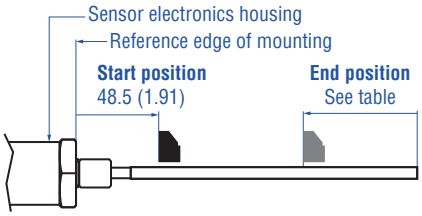
Stroke length	Tolerance of total length	Dead zone
Up to 7620 mm (300 in.)	+8 mm (0.31 in.)/ –5 mm (0.2 in.)	94 mm (3.7 in.)
Up to 10,000 mm (393.7 in.)	+15 mm (0.59 in.)/ –15 mm (0.59 in.)	100 mm (3.94 in.)
Up to 15,000 mm (590.55 in.)	+15 mm (0.59 in.)/ –30 mm (1.18 in.)	120 mm (4.72 in.)
Up to 20,000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

Fig. 42: Start- and end positions of magnets for RFV with ring- and U-magnets

RFV-B with block magnet



RFV-M/-S with block magnet

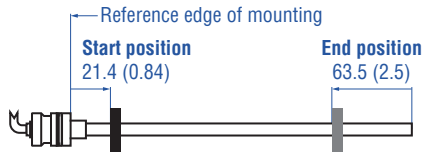


Stroke length	Tolerance of total length	Dead zone
Up to 7620 mm (300 in.)	+8 mm (0.31 in.)/ –5 mm (0.2 in.)	94 mm (3.7 in.)
Up to 10,000 mm (393.7 in.)	+15 mm (0.59 in.)/ –15 mm (0.59 in.)	100 mm (3.94 in.)
Up to 15,000 mm (590.55 in.)	+15 mm (0.59 in.)/ –30 mm (1.18 in.)	120 mm (4.72 in.)
Up to 20,000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

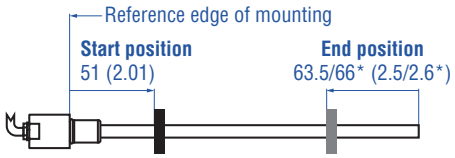
Fig. 43: Start- and end positions of magnets RFV with block magnets

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

RDV-S with ring magnet/U-magnet

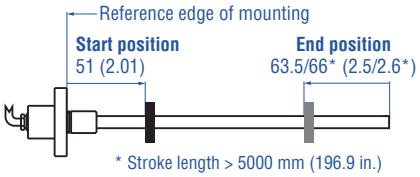


RDV-M/-T with ring magnet/U-magnet



* Stroke length > 5000 mm (196.9 in.)

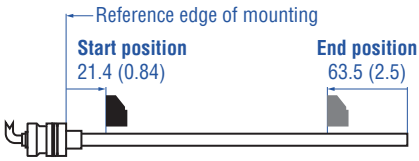
RDV-C/-D with ring magnet/U-magnet



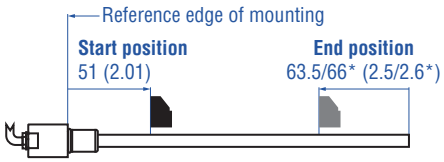
* Stroke length > 5000 mm (196.9 in.)

Fig. 44: Start- and end positions of magnets RDV with ring- and U-magnets

RDV-S with block magnet

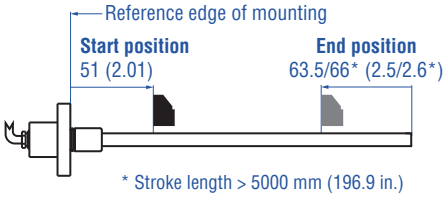


RDV-M/-T with block magnet



* Stroke length > 5000 mm (196.9 in.)

RDV-C/-D with block magnet



* Stroke length > 5000 mm (196.9 in.)

Fig. 45: Start- and end positions of magnets RDV with block magnets

NOTICE

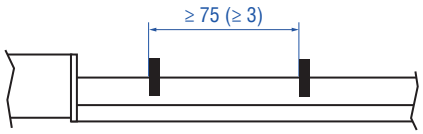
On all sensors, the areas left and right of the active stroke length are provided for null and dead zone. These zones should not be used for measurement, however the active stroke length can be exceeded.

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

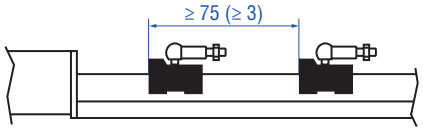
Multi-position measurement

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

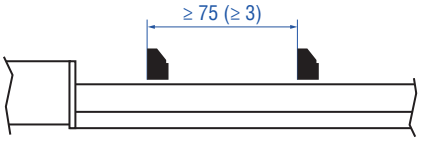
RP5 with U-magnets



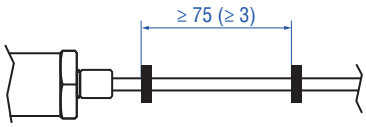
RP5 with magnet sliders



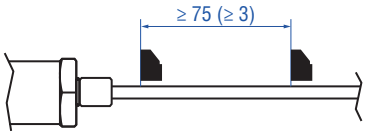
RP5 with block magnets



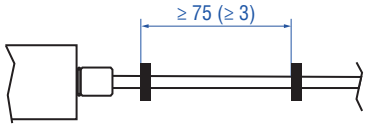
RH5 & RFV with ring magnets/U-magnets



RH5 & RFV with block magnets



RM5 with ring magnets/U-magnets



RM5 with block magnets

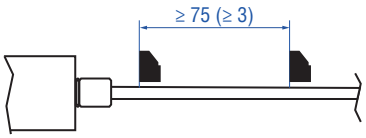
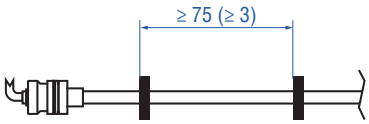


Fig. 46: Minimum distance for multi-position measurement (RH5, RP5, RFV, RM5)

RDV with ring magnets/U-magnets



RDV with block magnets

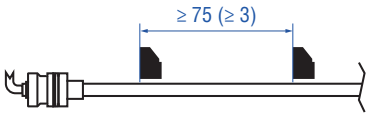


Fig. 47: Minimum distance for multi-position measurement (RDV)

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

4.8 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 & RDV only
- U-magnet OD33 (part no. 254 226)
- Ring magnet OD25.4 (part no. 253 621), for RH5, RM5 & 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. 48, Fig. 49, Fig. 50, Fig. 51 and Fig. 52).

For RH5 EtherCAT® 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.

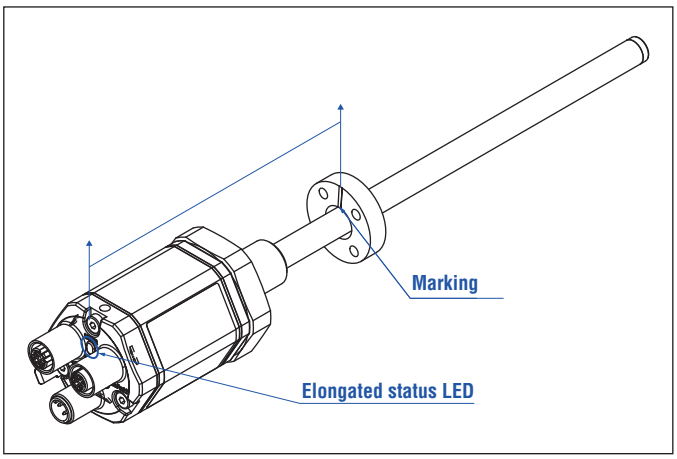


Fig. 48: Magnet alignment of ring magnet for RH5 EtherCAT® with internal linearization

For RP5 EtherCAT® 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.

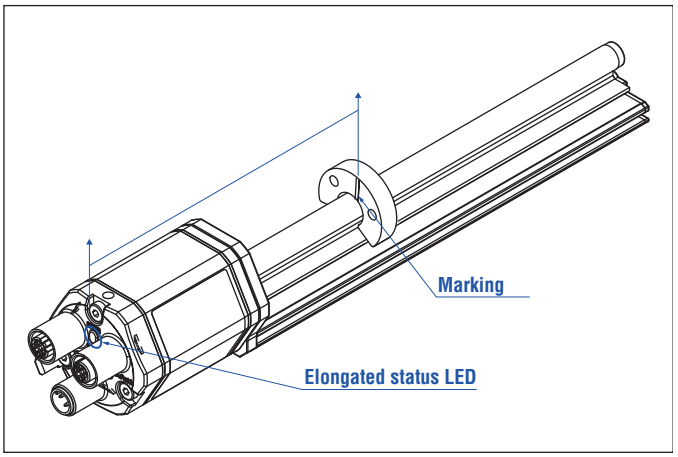


Fig. 49: Magnet alignment of U-magnet for RP5 EtherCAT® with internal linearization

For RP5 EtherCAT® 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.

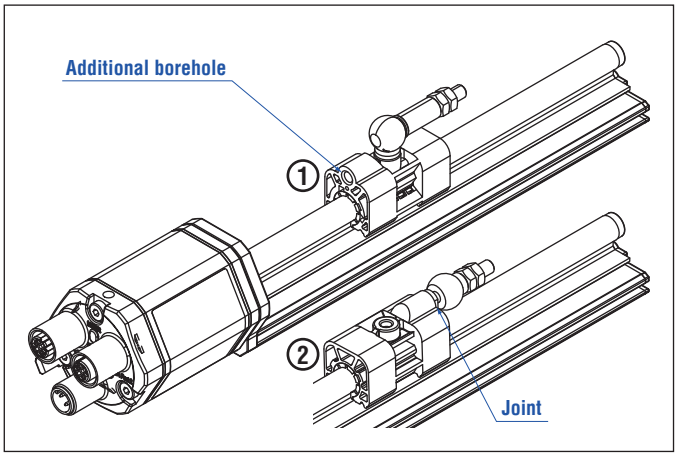


Fig. 50: Magnet alignment of magnet slider for RP5 EtherCAT® with internal linearization

For RDV EtherCAT® sensors with ring magnet/U-magnets 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.

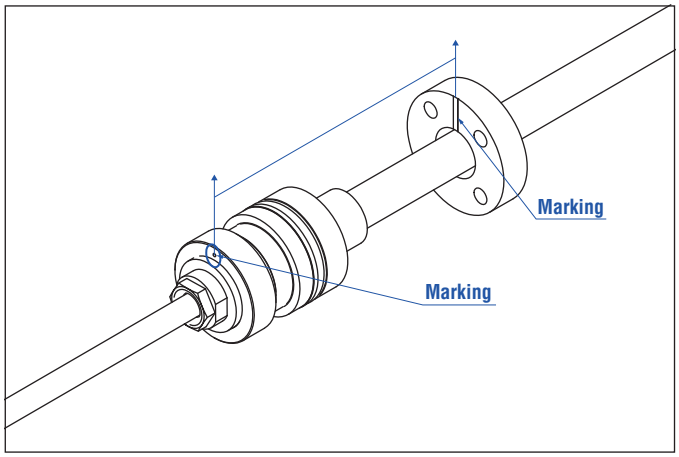


Fig. 51: Magnet alignment of ring magnet for RDV EtherCAT® with internal linearization using the example of an "S" flange

For RM5 EtherCAT® 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.

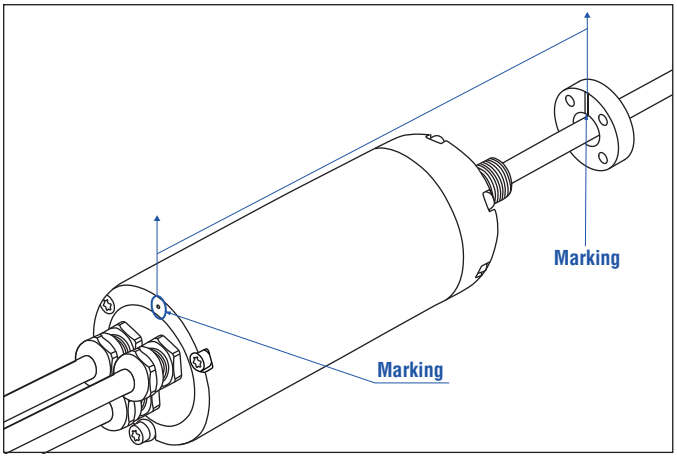


Fig. 52: Magnet alignment of ring magnet for RM5 EtherCAT® with internal linearization

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

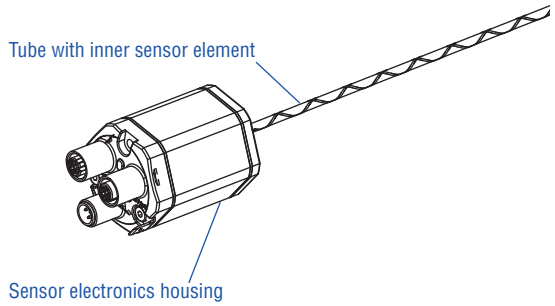
The generated linearization might deviate from the linearity tolerances regarding different environmental conditions. In addition, the use of a different position magnet or more position magnets may cause differences.

4.9 Replacement of base unit

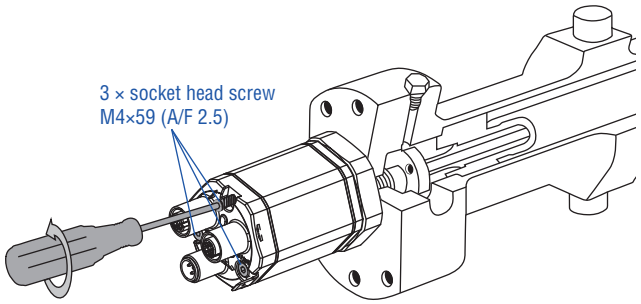
4.9.1. Replacement of base unit on the RH5/RFV model

The base unit of the sensor model RH5 (RH5-B) is replaceable as shown in Fig. 53 and Fig. 54 for the sensor designs »M«, »S« and »T«. The sensor can be replaced without interrupting the hydraulic circuit. This also applies to the RFV-B sensor, which is installed in the optional HD, HL and HP sensor rod.

Base unit



1. Loosen the screws.



2. Pull out the base unit.

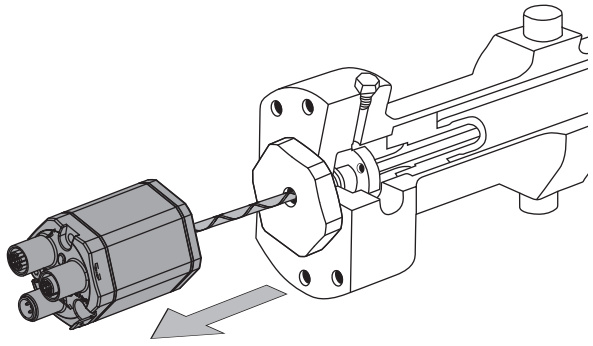


Fig. 53: Replacement of the base unit (e.g. RH5 sensor), part 1

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

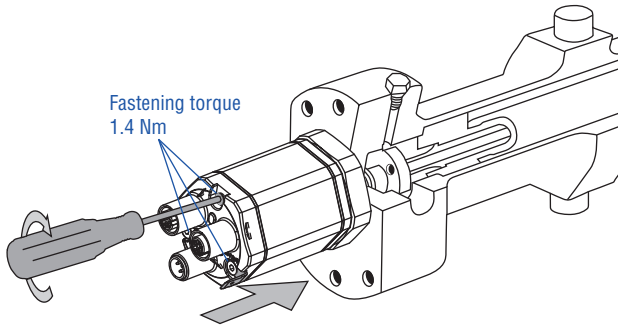


Fig. 54: Replacement of the base unit (e.g. RH5 sensor), part 2

NOTICE

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

4.9.2. Replacement of base unit on the RM5 model

A base unit RM5-B is installed in the super shield housing of the RM5 (Fig. 55). The base unit can be replaced without interrupting the hydraulic circuit.

