Temposonics
AN AMPHENOL COMPANY

Operation Manual

G-Series V Digital

Magnetostrictive Linear Position Sensors

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

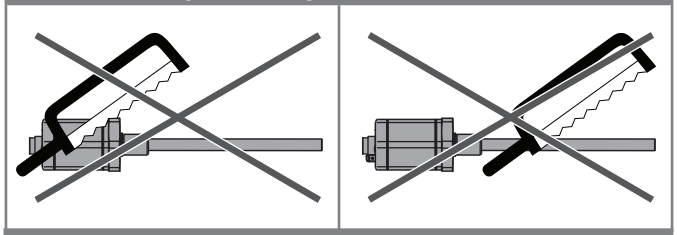
This product may be used only for the applications defined under item 1 and only in conjunction with the third-party devices and components recommended or approved by Temposonics. As a prerequisite of proper and safe operation the product requires correct transport, storage, mounting and commissioning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

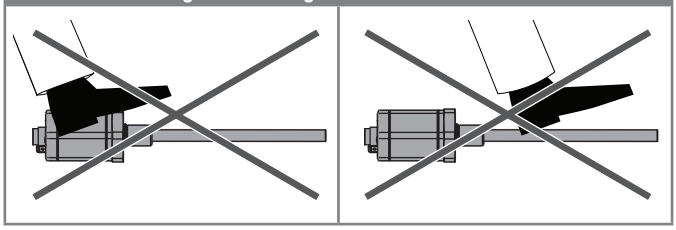
2.2 Foreseeable misuse

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
Sensor is exposed to overvoltage/ electrostatic discharge (e.g., welding work, electrostatically supported coating, etc.)	The sensor can be damaged

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 “9. Appendix I – Safety declaration”on page 34.

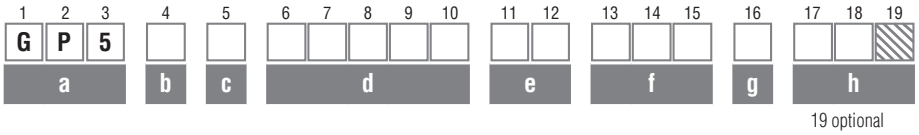
NOTICE

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® GP5



a	Sensor model
G P 5	Profile

b	Design
K	Block magnet K (part no. 251 298-2)
L	Block magnet L (part no. 403 448)
M	U-magnet OD33 (part no. 251 416-2)
O	No position magnet
S	Magnet slider joint at top (part no. 252 182)
V	Magnet slider joint at front (part no. 252 184)

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...09 positions (1...9 magnets) (multi-position measurement* only for outputs »R0« & »RF«)

**Number of magnets ≥ 2 magnets*

f	Connection type
Connector	
D 6 0	M16 male connector (6 pin)
Angled cable outlet	
E X X	XX m/ft. PVC cable (part no. 530 032) E01…E30 (1…30 m)/E03...E99 (3...99 ft.) See “Frequently ordered accessories” for cable specifications
G X X	XX m/ft. FEP cable (part no. 530 157) G01…G30 (1…30 m)/G03...G99 (3...99 ft.) See “Frequently ordered accessories” for cable specifications
L X X	XX m/ft. PUR cable (part no. 530 052) L01…L30 (1…30 m)/L03...L99 (3...99 ft.) See “Frequently ordered accessories” for cable specifications

Encode in meters if using metric stroke length.
Encode in feet if using US customary stroke length.

g	System
1	Standard
2	Wide operating voltage: +9... +28.8 VDC

h	Output
R O	Start/Stop
R F	Start/Stop with closed error signal utility
D I X	PWM, internal interrogation X denotes the number of circulations (see table 1)
F I X	PWM, internal interrogation with closed error signal utility X denotes the number of circulations (see table 1)
D E X	PWM, external interrogation X denotes the number of circulations (see table 1)
F E X	PWM, external interrogation and closed error signal utility X denotes the number of circulations (see table 1)

Table 1: see next page

»X« for output »DIX«, »FIX«, »DEX« and »FEX«										
Number of circulations	1	2	3	4	5	6	7	8	9	10
»X« in order code	1	2	3	4	5	6	7	8	9	A
Number of circulations	11	12	13	14	15	16	17	18	19	20
»X« in order code	B	C	D	E	F	G	H	I	J	K

Table 1: Number of circulations

NOTICE

- For GP5, 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.

3.2 Order code of Temposonics® GH5

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

19 optional

a	Sensor model
G H 5	Rod

b	Design
B	Base unit (only for replacement)
J	Threaded flange M22×1.5-6g (rod Ø 12.7 mm, 800 bars), stroke length: 25...5900 mm
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...09 positions (1...9 magnets) (multi-position measurement* only for outputs »R0« & »RF«)

**Number of magnets ≥ 2 magnets*

f	Connection type
Connector	
D 6 0	M16 male connector (6 pin)
Angled cable outlet	
E X X	XX m/ft. PVC cable (part no. 530 032) E01…E30 (1…30 m)/E03...E99 (3...99 ft.) See “Frequently ordered accessories” for cable specifications
G X X	XX m/ft. FEP cable (part no. 530 157) G01…G30 (1…30 m)/G03...G99 (3...99 ft.) See “Frequently ordered accessories” for cable specifications
L X X	XX m/ft. PUR cable (part no. 530 052) L01…L30 (1…30 m)/L03...L99 (3...99 ft.) See “Frequently ordered accessories” for cable specifications
Encode in meters if using metric stroke length. Encode in feet if using US customary stroke length.	

g	System
1	Standard
2	Wide operating voltage: +9... +28.8 VDC

h	Output
R 0	Start/Stop
R F	Start/Stop with closed error signal utility
D I X	PWM, internal interrogation X denotes the number of circulations (see table 2)
F I X	PWM, internal interrogation with closed error signal utility X denotes the number of circulations (see table 2)
D E X	PWM, external interrogation X denotes the number of circulations (see table 2)
F E X	PWM, external interrogation and closed error signal utility X denotes the number of circulations (see table 2)

Table 2: see next page

»X« for output »DIX«, »FIX«, »DEX« and »FEX«										
Number of circulations	1	2	3	4	5	6	7	8	9	10
»X« in order code	1	2	3	4	5	6	7	8	9	A
Number of circulations	11	12	13	14	15	16	17	18	19	20
»X« in order code	B	C	D	E	F	G	H	I	J	K

Table 2: Number of circulations

NOTICE

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

3.3 Nameplate

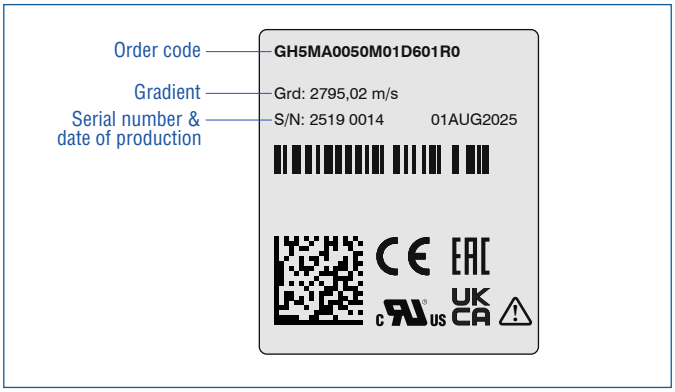


Fig. 1: Example of nameplate of G-Series V GH5 sensor with Digital output

3.4 Approvals

- CE declaration
- UKCA declaration
- EAC declaration
- UL declaration

NOTICE

For a detailed overview of the certifications, see:
www.temposonics.com

3.5 Scope of delivery

GP5 (profile sensor):

- Sensor
- Position magnet (not for GP5 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

GH5 (rod sensor):

- GH5-B: Base unit (without flange & rod assembly),
  3 × socket screws M4×59
- GH5-J/M/S/T: Sensor, O-ring

4. Product description and commissioning

4.1 Functionality and system design

Product designation
- Position sensor Temposonics® G-Series V

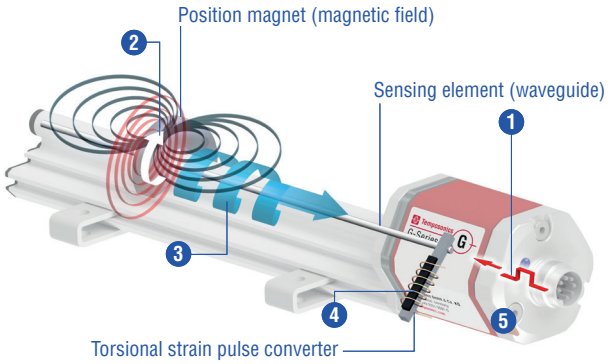
Sensor model
- Temposonics® G-Series V GP5 (profile sensor)
- Temposonics® G-Series V GH5 (rod sensor)

Stroke length
- Temposonics® G-Serie V GP5: 25…6350 mm (1…250 in.)
- Temposonics® G-Serie V GH5: 25…7620 mm (1…300 in.)

Output signal
- PWM/Start/Stop

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® GP5

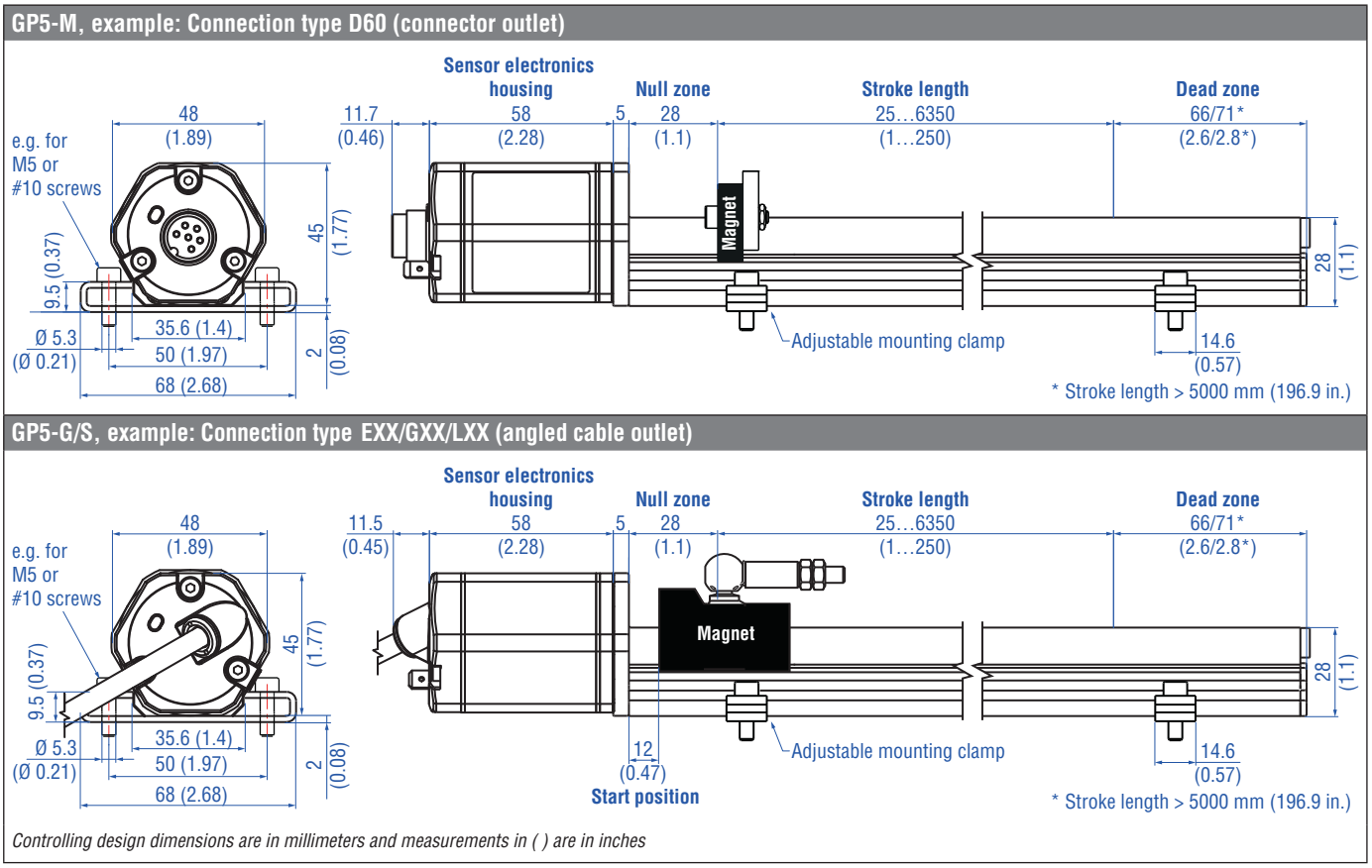


Fig. 3: Temposonics® GP5 with U-magnet a magnet slider

Installation of GP5

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.

