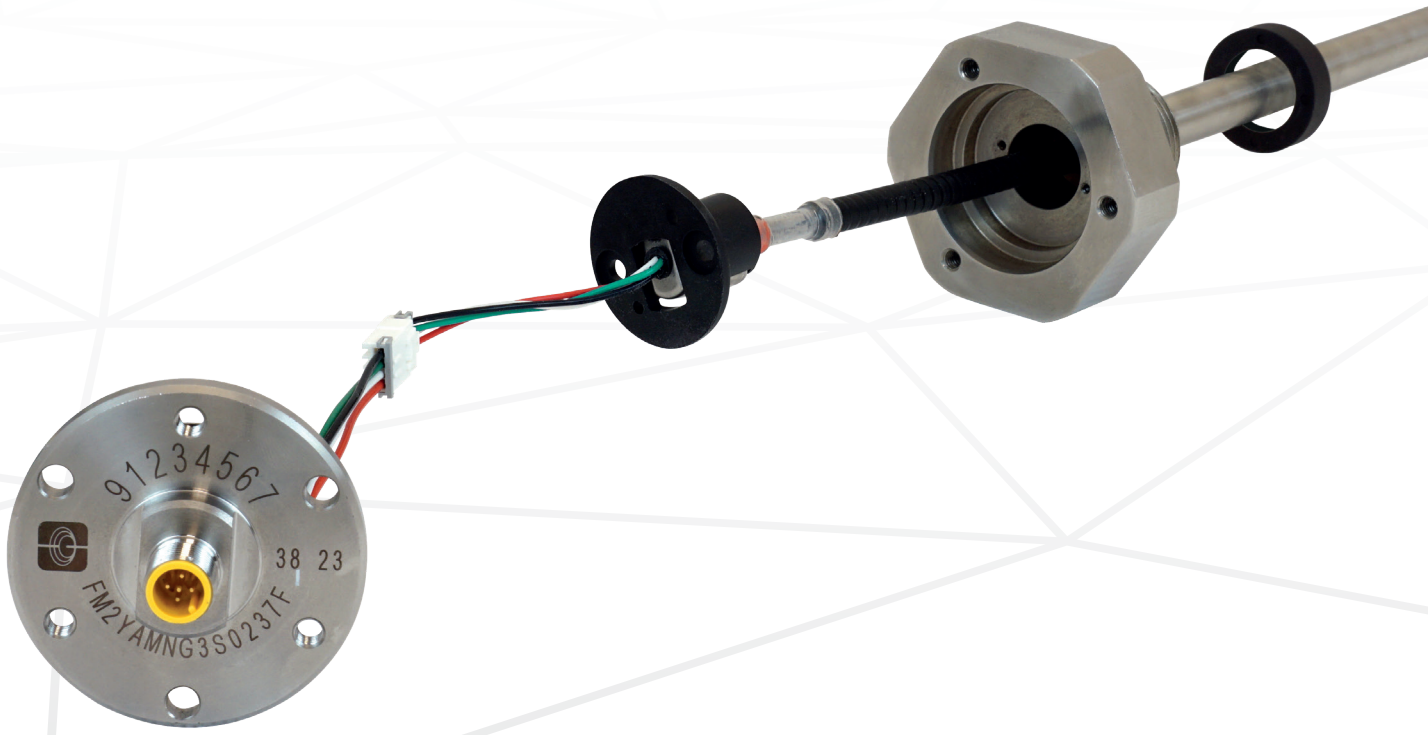
Temposonics
AN AMPHENOL COMPANY

Data Sheet

MH-Series FLEX Safety

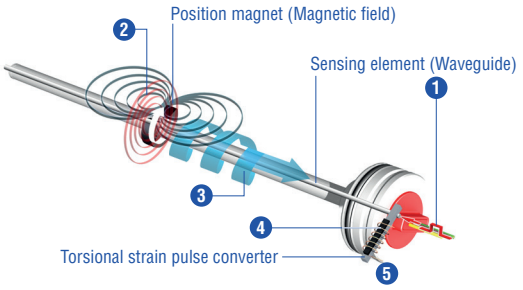
Magnetostrictive Linear Position Sensors