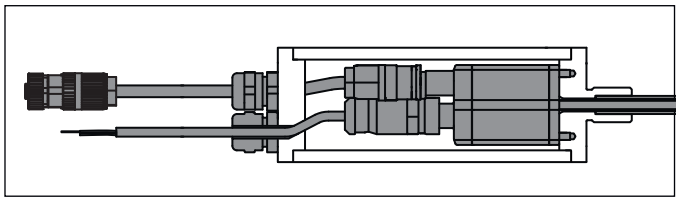
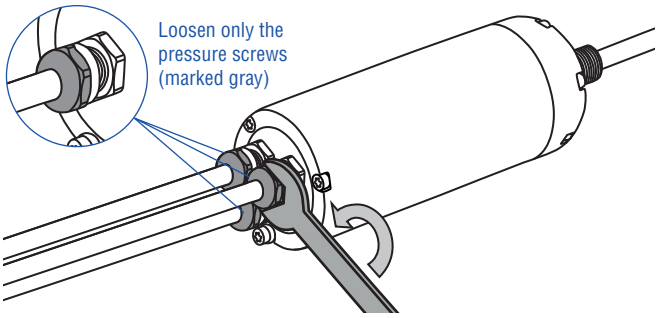
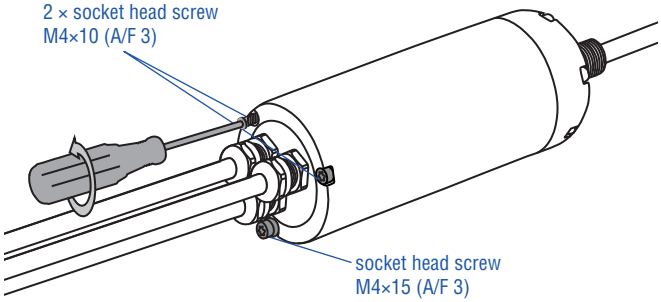


Fig. 55: Base unit in the super shield housing of the RM5

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.**

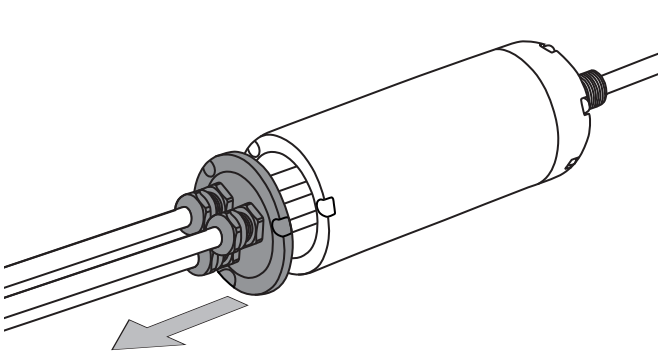
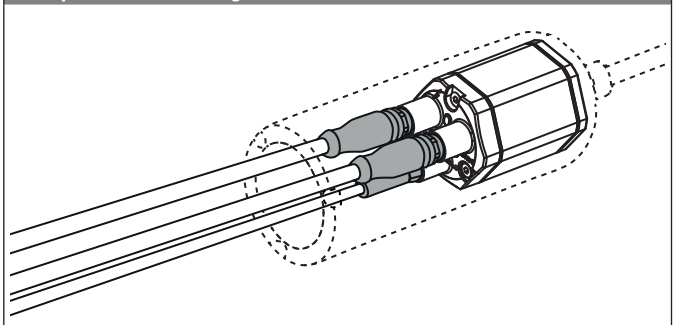
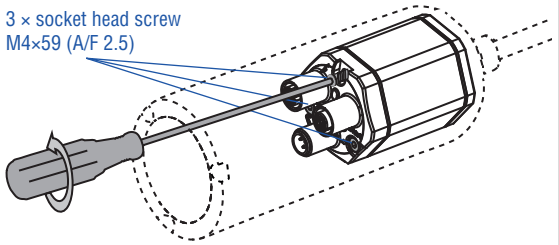


Fig. 56: Replacement of the base unit on model RM5, part 1

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.

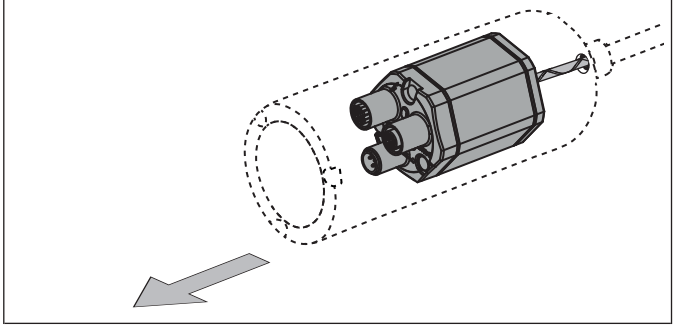
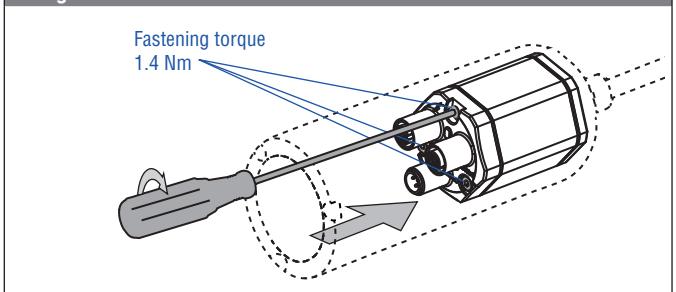


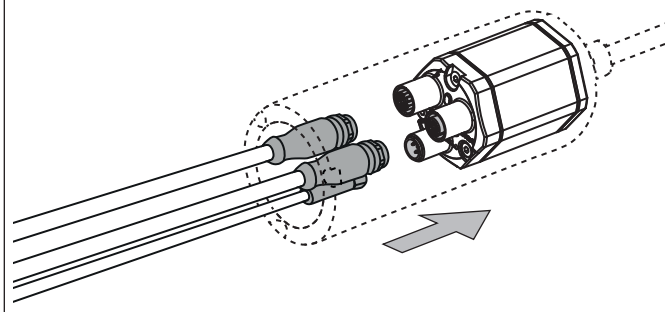
Fig. 57: Replacement of the base unit on model RM5, part 2

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.

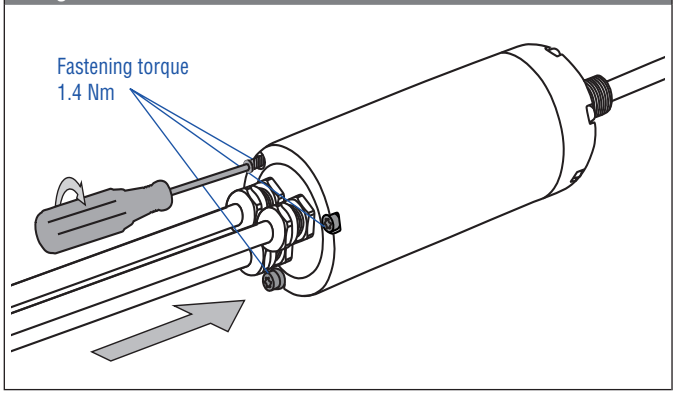


Fig. 58: Replacement of the base unit on model RM5, part 3

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.

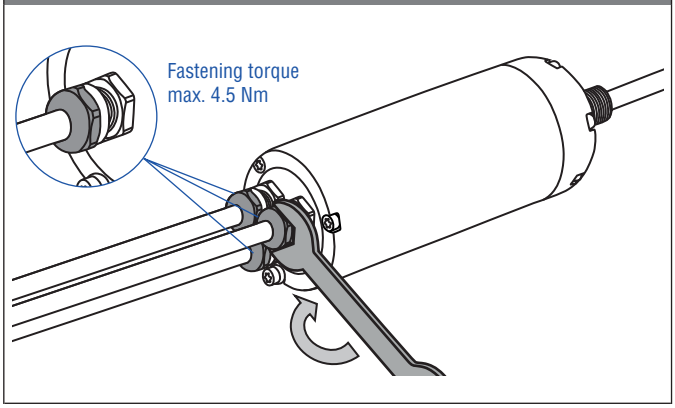


Fig. 59: Replacement of the base unit on model RM5, part 4

NOTICE

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

4.10 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. 60. Note the installation example for grounding an RM5 sensor in Fig. 61. In addition you can ground the sensor types RH5, RM5 and RFV via thread.

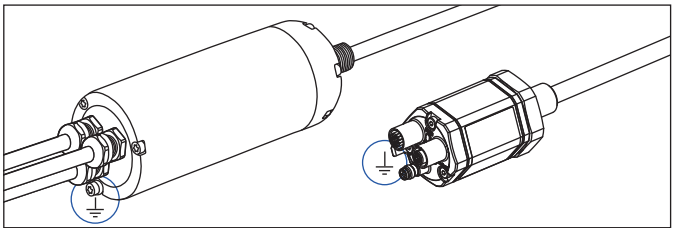


Fig. 60: Grounding via ground lug on the example of an RM5 sensor (left) / RH5 sensor (right)

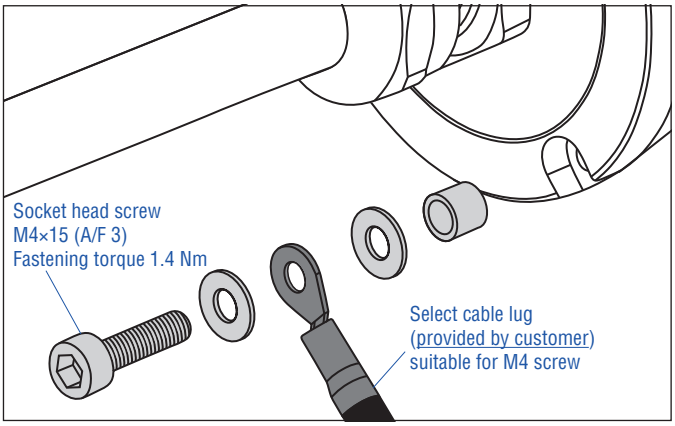


Fig. 61: Installation example for grounding of RM5 sensor

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:

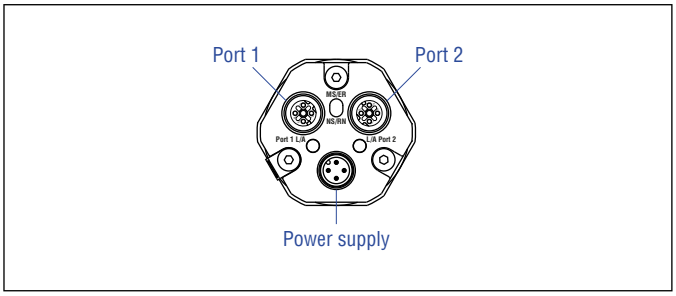


Fig. 62: Location of connections

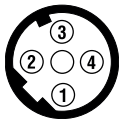
D56		
Port 1 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
 View on sensor	1	Tx (+)
	2	Rx (+)
	3	Tx (–)
	4	Rx (–)
Port 2 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
 View on sensor	1	Tx (+)
	2	Rx (+)
	3	Tx (–)
	4	Rx (–)
Power supply		
M8 male connector	**Pin**	**Function**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

Fig. 63: 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. 64: Connector wiring D58

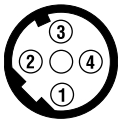
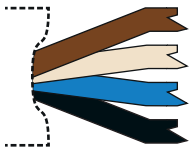
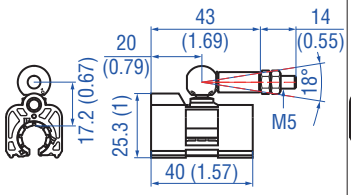
MXX		
Port 1 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
 View on sensor	1	Tx (+)
	2	Rx (+)
	3	Tx (–)
	4	Rx (–)
Port 2 – Signal		
M12 female connector (D-coded)	**Pin**	**Function**
 View on sensor	1	Tx (+)
	2	Rx (+)
	3	Tx (–)
	4	Rx (–)
Power supply		
Cable	**Color**	**Function**
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

Fig. 65: Connector wiring MXX

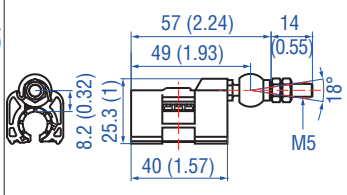
4.11 Frequently ordered accessories for Temposonics® RP5 – Additional options see Accessories Catalog 551444

Position magnets



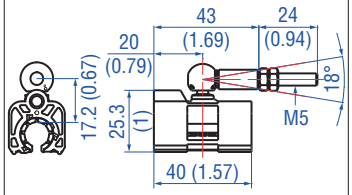
Magnet slider S,
joint at top
Part no. 252 182

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



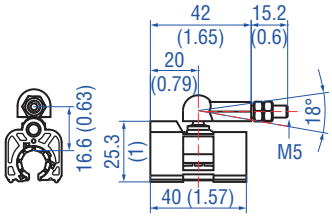
Magnet slider V,
joint at front
Part no. 252 184

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

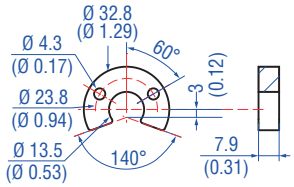
Material: GRP, magnet hard ferrite
Weight: Approx. 35 g
Operating temperature:
–40…+85 °C (–40…+185 °F)



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)

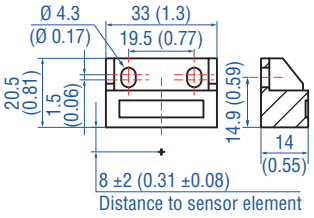
Position magnets



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…+105 °C (–40…+221 °F)

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

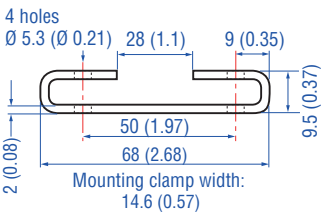


Block magnet L
Part no. 403 448

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

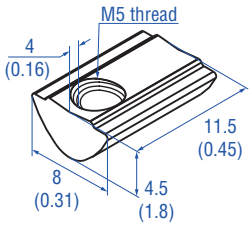
This magnet may influence the sensor performance specifications for some applications.

Mounting accessories



Mounting clamp
Part no. 400 802

Material: Stainless steel (AISI 304)



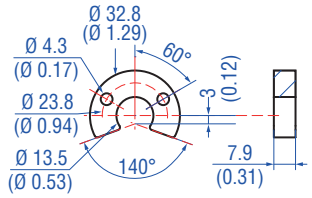
T-nut
Part no. 401 602

Fastening torque for M5 screw: 4.5 Nm

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

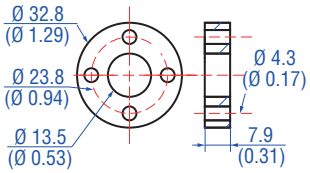
4.12 Frequently ordered accessories for Temposonics® RH5 – Additional options see Accessories Catalog 551444

Position magnets



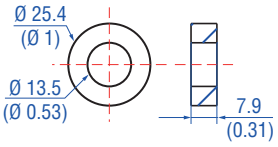
U-magnet OD33
Part no. 251 416-2

Material: PA ferrite GF20
Weight: Approx. 11 g
Surface pressure: Max. 40 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40…+105 °C (–40…+221 °F)
Marked version for sensors with internal linearization: Part no. 254 226



Ring magnet OD33
Part no. 201 542-2

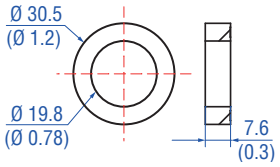
Material: PA ferrite GF20
Weight: Approx. 14 g
Surface pressure: Max. 40 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40…+105 °C (–40…+221 °F)
Marked version for sensors with internal linearization: Part no. 253 620



Ring magnet OD25.4
Part no. 400 533

Material: PA ferrite
Weight: Approx. 10 g
Surface pressure: Max. 40 N/mm²
Operating temperature:
–40…+105 °C (–40…+221 °F)

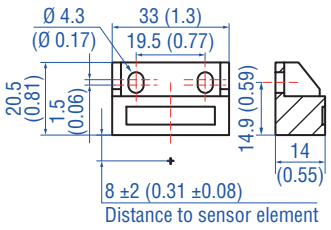
Marked version for sensors with internal linearization: Part no. 253 621



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

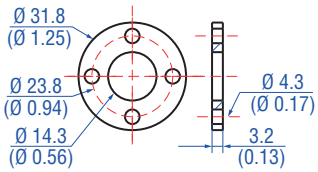


Block magnet L
Part no. 403 448

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.