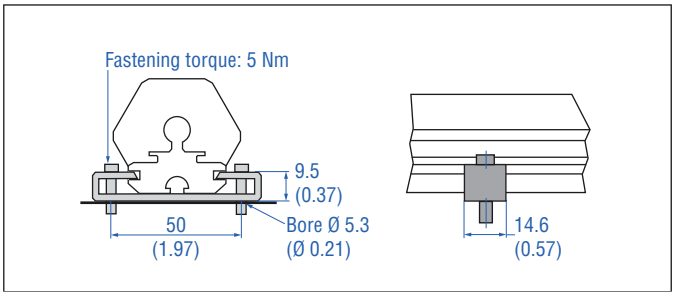


Fig. 4: Mounting clamps (part no. 400 802) with cylinder screw M5×20

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).

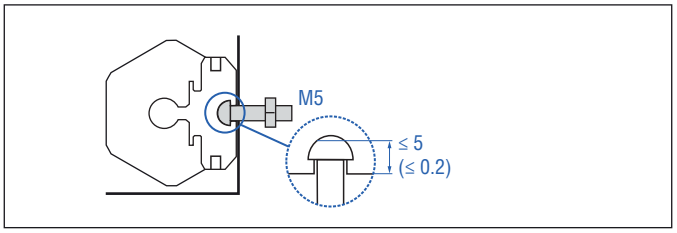


Fig. 5: T-slot nut M5 (part no. 401 602)

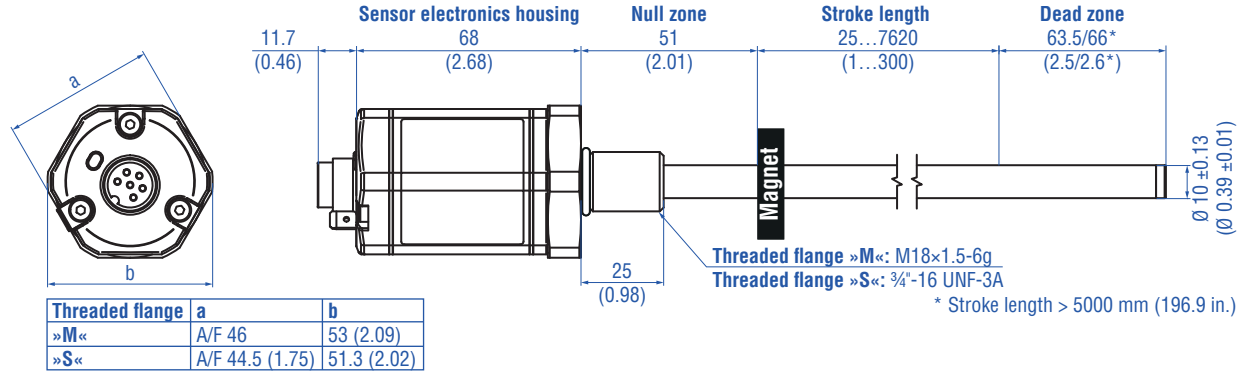
NOTICE

Take care to mount the sensor parallel to the axis of motion being measured to avoid damage to the magnet and sensor.

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

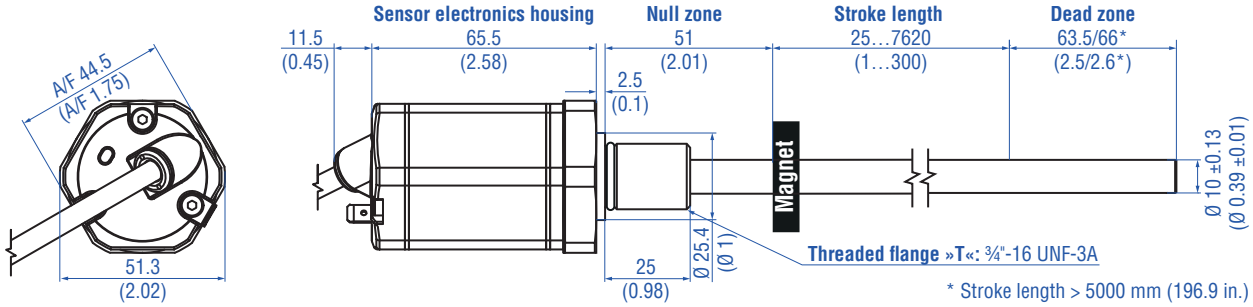
4.3 Installation and design of Temposonics® GH5

GH5-M/S-A/V – GH5 with threaded flange M18×1.5-6g or ¾"-16 UNF-3A, example: Connection type D60 (connector outlet)

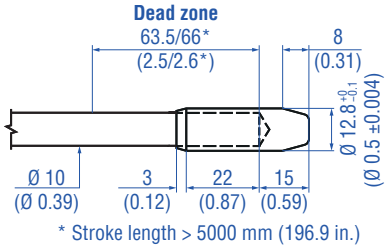


Threaded flange	a	b
»M«	A/F 46	53 (2.09)
»S«	A/F 44.5 (1.75)	51.3 (2.02)

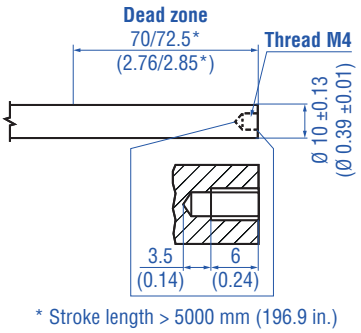
GH5-T-A/V – GH5 with threaded flange ¾"-16 UNF-3A with raised-face, example: Connection type EXX/GXX/LXX (angled cable outlet)



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



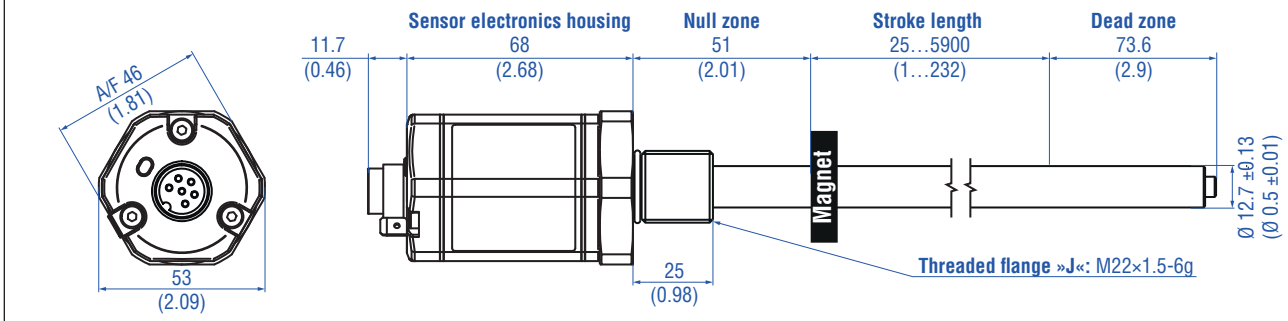
Mechanical option »M«: Thread M4 at rod end for threaded flange M18×1.5-6g or ¾"-16 UNF-3A



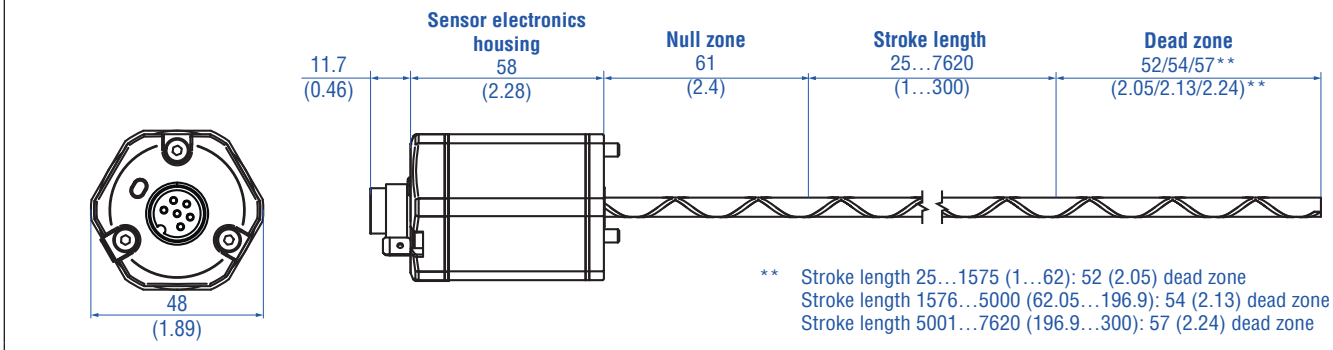
Controlling design dimensions are in millimeters and measurements in ( ) are in inches

Fig. 6: Temposonics® GH5 with ring magnet, part 1

GH5-J-A/V – GH5 with threaded flange M22×1.5-6g and Ø 12.7 mm rod, example: Connection type D60 (connector outlet)



GH5-B-A/F/V – GH5 GH5 base unit (only for replacement), example: Connection type D60 (connector outlet)



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

Fig. 7: Temposonics® GH5 with ring magnet, part 2

Installation of GH5 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. 7. Lightly oil the thread before tightening.

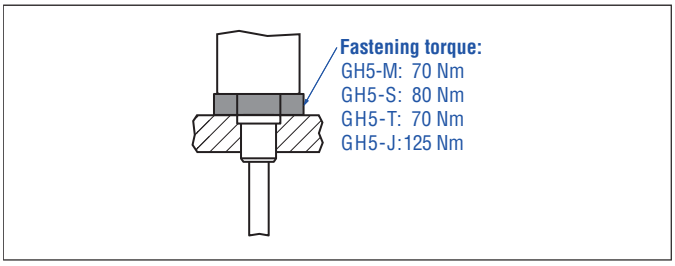


Fig. 8: Mounting example of threaded flange

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 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 “4.5 Replacement of base unit on GH5 model” on page 18.

