

# Temposonics®

Magnetostrictive Linear Position Sensors

**R-Series V EtherNet/IP™**  
Operation Manual



I AM THE NEW GENERATION

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## 1. Introduction

### 1.1 Purpose and use of this manual

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

The content of this technical documentation and of its appendix is intended to provide information on mounting, installation and commissioning by qualified automation personnel <sup>1</sup> 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
<b>NOTICE</b>	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 MTS Sensors. As a prerequisite of proper and safe operation the product requires correct transport, storage, mounting and commissioning and must be operated with utmost care.

- 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.

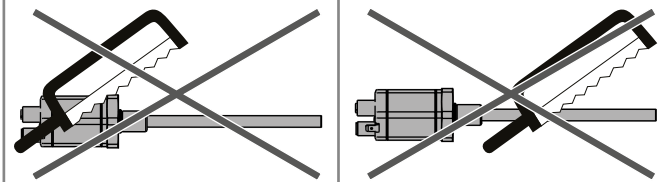
<sup>1/</sup> The term "qualified technical personnel" characterizes persons who

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

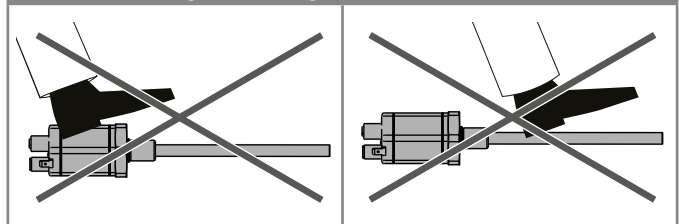
### 2.2 Foreseeable misuse

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

Do not alter the sensor afterwards.  
→ The sensor might be damaged.



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



## 2.3 Installation, commissioning and operation

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

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

### Safety instructions for commissioning

To maintain the sensor's operability, it is mandatory to follow the instructions given below.

1. Protect the sensor against mechanical damage during installation and operation.
2. Do not open or dismantle the sensor.
3. Connect the sensor very carefully and pay attention to the polarity of connections and power supply.
4. Use only approved power supplies.
5. Ensure the sensor is operating within the defined limits for supply voltage, environmental conditions, etc.
6. Check the function of the sensor regularly and provide documentation of the checks.
7. Before applying power, ensure that nobody's safety is jeopardized by starting machines.

## 2.4 Safety instructions for use in explosion-hazardous areas

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

## 2.5 Warranty

MTS Sensors grants a warranty period for the Temposonics® position sensors and supplied accessories relating to material defects and faults that occur despite correct use in accordance with the intended application<sup>2</sup>. The MTS Sensors 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 MTS Sensors accept liability in the event of offense against the warranty rules, no matter if these have been assured or expected, even in case of fault or negligence of the company. MTS Sensors explicitly excludes any further warranties. Neither the company's representatives, agents, dealers nor employees are authorized to increase or change the scope of warranty.

## 2.6 Return

For diagnostic purposes, the sensor can be returned to MTS Sensors or a repair facility explicitly authorized by MTS Sensors. Any shipment cost is the responsibility of the sender<sup>2</sup>. For a corresponding form, see chapter "11. Appendix I" on page 36.

<sup>2/</sup> See also applicable MTS Sensors terms of sales and delivery on:  
[www.mtssensors.com](http://www.mtssensors.com)

### 3. Identification

#### 3.1 Order code of Temposonics® R-Series V RP

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

<b>a</b>	<b>Sensor model</b>		
R	P	5	Profile

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

<b>c</b>	<b>Mechanical options</b>
A	Standard
V	Fluorelastomer seals for the electronics housing

<b>d</b>	<b>Stroke length</b>				
X	X	X	X	M	0025...6350 mm
<b>Standard stroke length (mm)*</b>		<b>Ordering steps</b>			
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.
<b>Standard stroke length (in.)*</b>		<b>Ordering steps</b>			
1 ... 20 in.		1 in.			
20...100 in.		2 in.			
100...200 in.		4 in.			
200...250 in.		10 in.			

<b>e</b>	<b>Number of magnets</b>	
X	X	01...20 Position(s) (1...20 magnet(s))

<b>f</b>	<b>Connection type</b>		
D	5	6	2 × M12 female connectors (5 pin), 1 × M8 male connector (4 pin)
D	5	8	2 × M12 female connectors (5 pin), 1 × M12 male connector (4 pin)

<b>g</b>	<b>System</b>
1	Standard

<b>h</b>	<b>Output</b>			
U	2	0	1	EtherNet/IP™, position and velocity (1...20 positions)
U	2	1	1	EtherNet/IP™, position and velocity, internal linearization (1...20 positions)

#### NOTICE

- For applications using more than 1 magnet, order the additional 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, e.g. 2 × U-magnets (part no. 251 416-2).

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

### 3.2 Order code of Temposonics® R-Series V RH

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

<b>a</b>	<b>Sensor model</b>		
R	H	5	Rod

<b>b</b>	<b>Design</b>
B	Base unit (only for replacement)
J	Threaded flange M22×1.5-6g (rod Ø 12.7 mm, 800 bar)
M	Threaded flange M18×1.5-6g (standard)
S	Threaded flange ¾"×16UNF - 3A (standard)
T	Threaded flange ¾"×16UNF - 3A (with raised-face)

<b>c</b>	<b>Mechanical options</b>
A	Standard
B	Bushing on rod end (only for flange option »M«, »S« & »T«)
M	Thread M4 at rod end (only for flange option »M«, »S« & »T«)
V	Fluorelastomer seals for the electronics housing

<b>d</b>	<b>Stroke length</b>				
X	X	X	X	M	0025...7620 mm
<b>Standard stroke length (mm)*</b>		<b>Ordering steps</b>			
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.
<b>Standard stroke length (in.)*</b>		<b>Ordering steps</b>			
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.			

<b>e</b>	<b>Number of magnets</b>	
X	X	01...20 Position(s) (1...20 magnet(s))

<b>f</b>	<b>Connection type</b>		
D	5	6	2×M12 female connectors (5 pin), 1×M8 male connector (4 pin)
D	5	8	2×M12 female connectors (5 pin), 1×M12 male connector (4 pin)

<b>g</b>	<b>System</b>
1	Standard

<b>h</b>	<b>Output</b>			
U	2	0	1	EtherNet/IP™, position and velocity (1...20 positions)
U	2	1	1	EtherNet/IP™, position and velocity, internal linearization (1...20 positions)

#### NOTICE

- For applications using more than 1 magnet, order the additional 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, e.g. 2 × U-magnets (part no. 251 416-2).

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

### 3.3 Nameplate

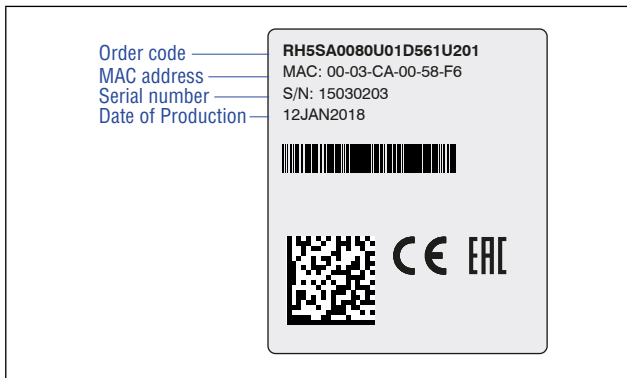


Fig. 1: Example of nameplate of a R-Series V RH5 sensor with EtherNet/IP™ output

### 3.4 Approvals

- CE certified
- EAC certified
- ODVA certified

### 3.5 Scope of delivery

#### RP5 (profile sensor):

- Sensor
- Position magnet
- 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, 3 socket screws M4
- RH5-J/M/S/T: Sensor, O-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 RP (profile sensor)
- Temposonics® R-Series V RH (rod sensor)

#### Stroke length

- Temposonics® R-Series V RP 25...6350 mm (1...250 in.)
- Temposonics® R-Series V RH 25...7620 mm (1...300 in.)

#### Output signal

- EtherNet/IP™

#### Application

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

#### Principle of operation and system construction

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

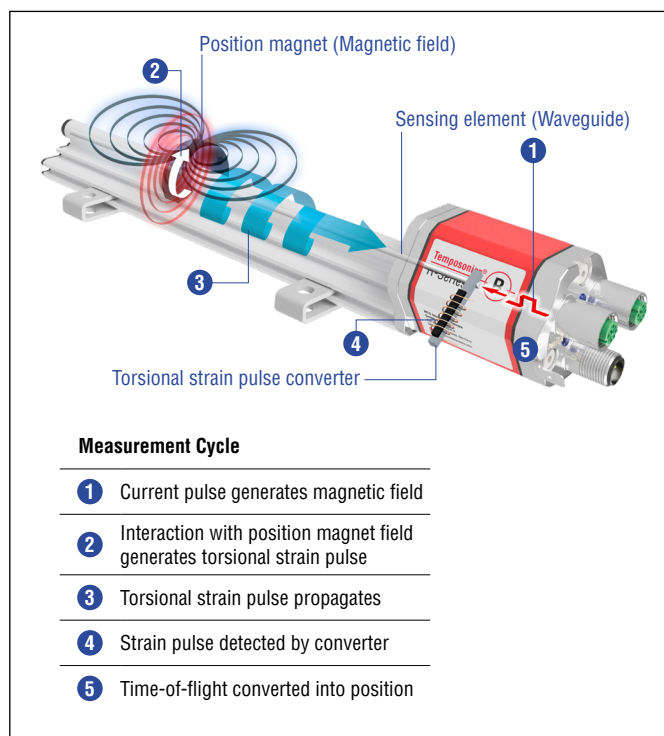


Fig. 2: Time-based magnetostrictive position sensing principle

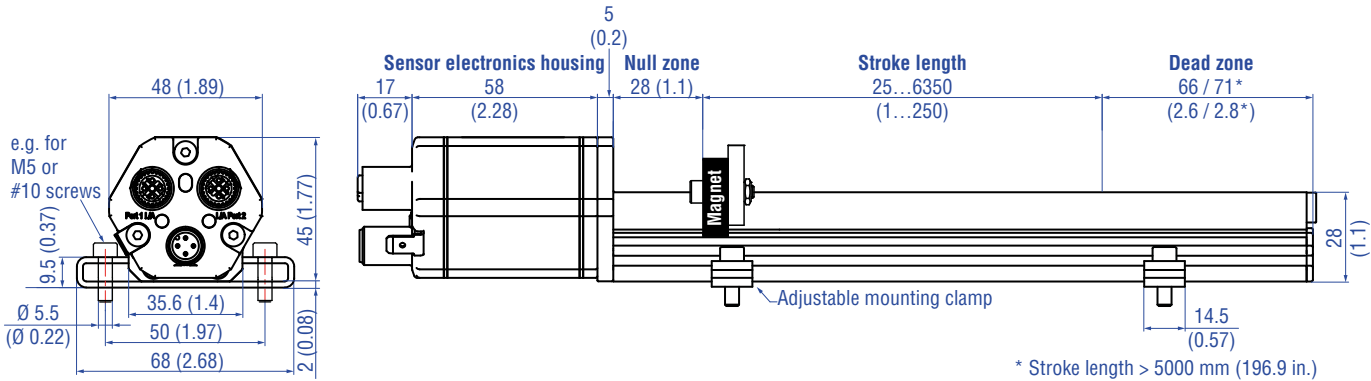
#### Modular mechanical and electronic construction

- The sensor rod or profile protects the inner sensor element.
- The sensor electronics housing, a rugged aluminum construction, contains the complete electronic interface with active signal conditioning. Double shielding ensures high safety of operation and optimum EMC (Electromagnetic Compatibility).
- 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 Styles and installation of Temposonics® R-Series V RP

RP5-M (connection type D58)



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

Fig. 3: Temposonics® RP5 with U-magnet

Installation of RP5

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

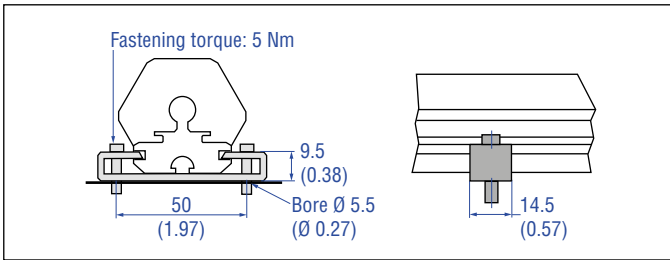


Fig. 4: Mounting clamps (part no. 400 802) with cylinder screw M5×20

Alternative:

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

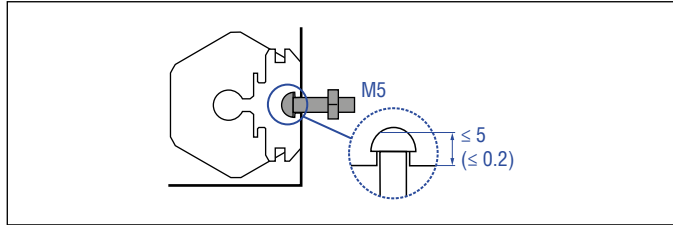


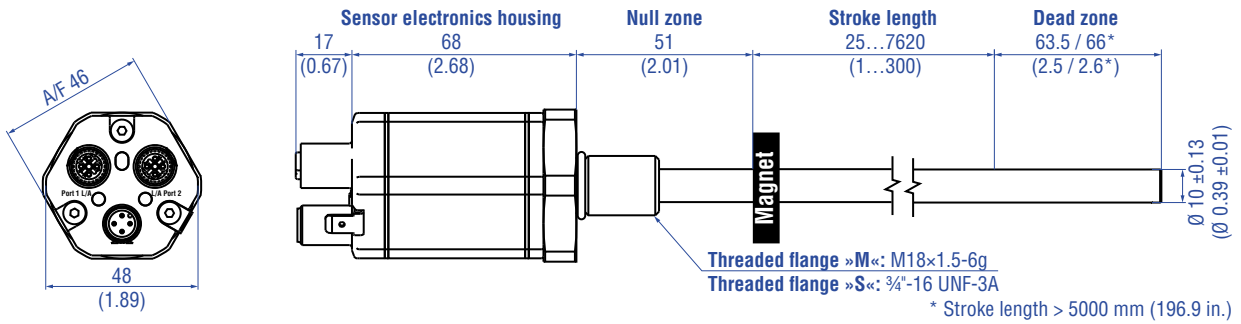
Fig. 5: T-slot nut M5 (part no. 401 602)

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

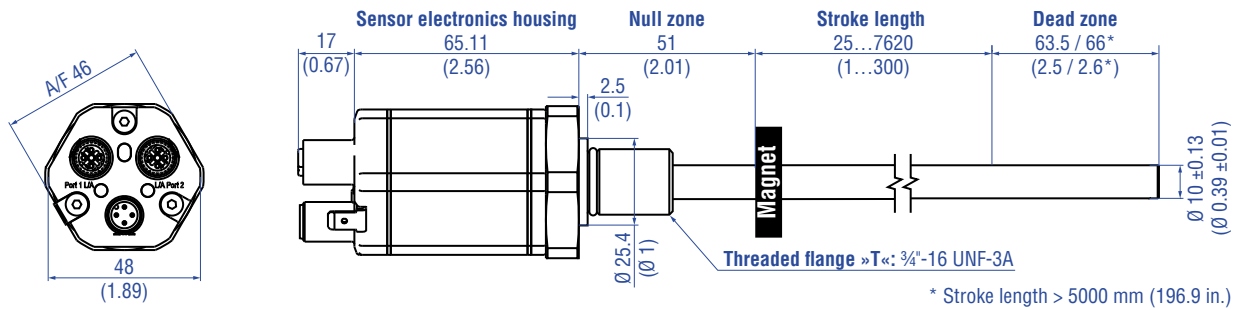
Controlling design dimensions are in millimeters and measurements in ( ) are in inches

4.3 Styles and installation of Temposonics® R-Series V RH

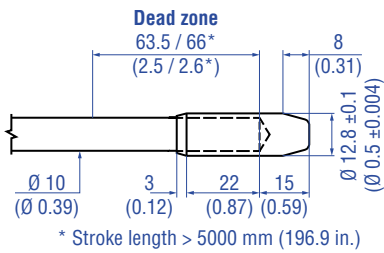
RH5-M/S-A/V – RH5 with threaded flange M18×1.5 or ¾"×16UNF (connection type D58)



RH5-T-A/V – RH5 with threaded, raised face flange ¾"×16UNF (connection type D58)

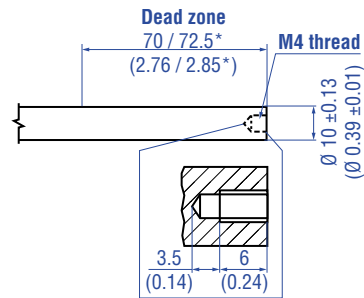


Optional bushing on rod end for threaded flange M18×1.5 or ¾"×16UNF



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

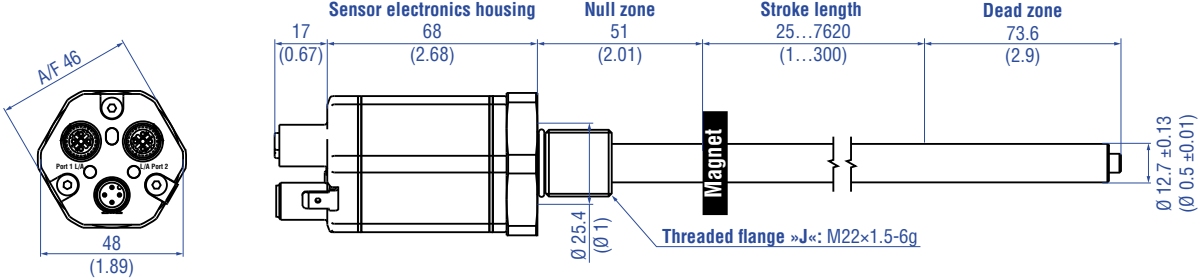
Optional thread M4 at rod end for threaded flange M18×1.5 or ¾"×16UNF



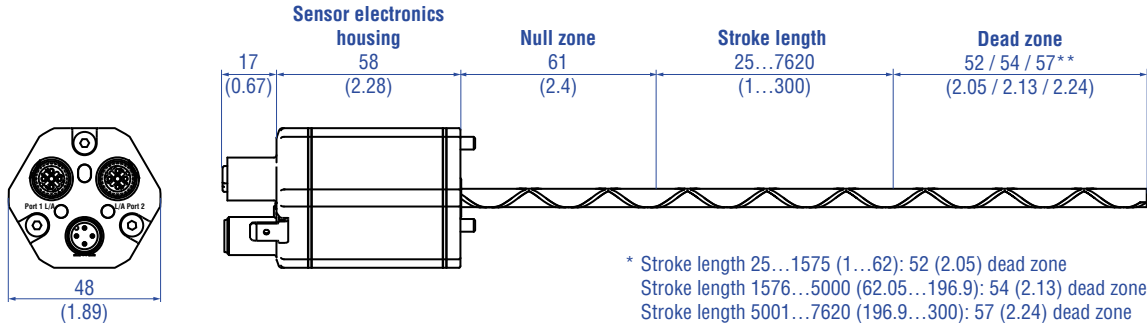
\* Stroke length > 5000 mm (196.9 in.)

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

**RH5-J-A/-V – RH5 with threaded flange M22×1.5 and Ø 12.7 mm rod (connection type D58)**



**RH5-B-A/-V – RH5 base unit for replacement (connection type D58)**



\* Stroke length 25...1575 (1...62): 52 (2.05) dead zone  
 Stroke length 1576...5000 (62.05...196.9): 54 (2.13) dead zone  
 Stroke length 5001...7620 (196.9...300): 57 (2.24) dead zone

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.

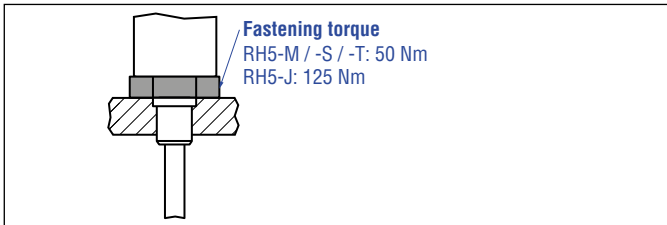


Fig. 8: Mounting example of threaded flange

### Installation 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 only two 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 "4.5 Replacement of sensor" on page 16.

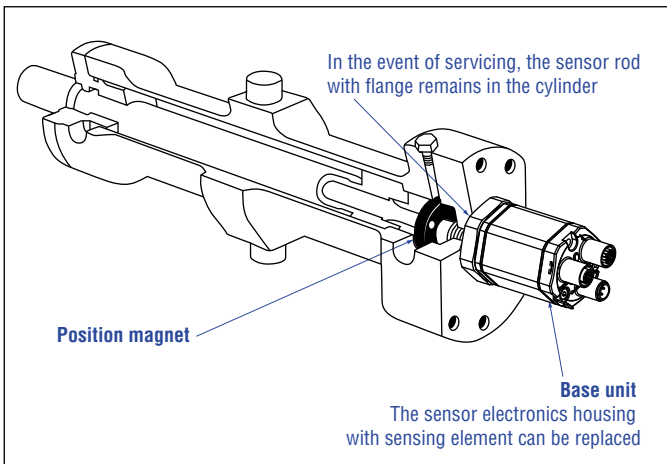


Fig. 9: Sensor in cylinder

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

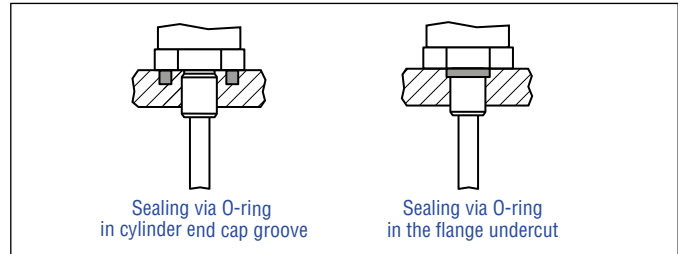


Fig. 10: Possibilities of sealing

- Note the fastening torque of:  
RH5-M / -S / -T: 50 Nm  
RH5-J: 125 Nm
- Seat the flange contact surface completely on the cylinder mounting surface.
- The cylinder manufacturer determines the pressure-resistant gasket (copper gasket, O-ring, etc.).
- The position magnet should not grind on the sensor rod.
- The piston rod drilling (RH5-M/S/T-A/V with rod Ø 10 mm: ≥ Ø 13 mm (≥ Ø 0.51 in.); RH5-M/S/T-A/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 <sub>1</sub> ×P)	d <sub>2</sub>	d <sub>3</sub>	d <sub>4</sub>	d <sub>5</sub> +0.1 0	L <sub>1</sub> +0.4 0	L <sub>2</sub>	L <sub>3</sub>	L <sub>4</sub>	Z° ±1°
<b>RH5-M-A/V/M</b>									
M18×1.5-6g	55	≥ 13	24.5	19.8	2.4	28.5	2	26	15°
<b>RH5-M-B</b>									
M18×1.5-6g	55	≥ 16	24.5	19.8	2.4	28.5	2	26	15°
<b>RH5-J-A/V</b>									
M22×1.5-6g	55	≥ 16	27.5	23.8	2.4	28.5	2	26	15°

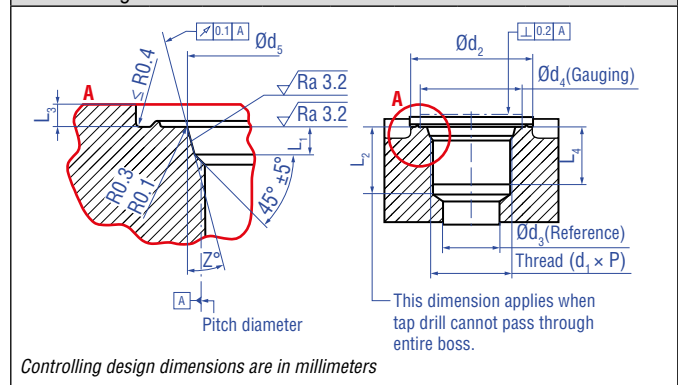


Fig. 11: Notice for metric threaded flange M18×1.5-6g / M22×1.5-6g based on DIN ISO 6149-1

#### 4.4 Magnet installation




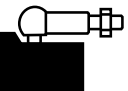
Magnet	Typical sensors	Benefits
 <b>Ring magnets</b>	<b>Rod model</b> (RH5)	<ul style="list-style-type: none"> <li>Rotationally symmetrical magnetic field</li> </ul>
 <b>U-magnets</b>	<b>Profile &amp; rod models</b> (RP5, RH5)	<ul style="list-style-type: none"> <li>The magnet can be lifted off (RP5)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

Fig. 12: 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/mm<sup>2</sup> (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. 15).
- If no other option exists and magnetic material is used, observe the specified dimensions (Fig. 15).

#### NOTICE

Mount ring magnets and U-magnets concentrically. Mount block magnets centrally over the sensor rod or the sensor profile. The maximum permissible air gap must not be exceeded (Fig. 13 / Fig. 14). 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.

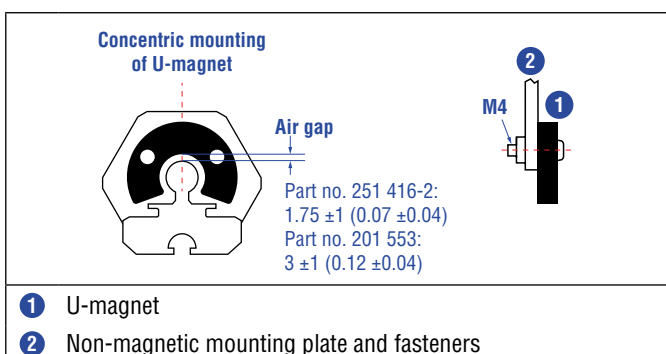


Fig. 13: Mounting of U-magnet (part no. 251 416-2 or part no. 201 553)

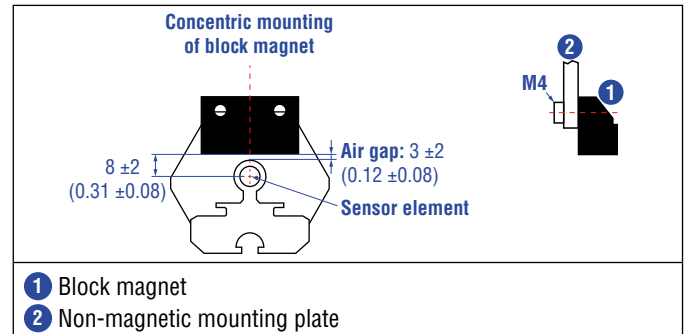


Fig. 14: Mounting of block magnet (part no. 403 448)

#### Magnet mounting with magnetic material

When using magnetic material the dimensions of Fig. 15 must be observed.