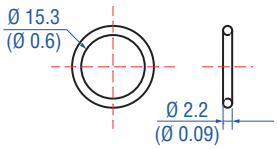
Magnet spacer



Magnet spacer
Part no. 400 633

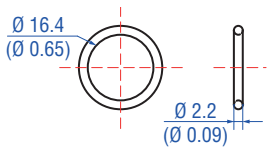
Material: Aluminum
Weight: Approx. 5 g
Surface pressure: Max. 20 N/mm²
Fastening torque for M4 screws: 1 Nm

O-rings



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

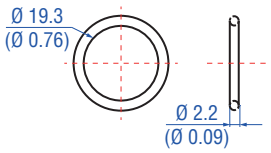
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)



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)

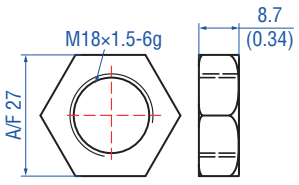
O-ring



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

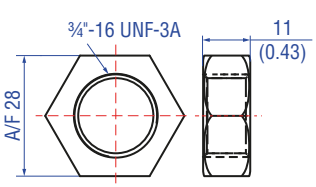
Material: FPM
Durometer: 75 Shore A
Operating temperature:
–20…+200 °C (–6…+392 °F)

Mounting accessories



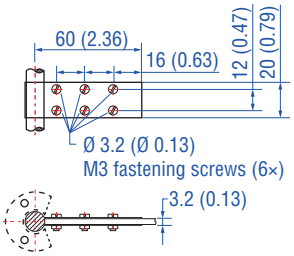
Hex jam nut M18×1.5-6g
Part no. 500 018

Material: Steel, zinc plated



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

Material: Steel, zinc plated



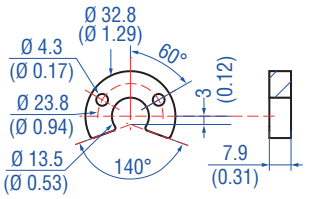
Fixing clip
Part no. 561 481

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

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

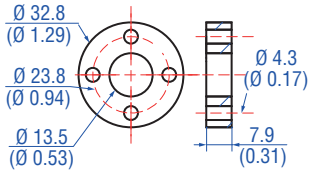
Position magnets



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…+105 °C (–40…+221 °F)

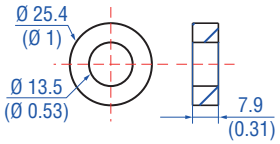
Marked version for sensors with internal linearization: Part no. 254 226



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…+105 °C (–40…+221 °F)

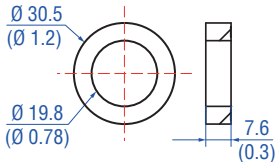
Marked version for sensors with internal linearization: Part no. 253 620



Ring magnet OD25.4
Part no. 400 533

Material: PA ferrite
Weight: Approx. 10 g
Surface pressure: Max. 40 N/mm²
Operating temperature:
–40…+105 °C (–40…+221 °F)

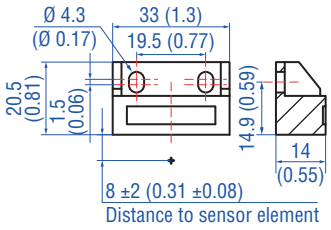
Marked version for sensors with internal linearization: Part no. 253 621



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

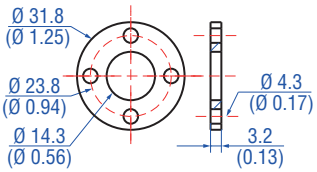


Block magnet L
Part no. 403 448

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.

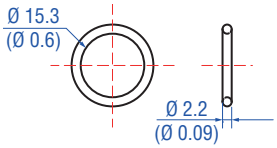
Magnet spacer



Magnet spacer
Part no. 400 633

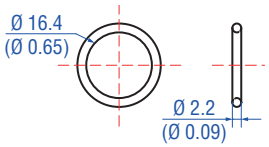
Material: Aluminum
Weight: Approx. 5 g
Surface pressure: Max. 20 N/mm²
Fastening torque for M4 screws: 1 Nm

O-rings



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

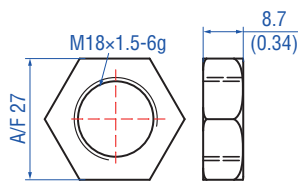
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)



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

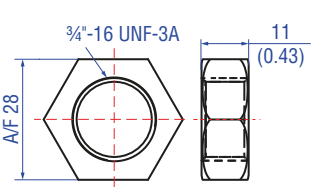
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)

Mounting accessories



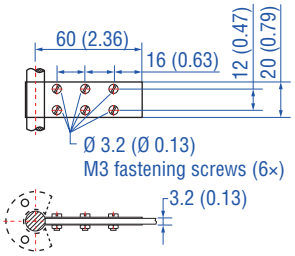
Hex jam nut M18×1.5-6g
Part no. 500 018

Material: Steel, zinc plated



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

Material: Steel, zinc plated

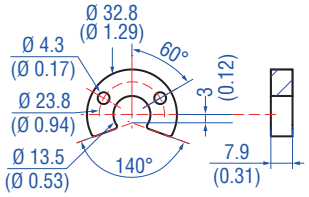


Fixing clip
Part no. 561 481

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

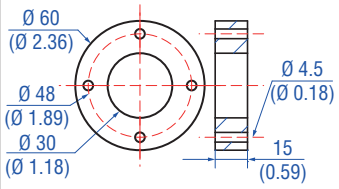
4.14 Frequently ordered accessories for Temposonics® RFV – Additional options see Accessories Catalog 551444

Position magnets



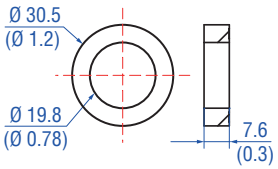
U-magnet OD33
Part no. 251 416-2

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



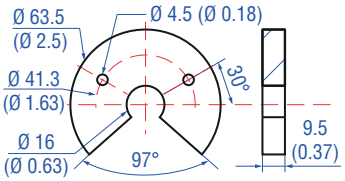
Ring magnet OD60
Part no. MT0162

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

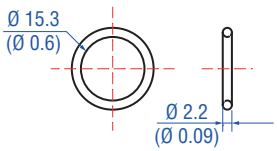
Material: PA ferrite coated
Weight: Approx. 13 g
Surface pressure: Max. 20 N/mm²
Operating temperature:
–40…+100 °C (–40…+212 °F)



U-magnet OD63.5
Part no. 201 553

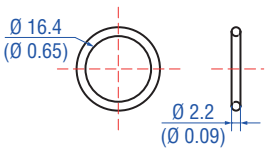
Material: PA 66-GF30,
magnets compound-filled
Weight: Approx. 26 g
Surface pressure: 20 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40…+75 °C (–40…+167 °F)

O-rings



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

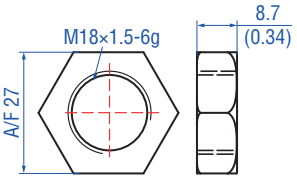
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)



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

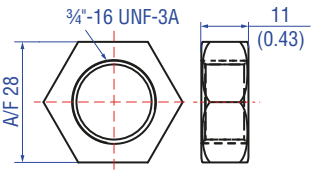
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)

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)

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

Material: Stainless steel 1.4305
(AISI 303)

Adapter plate
Part no. 255 198

Adapter plate for mounting an
RFV-B/RF5-B as replacement for an
RFV-B/RF5-B. Order the RFV-B/RF5-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

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)

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

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)

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

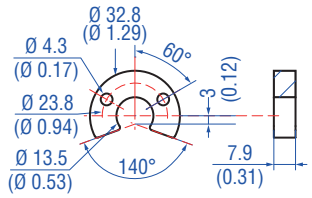
Pressure rod Ø: 12.7 mm (0.5 in.)
Length: 100…7500 mm (4…295 in.)
Operating pressure: 350 bar (5076 psi)
Material flange:
Stainless steel 1.4305 (AISI 303)
Material rod:
Stainless steel 1.4301 (AISI 304)

Profile with flange
HFP [length mm: XXXXX] M
HFP [length in.: XXXX.X] U

Length: Max. 20 000 mm (max. 787 in.)
Ingress protection: IP30
Material: Aluminum

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

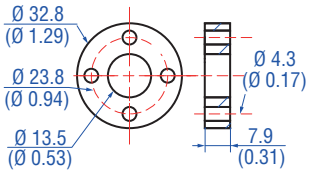
Position magnets



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…+105 °C (–40…+221 °F)

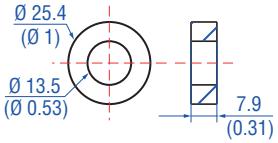
Marked version for sensors with internal linearization: Part no. 254 226



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…+105 °C (–40…+221 °F)

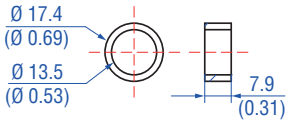
Marked version for sensors with internal linearization: Part no. 253 620



Ring magnet OD25.4
Part no. 400 533

Material: PA ferrite
Weight: Approx. 10 g
Surface pressure: Max. 40 N/mm²
Operating temperature:
–40…+105 °C (–40…+221 °F)

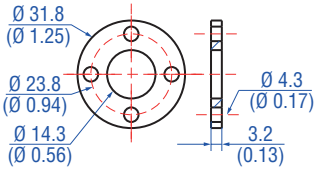
Marked version for sensors with internal linearization: Part no. 253 621



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)

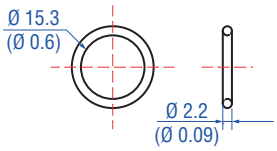
Magnet spacer



Magnet spacer
Part no. 400 633

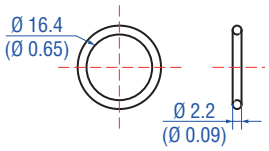
Material: Aluminum
Weight: Approx. 5 g
Surface pressure: Max. 20 N/mm²
Fastening torque for M4 screws: 1 Nm

O-rings



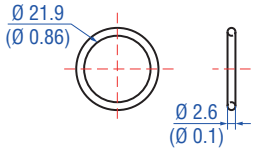
O-ring for threaded flange
M18×1.5-6g
Part no. 401 133

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

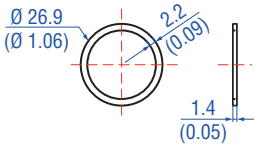
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)



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

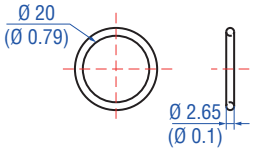
Material: Nitrile rubber
Operating temperature:
–53…+107 °C (–65…+225 °F)

O-rings



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

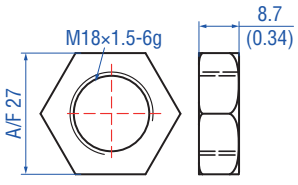
Material: Polymyte
Durometer: 90 Shore A



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

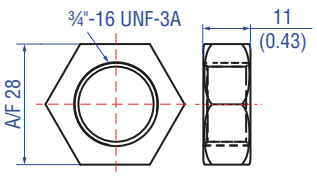
Material: FKM
Durometer: 80± 5 Shore A
Operating temperature:
–15…+200 °C (5…+392 °F)

Mounting accessories



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

Material: Steel, zinc plated

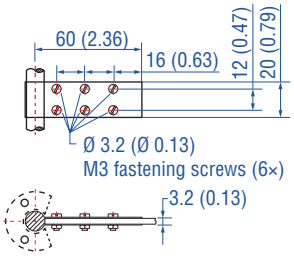


Hex jam nut ¾"-16 UNF-3A
Part no. 500 015

Material: Steel, zinc plated

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

Mounting accessories



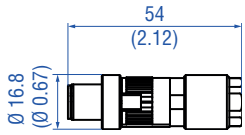
Fixing clip
Part no. 561 481

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

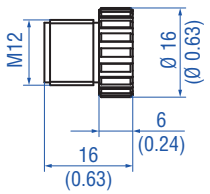
4.16 Frequently ordered accessories for EtherCAT® output – Additional options see Accessories Catalog 551444

Cable connectors* – Signal



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

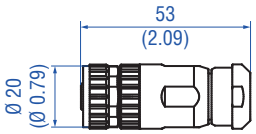
Material: Zinc nickel-plated
Termination: Insulation-displacement
Cable Ø: 6…7.2 mm (0.2…0.28 in.)
Wire: 24 AWG – 22 AWG
Operating temperature:
–25…+85 °C (–13…+185 °F)
Ingress protection: IP65 / IP67 (correctly fitted)
Fastening torque: 0.6 Nm



M12 connector end cap
Part no. 370 537

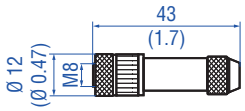
Female connectors M12 should be covered by this protective cap
Material: Brass nickel-plated
Ingress protection: IP67 (correctly fitted)
Fastening torque: 0.39…0.49 Nm

Cable connectors* – Power



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

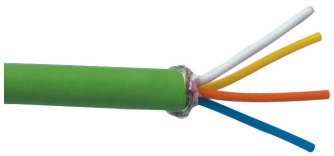
Material: GD-Zn, Ni
Termination: Screw
Contact insert: CuZn
Cable Ø: 4…8 mm (0.16…0.31 in.)
Wire: max. 1.5 mm² (16 AWG)
Operating temperature:
–30…+85 °C (–22…+185 °F)
Ingress protection: IP67 (correctly fitted)
Fastening torque: 0.6 Nm



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 position sensor R-Series V EtherCAT® transfers position, velocity and acceleration values via the EtherCAT® output. EtherCAT® means **Ether**net for **C**ontrol **A**utomation **T**echnology and is an Industrial Ethernet interface. It is managed by the **E**therCAT® **T**echnology **G**roup (ETG). The sensor and the corresponding ESI (**E**therCAT **S**lave **I**nformation) file are certified by the ETG.

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 Run status LED is green.
5. Check the preset span start and end values of the measuring range (see chapter 4.7) and correct them via the customer's control system, if necessary.

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 EtherCAT® is equipped with three LEDs:

- LED for status indication (condition indicator)
- LED for link activity of port 1 (port 1 L/A)
- LED for link activity of port 2 (port 2 L/A)

EtherCAT® LED status

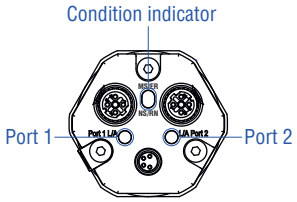
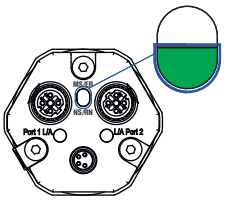


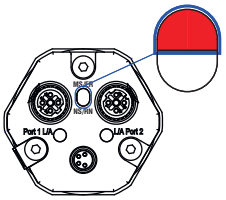
Fig. 66: LED status, part 1

Run status LED



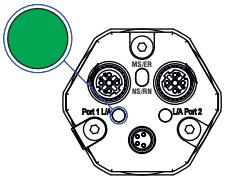
Green		Information
●	ON	OP mode
◐	Flashing 1×	SAFE-OP mode
◔	Blinking	PRE-OP mode
◔	Flickering	Booting process
○	OFF	INIT mode

Error status LED



Red		Information
●	ON	Critical error
◐	Flashing 1×	Slave drive state changed
◐	Flashing 2×	Watchdog timer error
◔	Blinking	Configuration error
○	OFF	Communication OK

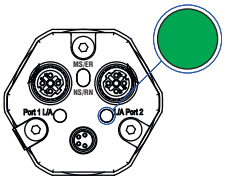
Port 1 L/A (IN)



Green		Information
●	ON	Link activity on port 1
◔	Blinking	Data transfer on port 1
○	OFF	Port closed

Fig. 67: LED status, part 2

Port 2 L/A (OUT)



Green		Information
●	ON	Link activity on port 2
◐	Blinking	Data transfer on port 2
○	OFF	Port closed

Fig. 68: LED status, part 3

5.3 Topologies and downstream devices

EtherCAT® supports different topologies when building a network. For example, line, star, ring and tree structures are possible. The two ports of the R-Series V EtherCAT® are coupled with each other inside the sensor. Therefore, a power failure of the sensor leads to the interruption of communication to the devices connected behind it. This can be avoided, for example, by extending a line structure to a ring structure.