- Suitable for Safety Integrity Level 2 (SIL2) applications
- Easy in-field installation and replacement
- Stroke lengths from 250…10,500 mm (500…5,000 mm with optional pipe)
- J1939-76 and CANopen Safety Output



MEASURING TECHNOLOGY

The absolute, linear position sensors provided by Temposonics rely on the company's proprietary 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 beginning 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 distance

Fig. 1: Time-of-flight based magnetostrictive position sensing principle

FLEXIBLE SENSOR

Designed for use in safety applications for off-highway machines, the FLEX Safety sensor features an innovative multi-part design. This design allows users to separate the flexible sensing element and electronics from the housing without opening the hydraulic system. While it is manageable to install and remove hydraulic cylinder sensors at a manufacturing facility, it can be extremely challenging in the field. Trained service technicians can remove and replace the internal components with just 200 mm of clearance regardless of stroke length and without breaking the hydraulic seal. This serviceability means decreased downtime and disruption, providing increased productivity. Replacement units ship as coiled rings to ease handling and reduce shipping costs.

SAFETY OUTPUT OPTIONS

The CANopen Safety and J1939-76 outputs can be used in applications up to SIL2 and Performance Level d for the safety function "Measurement of position & velocity".
The Flexible FM2 has been certified according to IEC 61508:2010 and ISO 13849-1:2015. For further details around the safety function of this product please consult the safety manual (552177).

Fig. 2: Typical applications

TECHNICAL DATA

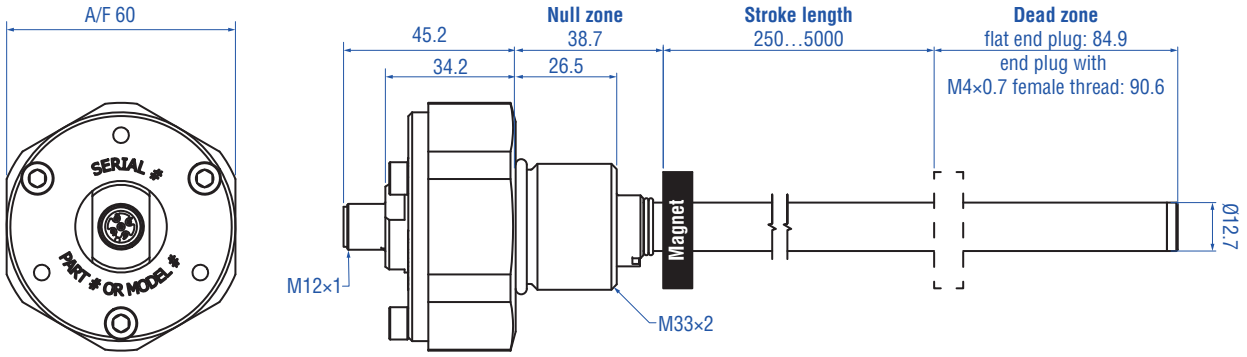
Output	
Bus-protocol	CANopen Protocol DS-301, DS-304 CANopen Safety protocol, device profile DS-406 and J1939-76
Measured value	Position
Measurement parameters	
Stroke length	250…10,500 mm
Resolution (position)	0.1 mm (F.S.) ≤ 5 m 0.2 mm (F.S.) > 5 m
Power up Time	400 ms (typical)
Cycle Time	Programmable (CANopen Safety: 25 ms default; J1939-76: 20 ms default)
Linearity	±0.04 % (F.S.) ≤ 2.5 m ±1 mm (F.S.) 2.5 m
Internal sample rate	1 ms (F.S.) ≤ 5 m 5 ms (F.S.) > 5 m
Setpoint tolerance	±1 mm or ±0.04 % F.S. (whatever is greater)
Operating conditions	
Operating temperature electronics	–40…+105 °C (F.S.) ≤ 7.5 m –40…+85 °C (F.S.) > 7.5 m
Humidity	90 % relative humidity, no condensation, EN 60068-2-30 during installation
Ingress protection - Connector	IP67/IP69K (connectors correctly fitted), EN 60529
Ingress protection with sensor housing	IP67, EN 60529
Shock test	100 g (6 ms) single shock per axis, IEC 60068-2-27 50 g (11 ms) at 1000 shocks per axis, IEC 60068-2-27
Vibration	Operational sine vibration test IEC 60068-2-6: 2 g (5…2000 Hz)* Survival random vibration test IEC 60068-2-64 15 g RMS (10…2000 Hz) 12 h per axis*
EMC	Compliant with: ISO 13766-1:2018 Earth-moving and building construction machinery ISO 16750-2:2012 Road vehicles ISO 13766-2:2018 Additional EMC requirements for functional safety
EMI	200 V/m (ISO 11452-2:2019 200…2000 MHz) 200 mA (ISO 11452-4:2011 20…200 MHz)
Operating pressure ratings**	**(with pressure pipe option)**
PN (nominal operating)	350 bar
Pmax (max. overload)	450 bar
Pstatic (proof pressure)	625 bar
Design/Material	
Sensor electronics housing	Stainless steel 1.4305 (AISI 303)
Sealing (with optional pressure pipe)	O-ring: H-NBR 70
Sensor rod	Stainless steel 1.4306 (AISI 304L)
Electrical connection	
Connection type	M12 connector
Operating voltage	12/24 VDC nominal (8…32 VDC)
Max. Inrush current	1.5 A/2 ms (1.0 A/2 ms if supply < 13 V)
Supply voltage ripple	< 10 V_{PP}
Power drain	< 1.5 W
Bus termination (HI-LO)	120 Ω
Over voltage protection (GND-VDC)	Up to +200 VDC
Polarity protection (GND-VDC)	Up to –600 VDC
Insulation Resistance	R ≥ 10 MΩ @ 60 sec
Electric strength	500 VDC (DC GND to chassis GND)