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

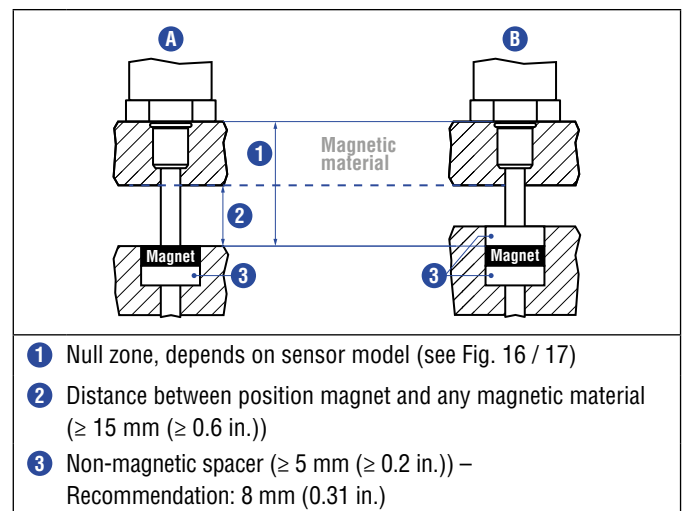


Fig. 15: Installation with magnetic material

#### Sensors with stroke lengths ≥ 1 meter (3.3 ft.)

Support horizontally installed sensors with a stroke length from 1 meter (3.3 ft.) mechanically at the rod end. Without the use of a support, rod and 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. 16) for measurement.

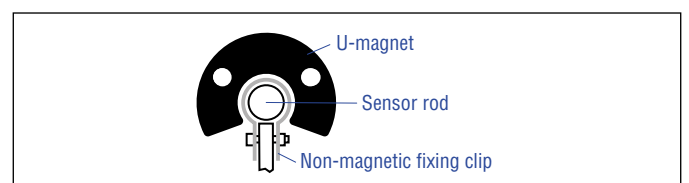


Fig. 16: Example of sensor support (part no. 561 481)

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

**Start- and end positions of the position magnets**

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

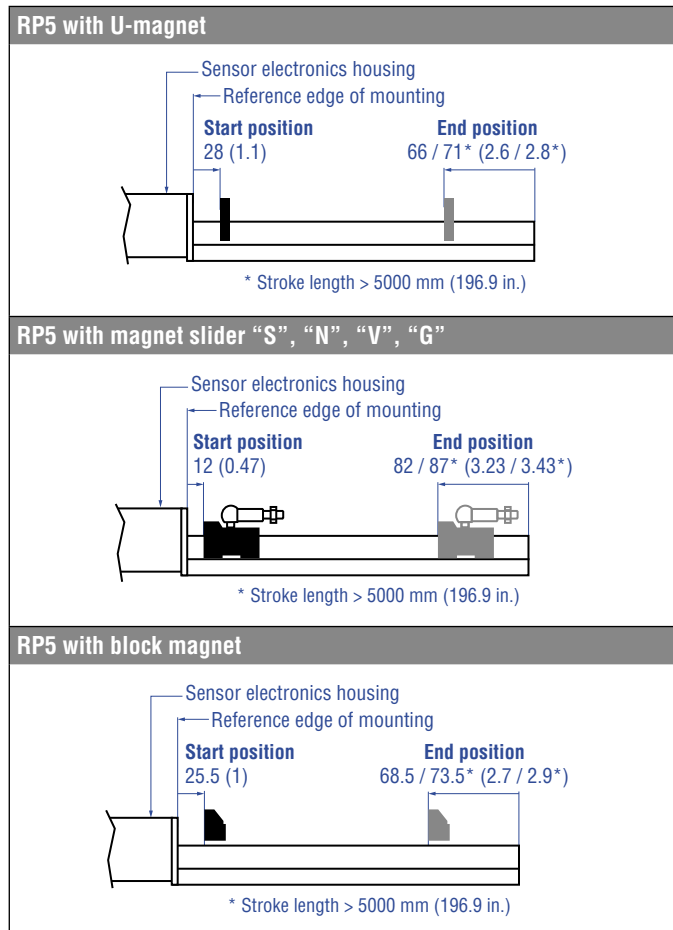


Fig. 17: Start- & end positions of magnets, part 1

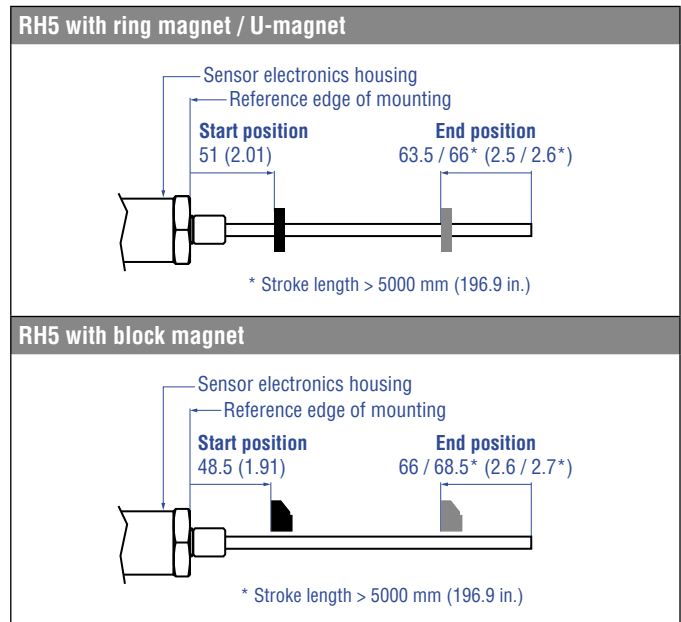


Fig. 18: Start- & end positions of magnets, part 2

**NOTICE**

On all sensors, use only the active measurement stroke, which is between the start and end positions. The magnet may move beyond these positions.

### Multi-position measurement

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

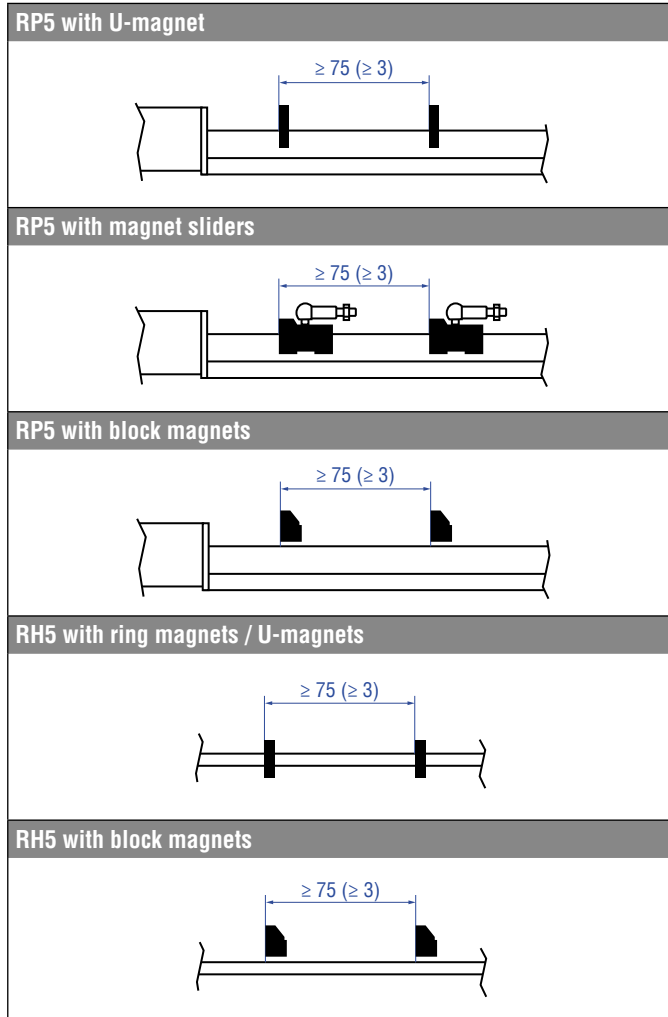


Fig. 19: Minimum distance for multi-position measurement

#### NOTICE

Use magnets of the same type (e.g. 2 ring magnets) for multi-position measurement.

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.). for multi-position measurement.\*

\*/ Contact MTS Sensors if you need a magnet distance, which is smaller than 75 mm (3 in.).

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

#### 4.5 Replacement of sensor

The base unit of the sensor models RH (RH5-B) is replaceable as shown in Fig. 20 and Fig. 21. The sensor can be replaced without interrupting the hydraulic circuit.

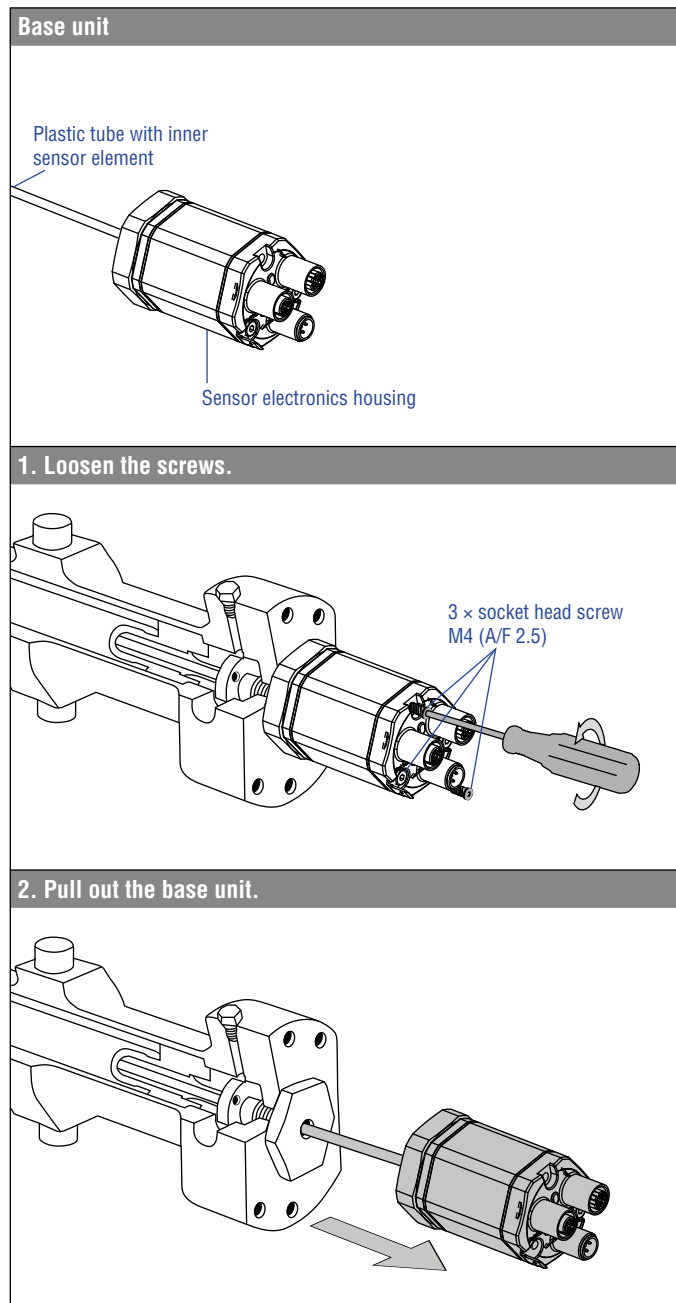


Fig. 20: Replacement of the base unit (e.g. RH5 sensor), part 1

**NOTICE**  
In the event the R-Series V is replacing the R-Series 2004 the plastic tube must also be removed.

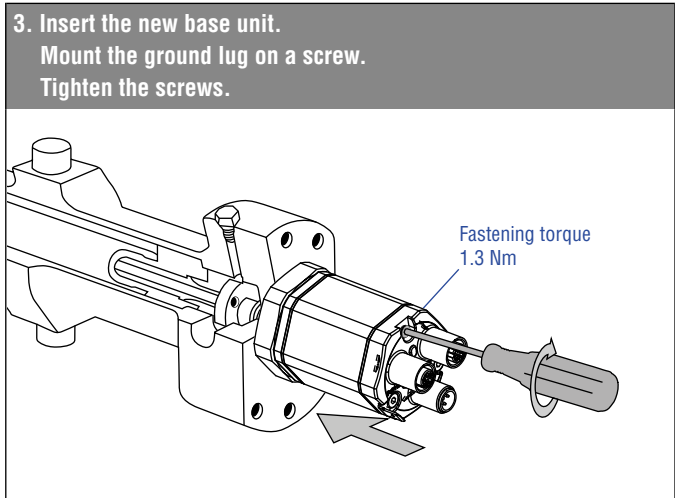


Fig. 21: Replacement of the base unit (e.g. RH5 sensor), part 2

**NOTICE**  
• Secure the base unit screws, e.g. using Loctite 243, before re-installing.



#### 4.6 Electrical connections

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 sensor types RP and RH via ground lug as shown in Fig. 22. In addition you can ground the sensor type RH via thread.