6. Implementation and configuration of R-Series V EtherCAT® with TwinCAT 3

6.1 General information

This instruction describes as an example the implementation and configuration of a Temposonics® R-Series V sensor with EtherCAT® in TwinCAT 3 (The Windows Control and Automation Technology) from Beckhoff Automation GmbH & Co. KG. In principle, you can integrate the sensor into an EtherCAT® network using any EtherCAT®-compatible software and hardware.

NOTICE

Follow the information given in the controller operation manual.

6.2 Implementation of R-Series V EtherCAT® in TwinCAT 3

In order to integrate R-Series V EtherCAT® into TwinCAT 3, you must first provide the ESI file of the sensor for TwinCAT 3. An ESI file (**E**therCAT **S**lave **I**nformation) describes the properties and functions of an EtherCAT® slave. The ESI file, which is based on XML, contains all relevant data that are important both for the implementation of the device in the controller and for data exchange during operation. The ESI file of the R-Series V EtherCAT® is packed in a zip file which is available for download on our homepage www.temposonics.com. Download the ESI file and save it on your computer. To include the ESI file in TwinCAT, unpack the file and place the XML file in the TwinCAT 3 installation directory in the *"Config\Io\EtherCAT"* subdirectory. Then start TwinCAT 3.
If you have stored the ESI file in the installation directory when TwinCAT is already running, you can make the device description file known to TwinCAT later. To do this, select in the menu bar *"File"* the entry *"EtherCAT Devices"* → *"Reload Device Descriptions"* (Fig. 69).

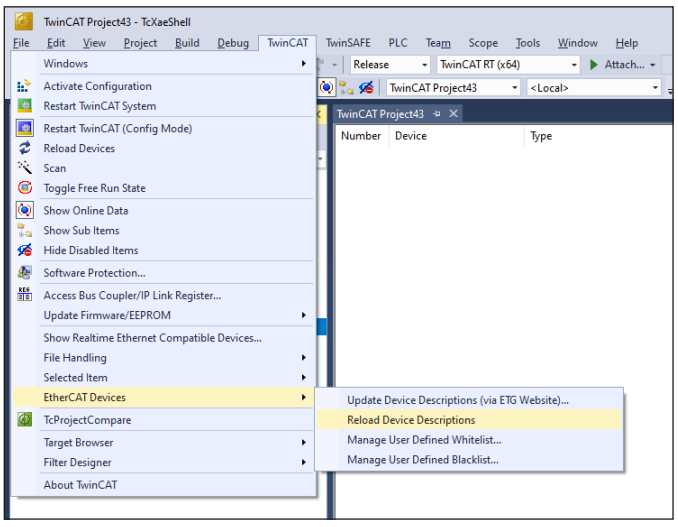


Fig. 69: Subsequent publication of device description files in TwinCAT 3

Fig. 70 shows the TwinCAT user interface in configuration mode (Config mode) after a project has been created and a master integrated. You can implement a slave such as the R-Series V EtherCAT® by selecting in the Solution Explorer in the tree the entry *"I/O → Devices → Devices 1 (EtherCAT)"*. A right mouse click opens a menu. In this menu click the entry *"Scan…"* (Fig. 71). TwinCAT then searches for slaves in the network. In EtherCAT® this process is known as "Scan for boxes".

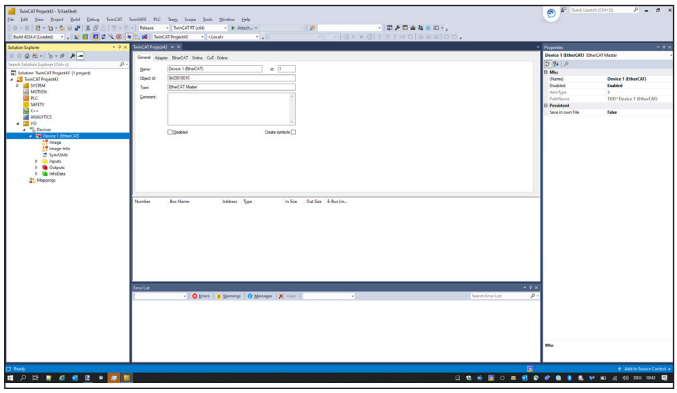


Fig. 70: TwinCAT 3 user interface in configuration mode after creating a project and including a master

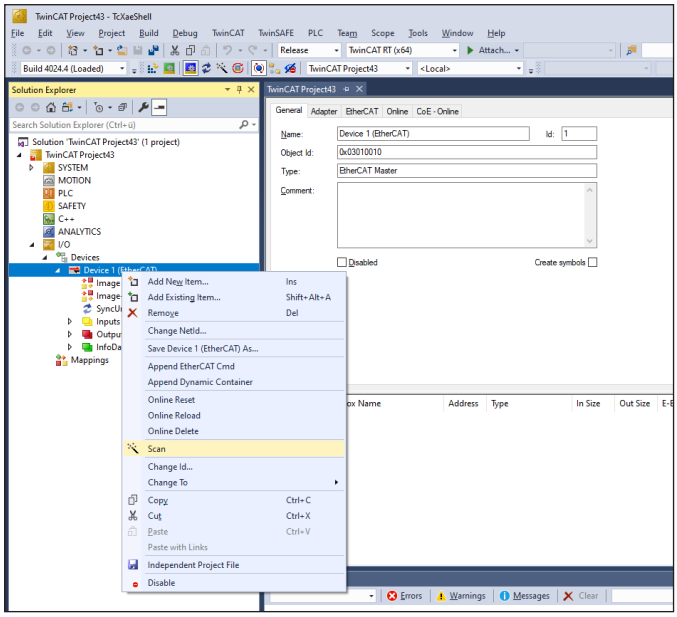


Fig. 71: Scan for boxes in the network

As shown in Fig. 72, the R-Series V EtherCAT® sensor is found in the network as “Box 1” with the name "MTS Temposonics V". If you have previously assigned the ESI file of the R-Series V EtherCAT® in the TwinCAT installation directory, TwinCAT can correctly assign this slave as "MTS Temposonics V".

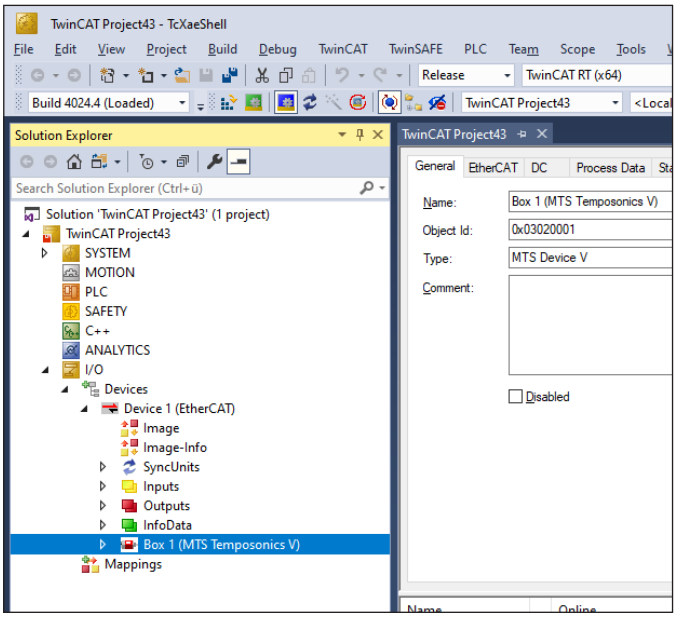


Fig. 72: R-Series V EtherCAT® found as "Box 1" in the network

In addition to adding a device through the "scan for boxes" process, you can also implement a device in another way. To do this, select in the Solution Explorer in the tree the entry *"I/O → Devices → Devices 1 (EtherCAT)"*. A right mouse click opens a menu. In this menu, click on the entry *"Add new item"*. The window *"Insert EtherCAT Device"* opens (Fig. 73). In this example, only the ESI file of the R-Series V EtherCAT® from Temposonics MTS Sensors (previous name of Temposonics) has been stored in the TwinCAT installation directory. Therefore, only this device with the name "MTS Device V" is displayed in this path. Select the "MTS Device V" device and confirm this by clicking the OK button.

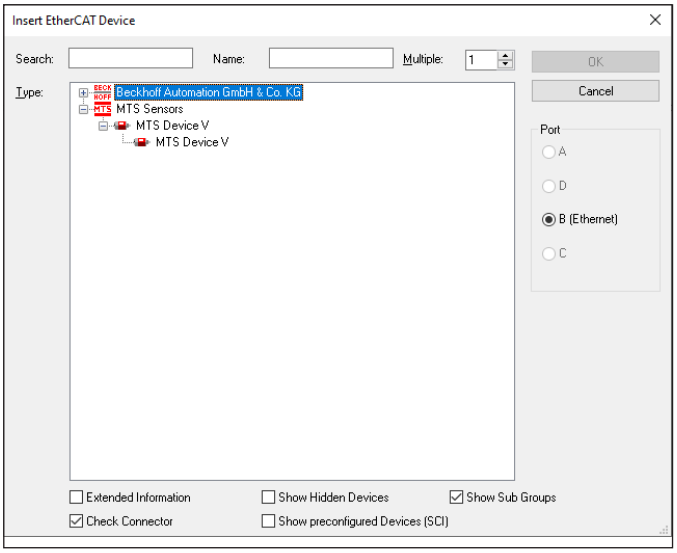


Fig. 73: The window "Insert EtherCAT Device" for implementing of devices

If you click on the added entry *"Box 1 (MTS Temposonics V)"* in the tree of the Solution Explorer, values of the sensor are displayed in the main window. Since the controller is not yet running, no values are requested from the sensor, so 0 is displayed (Fig. 74).

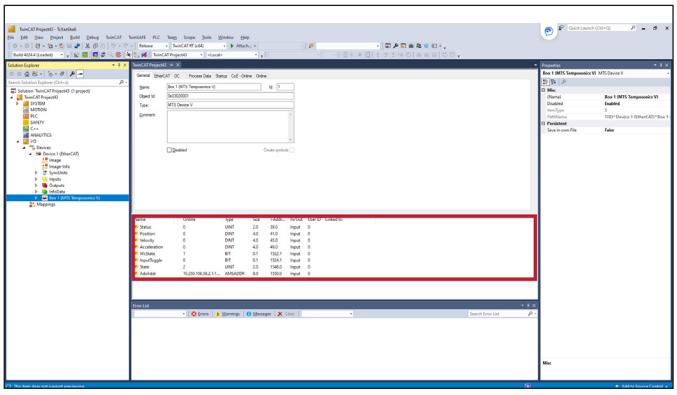


Fig. 74: Values of the R-Series V EtherCAT® displayed in the main window

To display current values, start the Free Run mode by clicking on the highlighted button in the upper menu bar (Fig. 75). Afterwards, current values of the sensor will be displayed in the main window. Among others, the following values are displayed when the position magnet is moved along the sensor rod/sensor profile:

- Status: current status of the magnet
- Position: current measured position of the position magnet on the rod/profile
- Velocity: current measured velocity of the position magnet on the rod/profile
- Acceleration: current measured acceleration of the position magnet on the rod/profile

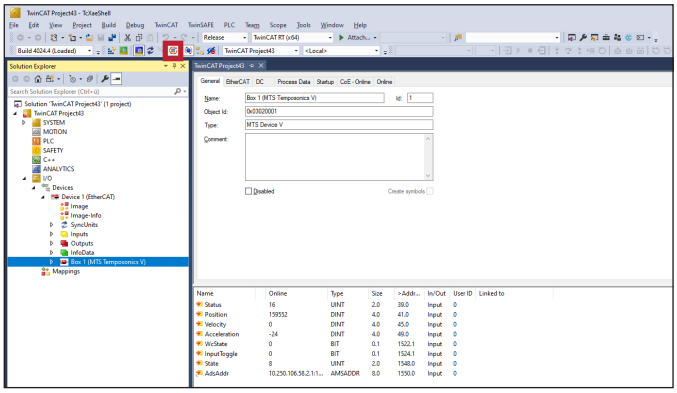


Fig. 75: Display of current values after starting the Free Run mode

If you expand the entry *"Box 1"* in the tree of the Solution Explorer, the variables for *"Magnet 1"* are displayed. In this example the sensor is operated with one magnet. For this magnet the following values are displayed as in the main window (Fig. 76):

- Status
- Position
- Velocity
- Acceleration

The WcState and InfoData values are described in the TwinCAT operation manual. The sensor is now implemented and ready for use.

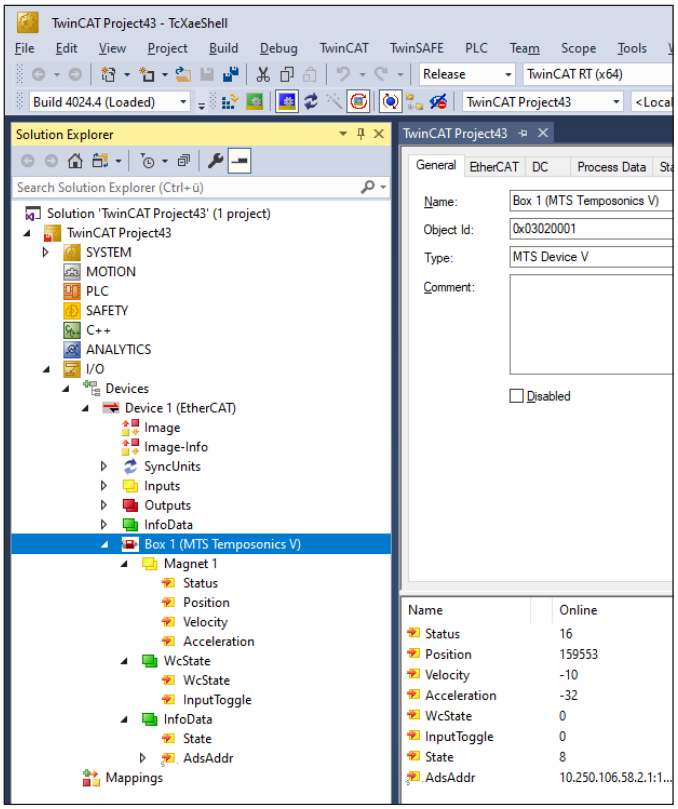


Fig. 76: Display variables of the R-Series V EtherCAT® in the solution explorer

If a multi-position measurement sensor (number of magnets > 1) is connected to the PLC, only the first magnet is initially displayed in the Solution Explorer. The other magnets must be enabled on the *"Process Data"* tab of the main window. This is described in the following section.

6.3 Configuration of R-Series V EtherCAT® in TwinCAT 3

Various tabs are available in the main window of the TwinCAT user interface for configuring the sensor:

The tab *"General"*

In the tab *"General"* the name of the device can be changed. For example, you can assign an application-specific name (Fig. 77).