*/ Resonance frequencies excluded
**/ According to calculations under use of the FKM guideline

Cycles	**Ø 12.7 mm sensor rod**
Dynamic pressure: < 2 × 10^6 pressure cycles	350 bar
Static pressure: < 2 × 10^4 pressure cycles	450 bar
Proof pressure: Maximum 5 minutes testing time for cylinder pressure test	625 bar

TECHNICAL DRAWING

FLEX Safety – Full Assembly

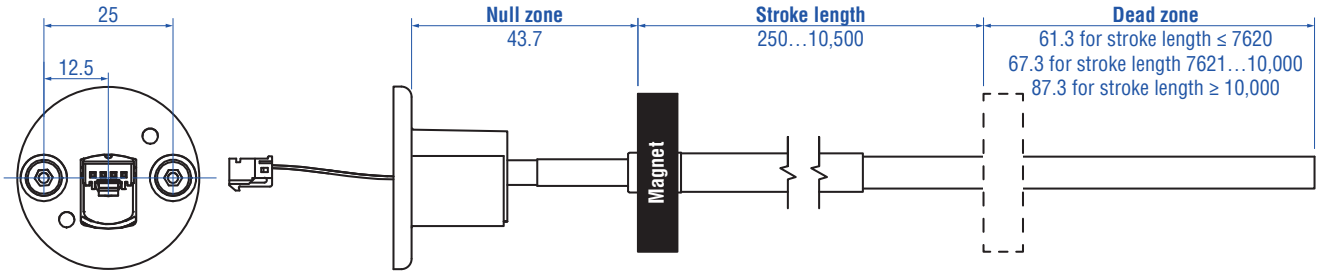


Controlling design dimensions are in millimeters

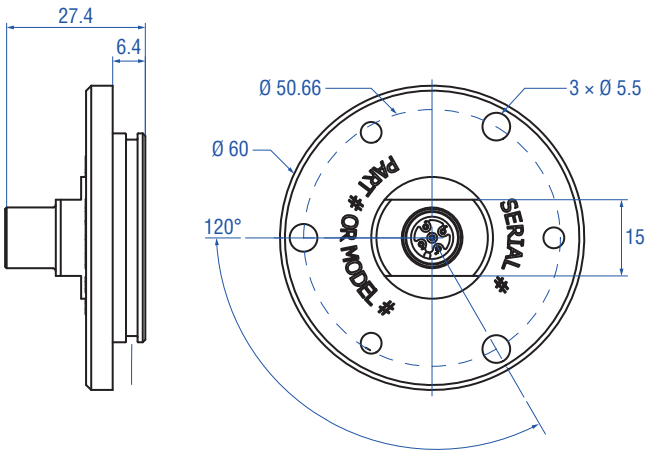
Fig. 3: Temposonics® MH-Series FLEX Safety – Full Assembly

TECHNICAL DRAWING

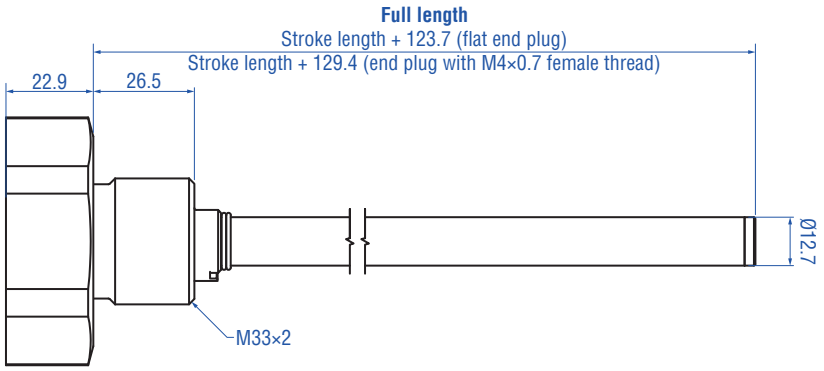
FLEX Safety – Smart sensor element



FLEX Safety – Lid electronics assembly



FLEX Safety – Pressure pipe

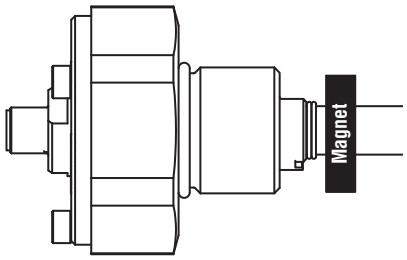


Controlling design dimensions are in millimeters

Fig. 4: Temposonics® MH-Series FLEX Safety parts

CONNECTOR WIRING

M12 connector (NF)



- Attached A-coded M12 connector
- Toolless assembly
- Sealing IP67, up to IP69K with plugged mating connector

Connector wiring — **F**