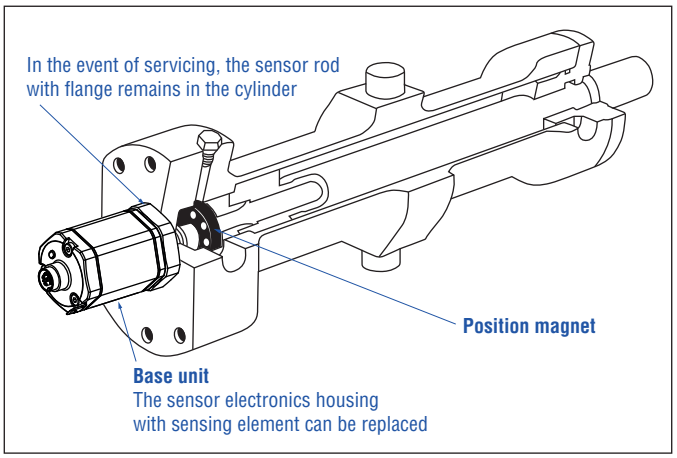


Fig. 9: Sensor in cylinder

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 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)
   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.

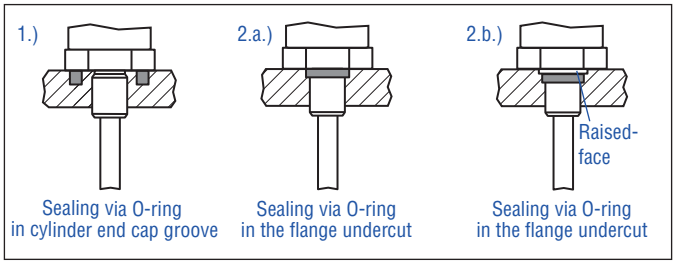
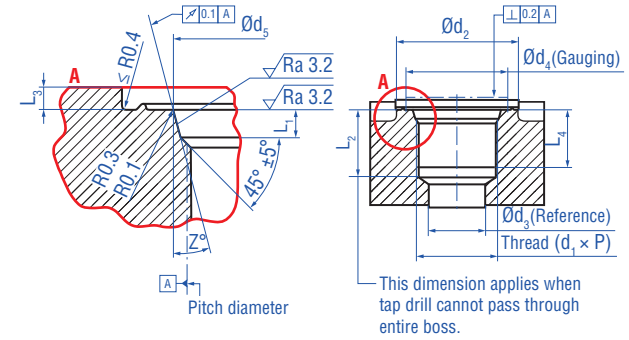


Fig. 10: Possibilities of sealing for threaded flange with flat face 1. + 2.a. (GH5-J/M/S) and with raised-face 2.b. (GH5-T)

- 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
  (GH5-M/S/T-A//M/V with rod Ø 10 mm: ≥ Ø 13 mm (≥ Ø 0.51 in.);
  GH5-M/S/T-B with rod Ø 10 mm: ≥ Ø 16 mm (≥ Ø 0.63 in.);
  GH5-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°
GH5-M-A/M/V									
M18×1.5	55	≥ 13	24.5	19.8	2.4	28.5	2	26	15°
GH5-M-B									
M18×1.5	55	≥ 16	24.5	19.8	2.4	28.5	2	26	15°
GH5-J-A/V									
M22x1.5	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 Magnet installation

Typical use of magnets

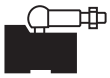
Magnet	Typical sensors	Benefits
Ring magnets 	**Rod model** (GH5)	• Rotationally symmetrical magnetic field
U-magnets 	**Profile & rod models** (GP5, GH5)	• Height tolerances can be compensated, because the magnet can be lifted off
Block magnets 	**Profile & rod models** (GP5, GH5)	• Height tolerances can be compensated, because the magnet can be lifted off
Magnet sliders 	**Profile models** (GP5)	• 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. 12: Typical use of magnets

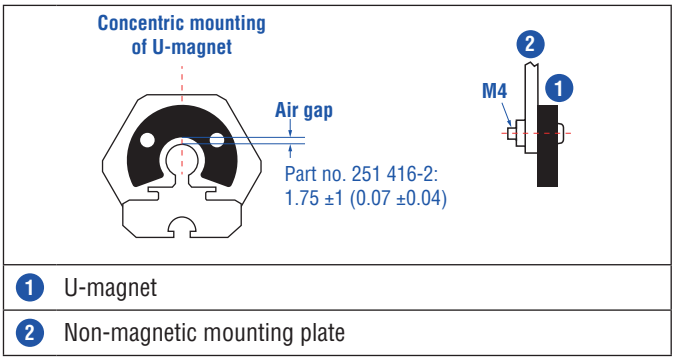
Mounting ring magnets, U-magnets & block magnets

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/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. 12).
- If no other option exists and magnetic material is used, observe the specified dimensions (Fig. 12).

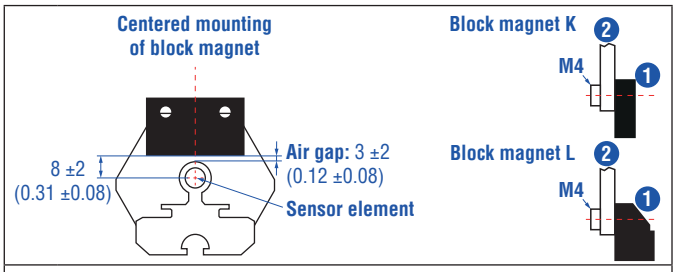
NOTICE

- 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. 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/sensor profile.



1	U-magnet
2	Non-magnetic mounting plate

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



1	Block magnet
2	Non-magnetic mounting plate

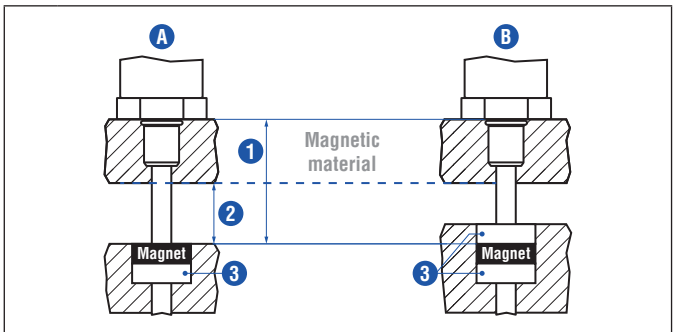
Fig. 14: Mounting of block magnet (part no. 403 448)

Magnet mounting with magnetic material

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

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. 15: 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. 16) for measurement.

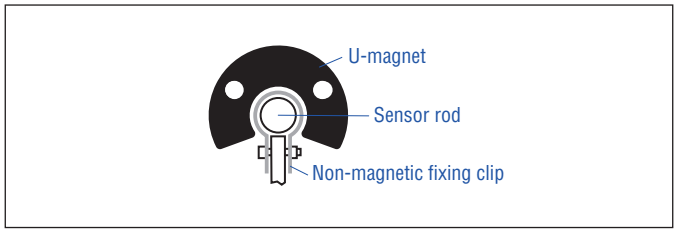
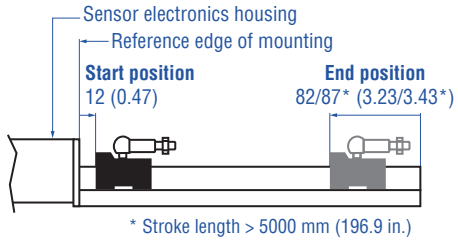


Fig. 16: Example of sensor support with the fixing clip (part no. 561 481)

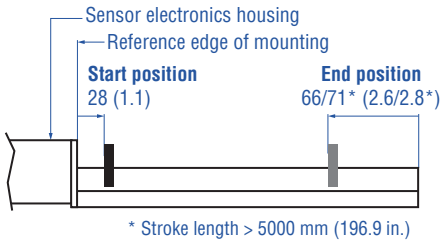
Start- and end positions of the position magnets

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.

GP5 with magnet slider "S", "N", "V", "G"



GP5 with U-magnet



GP5 with block magnet

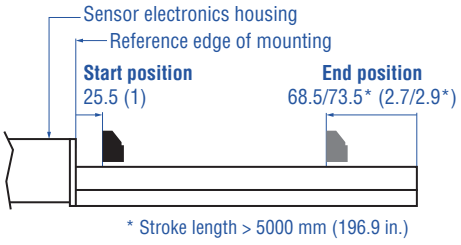
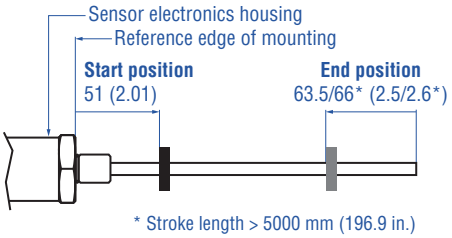


Fig. 17: Start- and end positions of magnets for GP5

GH5 with ring magnet/U-magnet



GH5 with block magnet

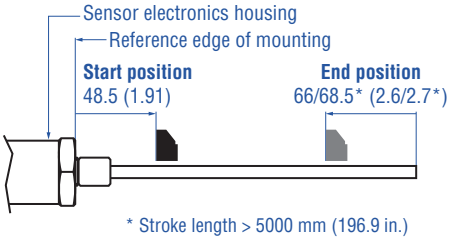


Fig. 18: Start- and end positions of magnets for GH5

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

Multi-position measurement
The minimum distance between magnets is 75 mm (3 in).

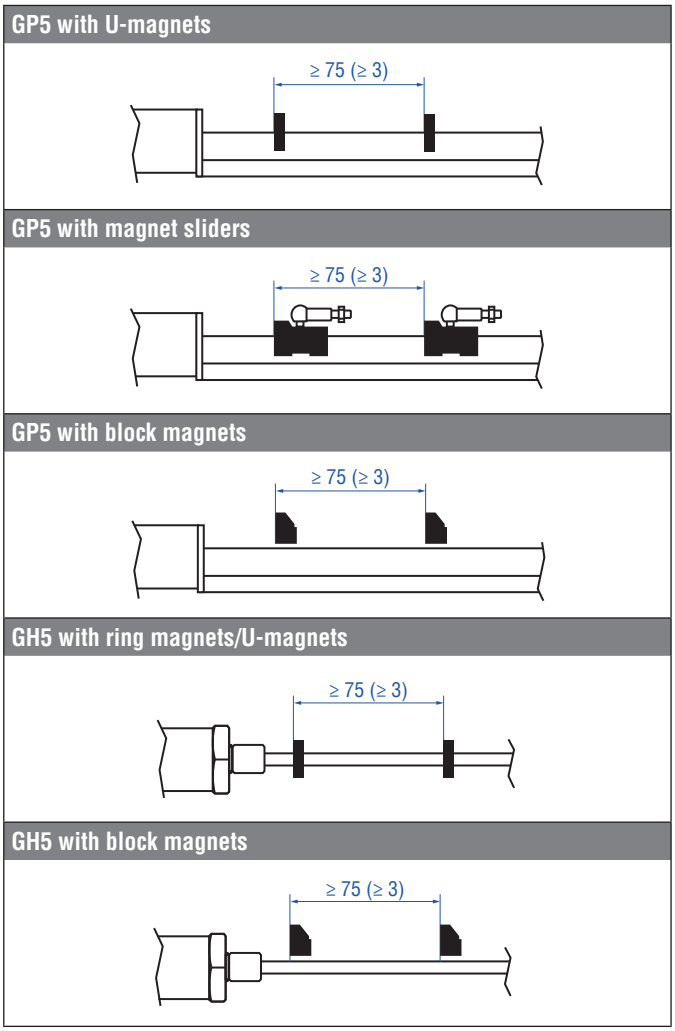


Fig. 19: Minimum distance between magnets for multi-position measurement (GP5 and GH5).