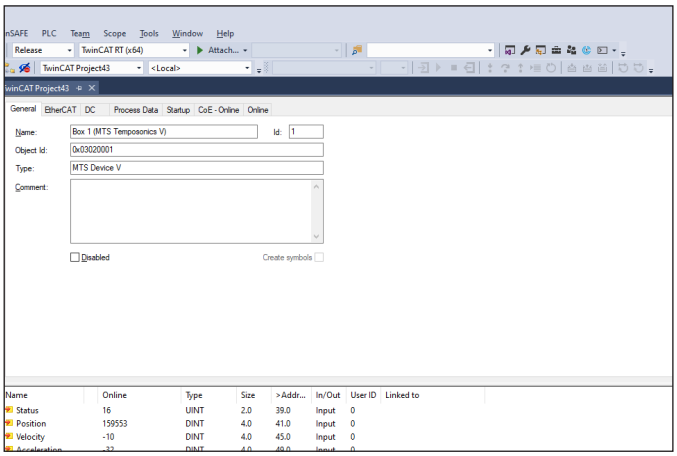


Fig. 77: The tab "General"

The tab *"EtherCAT"*

The tab *"EtherCAT"* shows EtherCAT® specific settings (Fig. 78).

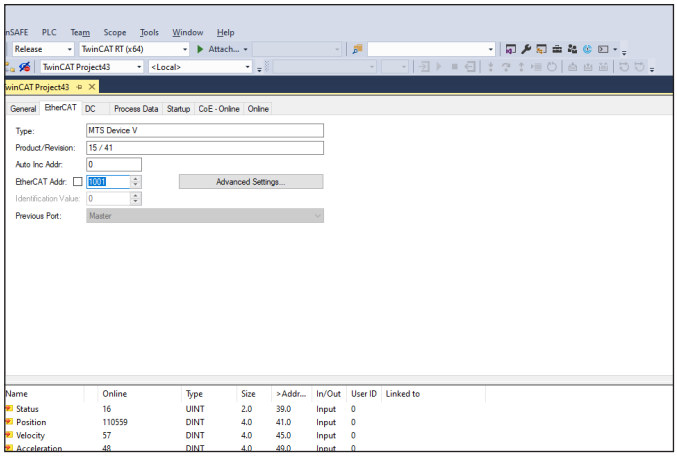


Fig. 78: The tab "EtherCAT"

The tab *"DC"*

In the tab *"DC"* you can set the mode in which the sensor should be operated in normal operation (Fig. 79):

- Synchronised on SyncManager event: The sensor is operated in SyncManager mode.
- Synchronised on DC sync event: The sensor is operated in distributed clock mode.

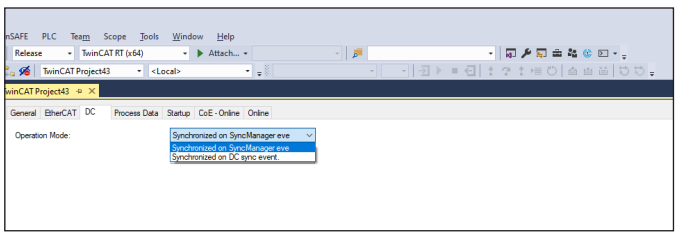


Fig. 79: The tab "DC"

The tab *"Process Data"*

The tab *"Process Data"* is used to configure process data of the sensor. As shown in Fig. 80, in this example the sensor is assigned to the Sync Manager "SM 3" and has a size of 14 bytes. The value of 14 bytes results from 2 bytes for the status and 4 bytes each for position, velocity and acceleration, as shown in the lower part of the main window. As shown in the "PDO Assignment" area, only the entry *"0x1A00"* is active. This is because the sensor is operated with one magnet. Accordingly, only "Magnet 1" is assigned to a Sync Manager in the "PDO List", in this case to “SM3”.

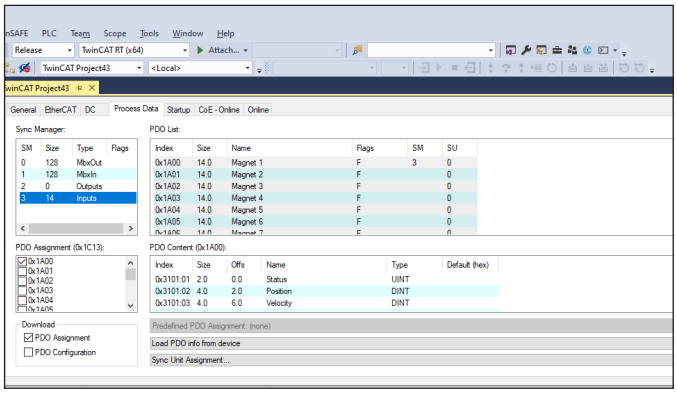


Fig. 80: The tab “Process Data”

For multi-position measurements, notice that only the first magnet in the "PDO Assignment" area is enabled by default. Additional magnets can be enabled by clicking on the other PDOs (Process Data Object) below the first one.

NOTICE

The sensor supports a maximum number of position magnets specified in the order code. If the sensor is operated with more magnets than specified in the order code, no values are displayed for the magnets above the maximum number in the order code. By default, only the first magnet is enabled on the sensor. To be able to use the other magnets in multi-position measurement, they must be enabled via the "PDO assignment" on the "*Process Data*" tab.

The tab *"Startup"*

The tab *"Startup"* shows which messages are exchanged between sensor and controller in the different startup phases (Fig. 81). You can use the *"New"* button to create additional messages to be exchanged in the startup phase. For more information see the TwinCAT operation manual.

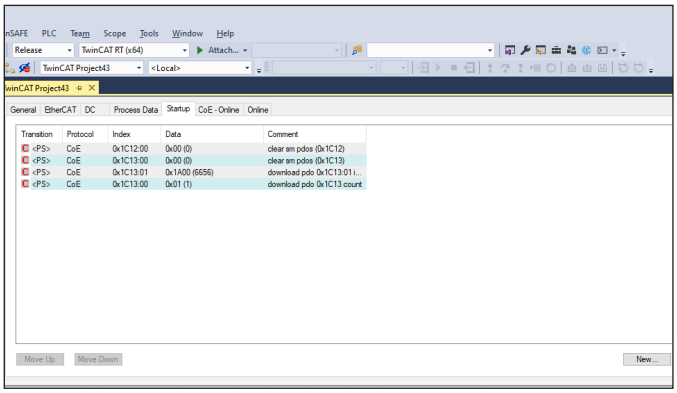


Fig. 81: The tab “Startup”

The tab *"CoE - Online"*

The R-Series V EtherCAT® supports the "**C**AN application protocol **o**ver **E**therCAT® (CoE)" communication profile. Therefore, in the tab *"CoE - Online"* the parameters of the sensor are displayed with the respective values (Fig. 82). According to the name of this tab the object structure is similar to CAN (Controller Area Network). Parameters with the attribute ("Flag") RO can only be read, while parameters with the attribute ("Flag") RW can be read and adjusted. For a description of the parameters see chapter 8. Object dictionary of R-Series V EtherCAT® on page 63.

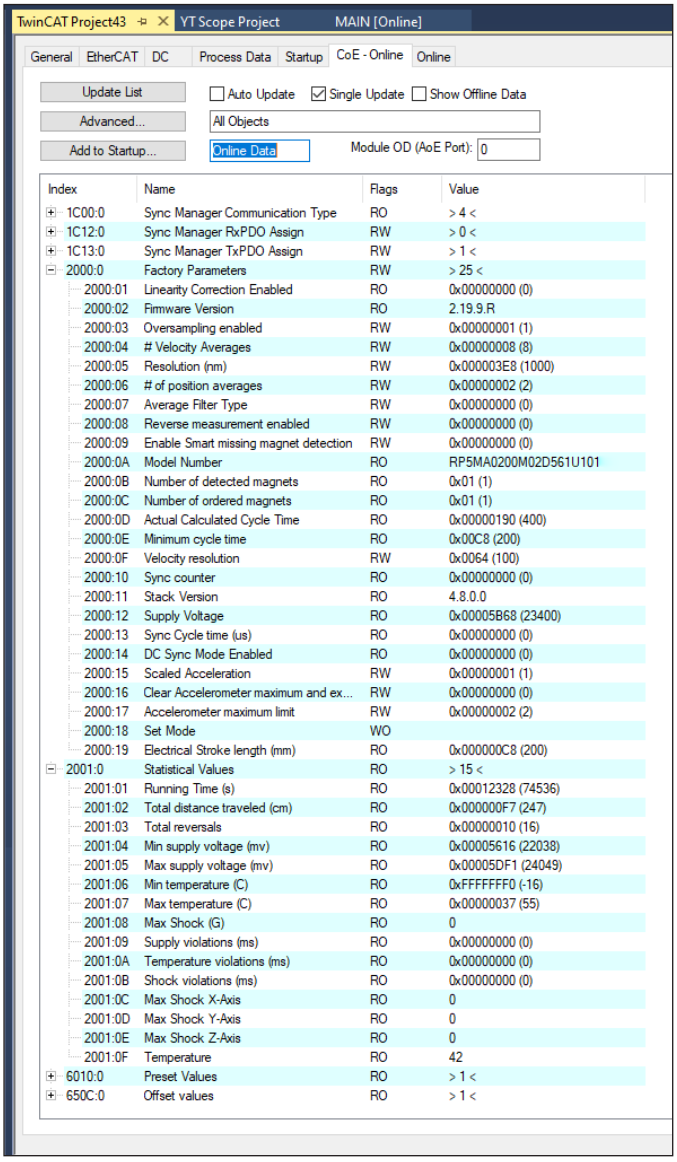


Fig. 82: The tab "CoE - Online"

The tab *"Online"*

In the tab *"Online"* you can set the sensor specifically in different modes and check the current status. (Fig. 83). For further information see the TwinCAT operation manual.

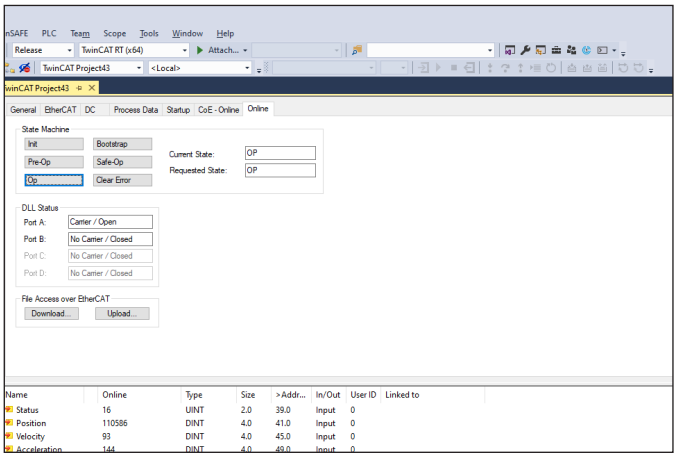


Fig. 83: The tab "Online"

For information on creating a program and transferring the program from the engineering environment to the runtime system see the TwinCAT operation manual.

7. Implementation and configuration of R-Series V EtherCAT® with TwinCAT 2

For the operation of the EtherCAT® Bus in this example, the following components are required:

- Temposonics® R-Series V with EtherCAT® interface
- EtherCAT® Slave Information (ESI) specification describes the structure of ESI files using the corresponding XML format
- This file is used to inform TwinCAT of characteristics and performance of the bus sensors.
- EtherCAT® Master (e.g. Industrial PC) with Windows OS
- EtherCAT® Master-Software 'TwinCAT System Manager'

The sensor is integrated into the bus system using the TwinCAT System Manager and ESI file from Temposonics (formally MTS). This file can be downloaded from www.temposonics.com.

7.1 Configuration of Ethernet card

For this example, the TwinCAT software-based controller is used. Thus, an Ethernet card is needed for the master in order to use an EtherCAT® network. The EtherCAT® drivers must be installed and the appropriate Ethernet card activated before the data frame can be read. The status can be checked by opening the network at Windows Start button, Control Panel, Network Connections. The window shown at Fig. 84 is opened with a right click on the appropriate EtherCAT® LAN connection. Check that ECAT® Filter Driver and TwinCAT RT-Ethernet Intermediate Driver are activated and confirm with OK.

NOTICE

Some PLCs come pre-configured, so setting up the network port may not be required. For TwinCAT software based PLC, this is required.

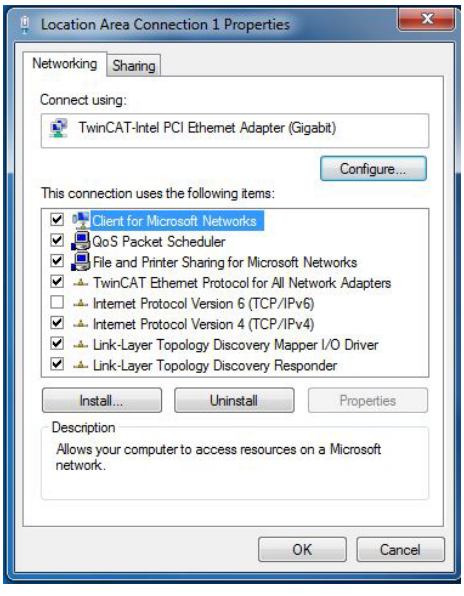


Fig. 84: Configure LAN drivers

7.2 Starting TwinCAT System Manager

Use TwinCAT System Manager to setup communication with EtherCAT® sensor.

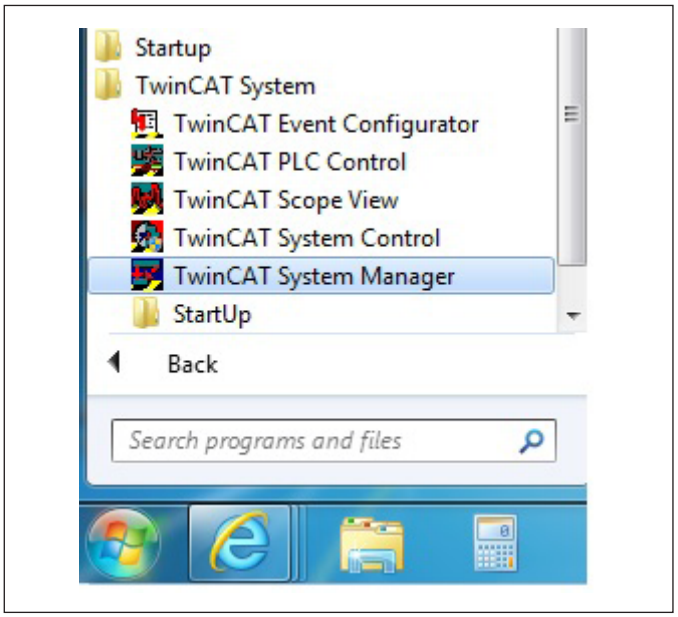


Fig. 85: Select TwinCAT System Manager

7.3 Adding the Ethernet card as an I/O device

On starting the TwinCAT System Manager the window shown at Fig. 86 is opened.

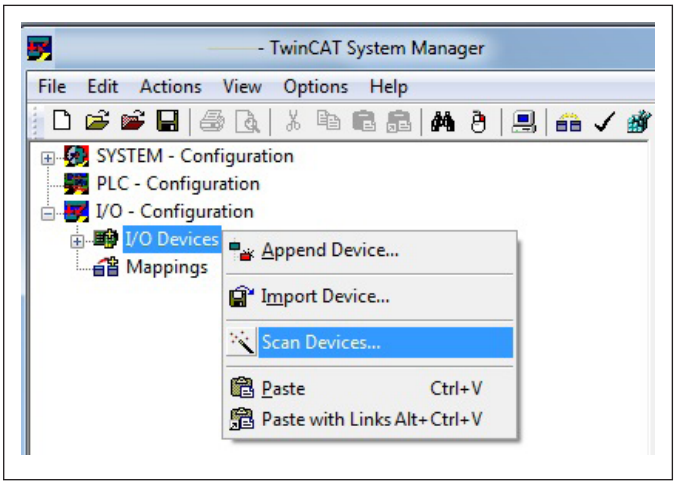


Fig. 86: Scan for Devices

An automatic search for a I/O Device (in this case the appropriate interface card) is initiated by a right click on *"I/O Device"* and then making *"Scan Devices"*. The following dialogue box is opened (Fig. 87). Click on OK to search further.