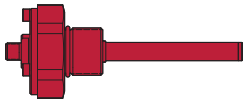
View on connector

Pin	Wire	Function
1	–	–
2	BN	VDC
3	WH	GND
4	YE	CAN_H
5	GN	CAN_L

Fig. 5: Connector wiring

Controlling design dimensions are in millimeters

ORDER CODE – FULL ASSEMBLY



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

a	Form factor
F M 2	Full assembly

b	Pipe
A	Rod Ø 12.7 mm, flat end plug
B	Rod Ø 12.7 mm, end plug with M4×0.7 female thread

c	Stroke length
X X X X X M	00250…5000 mm (in 5 mm steps)

d	Electrical wiring
M12 connector (VDC – GND – HI – LO) incl. flange	
N F	Connector wiring: F: 2-3-4-5

e	Sensor element wire length
A	80 mm

f	Output
S 0 2	CANopen Safety
J 9 1	SAE J1939-76 Safety

g	Baud rate
CANopen Safety (S02)	
0	1000 kbit/s
1	800 kbit/s
2	500 kbit/s (default)
3	250 kbit/s
4	125 kbit/s
6	50 kbit/s
7	20 kbit/s
8	10 kbit/s
SAE J1939-76 Safety (J91)	
2	500 kbit/s (default)
3	250 kbit/s

h	Node ID (CANopen)/Source address (SAE J1939)
CANopen Safety (S02)	
	Hex 01…7F (default: 7F)
SAE J1939-76 Safety (J91)	
	Hex 01…FD (default: FD)