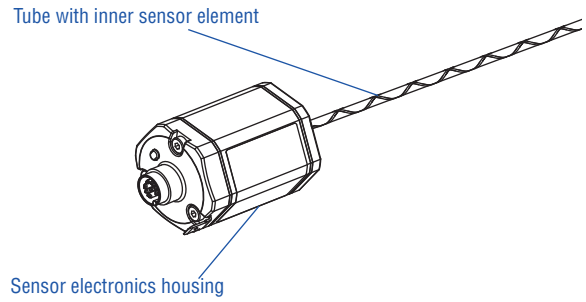
NOTICE

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

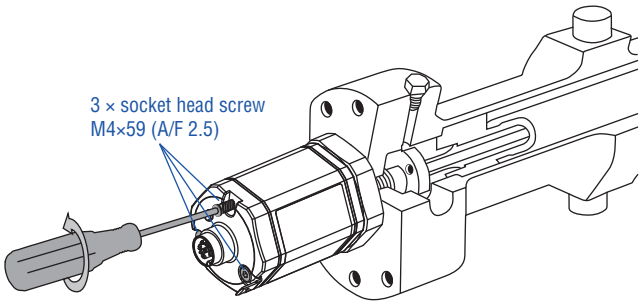
4.5 Replacement of base unit on GH5 model

The base unit of the sensor model GH5 (GH5-B) is replaceable as shown in Fig. 20 and Fig. 21 for the sensor designs »M«, »S« and »T«. The sensor can be replaced without interrupting the hydraulic circuit.

Base unit



1. Loosen the screws.



2. Pull out the base unit.

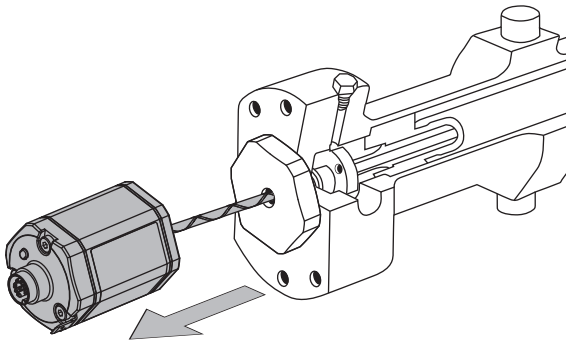


Fig. 20: Replacement of the base unit (e.g. GH5 sensor), part 1

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

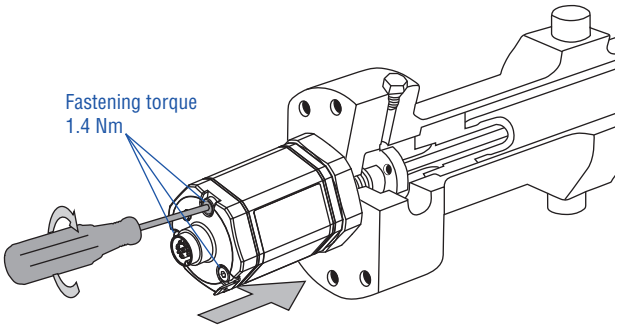


Fig. 21: Replacement of the base unit, part 2

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 G-Series V replaces a predecessor model of the G-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.
- The O-ring is secured with an adhesive strip. Remove the adhesive strip before tightening before reinstalling the base unit (see illustration “Remove adhesive strips”).

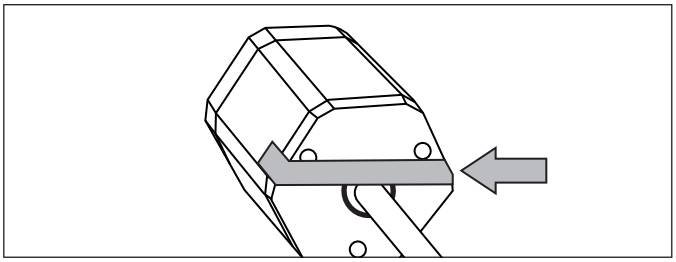


Fig. 22: Remove adhesive strips

4.6 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 control system 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 G-Series V via ground lug as shown in Fig. 23. In addition you can ground the sensor model GH5 via thread.

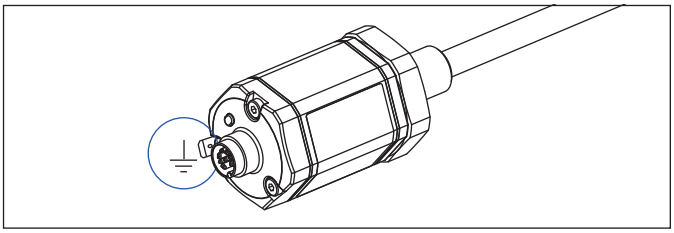


Fig. 23: Grounding via ground lug on the example of a GH5 sensor

D60		
Signal + power supply		
M16 male connector	**Pin**	**Function**
 View on sensor	1	Gate (–) for PWM Stop (–) for Start/Stop
	2	Gate (+) for PWM Stop (+) for Start/Stop
	3	Interrogation (+) for PWM Start (+) for Start/Stop
	4	Interrogation (–) for PWM Start (–) for Start/Stop
	5	+24 VDC (–15/+20 %)
	6	DC Ground (0 V)

Fig. 24: Connector wiring D60

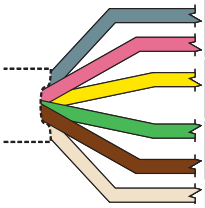
EXX/GXX/LXX		
Signal + power supply		
Cable	**Color**	**Function**
	GY	Gate (–) for PWM Stop (–) for Start/Stop
	PK	Gate (+) for PWM Stop (+) for Start/Stop
	YE	Interrogation (+) for PWM Start (+) for Start/Stop
	GN	Interrogation (–) for PWM Start (–) for Start/Stop
	BN	+24 VDC (–15/+20 %)
	WH	DC Ground (0 V)

Fig. 25: Connector wiring cable outlet

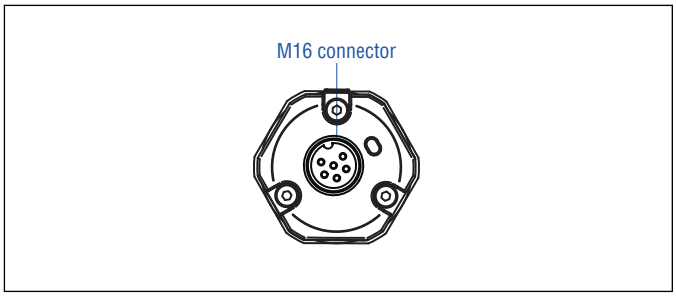
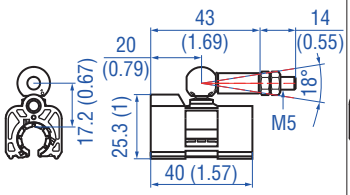


Fig. 26: Location of connection

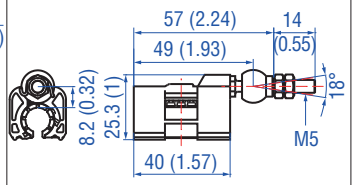
4.7 Frequently ordered accessories for Temposonics® GP5 – Additional options see Accessories Catalog 551444

Position magnets



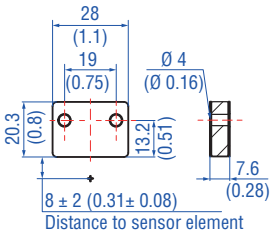
Magnet slider S,
joint at top
Part no. 252 182

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

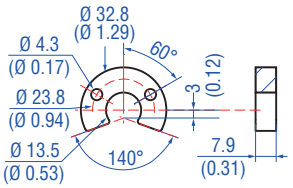
Material: GRP, magnet hard ferrite
Weight: Approx. 35 g
Operating temperature:
–40…+85 °C (–40…+185 °F)



Block magnet K
Part no. 251 298-2

Material: XOLOX Neobond 50L
Weight: Approx. 22 g
Surface pressure: Max. 20 N/mm²
Fastening torque for M4 screws: 1 Nm
Operating temperature:
–40…+105 °C (–40…+221 °F)

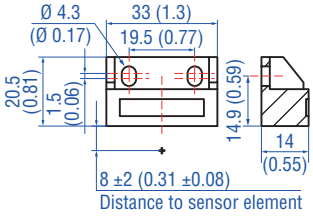
This magnet may influence the sensor performance specifications for some applications.



U-magnet OD33
Part no. 251 416-2

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

Position magnets

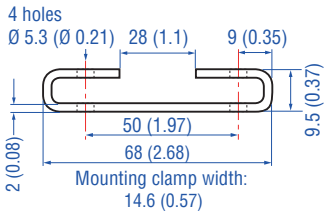


Block magnet L
Part no. 403 448

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)

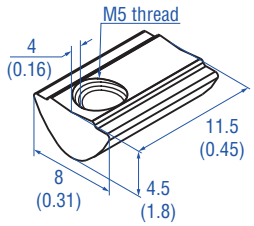
This magnet may influence the sensor performance specifications for some applications.

Mounting accessories



Mounting clamp
Part no. 400 802

Material: Stainless steel (AISI 304)



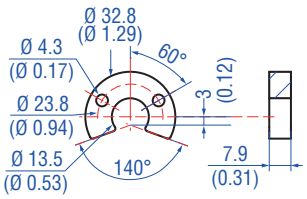
T-nut
Part no. 401 602

Fastening torque for M5 screw: 4.5 Nm

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

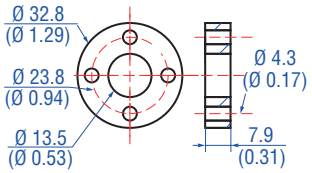
4.8 Frequently ordered accessories for Temposonics® GH5 – Additional options see Accessories Catalog 551444

Position magnets



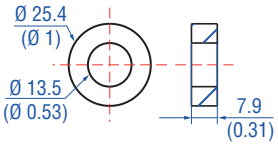
U-magnet OD33
Part no. 251 416-2

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



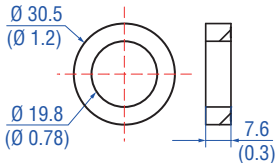
Ring magnet OD33
Part no. 201 542-2

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



Ring magnet OD25.4
Part no. 400 533

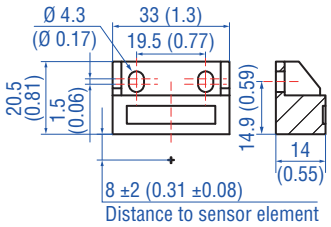
Material: PA ferrite
Weight: Approx. 10 g
Surface pressure: Max. 40 N/mm²
Operating temperature:
–40…+120 °C (–40…+248 °F)



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

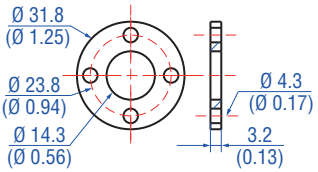


Block magnet L
Part no. 403 448

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.