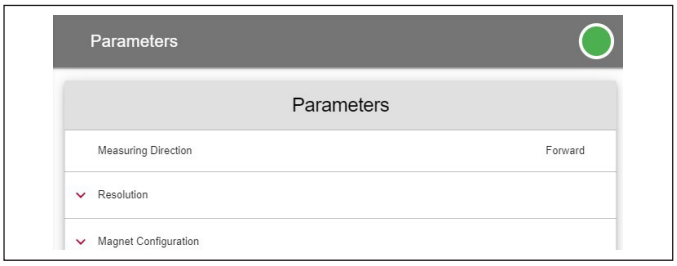


Fig. 87: Press OK to see available devices

A new menu is now opened showing the EtherCAT® interface card found and added to the file tree as I/O Device.

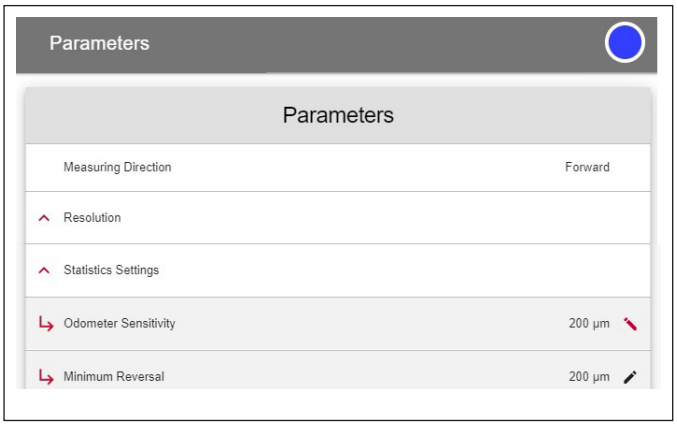


Fig. 88: Choose EtherCAT® Local Area Connection

Confirm with OK. A new dialogue box is opened (Fig. 89).

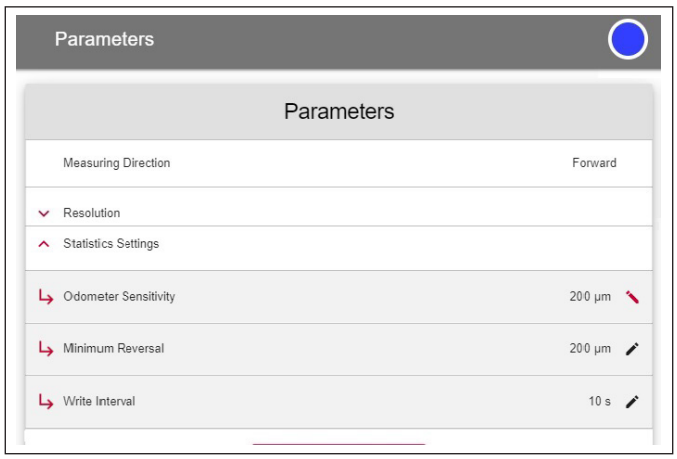


Fig. 89: Scan for boxes automatically

NOTICE

If you choose “Yes” the System Manager automatic search sensor(s) that can be connected to the EtherCAT® device. If “No” is selected, the sensor(s) must be added manually to the EtherCAT® device as described at manual addition.

7.4 Adding a sensor as a box

1. Automatic addition

The automatic search recognizes the sensor and a dialogue box is opened which asks whether the Free Run mode should be activated (Fig. 90). The sensor is added to corresponding I/O Device in the file system. The Free Run mode reports the position, velocity, and acceleration of the sensor – independent of whether a task is configured and activated. Yes tests the sensor/No closes the dialogue box.

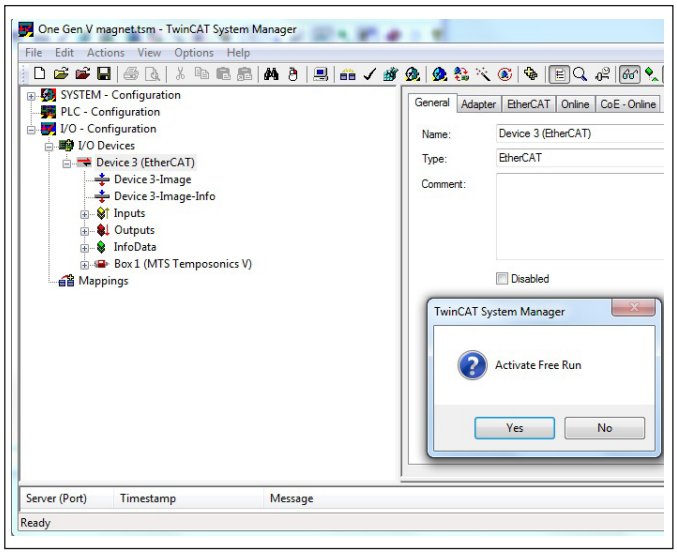


Fig. 90: Set to control to Free Run mode

2. Manual addition

Right click on the EtherCAT® symbol in the file tree in Fig. 90. In the new window which opens (not shown) select *Add Box*. Then open MTS Sensors (previous name of Temposonics) in the window which opens next (Fig. 91) and select MTS Device V. Confirm with OK. The additional sensor is added to the file tree system.

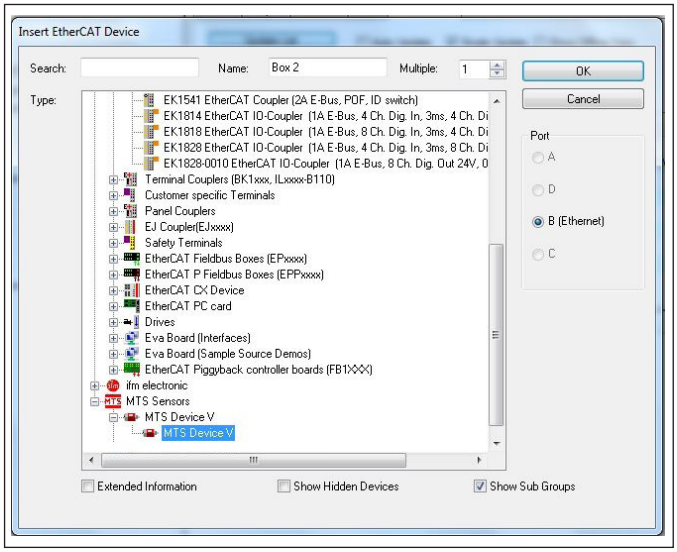


Fig. 91: Select MTS generation V sensor

Activate the button *(Reload I/O Device)* in the tool bar in order to update the configuration. The Free Run mode activation window opens (Fig. 92). The Free Run reports the position, velocity and acceleration of the sensor – independent of whether a task is configured and activated. Yes tests the sensor. No closes the window.

7.5 Setting up and parameterizing the sensor

After adding the sensor as a box it can be set up and the parameters can be modified. Click on the box required in the file tree. The sensor set-up tabs are opened in the main window (Fig. 92).

1. General

The name and the ID of the sensor can be changed here.

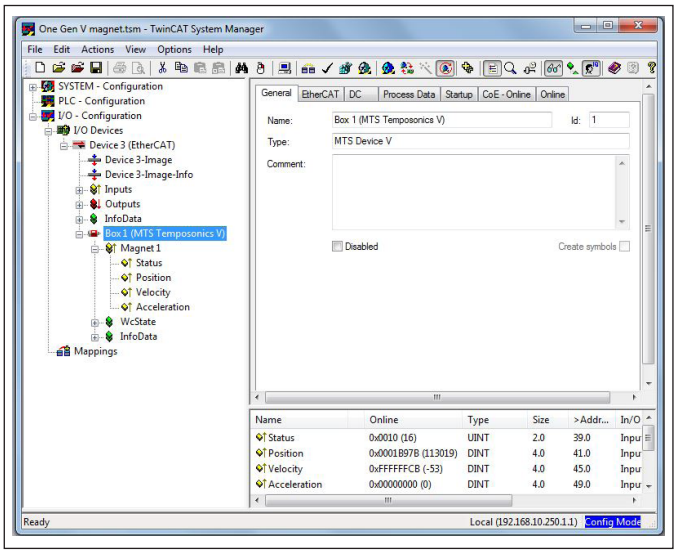


Fig. 92: Use General tab to update sensor info

2. EtherCAT

This tab includes the product no. and revision of the sensor.
By clicking on advanced settings certain product numbers and revisions can be approved.

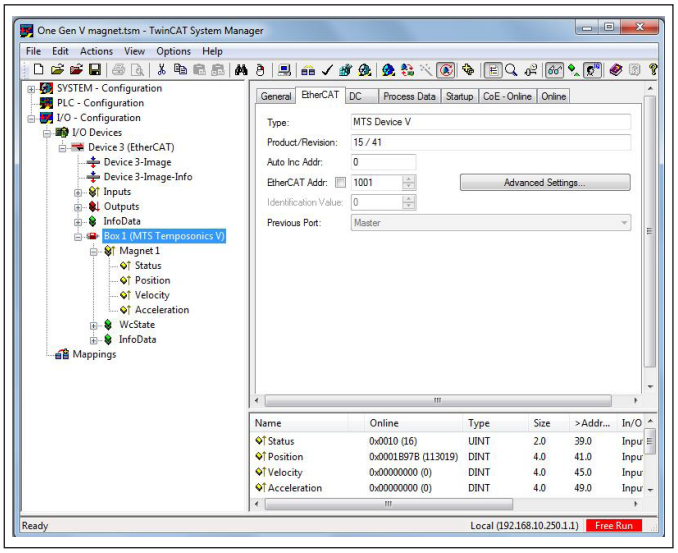


Fig. 93: EtherCAT tab used to identify product name and version

3. DC

The Distributed Clock (DC) mode which synchronizes the measurement cycle of the sensor by control unit, can be changed.

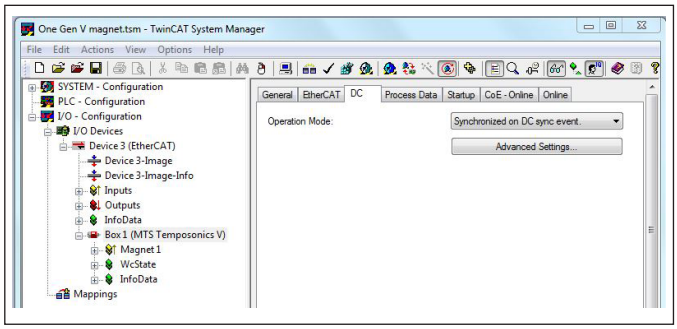


Fig. 94: Use General tab to update sensor info

To set the cycle time, click on *"Advanced Settings"*. On the *"Distributed Clock"* page that appears, enable the usage of the distributed clock by adding a checkmark to the Enable value. Configure SYNC0 for the desired cycle time.

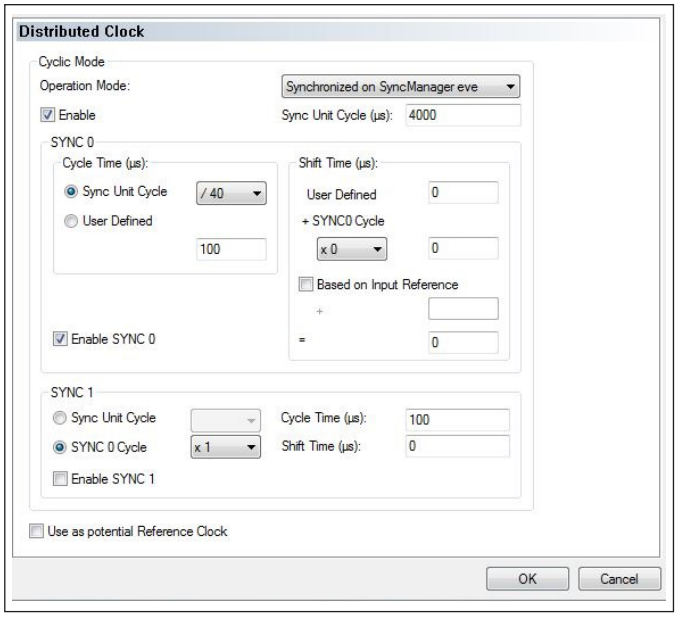


Fig. 95: Use to enable DC Sync mode

4. Startup

The *startup* tab can be used to insert mails which are transmitted to the sensor when starting up. After clicking on *"New"*, a new mail can be prepared which is then transmitted to the sensor at the next start up (Fig. 96).

The transition in which the new mail is to be sent can be selected at the state machine. The transmission goes via a CoE protocol (CoE = **C**ANopen application **o**n layer over **E**therCAT®). Startup enables a sensor to be replaced to meet different requirements without having to re-configure the new sensor.

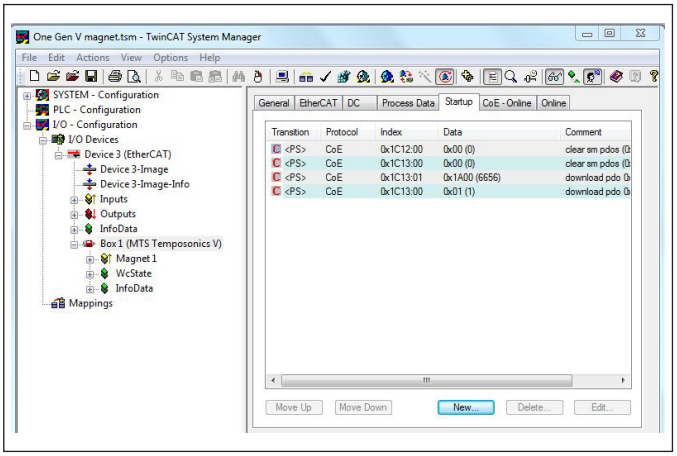


Fig. 96: Create new mail messages to send to the sensor

To select the number of magnets that will be monitoring, go to the *Process Data* tab and locate the "PDO Assignment" portion of the tab. There exists a complete list of the number of possible magnets that can be used based on the number of ordered magnets. The range of selectable magnets range from 0x1A00 to 0x1A1D. If one magnet is ordered, select 0x1A00. If two magnets are ordered, choose 0x1A00 and 0x1A01. Note: if you ordered two magnets and try to select more than two, all position, velocity, and acceleration data will return a value of 0.

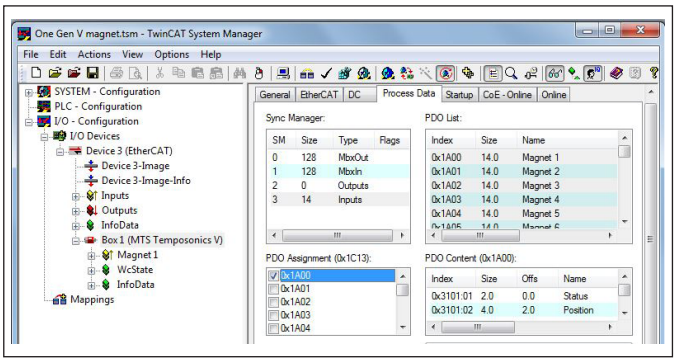


Fig. 97: Select the number of magnets used

5. CoE-Online

CoE lists the sensor's parameters. The flags column shows whether read (RO = read only) or read and write (RW) rights are available for the parameter. If rw rights are available the parameter can be changed by double clicking on the parameter and the alterations are sent to the sensor via the CoE-Mailbox.