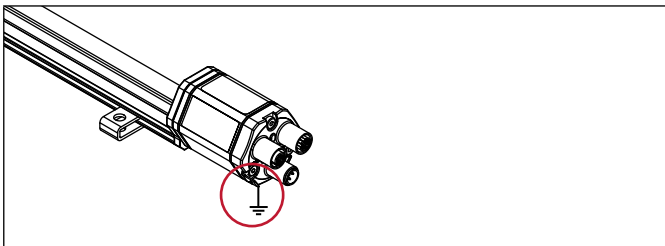


Fig. 22: Grounding via ground lug (e.g. RP5)

#### Connector wiring

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

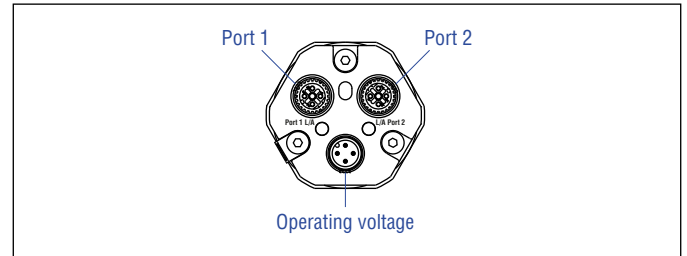


Fig. 23: Location of connections (e.g. D58 connector wiring)

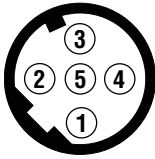


D56		
Signal		
Port 1 – M12 female connector (D-coded)	Pin	Function
 <p>View on sensor</p>	1	Tx (+)
	2	Rx (+)
	3	Tx (-)
	4	Rx (-)
	5	Not connected
Port 2 – M12 female connector (D-coded)	Pin	Function
 <p>View on sensor</p>	1	Tx (+)
	2	Rx (+)
	3	Tx (-)
	4	Rx (-)
	5	Not connected
Power supply		
M8 male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

Fig. 24: Connector wiring D56

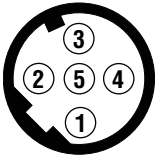
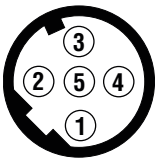
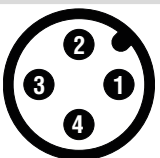
D58		
Signal		
<b>Port 1 – M12 female connector (D-coded)</b>   View on sensor	<b>Pin</b>	<b>Function</b>
	1	Tx (+)
	2	Rx (+)
	3	Tx (-)
	4	Rx (-)
	5	Not connected
<b>Port 2 – M12 female connector (D-coded)</b>   View on sensor	<b>Pin</b>	<b>Function</b>
	1	Tx (+)
	2	Rx (+)
	3	Tx (-)
	4	Rx (-)
	5	Not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

Fig. 25: Connector wiring D58

4.7 Frequently ordered accessories – Additional options available in our [Accessories Guide](#) 551 444

Position magnets

<p><b>Magnet slider S, joint at top</b> Part no. 252 182</p> <p>Material: GRP, magnet hard ferrite Weight: Approx. 35 g Operating temperature: -40...+75 °C (-40...+167 °F)</p>	<p><b>Magnet slider V, joint at front</b> Part no. 252 184</p> <p>Material: GRP, magnet hard ferrite Weight: Approx. 35 g Operating temperature: -40...+75 °C (-40...+167 °F)</p>	<p><b>Magnet slider N, longer ball-joint arm</b> Part no. 252 183</p> <p>Material: GRP, magnet hard ferrite Weight: Approx. 35 g Operating temperature: -40...+75 °C (-40...+167 °F)</p>	<p><b>Magnet slider G, backlash free</b> Part no. 253 421</p> <p>Material: GRP, magnet hard ferrite Weight: Approx. 25 g Operating temperature: -40...+75 °C (-40...+167 °F)</p>

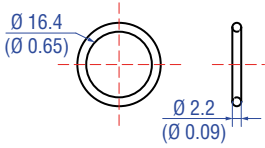
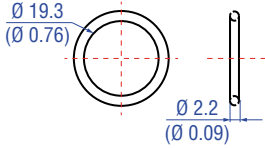
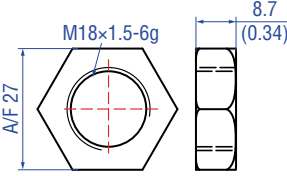
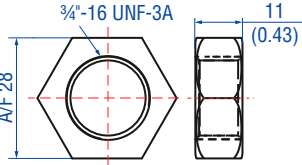
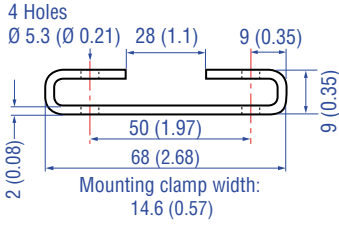
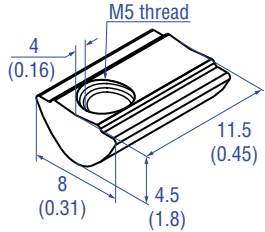
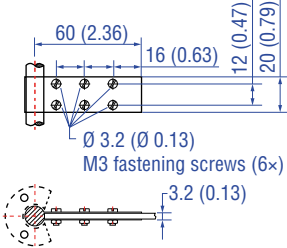
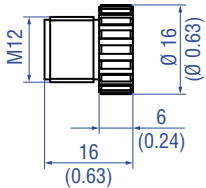
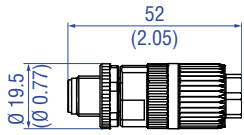
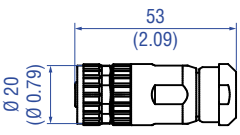
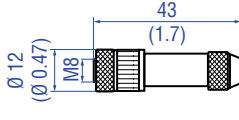
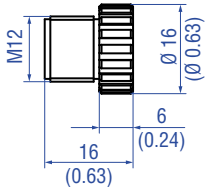
Position magnets

<p><b>U-magnet OD33</b> Part no. 251 416-2</p> <p>Material: PA ferrite GF20 Weight: Approx. 11 g Surface pressure: Max. 40 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p><b>U-magnet OD63.5</b> Part no. 201 553</p> <p>Material: PA 66-GF30, magnets compound-filled Weight: Approx. 26 g Surface pressure: 20 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+75 °C (-40...+167 °F)</p>	<p><b>Ring magnet OD33</b> Part no. 201 542-2</p> <p>Material: PA ferrite GF20 Weight: Approx. 14 g Surface pressure: Max. 40 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+105 °C (-40...+221 °F)</p>	<p><b>Ring magnet OD25.4</b> Part no. 400 533</p> <p>Material: PA ferrite Weight: Approx. 10 g Surface pressure: Max. 40 N/mm<sup>2</sup> Operating temperature: -40...+105 °C (-40...+221 °F)</p>

Position magnets      Magnet spacer      O-ring

<p><b>Ring magnet</b> Part no. 402 316</p> <p>Material: PA ferrite coated Weight: Approx. 13 g Surface pressure: Max. 20 N/mm<sup>2</sup> Operating temperature: -40...+100 °C (-40...+212 °F)</p>	<p><b>Block magnet L</b> Part no. 403 448</p> <p>Material: Hard ferrite Weight: Approx. 20 g Fastening torque for M4 screws: 1 Nm Operating temperature: -40...+75 °C (-40...+167 °F)</p> <p>This magnet may influence the sensor performance specifications for some applications.</p>	<p><b>Magnet spacer</b> Part no. 400 633</p> <p>Material: Aluminum Weight: Approx. 5 g Surface pressure: Max. 20 N/mm<sup>2</sup> Fastening torque for M4 screws: 1 Nm</p>	<p><b>O-ring for threaded flange</b> M18×1.5-6g Part no. 401 133</p> <p>Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)</p>

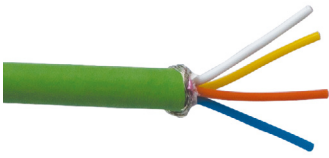
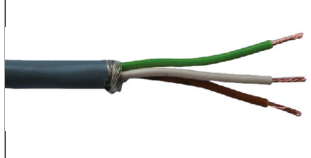


Controlling design dimensions are in millimeters and measurements in ( ) are in inches

O-rings		Mounting hardware	
			
<b>O-ring for threaded flange</b> <b>¾"-16 UNF-3A</b> <b>Part no. 560 315</b> Material: Fluoroelastomer Durometer: 75 ± 5 Shore A Operating temperature: -40...+204 °C (-40...+400 °F)	<b>O-ring for threaded flange</b> <b>M22x1.5-6g</b> <b>Part no. 561 337</b> Material: FPM Durometer: 75 Shore A Operating temperature: -20...+200 °C (-6...+392 °F)	<b>Hex jam nut M18x1.5-6g</b> <b>Part no. 500 018</b> Material: Steel, zinc, plated	<b>Hex jam nut ¾"-16 UNF-3A</b> <b>Part no. 500 015</b> Material: Zinc plated with nylon insert
Mounting hardware		Accessory for M12 cable connector	
			
<b>Mounting clamp</b> <b>Part no. 400 802</b> Material: Stainless steel (AISI 304)	<b>T-nut</b> <b>Part no. 401 602</b> Fastening torque for M5 screw: 4.5 Nm	<b>Fixing clip for rod with Ø 10 mm</b> <b>Part no. 561 481</b> 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	<b>M12 connector end cap</b> <b>Part no. 370 537</b> 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 <sup>4</sup>		Cables	
			
<b>M12 D-coded male connector</b> <b>(4 pin), straight</b> <b>Part no. 370 523</b> Material: Zinc nickel-plated Termination: Insulation-displacement Cable Ø: 5.5...7.2 mm (0.2...0.28 in.) Wire: 24 AWG – 22 AWG Operating temperature: -25...+85 °C (-13...+185 °F) Ingress protection: IP65 / IP67 (correctly fitted) Fastening torque: 0.6 Nm	<b>M12 A-coded female connector</b> <b>(5 pin), straight</b> <b>Part no. 370 677</b> Material: GD-Zn, Ni Termination: Screw Contact insert: CuZn Cable Ø: 4...8 mm (0.16...0.31 in.) Wire: 1.5 mm <sup>2</sup> Operating temperature: -30...+85 °C (-22...+185 °F) Ingress protection: IP67 (correctly fitted) Fastening torque: 0.6 Nm	<b>M8 female connector (4 pin), straight</b> <b>Part no. 370 504</b> Material: CuZn nickel plated Termination: Solder Cable Ø: 3.5...5 mm (0.14...0.28 in.) Wire: 0.25 mm <sup>2</sup> Operating temperature: -40...+85 °C (-40...+185 °F) Ingress protection: IP67 (correctly fitted) Fastening torque: 0.5 Nm	<b>M12 connector end cap</b> <b>Part no. 370 537</b> 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

<sup>4/</sup> Follow the manufacturer's mounting instructions

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

Cables

			
<p><b>PUR cable</b>  <b>Part no. 530 125</b></p>	<p><b>PVC cable</b>  <b>Part no. 530 108</b></p>	<p><b>Cable with M12 D-coded male connector (4 pin), straight – M12 D-coded, male connector (4 pin), straight</b>  <b>Part no. 530 064</b></p>	<p><b>Cable with M12 D-coded male connector (4 pin), straight – RJ45 male connector, straight</b>  <b>Part no. 530 065</b></p>
<p>Material: PUR jacket; green          Features: Cat 5, highly flexible          Cable Ø: 6.5 mm (0.26 in.)          Cross section: 2 × 2 × 0.35 mm<sup>2</sup> (22/7 AWG)          Operating temperature: -20...+60 °C (-4...+140 °F)</p>	<p>Material: PVC jacket; gray          Features: Shielded, flexible          Cable Ø: 4.9 mm (0.19 in.)          Cross section: 3 × 0.34 mm<sup>2</sup>          Operating temperature: -30...+80 °C (-22...+176 °F)</p>	<p>Material: PUR jacket; green          Features: Cat 5e          Cable length: 5 m (16.4 ft)          Cable Ø: 6.5 mm (0.26 in.)          Ingress protection: IP65, IP67, IP68 (correctly fitted)          Operating temperature: -30...+70 °C (-22...+158 °F)</p>	<p>Material: PUR jacket; green          Features: Cat 5e          Cable length: 5 m (16.4 ft)          Cable Ø: 6.5 mm (0.26 in.)          Ingress protection M12 connector: IP67 (correctly fitted)          Ingress protection RJ45 connector: IP20 (correctly fitted)          Operating temperature: -30...+70 °C (-22...+158 °F)</p>