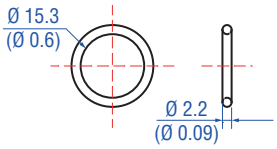
Magnet spacer



Magnet spacer
Part no. 400 633

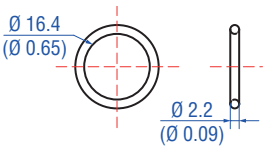
Material: Aluminum
Weight: Approx. 5 g
Surface pressure: Max. 20 N/mm²
Fastening torque for M4 screws: 1 Nm

O-rings



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

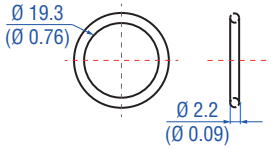
Material: Fluoroelastomer
Durometer: 75 ±5 Shore A
Operating temperature:
–40…+204 °C (–40…+400 °F)



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)

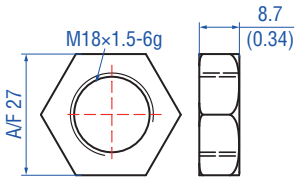
O-ring



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

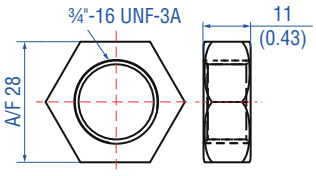
Material: FPM
Durometer: 75 Shore A
Operating temperature:
–20…+200 °C (–6…+392 °F)

Mounting accessories



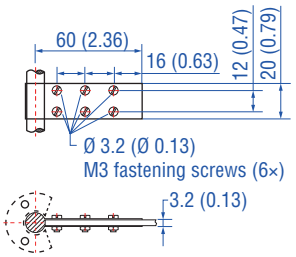
Hex jam nut M18×1.5-6g
Part no. 500 018

Material: Steel, zinc plated



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

Material: Steel, zinc plated



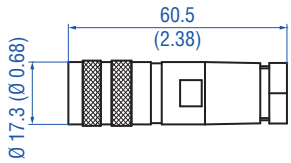
Fixing clip
Part no. 561 481

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

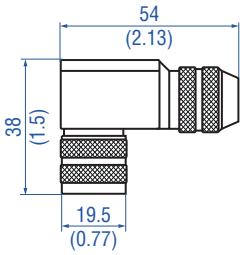
4.9 Frequently ordered accessories for Start/Stop/PWM output – Additional options see Accessories Catalog 551444

Cable connectors*



M16 female connector (6 pin), straight
Part no. 370 423

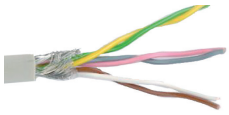
Material: Zinc nickel plated
Termination: Solder
Cable Ø: 6…8 mm (0.24…0.31 in.)
Operating temperature:
–40…+100 °C (–40…+212 °F)
Ingress protection: IP65/IP67
(correctly fitted)
Fastening torque: 0.6 Nm



M16 female connector (6 pin), angled
Part no. 370 460

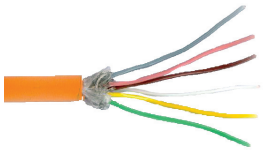
Material: Zinc nickel plated
Termination: Solder
Cable Ø: 6…8 mm (0.24…0.31 in.)
Wire: 0.75 mm² (20 AWG)
Operating temperature:
–40…+95 °C (–40…+203 °F)
Ingress protection: IP67 (correctly fitted)
Fastening torque: 0.6 Nm

Cables



PVC cable
Part no. 530 032

Material: PVC jacket; gray
Features: Twisted pair, shielded, flexible
Cable Ø: 6 mm (0.23 in.)
Cross section: 3 × 2 × 0.14 mm²
Bending radius: 10 × D
(fixed installation)
Operating temperature:
–40…+105 °C (–40…+221 °F)



PUR cable
Part no. 530 052

Material: PUR jacket; orange
Features: Twisted pair, shielded, highly flexible, halogen free, suitable for drag chains, mostly oil & flame resistant
Cable Ø: 6.4 mm (0.25 in.)
Cross section: 3 × 2 × 0.25 mm²
Bending radius: 5 × D
(fixed installation)
Operating temperature:
–20…+80 °C (–4…+176 °F)

Cable

FEP cable
Part no. 530 157

Material: FEP jacket; black
Features: Twisted pair, shielded
Cable Ø: 6.7 mm (0.26 in.)
Cross section: 3 × 2 × 0.14 mm²
Operating temperature: –40…+180 °C
(–40…+356 °F)

Programming tools

TempoLink® kit for Temposonics® G-Series V
Part no. TL-1-0-AD60 (for D60)
Part no. TL-1-0-AS00 (for cable outlet)

- 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

5. Commissioning

5.1 Getting started

Digital-Pulse Outputs (Start/Stop and PWM)

G-Series V digital-pulse sensors provide either PWM (**P**ulse **W**idth **M**odulation) or Start/Stop output signals (see Fig. 27).

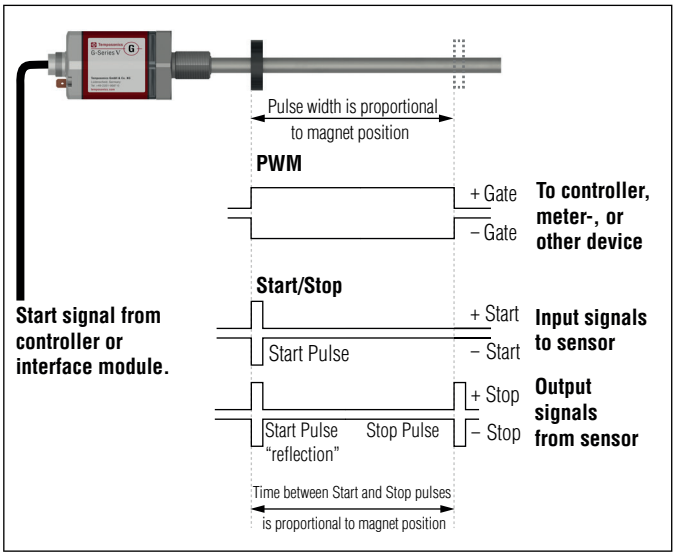


Fig. 27: Direct Start/Stop and PWM output diagram

Start/Stop output

With Start/Stop interface the sensor receives a start pulse of the controller and acknowledges it with a stop pulse; the position measurement starts. At the end of the measurement the sensor generates a second stop pulse. The time between the start pulse and the second stop pulse is the travel time. The travel time and the gradient are used to determine the position of the position magnet. The gradient specifies the travelling speed of the measurement pulse. It applies:

Position = gradient × travel time

The speed of the measuring pulse is approx. 2780 m/s (9.14 µs/inch.). The exact value is determined during final component checking and specified as a gradient on the nameplate.

Set the start pulse width and the cycle time according to the stroke length on the controller:

- Start impulse width: 1… 2.5 µs
- Minimum update time:

25…500 mm (0.98 ... 19.6 in.) stroke length:	0,5 ms
501…1100 mm (19.7 ... 43.3 in.) stroke length:	1 ms
1101…3000 mm (43.4 ... 118.1 in.) stroke length:	2 ms
3001…6250 mm (118.2 ... 246 in.) stroke length:	4 ms
6251…7620 mm (246.1... 300 in.) stroke length:	5 ms

If the position magnet is out of the stroke length, the sensor does not send a reply signal. This behavior can be evaluated and used for monitoring by the controller.

PWM-Output

As with the start/stop interface, with the PWM interface a time measurement is performed by the controller. The time measurement starts and the sensor begins its measurement. The measurement starts either due to an external start signal from the controller (external interrogation) or the sensor operates in its own internal measurement clock (internal interrogation). The duration of the pulse is directly proportional to the magnet's position along the active stroke length. The sensor resolution can be improved by using multiple back to back measurement cycles that are grouped together to generate a single PWM output signal. This is referred to as circulations. Using multiple circulations will slow down the sensor's update time:

PWM total update time = sensor update time × number of circulations

However, using multiple circulations has the same effect for improving the measured resolution as it would be to increase the frequency of the counter clock in the controller.

If the position magnet is out of the stroke length, the sensor does not send a reply signal. This behavior can be evaluated and used for monitoring by the controller.

NOTICE

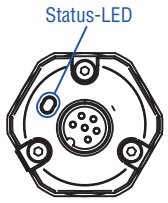
Observe during commissioning

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.
5. Check the pre-set span start and end values of the measuring range (see chapter 4.4) and correct them via the TempoLink® smart assistant, if necessary.

5.2 LED status

The LED on the sensor visualizes the current sensor status. In normal function the LED is continuously green. In other cases the color of the LED changes in the time slot of 0.5 seconds as shown in Fig. 28.

G-Series V Digital LED-Status



Time slot 1	Time slot 2	Information
GN	GN	Normal function
Off	RD	Storage error
GN	RD	Magnet not detected
Off + GN	RD + GN	Missing (external) interrogation
RD + GN	Off	Command mode
RD + GN	RD + Off	Magnet signal weak
RD + GN	RD + GN	Power supply error

1 × Time slot = 0,5 seconds

Fig. 28: LED status

Error condition	Description	Troubleshooting
Storage error	Error in internal data storage	Contact Temposonics.
Magnet not detected	No magnet found on the stroke	Ensure that the magnet is placed correctly
Missing (external) interrogation	No interrogation signal received	Check connection to external source
Magnet signal weak	Poor magnet placement on rod/profile	Check magnet placement
Power Supply Error	Power supply of the sensor is out of the allowable range	Set the power supply for the sensor to the allowable range

Fig. 29: Error conditions and troubleshooting

5.3 Adjustment of sensor on-site

5.3.1. Customization of the G-Series V via TempoLink® smart assistant

The TempoLink® smart assistant can be connected to all G-Series V sensors. Use the adapter cable for connection of the TempoLink® smart assistant to the G-Series V. If the sensor is connected to a control system, disconnect the sensor from that control system before connecting the TempoLink® smart assistant to the sensor. Connect the barrel connector of the adapter cable to the connection point labeled “OUTPUT SENSOR” on the TempoLink® smart assistant (Fig. 30).

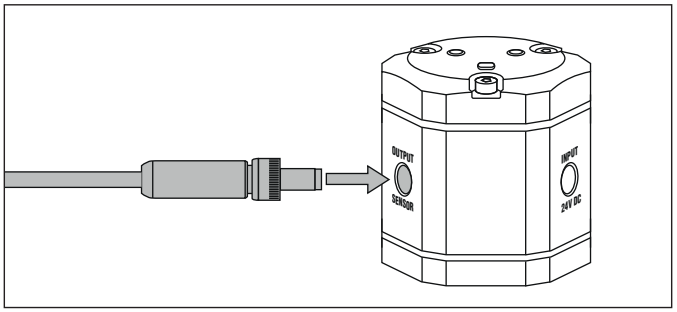


Fig. 30: Connecting the adapter cable to the TempoLink® smart assistant

NOTICE

- When disconnecting the power supply of the sensor, possibly error messages occur at the connected control system.
- Do not exceed the maximum cable length between TempoLink® smart assistant and G-Series V sensor of 30 m (99 ft.).

1. Connection to a sensor with connector outlet

Connect the other end of the adapter cable to the G-Series V. The sensor is powered by the TempoLink® smart assistant (Fig. 31).