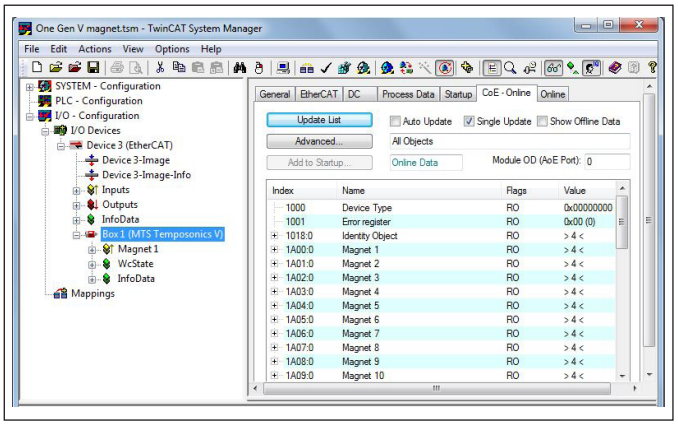


Fig. 98: Provides sensor parameter list

6. Online

The *online* tab shows the state machine of the sensor. The fields on the right show the current state and the requested state. By clicking on the buttons on the left a transition to a different sensor status can be requested.

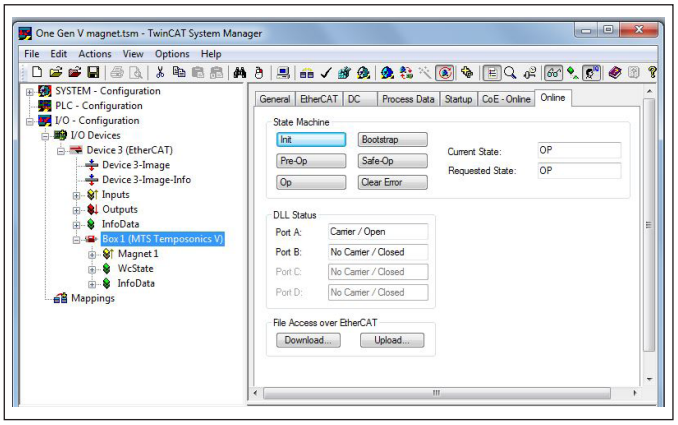


Fig. 99: View the state machine of current sensor

7.6 Sensor in operation

The sensor delivers input data into the process image in Free Run mode. On opening up the file system at *Inputs* the data is updated in the main window in the *Online* column (Fig. 100). The amount of data is dependent on the number of magnets. The status, position, velocity, and acceleration of each magnet is listed hexadecimally (decimally) in the online column.

1. Status
The status is a 2 byte number without prefix. Byte 1 is empty, Byte 2 shows the magnets and reports failures.
Example: 0x0010 Magnet No. 1 is OK
0x0018 Magnet No. 1 shows the failure bit

2. Position
The position is a 4 byte number without prefix. This value does not have a unit and must therefore be multiplied by the resolution in meters.
Example: Magnet No. 1 shows position value of 0x0000E998 (59800), a selected resolution of 1 µm results in a value of 59.8 mm.

3. Velocity
The velocity is shown as a 4 byte number with prefix. When the magnet moves away from the sensor head the speed value is positive and in the opposite direction it is negative. This value has no unit and must therefore be multiplied by µm/sec.
Example: Magnet No. 1 shows a speed value of 0x00030D4 (200000), a selected position resolution of 1 µm results in 200 mm/sec.

4. Acceleration
The acceleration for all selected magnets is available as well. In this case it is given with an additional 4 bytes. The prefix is independent of the direction of movement. A negative value depicts a deceleration of the magnet.

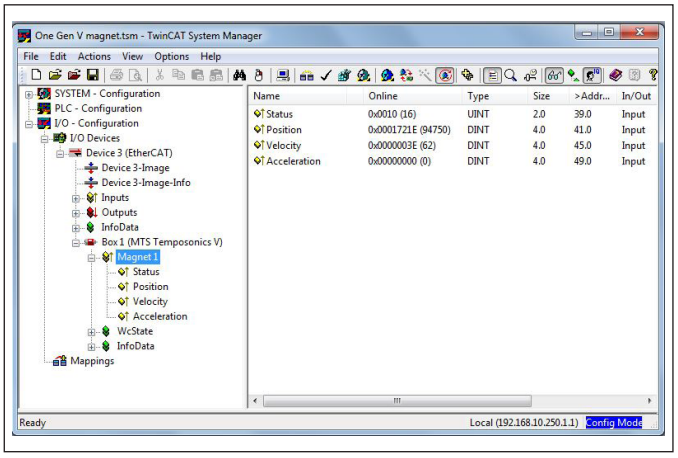


Fig. 100: View the state machine of current sensor

8. Object dictionary of R-Series V EtherCAT®

The R-Series V EtherCAT® supports the "CAN application protocol over EtherCAT® (CoE)" communication profile. The following tables describe the object dictionary relevant for R-Series V EtherCAT®.

Standard object					
Index	**Subindex**	**Name**	**Attribute**	**Data type**	**Description**
1000	00	Device type	RO	Unsigned32	Device type of the EtherCAT® slave

Table 1: The standard object

Error object					
Index	**Subindex**	**Name**	**Attribute**	**Data type**	**Description**
1001	00	Error register	RO	Unsigned8	The corresponding error bit is set in case of an error. If the error no longer exists, it is deleted automatically. • Value 0: No errors detected • Value 1: An error has been detected

Table 2: The error object

Identity object					
Index	**Subindex**	**Name**	**Attribute**	**Data type**	**Description**
1018	01	Vendor ID	RO	Unsigned32	Vendor ID (Temposonics, formally MTS Sensors)
	02	Product code	RO	Unsigned32	Product code of the sensor
	03	Revision	RO	Unsigned32	Revision number of the sensor
	04	Serial number	RO	Unsigned32	Serial number of the sensor

Table 3: The identity object

Magnet object					
Index	**Subindex**	**Name**	**Attribute**	**Data type**	**Description**
1A00-1A1D		Number of entries	RO	Unsigned8	Number of magnets available on the sensor according to the number specified in the order code
	01	Status	RW	Unsigned16	Reference to the status value of the magnet and the errors or failures (Fig. 101)
	02	Position	RW	Unsigned32	Reference to the position value of the magnet
	03	Velocity	RW	Unsigned32	Reference to the velocity value of the magnet. This value can be positive or negative depending on measurement direction (object 2000:08).
	04	Acceleration	RW	Unsigned32	Reference to the acceleration value of the magnet. The acceleration value is derived from the velocity of the magnet. A positive value denotes acceleration and negative value denotes deceleration.

Table 4: The magnet object

The status of a magnet is indicated in a 16 bit word (Fig. 101).
It applies:

- The first 7 bits are empty
- The following 5 bits **xxxxx** indicate the number of the magnet
- The bit 3 (the bit after the magnet number) indicates the status:
  - Bit value **y** = 0: No error
  - Bit value **y** = 1: Error detected: Magnet missing or too many magnets

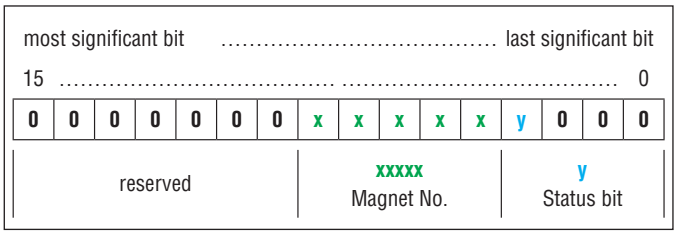


Fig. 101: Structure of the status object

Sync Manager Communication Type / Sync Manager RxPDO Assign / Sync Manger TxPDO Assign
These parameters are not relevant for the user and set by the EtherCAT® master in the network.

Accelerometer Data (for future use)

The sensor can optionally be equipped with an acceleration sensor. If the sensor is equipped with the accelerometer the following accelerometer data is available.

Accelerometer data					
Index	**Subindex**	**Name**	**Attribute**	**Data type**	**Description**
1B00	01	Status	RW	Unsigned32	The status value will update continuously when an accelerometer is present. If no accelerometer is present, the status will return a value of 65535.
	02	Axis X	RW	Signed32	X axis acceleration based on board orientation
	03	Axis Y	RW	Signed32	Y axis acceleration based on board orientation
	04	Axis Z	RW	Signed32	Z axis acceleration based on board orientation
	05	Combined X,Y,Z	RW	Signed32	Combined value determined from the three individual values Axis X, Axis Y and Axis Z
	06	Maximum of combined	RW	Signed32	Maximum value of the combined acceleration (subindex 05) so far
	07	Times limit exceeded	RW	Signed32	Indicates the number of times that the value Maximum of combined (subindex 06) has exceeded the accelerometer maximum limit (object 2000:17).

Table 5: The accelerometer data

Factory Parameters					
Index	**Subindex**	**Name**	**Attribute**	**Data type**	**Description**
2000	01	Linearity correction enabled	RO	Unsigned32	Indicating that the sensor was ordered with the internal linearization option. • Value 0: Not Ordered • Value 1: Ordered and enabled
	02	Firmware revision	RO	String	Firmware revision of the sensor
	03	Oversampling enabled	RW	Unsigned32	Enabling and disabling the extrapolation • Value 0: Disabled • Value 1: Enabled (default)
	04	# Velocity averages	RW	Unsigned32	Velocity Window Size: Setting the number of position values for determining the velocity of the position magnet. Possible values: 2…16 Default value: 8
	05	Resolution (nm)	RW	Unsigned32	Resolution of the position output in nm Possible values: 100…1,000,000 in steps of 100 nm Default value: 1000 nm (1 µm)
	06	# Position averages	RW	Unsigned32	Filter Window Size: Setting the number of position values for calculating the filter of the output value. Possible values: 2…16
	07	Average filter type	RW	Unsigned32	Filter Type: Setting of the filters for the output value. • Value 0: No filter • Value 1: FIR (finite impulse response) filter • Value 2: IIR (infinite impulse response) filter
	08	Reverse mode enabled	RW	Unsigned32	Measuring direction • Value 0: Measuring direction forward • Value 1: Measuring direction reverse

Table 6: The factory parameters (part 1)

Factory Parameters					
Index	**Subindex**	**Name**	**Attribute**	**Data type**	**Description**
2000	09	Enable smart missing magnet detection	RW	Unsigned32	This parameter detects the number of the missing magnet on the sensor rod/sensor profile in case of a multi-position measurement. If this parameter is enabled, either the last measured position or 0 can be reported for the missing magnet. • Value 0: Disabled; if a magnet is missing, an error is indicated for each magnet via the status bit (default) • Value 1: Enabled; if a magnet is missing, an error is only indicated for the missing magnet via the status bit and the last measured position value is reported for this magnet • Value 2: Enabled; if a magnet is missing, an error is only indicated for the missing magnet via the status bit and zero is reported as position value for this magnet **Note**: The status of the missing magnet is reported in the Magnet Object: Status.
	0A	Model number	RO	String	Order code of the sensor
	0B	Number of detected magnets	RO	Unsigned8	Current number of magnets detected on the sensor
	0C	Number of ordered magnets	RO	Unsigned8	Maximum number of magnets with which the sensor can be operated
	0D	Actual calculated cycle time	RO	Unsigned32	Cycle time of the sensor according to the stroke length
	0E	Minimum cycle time	RO	Unsigned16	Factory use only
	0F	Velocity resolution	RW	Unsigned16	Resolution of the velocity output in 0.1 µm/sec Default values: 10 (= 1 µm/sec)
	10	Sync counter	RO	Unsigned 32	If the EtherCAT® master runs in DC mode and the sensor is synchronized to the EtherCAT® master, this value is incremented. **Note**: DC sync model enabled (object 2000:14) is enabled
	11	Stack version	RO	String	Factory use only
	12	Supply voltage	RO	Unsigned32	Current power supply in mV
	13	Sync cycle time (µs)	RO	Unsigned32	Cycle time from the EtherCAT® master in synchronous mode (distributed clock mode). **Note:** The minimum cycle time of the sensor in distributed clock mode is 100 µs for up to 10 magnets and 250 µs for 11…30 magnets.
	14	DC sync mode enabled	RO	Unsigend32	Indicating that the EtherCAT® master is in distributed clock mode • Value 0: Disabled • Value 1: Enabled
	15	Scaled acceleration	RW	Unsigend32	Factory use only
	16	Clear accelerometer maximum and exceed count	RW	Unsigend32	Each exceeding of the Accelerometer maximum limit (object 2000:17) is counted. The number of exceeding can be cleared by setting this bit value to 1. **Note:** Only possible if the sensor is equipped with the optional accelerometer (for future use).
	17	Accelerometer maximum limit	RW	Unsigend32	The maximum limit of the measured accelerometer values. Each excess is counted in the parameter Times limit exceeded (object IB00:07). **Note:** Only possible if the sensor is equipped with the optional accelerometer (for future use).
	18	Set mode	WO	Unsigend32	Factory use only
	19	Electrical stroke length (mm)	RO	Unsigend32	Stroke length of the sensor

Table 7: The factory parameters (part 2)

Sensor statistics					
Index	**Subindex**	**Name**	**Attribute**	**Data type**	**Description**
2001	01	Running time (s)	RO	Unsigned32	Operational Time: Total operational time of the sensor in seconds
	02	Total distance traveled (cm)	RO	Unsigned32	Odometer: Total distance traveled by the position magnet in cm
	03	Total reversals	RO	Unsigned32	Magnet cycles: Total number of directional changes by the magnet
	04	Min supply voltage (mV)	RO	Unsigned32	Minimum input voltage so far in mV
	05	Max supply voltage (mV)	RO	Unsigned32	Maximum input voltage so far in mV
	06	Min temperature (C)	RO	Signed16	Minimum temperature inside the sensor electronics housing so far in °C
	07	Max temperature (C)	RO	Signed16	Maximum temperature inside the sensor electronics housing so far in °C
	08	Max shock (G)	RO	Unsigned32	Maximum shock so far measured by the integrated accelerometer **Note:** Only available if the sensor is equipped with the optional accelerometer (for future use).
	09	Supply violations (ms)	RO	Unsigned32	Input Voltage out of range: Duration of exceeding or falling below the permissible power supply range

Table 8: The sensor statistics

Preset and Offset					
Index	**Subindex**	**Name**	**Attribute**	**Data type**	**Description**
6010	01…1E	Preset for 1…30 magnets	RW	Unsigned32	Setting the preset for up to 30 magnets
650C	01…1E	Offset for 1…30 magnets	RW	Unsigned32	Setting the offset for up to 30 magnets

Table 9: Preset and offset

9. TempoLink® smart assistant with R-Series V EtherCAT®

TempoLink® smart assistant supports the R-Series V EtherCAT®. The values listed in the object dictionary “Sensor Statistics” can be read out via TempoLink® smart assistant. In addition, the current parameter settings can be viewed via the TempoLink® smart assistant. This allows the sensor to be checked offline, i.e. without integration into a network. For further information see the TempoLink® smart assistant operation manual (document part number: 551986).

10. Maintenance and troubleshooting

10.1 Error conditions, troubleshooting

See chapter "5. Commissioning" on page 50.

10.2 Maintenance

The sensor is maintenance-free.

10.3 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.

10.4 List of spare parts

No spare parts are available for this sensor.