Cables

Programming kit



<p><b>Cable with M8 female connector (4 pin), straight – pigtail</b>  <b>Part no. 530 066 (5 m (16.4 ft.))</b>  <b>Part no. 530 096 (10 m (32.8 ft.))</b>  <b>Part no. 530 093 (15 m (49.2 ft.))</b></p>	<p><b>TempoLink smart assistant for Temposonics® R-Series V</b>  <b>Part no. TL-1-0-EM12</b></p>
--	--

Material: PUR jacket; gray  
 Features: Shielded  
 Cable Ø: 8 mm (0.3 in.)  
 Operating temperature: -40...+90 °C (-40...+194 °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
- User friendly interface for mobile devices and desktop computers
- Rugged ABS plastic construction for the industrial environment
- See product brief “TempoLink smart assistant” (document part no.: 551976) for further information

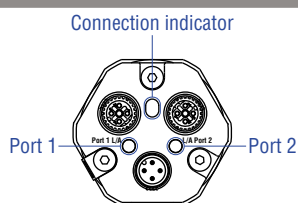
**Manuals & Software available at:**  
[www.mtssensors.com](http://www.mtssensors.com)

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

## 5. Operation

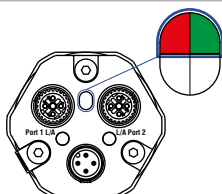
### 5.1 LED Status

#### EtherNet/IP™ LED status



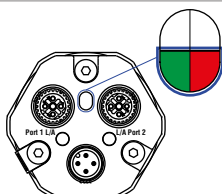
#### Connection indicator

##### Module status LED



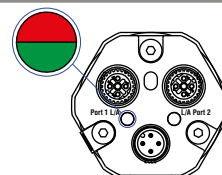
Green	Red	Information
● ON	○ OFF	IP address configured
● Flashing	○ OFF	IP address not configured
○ OFF	● Flashing	Duplicate of IP address recognized

##### Network status LED



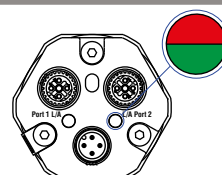
Green	Red	Information
● ON	○ OFF	Connection established
● Flashing	○ OFF	No connection
○ OFF	● ON	Unrecoverable error
○ OFF	● Flashing	Recoverable error

#### Port 1 L/A (IN)



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

#### Port 2 L/A (OUT)



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

#### NOTICE

##### Observe during commissioning

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

## 6. Programming and configuration

### 6.1 IP address Configuration

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

#### NOTICE

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

### 6.2 Setting the IP address of the sensor

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

**6.2.1** Open the **BOOTP/DHCP Server** software.

▶ The 'BOOTP/DHCP Server' window opens.

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

▶ The 'New Entry' window opens.

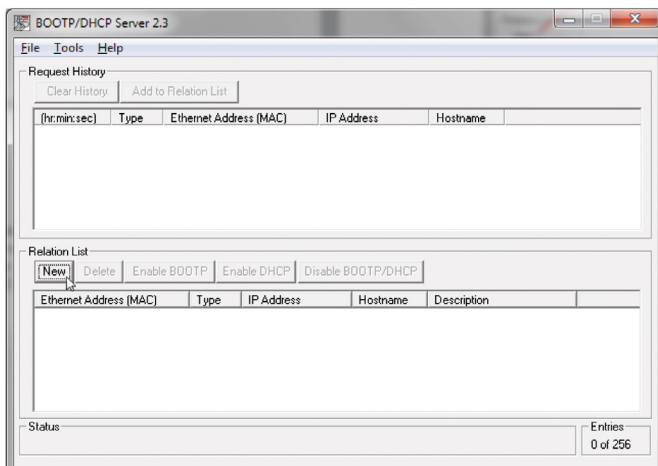


Fig. 26: Create new relation list entry

#### NOTICE

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

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

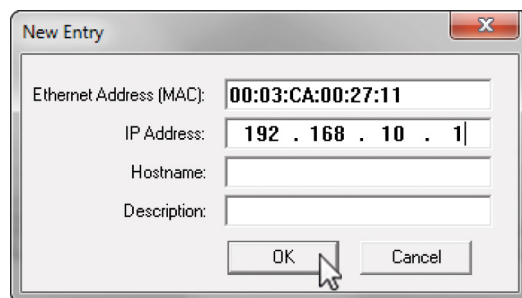


Fig. 27: Enter MAC ID and unique IP address

**6.2.4** Verify that your unique IP address and MAC ID appear in the 'Relation List' window. If the relation list window does not contain both MAC ID and IP address, repeat steps 6.2.2 to 6.2.4. Otherwise, continue to step 6.2.5.

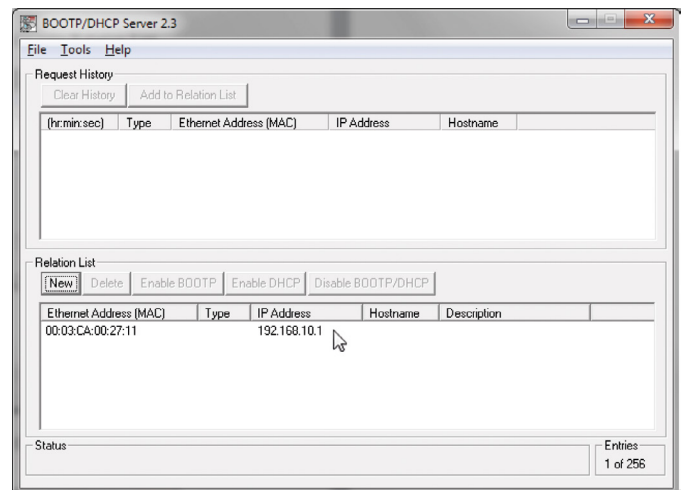


Fig. 28: Populated relation list

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

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

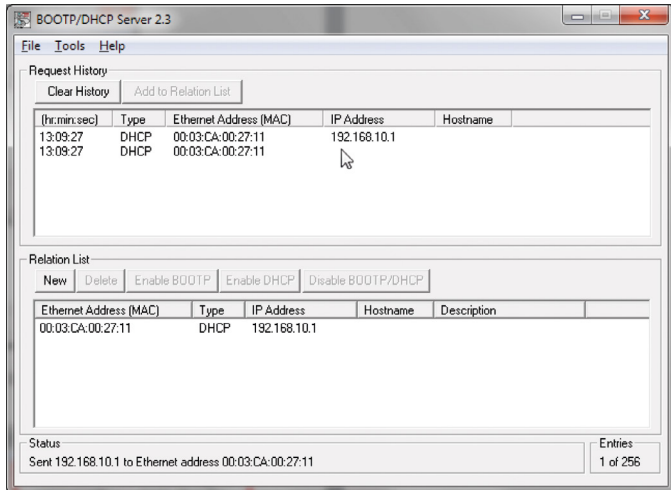


Fig. 29: Request History shows MAC ID and IP address

**NOTICE**

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

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

**6.2.8** The 'Status' message at the bottom of the window will read "Command Successful" if the disable command was successful. The sensor is now assigned a static IP address. If needed, repeat step 6.2.7 until the disable command is successful.

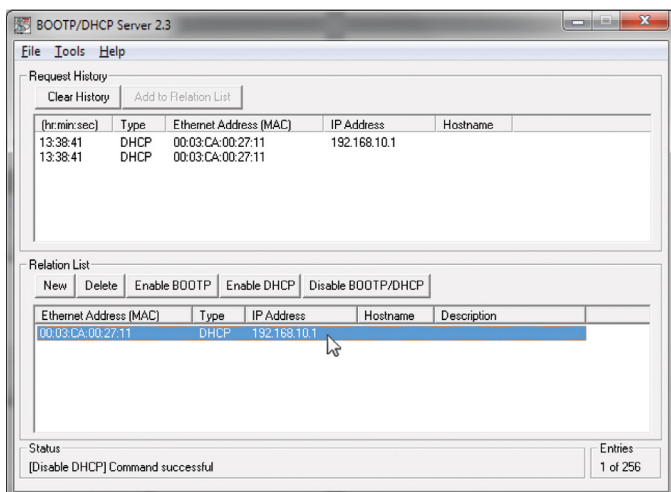


Fig. 30: Sensor shows the static IP address

**6.2.9** Exit the BOOT/DHCP Server software. If installing the MTS EtherNet/IP™ EDS file (download at [www.mtssensors.com](http://www.mtssensors.com)) continue with chapter 7.1. To utilize the EDS file, the RSLogix 5000 software must be version 20 or later.

If not installing the sensor EDS file, or if using an earlier version of the RSLogix 5000 software, the sensor parameter data must be manually loaded. In that case, continue with Steps 2 and 3.



## 7. Integration in RSLogix 5000

### 7.1 Install the MTS EtherNet/IP™ EDS file

The EDS file for the R-Series V EtherNet/IP™ sensor is available at [www.mtssensors.com](http://www.mtssensors.com). It provides full backwards compatibility to the previous generation of R-Series EtherNet/IP™ sensors.

7.1.1 Open the RSLogix 5000 software interface.

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

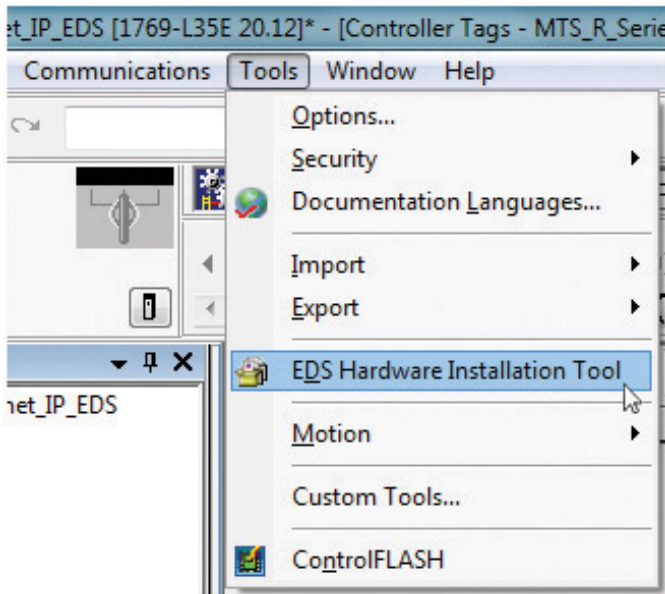


Fig. 31: Select the “EDS Hardware Installation Tool”