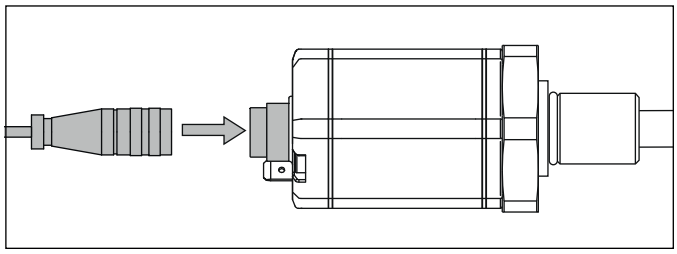


Fig. 31: Connecting the adapter cable to the TempoLink® smart assistant

2. Connection to a sensor with cable outlet

Connect the pig-tails of the sensor cable to the terminal clamps of the adapter cable according to the connector wiring in Fig. 32 and Fig. 33.

Color sensor cable	Color adapter cable	Function
GY	GY	–
PK	PK	–
YE	YE	–
GN	GN	–
BN	BN	+ 24 VDC
WH	WH	DC Ground (0 V)

Fig. 32: Connection of adapter cable to sensor cable

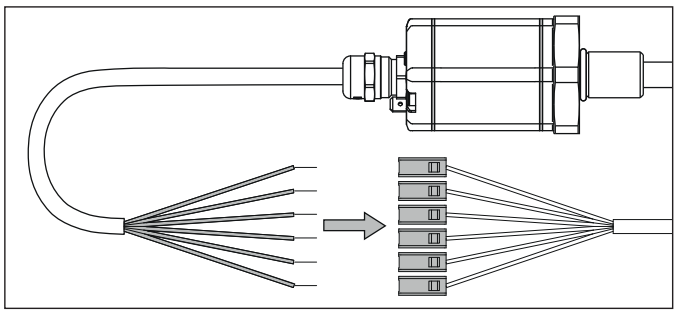


Fig. 33: Connection of adapter cable to G-Series V sensor with cable outlet

5.3.2. Connection of TempoLink® smart assistant to power supply

Connect the barrel connector of the power supply to the connection point labeled “INPUT 24 VDC” on the TempoLink® smart assistant (Fig. 34).

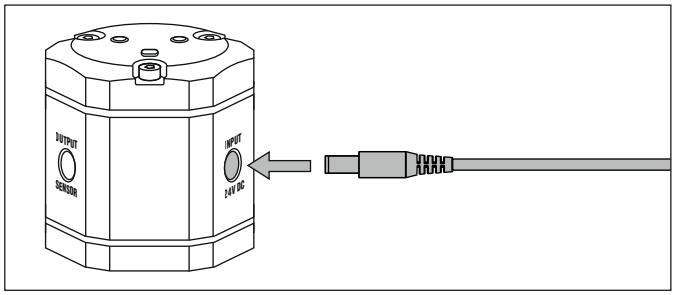


Fig. 34: Connecting the power supply to the TempoLink® smart assistant

There are two ways to connect the TempoLink® smart assistant to a power supply:

1. Connection via the plug-in power supply with plug adapters

Attach the plug attachment suitable for your country to the plug. Insert the plug into the outlet (Fig. 35)

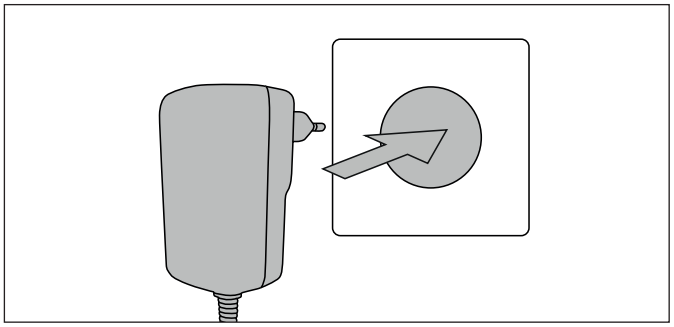


Fig. 35: Connecting the pig-tail to power supply

2. Connection via the cable with barrel connector and pig-tail

Connect the cable to a power supply according to the connector wiring in Fig. 36 (Fig. 37).

Cable	Function
RD	+24 VDC
BK	DC Ground (0 V)

Fig. 36: Connector wiring cable

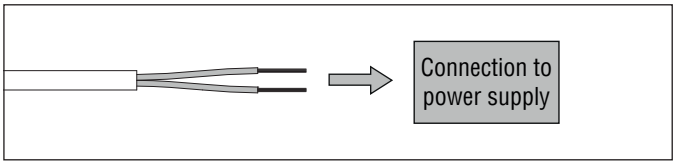


Fig. 37: Connection of cable with barrel connector and pig-tails

5.3.3. Connection of TempoLink® smart assistant to smartphone, tablet or computer

Connect to a smartphone, tablet or computer to display the graphical user interface of the TempoLink® smart assistant.

Connecting a Wi-Fi enabled device to the integrated Wi-Fi access point [3]

Activate Wi-Fi on the device and choose the network "TempoLink_xxxx" (xxxx indicates the last four digits of the serial number). The access to the Wi-Fi network is password protected. The default password is the serial number printed on the label on the bottom of the TempoLink® smart assistant.

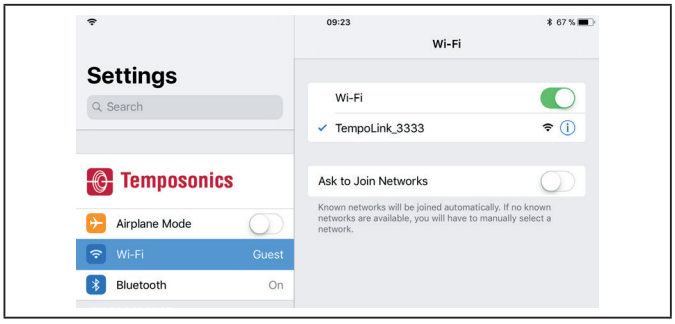


Fig. 38: Choose the network "TempoLink_xxxx" in the Wi-Fi settings of the Wi-Fi-enabled device

NOTICE

If you are using a mobile device, ensure cellular data is off Depending on your operation system, message can appear, that there is no internet access. TempoLink® smart assistant does not need internet access. Connecting to the user interface may take longer if Wi-Fi and cellular data are active.

The TempoLink® smart assistant can also be connected via USB.
If the computer is Wi-Fi enabled deactivate Wi-Fi on the computer before setting up the USB connection.

1. Connect the USB cable with the micro USB connector to the port labeled "USB" on the TempoLink® smart assistant (Fig. 39).
2. Next, connect the USB type-A connector to a free USB port of the computer. The USB connection simulates a network card. In the folder "network connections" on the computer the connection is shown as "IP-over-USB" or "Remote NDIS".

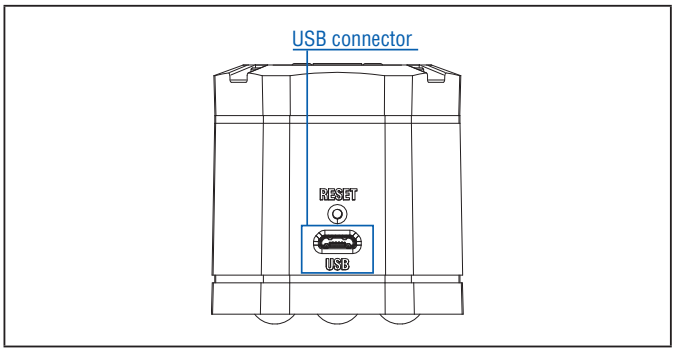


Fig. 39: USB port on the TempoLink® smart assistant

NOTICE

- Only one device can be connected to the TempoLink® smart assistant at a time in order to display the graphical user interface.
- Disable all Wi-Fi and LAN connections before connecting TempoLink® smart assistant via USB. Connecting to the user interface may take longer if Wi-Fi and LAN connections are active.
- Should the website do not build up, it may be useful to press CTRL + F5 to delete cached text and images from prior to launching the *http://tempolink.local* website.

5.3.4. Establishing a connection via browse

After the connection via Wi-Fi or USB is established, open the browser and go to the website-URL: **http://tempolink.local**
It is recommended to use the browser Mozilla Firefox, Google Chrome, Microsoft Edge or Apple Safari.

Fig. 40: Main menu of the graphical user interface

Connection status		
Green		**Information**
●	ON	Connection to sensor is established
Red		**Information**
●	ON	Connection to sensor is not established
Blue		**Information**
●	ON	Sensor in command mode

Fig. 41: Connection status

3/ *The integrated Wi-Fi access point does not provide internet access*

5.3.5. Graphical user interface

Click the menu symbol ≡ in the top left to get to the main menu of the graphical user interface (GUI) (Fig. 42):

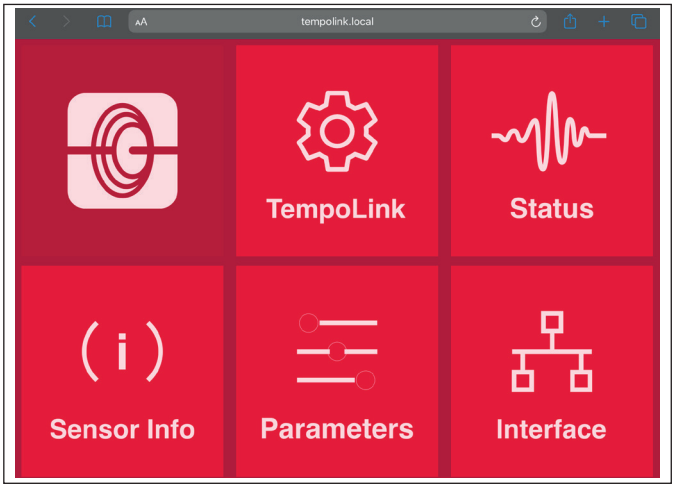


Fig. 42: Main menu of the graphical user interface

NOTICE

Read the TempoLink® smart assistant operation manual (document part number: 551986) for more information.

Menu item TempoLink

Includes information about the TempoLink® smart assistant.

Menu item Status

Includes information about the sensor status.

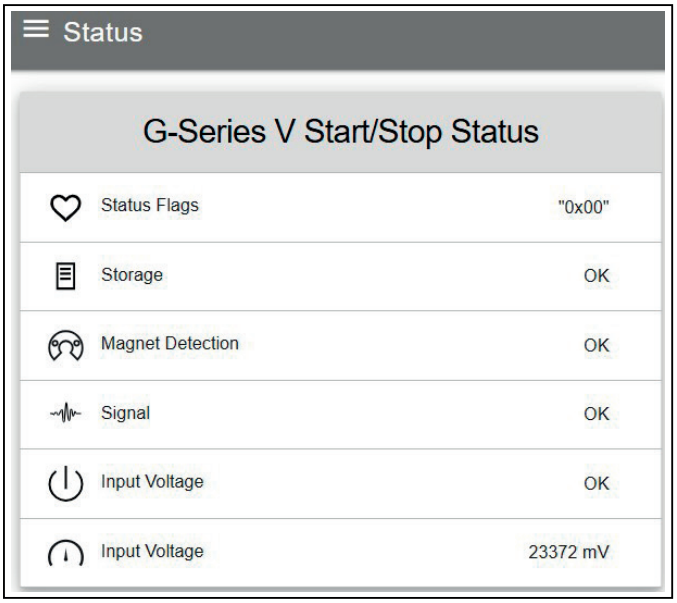


Fig. 43: Status Page

- **Status Flags:** Display of the complete status word in hexadecimal format
- **Storage:** Displays the current status of the internal memory.
  - **OK:** Memory readout is functioning properly.
  - **Error:** Error reading memory. Restart the sensor. If the error persists, contact Temposonics.
- **Magnet Detection:** Displays the current status of magnet detection.
  - **OK:** Magnet on the sensor is detected.
  - **Magnet Missing:** No magnet is detected on the sensor.
- **Signal:** Displays the current status of the signal detection.
  - **OK:** Signal is okay.
  - **Error:** Signal is not okay.
- **Input Voltage:** Shows the current status of the senor's operating voltage
- **Input Voltage:** Shows the current value of the senor's operating voltage

Menu item Sensor Info

Includes information about the connected sensor like stroke length, serial number and order code.