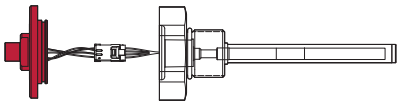
i	Cycle time
B	05 msec
C	10 msec
D	20 msec (default SAE J1939-76 Safety)
E	25 msec (default CANopen Safety)
F	30 msec
G	40 msec
H	50 msec

DELIVERY

- Pressure pipe
- Lid electronics assembly
- Smart sensor element
- O-ring

Accessories (e.g. position magnets) have to be ordered separately

ORDER CODE – LID ELECTRONICS ASSEMBLY



1	2	3	4	5	6	7	8	9	10	11	12	13
F	M	2	L	N	F							
a			b	c		d			e	f		g

a	Form factor
F M 2	Lid electronics assembly

b	Lid electronics assembly
L	Lid electronics assembly

c	Connection type
N F	Connector wiring: F: 2-3-4-5

d	Output
S 0 2	CANopen Safety
J 9 1	SAE J1939-76 Safety

e	Baud rate
CANopen Safety (S02)	
0	1000 kbit/s
1	800 kbit/s
2	500 kbit/s (default)
3	250 kbit/s
4	125 kbit/s
6	50 kbit/s
7	20 kbit/s
8	10 kbit/s
SAE J1939-76 Safety (J91)	
2	500 kbit/s (default)
3	250 kbit/s

f	Node ID (CANopen)/Source address (SAE J1939)
CANopen Safety (S02)	
	Hex 01…7F (default: 7F)
SAE J1939-76 Safety (J91)	
	Hex 01…FD (default: FD)

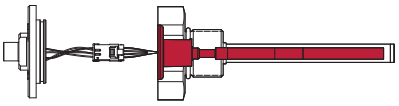
g	Cycle time
B	05 msec
C	10 msec
D	20 msec (default SAE J1939-76 Safety)
E	25 msec (default CANopen Safety)
F	30 msec
G	40 msec
H	50 msec

DELIVERY

- Lid electronics assembly

Accessories (e.g. position magnets) have to be ordered separately

ORDER CODE – SMART SENSOR ELEMENT



1	2	3	4	5	6	7	8	9	10	11
F	M	2	E						M	
a			b	c						d

a	Form factor
F M 2	Smart sensor element

b	Smart sensor element
E	Smart sensor element

c	Stroke length
X X X X X M	00250…10,500 mm (in 5 mm steps)

d	Sensor element wire length
A	80 mm (default)
B	130 mm
C	210 mm

DELIVERY

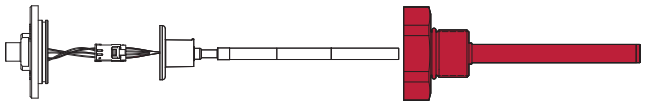
- Smart sensor element

Accessories (e.g. position magnets) have to be ordered separately

NOTICE

Smart sensor element available up to 10.5 m for use in applications with customer supplied enclosures.

ORDER CODE – PRESSURE PIPE



1	2	3	4	5	6	7	8	9	10
F	M	2							M
a			b	c					

a	Form factor
F M 2	Pressure pipe

b	Pipe
C	Rod Ø 12.7 mm, flat end plug
D	Rod Ø 12.7 mm, end plug with M4×0.7 female thread

c	Stroke length
X X X X X M	00250…05000 mm (in 5 mm steps)

DELIVERY

- Pressure pipe
- O-ring

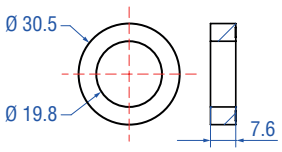
Accessories (e.g. position magnets) have to be ordered separately

NOTICE

Pressure pipe available up to 5 m.

FREQUENTLY ORDERED ACCESSORIES

Position magnets



Ring magnet
Part no. 402 316

Material: PA ferrite coated
Weight: ca. 13 g
Operating temperature: –40…+100 °C
Surface pressure: 20 N/mm²

Controlling design dimensions are in millimeters

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