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



Fig. 32: EDS wizard launch screen

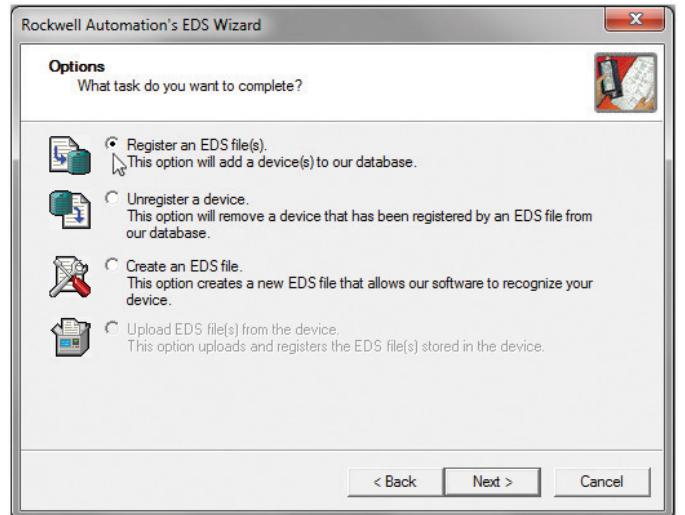


Fig. 33: Register an EDS file

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

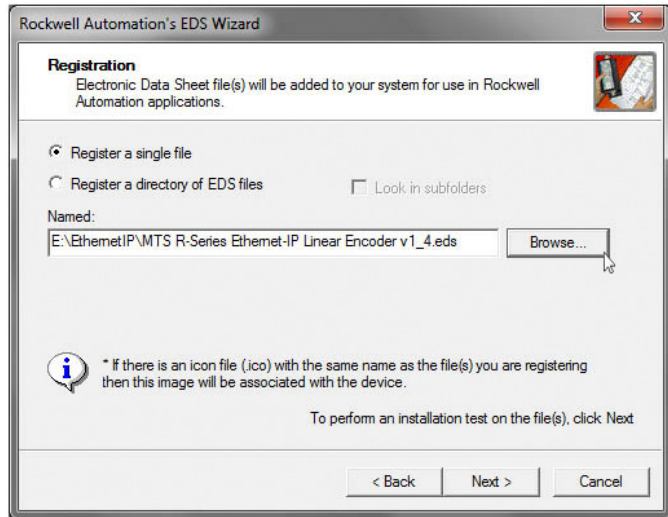


Fig. 34: Enter the path to the EDS file

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

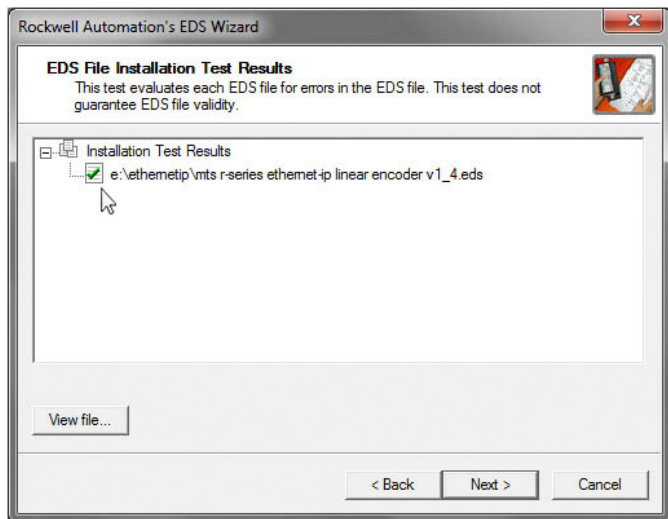


Fig. 35: Confirmation of path to the EDS file

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

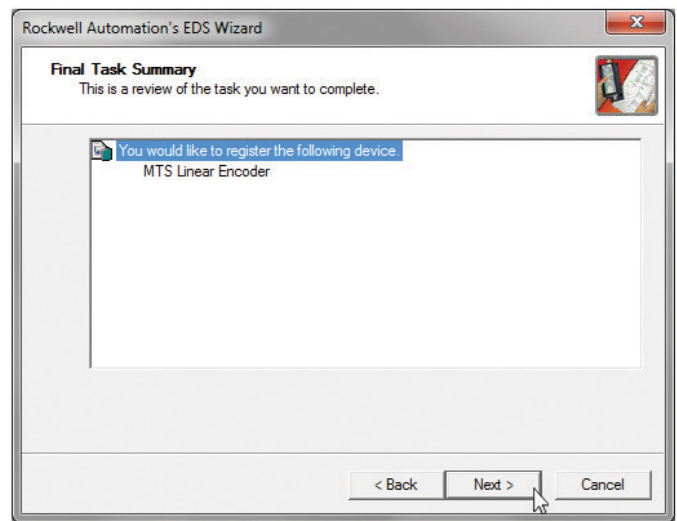


Fig. 36: Confirmation of EDS file origin

7.1.7 Click "Finish".

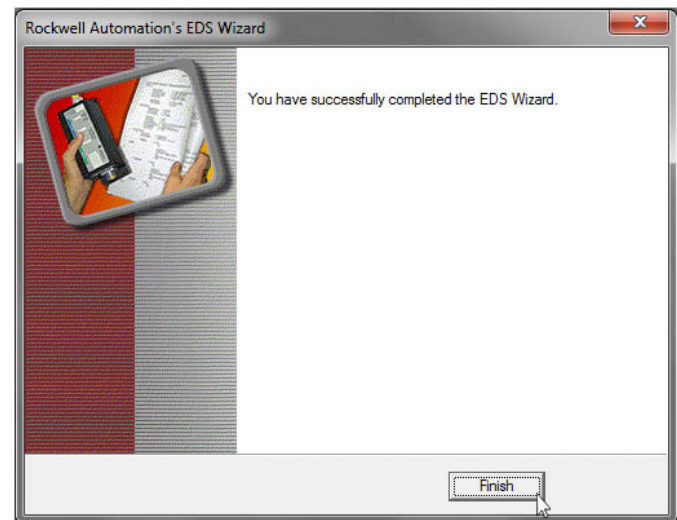


Fig. 37: EDS Installation Complete

## 7.2 Add sensor to I/O configuration using EDS file

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

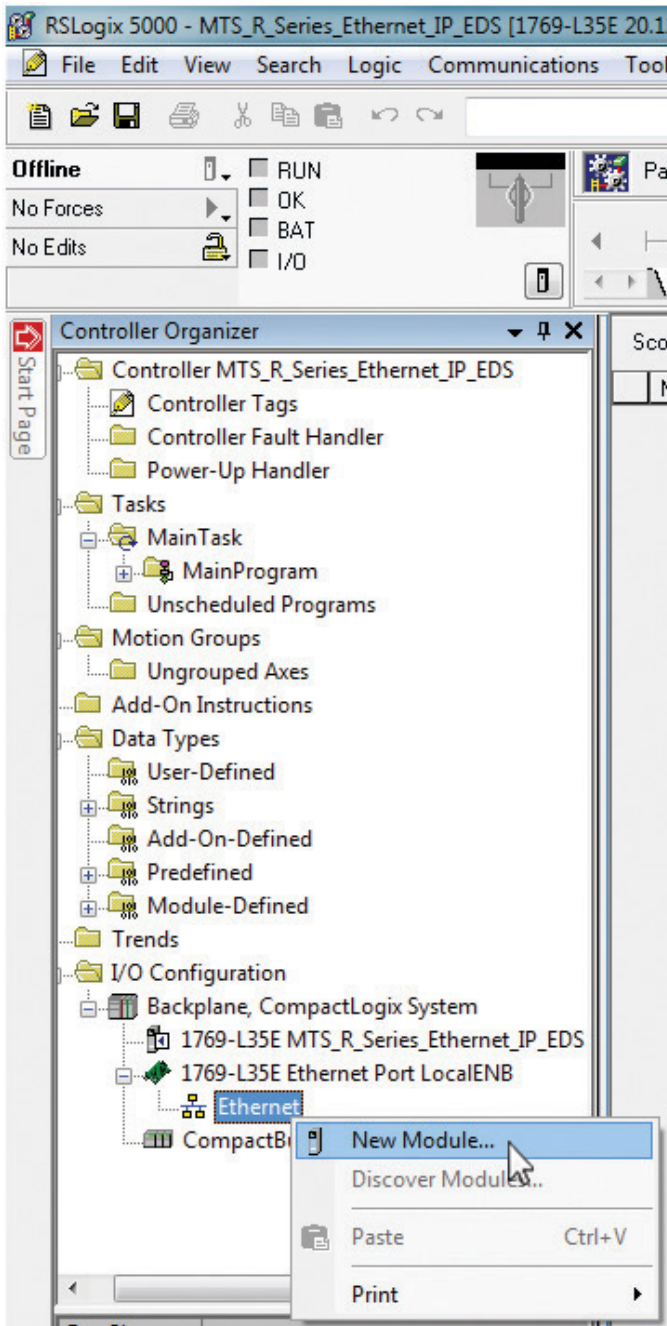


Fig. 38: Add a new module to the RSLogix 5000 I/O tree

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

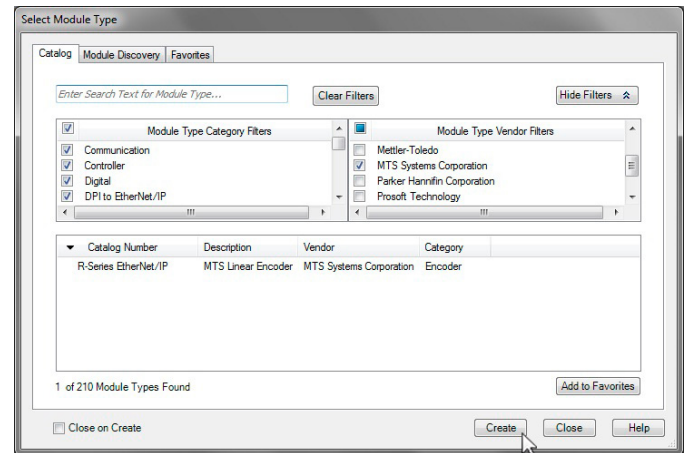


Fig. 39: Create new moduletree

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

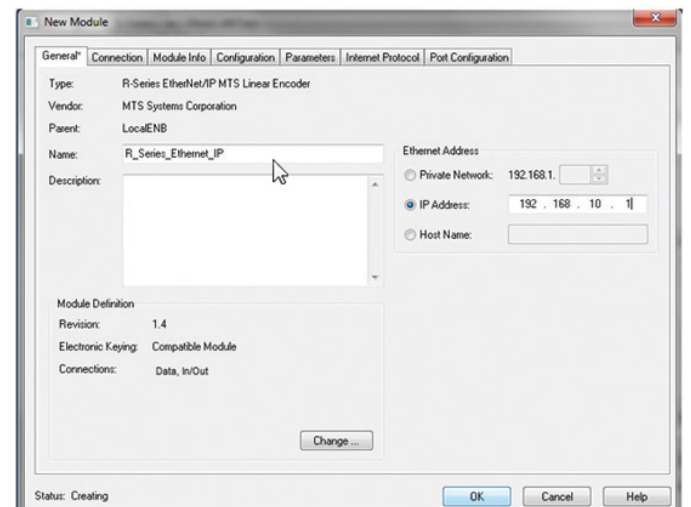


Fig. 40: Confirm the new module settings

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

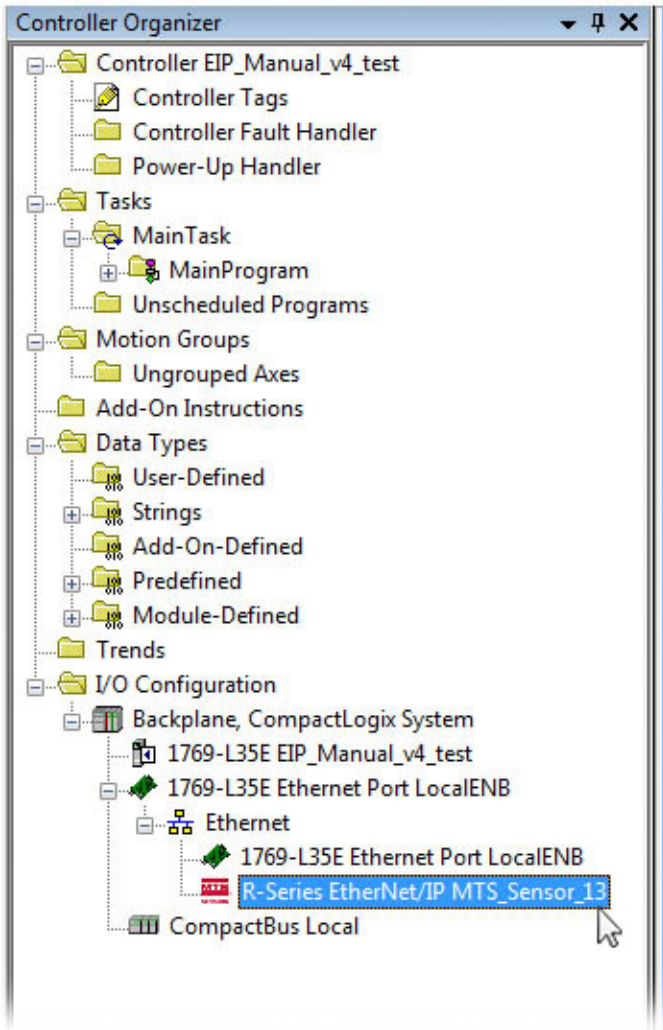


Fig. 41: New module on the network

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

7.3 Add sensor to I/O configuration without using EDS file

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

- 7.3.1 Open the RSLogix 5000 software interface.
- 7.3.2 Open the controllers' directory tree. Click I/O configuration, then right click your network. Select "New Module". The "Select Module" window opens.
- 7.3.3 In the "Select Module" window, select "Generic Ethernet Module" and press "OK". The "New Module" window opens.

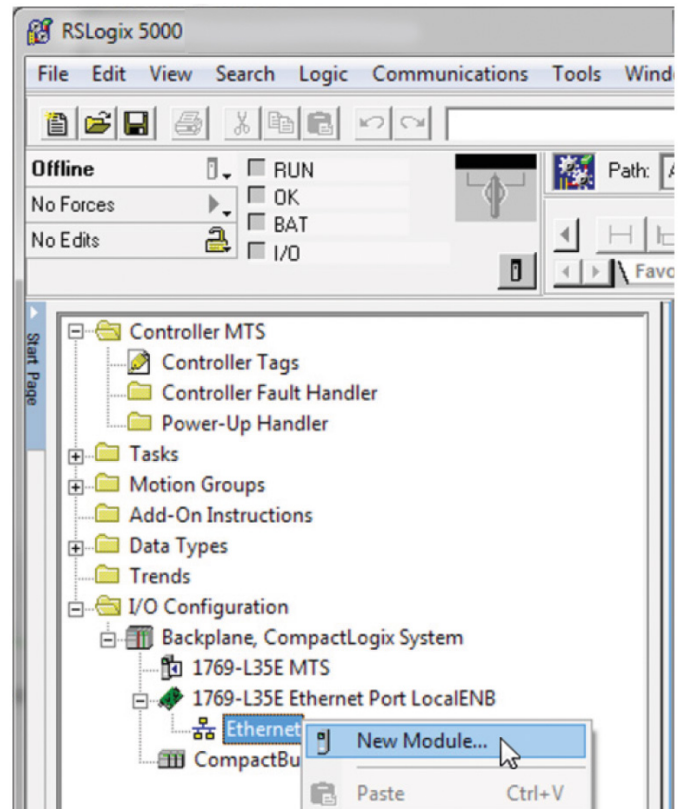


Fig. 42: Add a new module to the RSLogix 5000 I/O tree

**NOTICE**

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

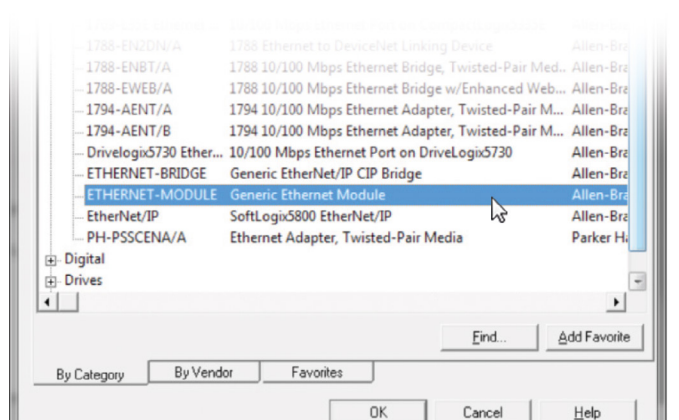


Fig. 43: Add a new Generic moduletree



**7.3.4** In the 'New Module' window (Fig. 44) perform step 7.3.4.1 – 7.3.4.4 to configure the new generic ethernet module to the R-Series EtherNet/IP™ sensor.