Menu item Parameters

Includes information about the operational settings of the connected sensor.

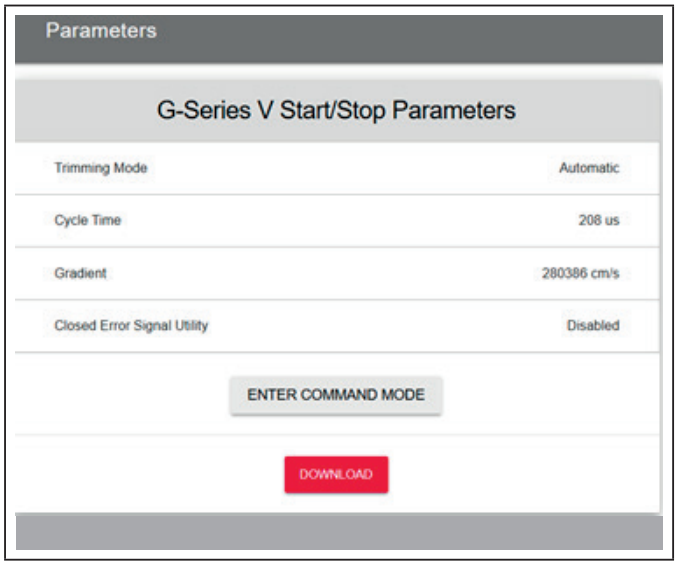


Fig. 44: Parameter page

Via the DOWNLOAD button you can save the settings of the sensor in a cek file on your computer as a backup of your sensor settings (Fig. 46). The file is saved in the location according to your browser settings.

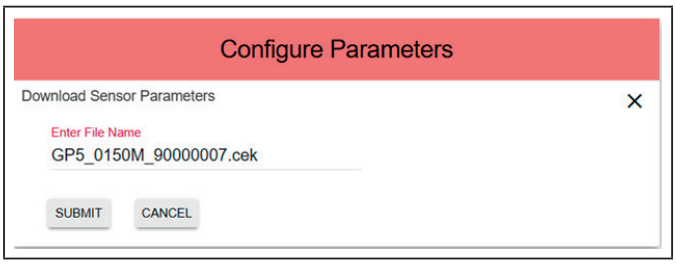


Fig. 45: Download a cek file with the settings of the sensor

To upload a cek file to the connected sensor, start “Command Mode.” Click the ENTER COMMAND MODE button and the “Enter Command Mode” window will open (Fig. 47). After reading the information, enter the word COMMAND and confirm by clicking the OK button (Fig. 48). After starting “Command Mode,” the color of the connection indicator in the upper right corner changes from green to blue. In addition, the status LED of the sensor flashes green.

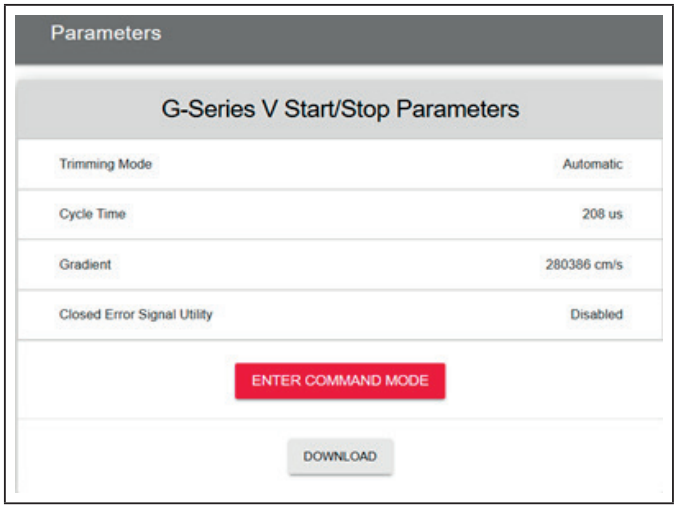


Fig. 46: Start Command Mode

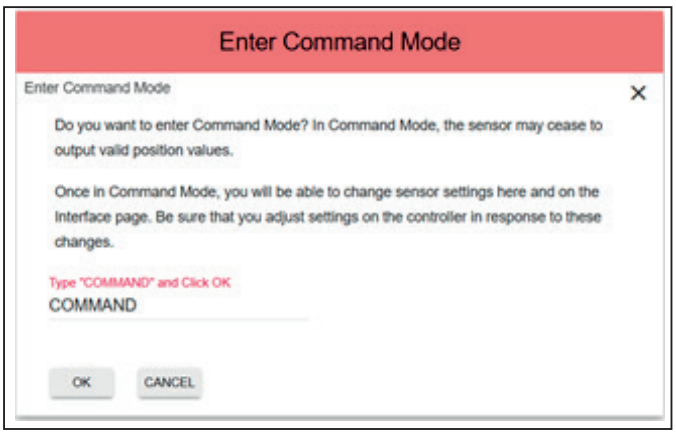


Fig. 47: Enter Command Mode

To upload a cek file to the connected sensor, click the UPLOAD button (Fig. 48). Click the CHOOSE FILE button and navigate to the location of the cek file that you want to upload. The selected file is displayed in the “File Selected” field. Click the SUBMIT button to execute uploading the cek file to the connected sensor.

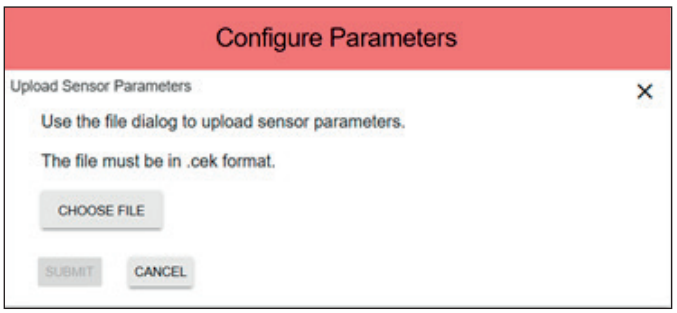


Fig. 48: Uploading a cek file

NOTICE

The cek file of a G-Series V sensor is only valid for this G-Series V sensor. Transferring the cek file of a G-Series V sensor to another G-Series V sensor may result in incorrect measurements by the sensor.

In the Command Mode a pencil icon will appear to the right of parameter “Closed Error Signal Utility”. By clicking the pencil icon a new window for configuring this parameter will open (Fig. 49). Enabling “Closed Error Signal Utility” can be useful at very high shock or vibration events because in this case the magnet may no longer be detected properly. For these error events the Closed Error Signal Utility will produce an output signal waveform that corresponds to a value of just over the 100 % full stroke position. When enabling “Closed Error Signal Utility” ensure that the interface card is designed to process this sensor output appropriately.

- Disabled: Closed Error Signal Utility is disabled
- Enabled: Closed Error Signal Utility is enabled

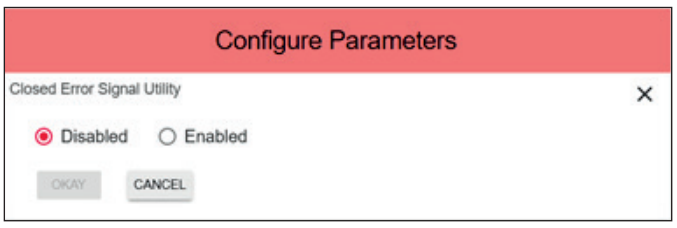


Fig. 49: Disabling or enabling “Closed Error Signal Utility”

After uploading the cek file or configuring the parameter, click the EXIT COMMAND MODE button. The window for exiting the “Exit Command Mode” opens. Click the SAVE AND EXIT button to exit the “Command Mode” and to transfer the changed parameters to the sensor. If you click the EXIT WITHOUT SAVING button, the changes you have made will not be transferred to the sensor. In both cases the sensor returns to the normal function and outputs the current position value.
The connection icon on the top right will turn to green. The status LED of the sensor lights up green.

Menu item interface

Includes information about the settings of the sensor

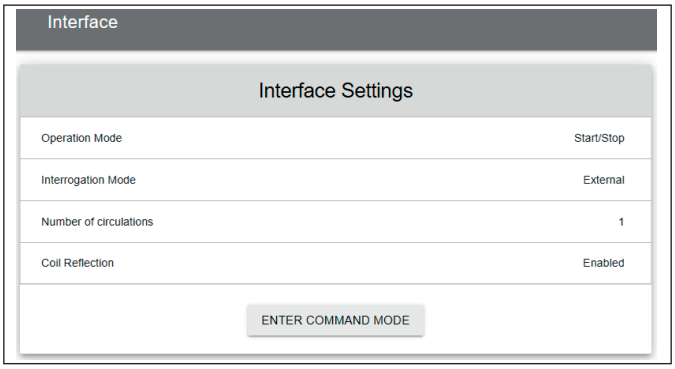


Fig. 50: Interface page

To change interface settings, start the command mode (see menu item Parameters). After entering the command mode a pencil icon will appear to the right of the setting values. By clicking the pencil icon a new menu for configuring the settings will open. Change the parameter and confirm it by clicking the “SUBMIT” button.

- **Operation Mode:** Allows for switching between Start/Stop and PWM
  - Start/Stop: Sensor provides the output signal in start/stop mode
  - PWM: Sensor provides the output signal in PWM mode

- **Interrogation Mode:** Allows for selection of internal or external interrogation (only for PWM output)
  - Internal Interrogation: Sensor is configured for internal interrogation
  - External Interrogation: Sensor is configured for external interrogation

- **Number of Circulations:** Number of times the sensing element is interrogated to produce magnet reading (only available in PWM mode. It is called "recirculations" in the previous G-Series model.)

- **Coil Reflection:** Unique method for generating sensor output signals and is reserved for certain OEM interfaces.

After the parameters have been configured, click the EXIT COMMAND MODE button. The window for exiting the “Exit Command Mode” opens (Fig. 51). Click the SAVE AND EXIT button to exit the “Command Mode” and to transfer the changed parameters to the sensor. If you click the EXIT WITHOUT SAVING button, the changes you have made will not be transferred to the sensor. In both cases the sensor returns to the normal function and outputs the current position value. The connection icon on the top right will turn to green. The status LED of the sensor lights up green.

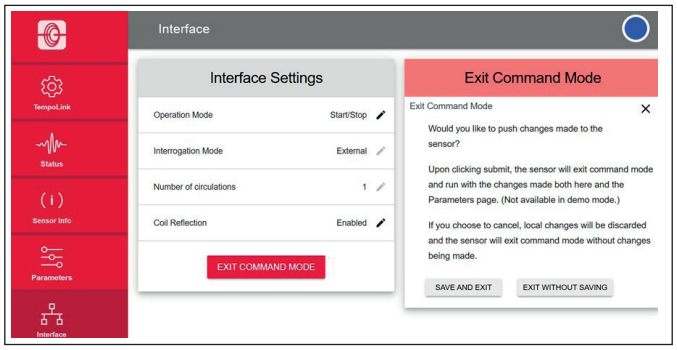


Fig. 51: Exit Command Mode

6. Maintenance and troubleshooting

6.1 Error conditions, troubleshooting

See chapter “5.2 LED status” on page 25.