10.5 Transport and storage

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

11. Removal from service/dismantling

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

12. Technical data

12.1 Technical data Temposonics® RP5

Output						
Interface	EtherCAT® Ethernet for Control Automation Technology					
Data protocol	EtherCAT® 100 Base-Tx, Fast Ethernet					
Data transmission rate	100 Mbit/s (maximum)					
Measured value	Simultaneous position, velocity and acceleration for up to 30 magnets					
Measurement parameters						
Resolution: Position	0.5…1000 µm (selectable)					
Native cycle time	Stroke length	≤ 50 mm	≤ 715 mm	≤ 2000 mm	≤ 4675 mm	≤ 6350 mm
	Cycle time	250 µs	500 µs	1000 µs	2000 µs	4000 µs
Extrapolation cycle time	Number of magnets	≤ 10 magnets	11…30 magnets			
	Cycle time	100 µs	250 µs			
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	1200…3000 mm	3000…5000 mm	5000…6350 mm
	typical	±15 µm	±20 µm	±25 µm	±45 µm	±85 µm	±95 µm
	maximum	±25 µm	±30 µm	±50 µm	±90 µm	±150 µm	±190 µm
Repeatability	< ±0.001 % F.S. (minimum ±2.5 µm)					
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)					
EMC test	Electromagnetic emission according to EN 61000-6-3 Electromagnetic immunity according to EN 61000-6-2 The RP5 sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TR CU 020/2011					
Magnet movement velocity	Magnet slider: Max. 10 m/s; U-magnet: Any; block magnet: Any					
Design/Material						
Sensor electronics housing	Aluminum (painted), zinc die cast					
Sensor profile	Aluminum					
RoHS compliance	The used materials are compliant with the requirements of EU directive 2011/65/EU and EU regulation 2015/863 as well as UKSI 2022 No. 622					
Stroke length	25…6350 mm (1…250 in.)					
Mechanical mounting						
Mounting position	Any					
Mounting instruction	Please consult the technical drawings on page 13					

Technical data “Electrical connection” on page 69

3/ With position magnet # 251 416-2

Electrical connection	
Connection type	2 × M12 female connectors, 1 × M8 male connector or 2 × M12 female connectors, 1 × M12 male connector
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

12.2 Technical data Temposonics® RH5

Output						
Interface	EtherCAT® Ethernet for Control Automation Technology					
Data protocol	EtherCAT® 100 Base-Tx, Fast Ethernet					
Data transmission rate	100 Mbit/s (maximum)					
Measured value	Simultaneous position, velocity and acceleration for up to 30 magnets					
Measurement parameters						
Resolution: Position	0.5…1000 µm (selectable)					
Native cycle time	Stroke length	≤ 50 mm	≤ 715 mm	≤ 2000 mm	≤ 4675 mm	≤ 7620 mm
	Cycle time	250 µs	500 µs	1000 µs	2000 µs	4000 µs
Extrapolation cycle time	Number of magnets	≤ 10 magnets	11…30 magnets			
	Cycle time	100 µs	250 µs			
Linearity deviation [4]	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)					
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 1.4306/1.4307 (AISI 304L)/RH5-J: Stainless steel 1.4301 (AISI 304)					
RoHS compliance	The used materials are compliant with the requirements of EU directive 2011/65/EU and EU regulation 2015/863 as well as UKSI 2022 No. 622					
Stroke length	25…7620 mm (1…300 in.)/RH5-J: 25…5900 mm (1…232 in.)					
Mechanical mounting						
Mounting position	Any					
Mounting instruction	Please consult the technical drawings on page 14 and page 15					

Technical data “Electrical connection” on page 71

4/ With position magnet # 251 416-2

Electrical connection	
Connection type	2 × M12 female connectors, 1 × M8 male connector or 2 × M12 female connectors, 1 × M12 male connector
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

12.3 Technical data Temposonics® RM5

Output						
Interface	EtherCAT® Ethernet for Control Automation Technology					
Data protocol	EtherCAT® 100 Base-Tx, Fast Ethernet					
Data transmission rate	100 Mbit/s (maximum)					
Measured value	Position, velocity and acceleration/option: Simultaneous multi-position, multi-velocity and multi-acceleration measurements up to 30 magnets					
Measurement parameters						
Resolution: Position	0.5…1000 µm (selectable)					
Native cycle time	Stroke length	≤ 50 mm	≤ 715 mm	≤ 2000 mm	≤ 4675 mm	≤ 7615 mm
	Cycle time	250 µs	500 µs	1000 µs	2000 µs	4000 µs
Extrapolation cycle time	Number of magnets	≤ 10 magnets	11…30 magnets			
	Cycle time	100 µs	250 µs			
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)					
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					
Stroke length	25…7615 mm (1…299.8 in.)					
Mechanical mounting						
Mounting position	Any					
Mounting instruction	Please consult the technical drawings on page 17					
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					

5/ With position magnet # 251 416-2

12.4 Technical data Temposonics® RFV

Output						
Interface	EtherCAT® Ethernet for Control Automation Technology					
Data protocol	EtherCAT® 100 Base-Tx, Fast Ethernet					
Data transmission rate	100 Mbit/s (maximum)					
Measured value	Position, velocity and acceleration/option: Simultaneous multi-position, multi-velocity and multi-acceleration measurements up to 30 magnets					
Measurement parameters						
Resolution: Position	0.5…1000 µm (selectable)					
Cycle time	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 [6]	< ±0.02 % F.S. (minimum ±100 µm)					
Repeatability	< ±0.001 % F.S. (minimum ±2.5 µm)					
Hysteresis	< 4 µm typical					
Temperature coefficient	< 15 ppm/K typical					
Operating conditions						
Operating temperature	–40…+85 °C (–40…+185 °F)					
Humidity	90 % relative humidity, no condensation					
Ingress protection	IP30 (IP65 rating only for professional mounted guide pipe and if mating connectors are correctly fitted)					
Shock test	100 g/6 ms, IEC standard 60068-2-27					
Vibration test	5 g/10…2000 Hz, IEC standard 60068-2-6 (excluding resonant frequencies)					
EMC test	Electromagnetic emission according to EN 61000-6-3 Electromagnetic immunity according to EN 61000-6-2 The RFV sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TR CU 020/2011 under the condition of an EMC-compliant installation. [7]					
Magnet movement velocity	Any					
Design/Material						
Sensor electronics housing	Aluminum (painted), zinc die cast					
Sensor flange	Stainless steel 1.4305 (AISI 303)					
Sensor rod	Stainless steel conduct with PTFE coating					
RoHS compliance	The used materials are compliant with the requirements of EU directive 2011/65/EU and EU regulation 2015/863 as well as UKSI 2022 No. 622					
Stroke length	150…20,000 mm (6…787 in.)					
Mechanical mounting						
Mounting position	Any					
Mounting instruction	Please consult the technical drawings on page 19					
Electrical connection						
Connection type	2 × M12 female connectors, 1 × M8 male connector or 2 × M12 female connectors, 1 × M12 male connector					
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					

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

12.5 Technical data Temposonics® RDV

Output					
Interface	EtherCAT® Ethernet for Control Automation Technology				
Data protocol	EtherCAT® 100 Base-Tx, Fast Ethernet				
Data transmission rate	100 Mbit/s (maximum)				
Measured value	Position, velocity and acceleration/option: Simultaneous multi-position, multi-velocity and multi-acceleration measurements up to 30 magnets				
Measurement parameters					
Resolution: Position	0.5…1000 µm (selectable)				
Native cycle time	Stroke length	≤ 715 mm	≤ 2000 mm	≤ 4675 mm	≤ 5080 mm
	Cycle time	500 µs	1000 µs	2000 µs	2273 µs
Extrapolation cycle time	Number of magnets	≤ 10 magnets	11…30 magnets		
	Cycle time	100 µs	250 µs		
Linearity deviation [8, 9]	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)				
Hysteresis	< 4 µm typical				
Temperature coefficient	< 15 ppm/K typical				
Operating conditions					
Operating temperature	–40…+85 °C (–40…+185 °F)				
Humidity	90 % relative humidity, no condensation				
Ingress protection	Sensor electronics IP67 (with professional mounted housing and connectors) Measuring rod with connecting cable for side cable entry IP65 Measuring rod with single wires and flat connector with bottom cable entry IP30				
Shock test	100 g/11 ms, IEC standard 60068-2-27				
Vibration test	10 g/10…2000 Hz, IEC standard 60068-2-6 (excluding resonant frequencies)				
EMC test	Electromagnetic emission according to EN 61000-6-3 Electromagnetic immunity according to EN 61000-6-2 The RDV sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TR CU 020/2011 under the condition of an EMC-compliant installation. [10]				
Operating pressure	350 bar (5076 psi)/700 bar (10,153 psi) peak (at 10 × 1 min) for sensor rod				
Magnet movement velocity	Any				
Design/Material					
Sensor electronics housing	Aluminum (painted), zinc die cast				
Sensor rod with flange	Stainless steel 1.4301 (AISI 304)				
RoHS compliance	The used materials are compliant with the requirements of EU directive 2011/65/EU and EU regulation 2015/863 as well as UKSI 2022 No. 622				
Stroke length	25…2540 mm (1…100 in.) for pressure-fit flange »S« 25…5080 mm (1…200 in.) for all threaded flanges				
Mechanical mounting					
Mounting position	Any				
Mounting instruction	Please consult the technical drawings on page 23				

Technical data “Electrical connection” on page 75

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

Electrical connection	
Connection type	2 × M12 female connectors, 1 × M8 male connector or 2 × M12 female connectors, 1 × M12 male connector
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

13. 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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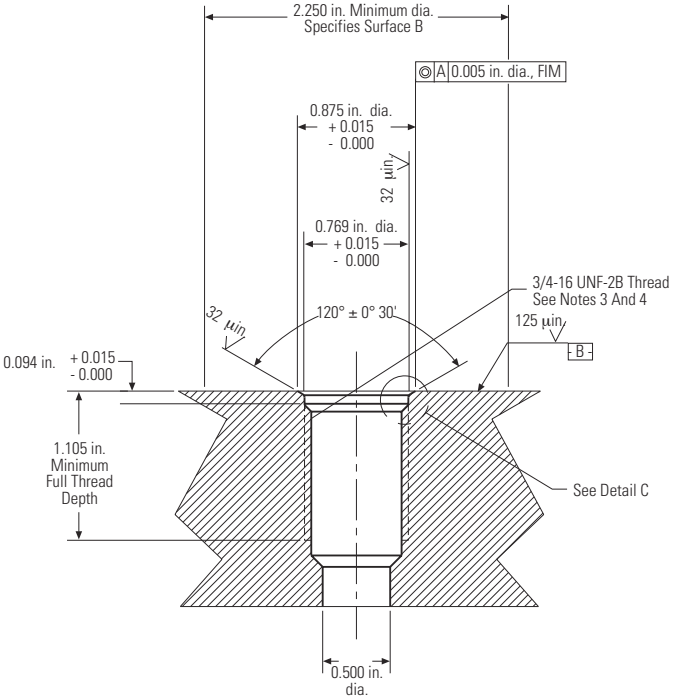
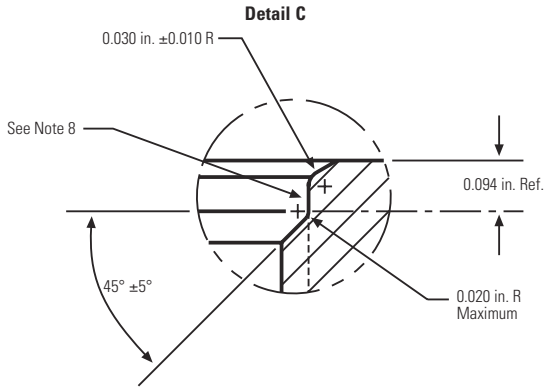
14. Appendix II – Cylinder port details

PORT DETAIL (PD) FOR RH5-S:

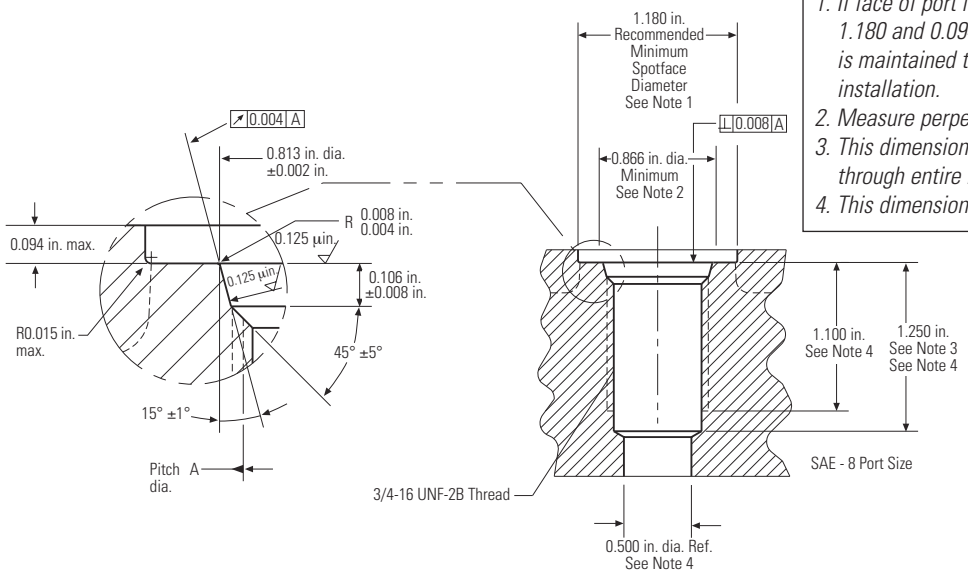


NOTES:

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.*

15. Glossary

D

Distributed Clock
EtherCAT® uses a logical network of **D**istributed **C**locks (DC) to synchronize the time on all local bus devices on the network. The EtherCAT® master usually selects the first Distributed Clock capable slave device as a Reference Clock, and then maintains a precise mapping of frame delays for all other slave devices in order to adjust their time to match the system time.
(→ Free Run, → Synchronous to SyncManager Event)

E

ESI
The properties and functions of an EtherCAT® device are described in an ESI file (**E**therCAT® **S**lave **I**nformation). The XML-based ESI 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 ESI file of the R-Series V EtherCAT® is available on the homepage www.temposonics.com.

EtherCAT®
EtherCAT® (**Ether**net for **C**ontrol **A**utomation **T**echnology) is an Industrial Ethernet interface and is managed by the **E**therCAT® **T**echnology **G**roup (ETG). The R-Series V EtherCAT® and its corresponding ESI file are certitified by the ETG.

Extrapolation
The native measurement cycle time of a sensor increases with the stroke length. With extrapolation, the sensor is able to report data faster than the native cycle time, independent of the stroke length of the sensor. Without extrapolation, if data is requested faster than the native cycle time, the last measured value is repeated.

F

FIR Filter
The FIR filter (**F**inite **I**mpulse **R**esponse) is used to smooth the measured position value before output. To determine the output value, only input values corresponding to the window (filter window size) are used for filter calculation. The output value is calculated from these input values in the form of a moving average value.
(→ IIR Filter)

Free Run
The sensor operates autonomously based on its own cycle and is not synchronized with the EtherCAT® cycle.
(→ Distributed Clock, → Synchronous to SyncManager Event)

I

IIR Filter
The IIR filter (**I**nfinite **I**mpulse **R**esponse) is used to smooth the measured position value before output. To determine the outputvalue, the input values corresponding to the filter grade (filter window size) are used for the filter calculation. The previous values are also taken into account when calculating the output value. (→ FIR Filter)

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 and acceleration are continuously calculated based on these changing position values as the magnets are moved.

O

Offset
A value which will be added or deducted to the actual position value. This leads to a shift of the measurement range start.
(→ Preset)

P

Preset
With the preset, a value is entered for the current position which is to be output at this position in the future. The difference between the entered value and the currently ensured position is calculated as an offset. (→ Offset)

R

RO
RO (**R**ead **O**nly) means that the value of the variable can only be read but is not modifiable.

RW
RW (**R**ead/**W**rite) means that the value of the variable can be read and written. The value of the variable is modifiable.

S

Synchronous to SyncManager Event
Besides the “Free Run” mode and the “Distributed Clock” DC mode, the sensor can be operated in the mode „Synchronous to **S**ync**M**anager (SM) Event“. The SM event is triggered by the SyncManager when a passing frame is processed.
(→ Distributed Clock, → Free Run)

T

TwinCAT
TwinCAT (**T**he **Win**dows **C**ontrol and **A**utomation **T**echnology) is an automation solution from Beckhoff Automation GmbH & Co. KG for operating an EtherCAT® network.

W

WO
WO (**W**rite **O**nly) means that the value can only be written.

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EtherCAT® Conformance tested

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