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

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

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

**7.3.4.3** In the “Address / Host Name” field, select the IP address option and enter the static IP address you assigned to the sensor in chapter 6.1.

**7.3.4.4** To set the “Connection Parameters” enter the following connection parameters field information:

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

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

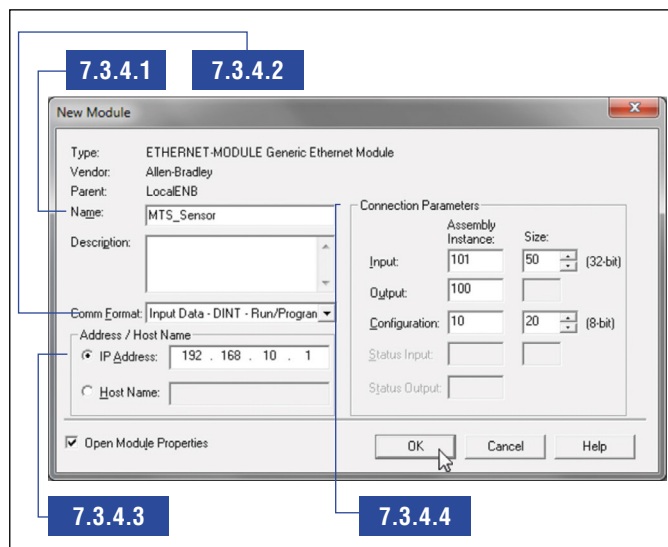


Fig. 44: New Module window

## 7.4 Set Module RPI

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

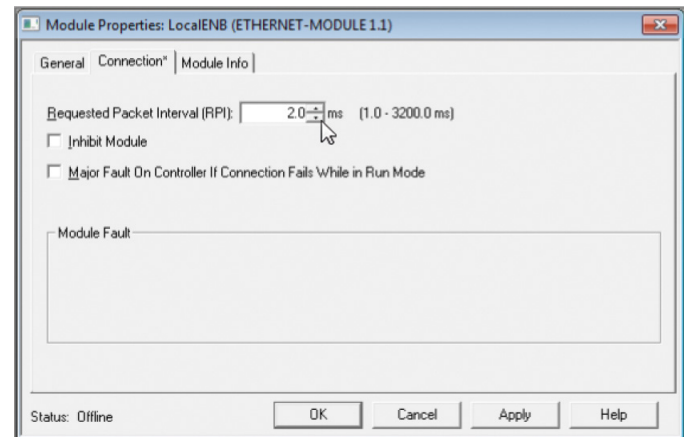


Fig. 45: New module properties

## NOTICE

### RPI limitations are:

- 2 ms up to 4800 mm stroke
- 4 ms up to 7620 mm stroke

## 7.5 Verify Generic EtherNet Module

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

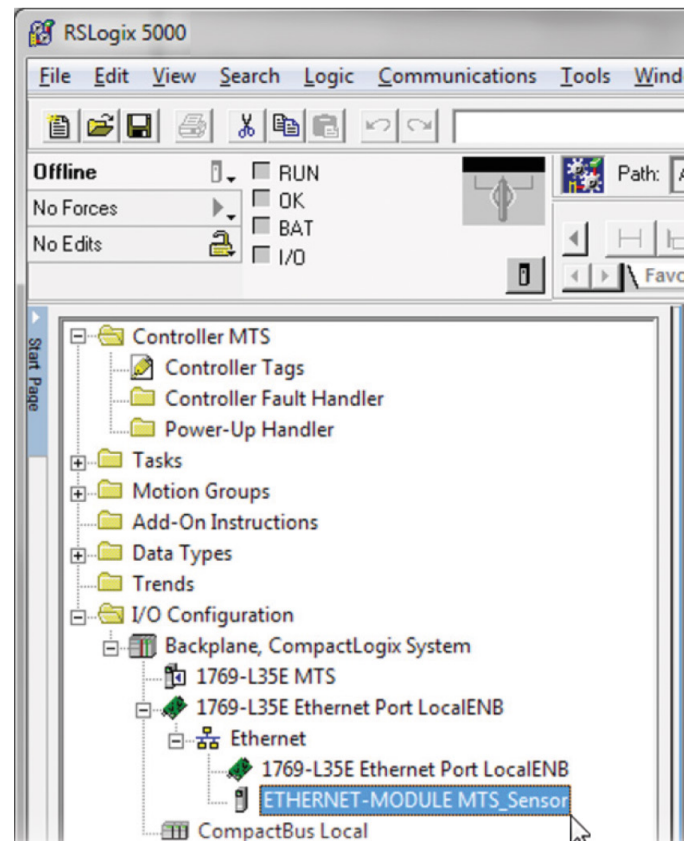


Fig. 46: New generic module has been added to the network

## 7.6 Verify Generic Ethernet Module

7.6.1 In the 'I/O configuration tree', click to open the 'Controller Tags' directory. The controller tag table displays in the left pane (Fig. 47). The description column fields will be blank by default.

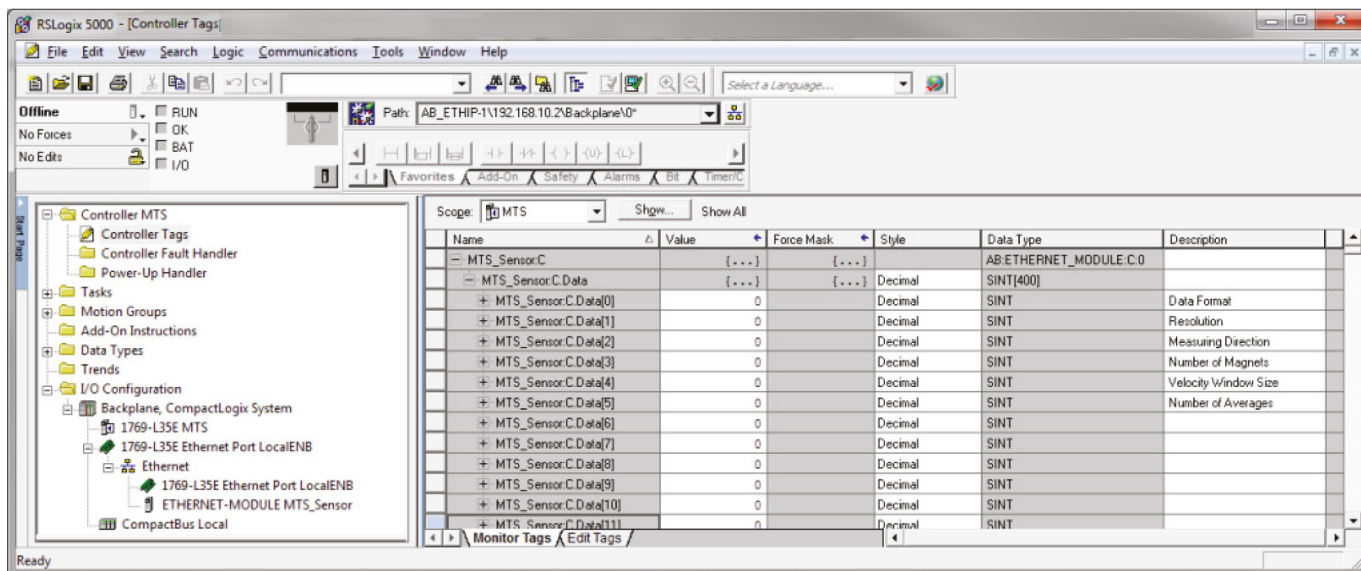


Fig. 47: Device control tags

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

7.6.3 Locate Data Byte [0] through [5] In the 'Name' column. In the 'Description' column, enter the following Data Byte field information.

Name	Description	Values	Description
<b>Data Byte [0]</b>	Data format	0	4 bytes signed position, 4 bytes signed velocity (repeats for each magnet)
		1	4 bytes signed position (repeats for each magnet)
		2	4 bytes signed velocity (repeats for each magnet)
		3	(default value) First 4 bytes are status. Then repeating for each magnet: 4 bytes signed position, 4 bytes signed velocity. The 4 status bytes are defined as follows: <ul style="list-style-type: none"> <li>• Lower byte (bits 0 – 7) = Status <ul style="list-style-type: none"> <li>• Bit 0 = Magnet missing (0 = magnet not missing, 1 = magnet missing)</li> <li>• Bit 1 = CPU Watchdog (0 = not triggered, 1 = triggered)</li> <li>• Bits 2 – 7 = Not used</li> </ul> </li> <li>• Middle 2 bytes (bits 8 – 23) = Unused</li> <li>• Upper byte (bits 24 – 31) = Number of magnets found on the sensor</li> </ul>
<b>Data Byte [1]</b>	Resolution	0	0.001 mm (default value, also the same as value = 1)
		1	0.001 mm
		2	0.002 mm
		5	0.005 mm
		10	0.010 mm
		20	0.020 mm
		50	0.050 mm
		100	0.100 mm
		200	0.200 mm
		500	0.500 mm
<b>Data Byte [2]</b>	Measuring direction	0	Forward (counts increase as you move away from the electronics) (default value)
		1	Reverse (counts decrease as you move away from the electronics)
<b>Data Byte [3]</b>	Number of magnets	0	Used for missing magnet detection purposes only. If the 'Value' = 0, the sensor will determine how many magnets are on the sensor at startup. It will use the determined number of magnets to determine missing magnet status. The missing magnet status is reported in the status attribute of the Position Sensor object and through the LEDs in the connector flange.
<b>Data Byte [4]</b>	Velocity window size	1...1000	The number of cycles that is used to calculate the velocity. The larger the number of cycles the more resolute the velocity becomes, but the slower the sensor is to respond to a change in velocity (default value: 1, no smoothing).
<b>Data Byte [5]</b>	Number of averages	0...100	A simple moving average that can be used to filter the position data in noisy environments (default value: 1, no averaging).

## 7.7 Controller tags input data

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

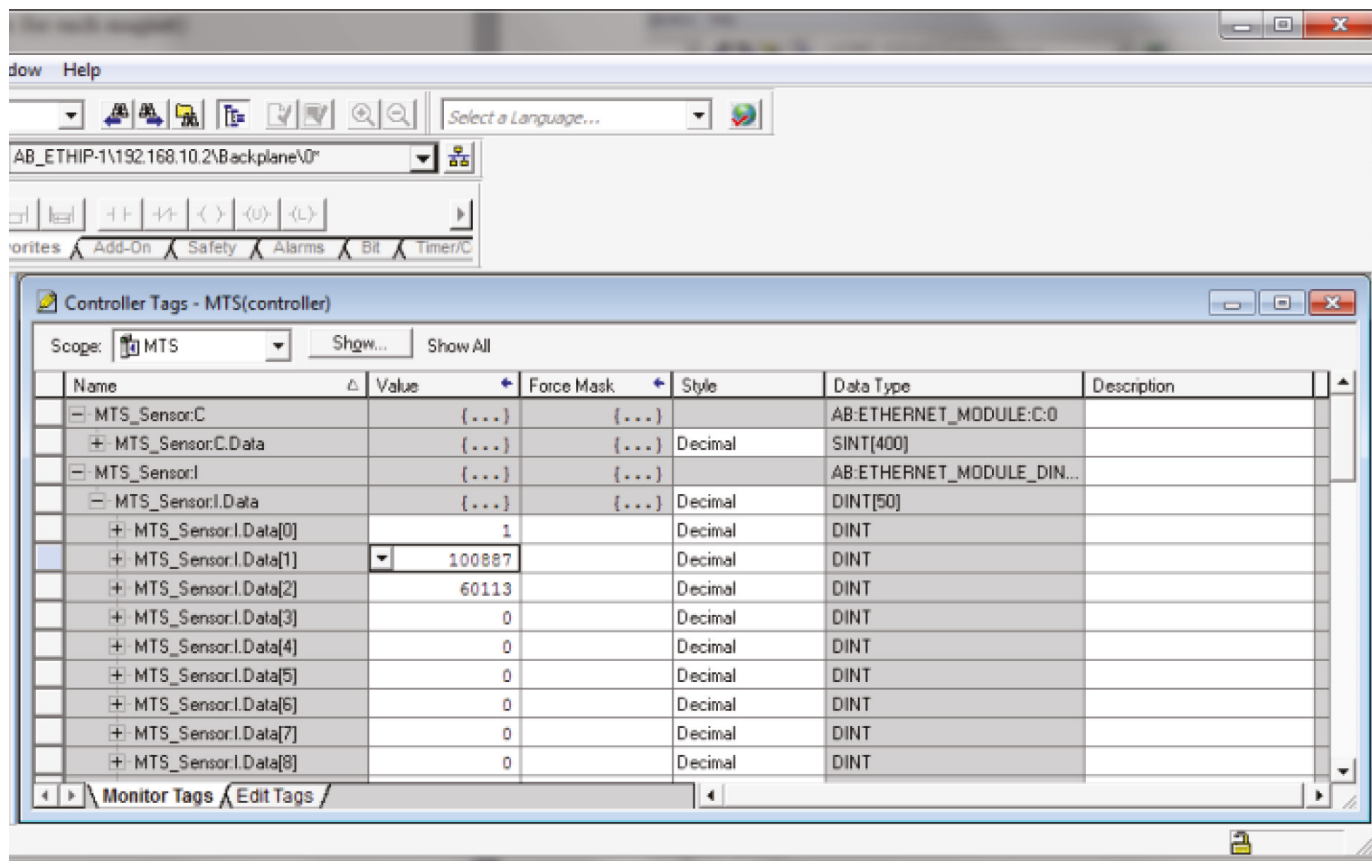


Fig. 48: Controller tags

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

### 7.8.1 Run/Idle Header

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

### 7.8.2 Magnet Data

The remaining data is laid out according to the data format selected in the configuration. The screenshot on page 32 in section 7.8 shows the position data for magnet 1 in Data[1], and the velocity for magnet 1 in Data[2].