6.2 Maintenance

The sensor is maintenance-free.

6.3 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 4.

6.4 List of spare parts

No spare parts are available for this sensor.

6.5 Transport and storage

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

7. Removal from service/dismantling

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

8. Technical data

8.1 Technical data Temposonics® GP5

Output	
Digital pulse outputs	Start/Stop and Pulse Width Modulation (PWM)
Measured output variables	Position
Measurement parameters	
Resolution	0.1, 0.01 and 0.005 mm (controller dependent)
Update time	Controller and stroke length depent Recommendation: Stroke length: ≤ 500 mm | ≤ 1100 mm | ≤ 3000 mm | ≤ 6250 mm Update time: 500 µs | 1 ms | 2 ms | 4 ms
Linearity deviation [3]	< ±0.02 % F.S. (minimum ±50 µm)
Repeatability	< ±0.002% % F.S. (minimum ±5 µm)
Hysteresis	< 4 µm typical
Temperature coefficient	< 30 ppm/K typical
Operating conditions	
Operating temperature	–40…+80 °C (–40…+176 °F)
Humidity	90 % relative humidity, no condensation
Ingress protection	IP67 (connectors correctly fitted)/IP68 (3 m/3 d) for cable outlet
Shock test	100 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 GP5 sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TR CU 020/2011.
Magnet movement velocity	Magnet slider: Max. 10 m/s; U-magnet: Any; Block magnet: Any
Design/Material	
Sensor electronics housing	Aluminum (painted), zinc die cast
Sensor profile	Aluminum
RoHS compliance	The used materials are compliant with the requirements of EU Directive 2011/65/EU and EU Regulation 2015/863 as well as UKSI 2022 No. 622 with amendments
Stroke length	25…6350 mm (1…250 in.)
Mechanical mounting	
Mounting position	Any
Mounting instruction	Please consult the technical drawings on page 11
Electrical connection	
Connection type	1 × M16 male connector (6 pin) or cable outlet
Operating voltage	Standard: +24 VDC (–15/+20 %)/option: +9 VDC...+28.8 VDC; The GP5 sensors must be power supplied via an external Class 2 power source in accordance with the UL approval
Power consumption	2.5 W typical (3.5 W maximum)
Dielectric strength	500 VDC (DC ground to machine ground)
Polarity protection	Up to –30 VDC
Overvoltage protection	Up to 36 VDC

3/ With position magnet # 251 416-2

8.2 Technical data Temposonics® GH5

Output	
Digital pulse outputs	Start/Stop and Pulse Width Modulation (PWM)
Measured output variables	Position or liquid level
Measurement parameters	
Resolution	0.1, 0.01 and 0.005 mm (controller dependent)
Update time	Controller and stroke length depent Recommendation:

Stroke length	≤ 500 mm	≤ 1100 mm	≤ 3000 mm	≤ 6250 mm	≤ 7620 mm
Update time	500 µs	1 ms	2 ms	4 ms	5 ms

Linearity deviation [4]	< ±0.02 % F.S. (minimum ±50 µm)
Repeatability	< ±0.002% % F.S. (minimum ±5 µm)
Hysteresis	< 4 µm typical
Temperature coefficient	< 30 ppm/K typical
Operating conditions	
Operating temperature	–40…+80 °C (–40…+176 °F)
Humidity	90 % relative humidity, no condensation
Ingress protection	IP67 (connectors correctly fitted)/IP68 (3 m/3 d) and IP69 for cable outlet
Shock test	100 g/11 ms, IEC standard 60068-2-27
Vibration test	30 g/10…2000 Hz, IEC standard 60068-2-6 (excluding resonant frequencies)/ GH5-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 GH5 sensors fulfill the requirements of the EMC directives 2014/30/EU, UKSI 2016 No. 1091 and TR CU 020/2011.
Operating pressure	450 bar (6,527 psi)/700 bar (10,153 psi) peak (at 10 × 1 min) for sensor rod/GH5-J: 800 bar (11,603 psi)
Magnet movement velocity	Any
Design/Material	
Sensor electronics housing	Aluminum (painted), zinc die cast
Sensor flange	Stainless steel 1.4305 (AISI 303)
Sensor rod	Stainless steel 1.4306 (AISI 304L)
RoHS compliance	The used materials are compliant with the requirements of EU Directive 2011/65/EU and EU Regulation 2015/863 as well as UKSI 2022 No. 622 with amendments
Stroke length	25…7620 mm (1…300 in.)/GH5-J: 25...5900 mm (1…232 in.)
Mechanical mounting	
Mounting position	Any
Mounting instruction	Please consult the technical drawings on page 12
Electrical connection	
Connection type	1 × M16 male connector (6 pin) or cable outlet
Operating voltage	Standard: +24 VDC (–15/+20 %)/option: +9 VDC...+28.8 VDC; The GH5 sensors must be power supplied via an external Class 2 power source in accordance with the UL approval
Power consumption	2.5 W typical (3.5 W maximum)
Dielectric strength	500 VDC (DC ground to machine ground)
Polarity protection	Up to –30 VDC
Overvoltage protection	Up to 36 VDC

4/ With position magnet # 251 416-2

Temposonics
AN AMPHENOL COMPANY

9. 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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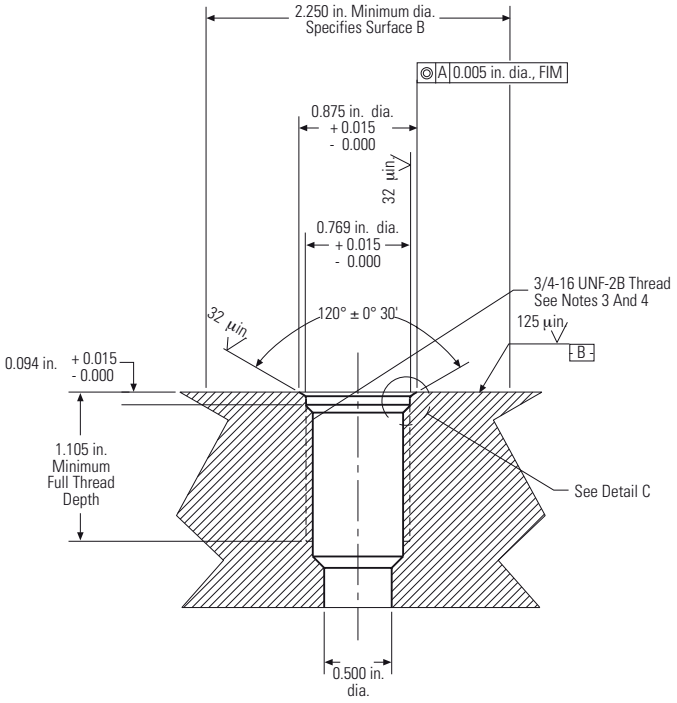
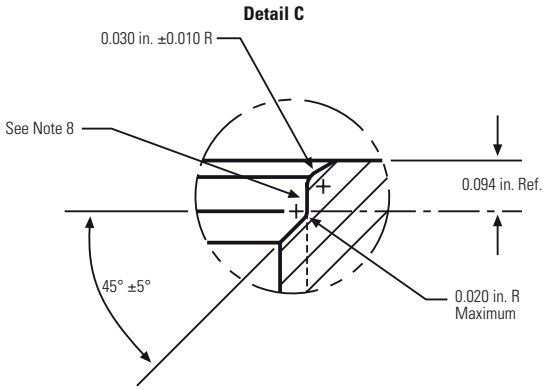
10. Appendix II – Cylinder port details

PORT DETAIL (PD) FOR GH5-S:

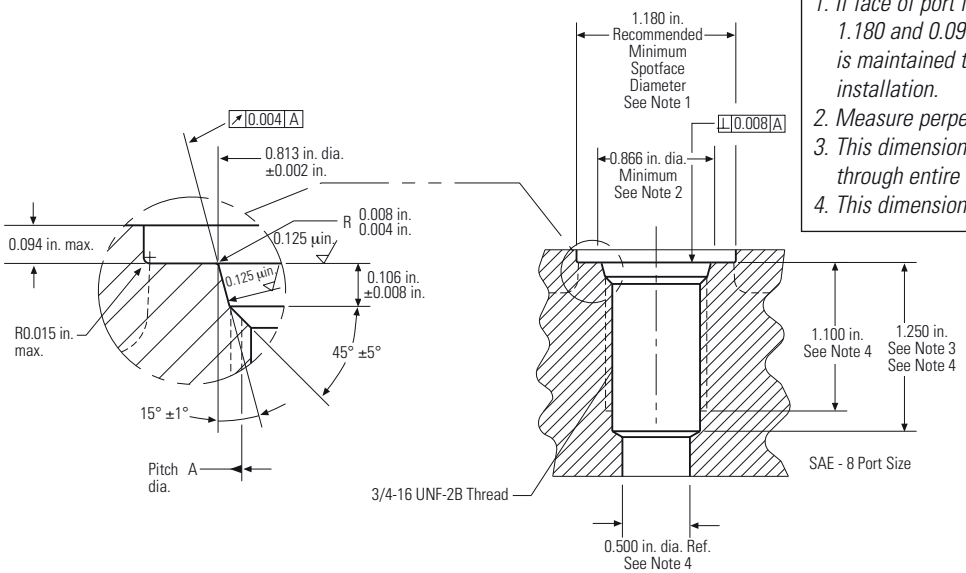


NOTES:

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 GH5-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.*

11. Glossary

C

Closed Error Signal Utility
At very high shock or vibration events, the magnet may no longer be detected properly. For these error events the Closed Error Signal Utility will produce an output signal waveform that corresponds to a value of just over the 100 % full stroke position. Contact Applications Engineering for more information.

E

External Interrogation
For a sensor that is configured for external interrogation, a signal is required from the controller or interface module to initiate every measurement cycle.

I

Internal Interrogation
For a sensor that is configured for internal interrogation, no signal is needed from the controller as the sensor itself initiates the next measurement cycle upon the completion of the current cycle.

M

Multi-position measurement
During the measurement cycle, the positions of every magnet on the sensor are simultaneously reported. With the srat/stop interface, for a multi-position measurement a stop pulse is generated for each magnet during the measurement cycle and send to the controller.

P

Pulse width modulation (PWM)
With pulse width modulation, the position of the magnet is determined »X« times according to the number of circulations after the start of the measurement. The number of circulations »X« is specified in the order code of the sensor. The measurement is stopped after these »X« position determinations have been completed. The time between the start and end of the measurement is measured in the controller. Since the controller knows the number of circulations »X«, it calculates the magnets position on the sensor rod/sensor profile from the number of circulations »X« and the measured time. This procedure increases the resolution of the measurement and extends the duration of a measurement.

S

Start/Stop
With the Start/Stop interface, the sensor receives a start pulse from the controller and sends back a stop pulse at the end of the measurement. The time between the start and stop pulse is proportional to the position of the magnet on the sensor rod/sensor profile. As the time measurement takes place in the controller, the time resolution of the controller unit determines the position resolution.

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