#### Magnet data – Position

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

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

#### Magnet data – Velocity

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

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

### 7.8.3 Configuration complete

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



## 8. Maintenance and troubleshooting

### 8.1 Error conditions, troubleshooting

See chapter "5. Operation" on page 22.

### 8.2 Maintenance

The sensor is maintenance-free.

### 8.3 Repair

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

### 8.4 List of spare parts

No spare parts are available for this sensor.

### 8.5 Transport and storage

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

## 9. Removal from service / dismantling

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

## 10. Technical data

### 9.1 Technical data Temposonics® R-Series V RP

#### Output

Interface	EtherNet/IP™
Data protocol	Encoder CIP device profile with CIP Sync and DLR capabilities
Data transmission rate	100 MBit/s (maximum)
Measured value	Position, velocity / option: Simultaneous multi-position and multi-velocity measurements up to 20 magnets

#### Measurement parameters

Resolution: Position	1...500 µm (selectable)			
Cycle time	Stroke length	up to 2000 mm	up to 4800 mm	up to 7620 mm
	Cycle time	1.0 ms	2.0 ms	3.0 ms
Linearity deviation <sup>5</sup>	Stroke length	up to 500 mm	greater than 500 mm	
	Linearity deviation	≤ ±50 µm	< 0.01 % F.S.	
Repeatability	< ±0.001 % F.S. (minimum ±2.5 µm) typical			
Hysteresis	< 4 µm, typical 2 µm			

#### Operating conditions

Operating temperature	-40...+85 °C (-40...+185 °F)
Humidity	90 % relative humidity, no condensation
Ingress protection	IP65 (connectors correctly fitted)
Shock test	150 g / 11 ms, IEC standard 60068-2-27
Vibration test	30 g / 10...2000 Hz, IEC standard 60068-2-6 (excluding resonant frequencies)
EMC test	Electromagnetic emission according to EN 61000-6-3
	Electromagnetic immunity according to EN 61000-6-2
	The sensor meets the requirements of the EC directives and is marked with <b>CE</b>
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
Stroke length	25...6350 mm (1...250 in.)

#### Mechanical mounting

Mounting position	Any
Mounting instruction	Please consult the technical drawings on <a href="#">page 9</a>

#### Electrical connection

Connection type	2 × M12 female connectors (5 pin), 1 × M8 male connector (4 pin), 2 × M12 female connectors (5 pin), 1 × M12 male connector (4 pin)
Operating voltage	12...30 VDC ±20 % (9.6...36 VDC) <sup>6</sup>
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 # 252 182

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

## 9.2 Technical data Temposonics® R-Series V RH

### Output

Interface	EtherNet/IP™
Data protocol	Encoder CIP device profile with CIP Sync and DLR capabilities
Data transmission rate	100 MBit/s (maximum)
Measured value	Position, velocity / option: Simultaneous multi-position and multi-velocity measurements up to 20 magnets

### Measurement parameters

Resolution: Position	1...500 µm (selectable)			
Cycle time	Stroke length	up to 2000 mm	up to 4800 mm	up to 7620 mm
	Cycle time	1.0 ms	2.0 ms	3.0 ms
Linearity deviation <sup>7</sup>	Stroke length	up to 500 mm	greater than 500 mm	
	Linearity deviation	≤ ±50 µm	< 0.01 % F.S.	
Repeatability	< ±0.001 % F.S. (minimum ±2.5 µm) typical			
Hysteresis	< 4 µm, typical 2 µm			

### Operating conditions

Operating temperature	-40...+85 °C (-40...+185 °F)
Humidity	90 % relative humidity, no condensation
Ingress protection	IP67 (connectors correctly fitted)
Shock test	150 g / 11 ms, IEC standard 60068-2-27
Vibration test	30 g / 10...2000 Hz, IEC 60068-2-6 (excluding resonant frequencies)
EMC test	Electromagnetic emission according to EN 61000-6-3
	Electromagnetic immunity according to EN 61000-6-2
	The sensor meets the requirements of the EC directives and is marked with <b>CE</b>
Operating pressure	350 bar (5076 psi) / 700 bar (10153 psi) peak (at 10 × 1 min) for sensor rod
Magnet movement velocity	Any

### Design / Material

Sensor electronics housing	Aluminum (painted), zinc die cast
Sensor flange	Stainless steel 1.4305 (AISI 303) / RH5-J: Stainless steel 1.4305 (AISI 303)
Sensor rod	Stainless steel 1.4306 (AISI 304L) / RH5-J: Stainless steel 1.4301 (AISI 304)
Stroke length	25...7620 mm (1...300 in.)

### Mechanical mounting

Mounting position	Any
Mounting instruction	Please consult the technical drawings on <a href="#">page 10</a>

### Electrical connection

Connection type	2 × M12 female connectors (5 pin), 1 × M8 male connector (4 pin), 2 × M12 female connectors (5 pin), 1 × M12 male connector (4 pin)
Operating voltage	12...30 VDC ±20 % (9.6...36 VDC) <sup>8</sup>
Power consumption	Less than 4 W typical
Dielectric strength	500 VDC (DC ground to machine ground)
Polarity protection	Up to -36 VDC
Overvoltage protection	Up to 36 VDC

7/ With position magnet # 251 416-2

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

## 11. Appendix I

### Safety Declaration

Dear Customer,

If you return one or several sensors for checking or repair, we need you to sign a safety declaration. The purpose of this declaration is to ensure that the returned items do not contain residues of harmful substances and / or that people handling these items will not be in danger.

MTS Sensors order number: \_\_\_\_\_ Sensor type(s): \_\_\_\_\_

Serial number(s): \_\_\_\_\_ Sensor length(s): \_\_\_\_\_

**The sensor has been in contact with the following materials:**

Do not specify chemical formulas.  
Please include safety data sheets of the substances, if applicable.

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

**Short description of malfunction:**

**Corporate information**

Company: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

**Contact partner**

Name: \_\_\_\_\_

Phone: \_\_\_\_\_

E-mail: \_\_\_\_\_

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

Stamp

Signature

Date

**GERMANY**

**MTS Sensor Technologie GmbH & Co.KG**  
Auf dem Schüffel 9  
58513 Lüdenscheid, Germany  
Tel. +49-23 51-95 87 0  
Fax. +49-23 51-5 64 91  
info.de@mtssensors.com  
www.mtssensors.com

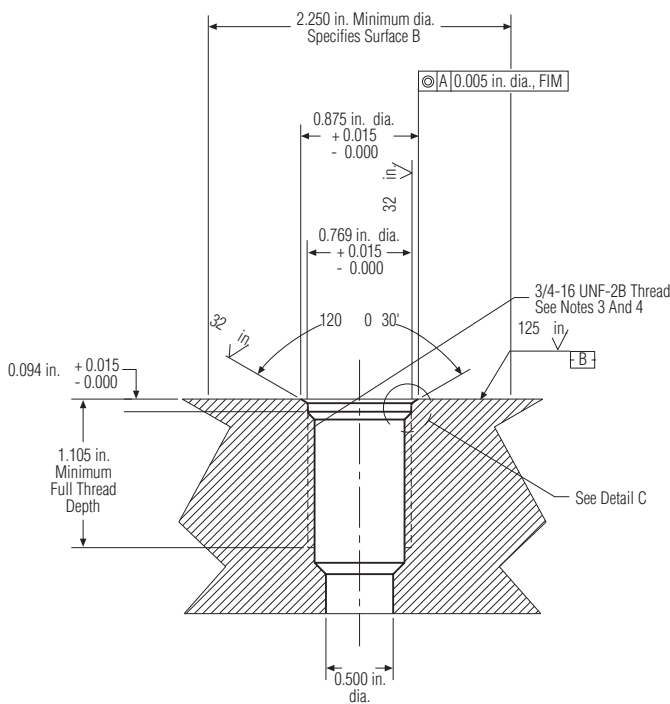
**USA**

**MTS Systems Corporation Sensors Division**  
3001 Sheldon Drive  
Cary, N.C. 27513, USA  
Tel. +1 919 677-0100  
Fax +1 919 677-0200  
info.us@mtssensors.com  
www.mtssensors.com

## 12. Appendix II

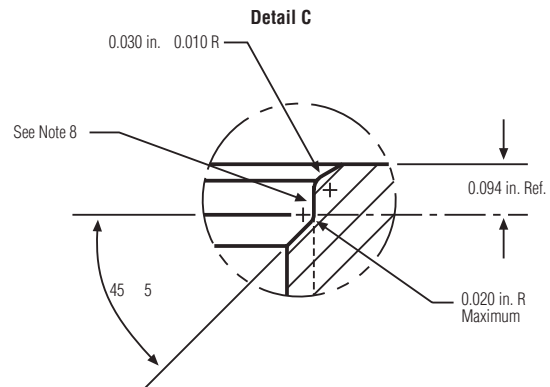
### CYLINDER PORT DETAILS

#### PORT DETAIL (PD) FOR RH5-S:

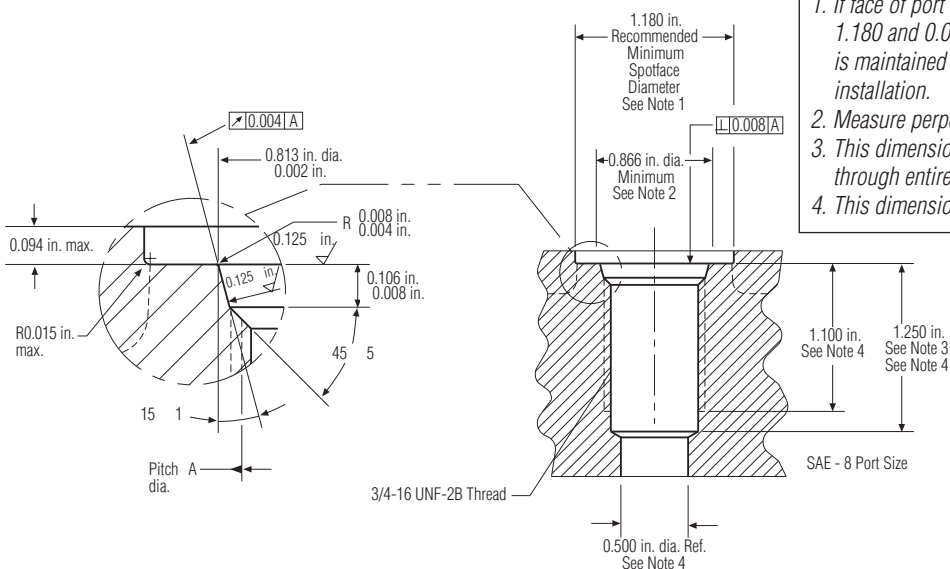


#### NOTES:

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



#### PORT DETAIL (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.

**UNITED STATES** 3001 Sheldon Drive  
MTS Systems Corporation Cary, N.C. 27513  
Sensors Division Phone: +1 919 677-0100  
E-mail: info.us@mtssensors.com

---

**GERMANY** Auf dem Schüffel 9  
MTS Sensor Technologie 58513 Lüdenscheid  
GmbH & Co. KG Phone: +49 2351 9587-0  
E-mail: info.de@mtssensors.com

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**ITALY** Phone: +39 030 988 3819  
Branch Office E-mail: info.it@mtssensors.com

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**FRANCE** Phone: +33 1 58 4390-28  
Branch Office E-mail: info.fr@mtssensors.com

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**GREAT BRITAIN** Phone: +44 79 44 15 03 00  
Branch Office E-mail: info.uk@mtssensors.com

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**CHINA** Phone: +86 21 6485 5800  
Branch Office E-mail: info.cn@mtssensors.com

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**JAPAN** Phone: +81 42 707 7710  
Branch Office E-mail: info.jp@mtssensors.com

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[www.mtssensors.com](http://www.mtssensors.com)

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