MTS®
SENSORS

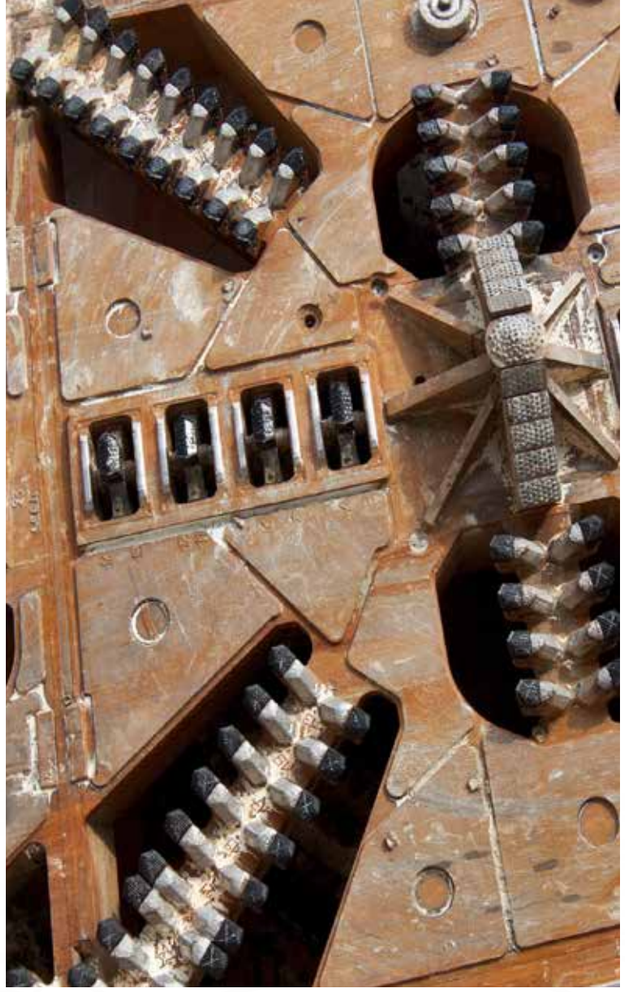
Temposonics®

Magnetostrictive Linear Position Sensors

SENSOR SELECTOR GUIDE

Industry

be certain.



MEETING THE CHALLENGES OF INDUSTRIAL APPLICATIONS

Metal Working • Wood Processing • Testing Machines • Drive Technology • Machine Tools
Packaging & Printing Machineries • Paper & Glass Processing • Food & Beverage Plants
Plastics & Rubber Processing • Textile Production • Renewable Energy • Power Generation

MTS Sensors also offers solutions for Mobile Hydraulics (off-highway vehicles) and Liquid Level applications

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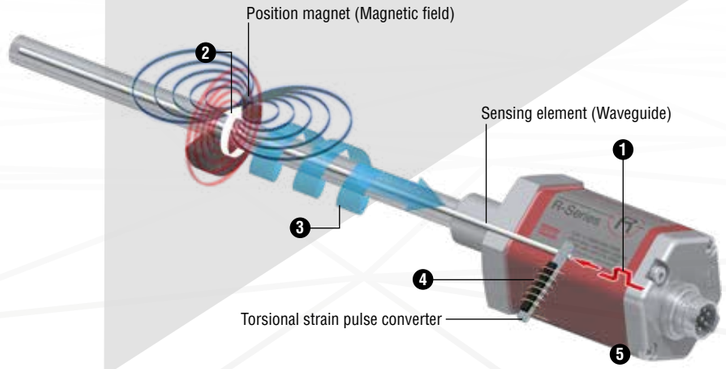
COMPANY

MTS Sensors is recognized as an industry leader in sensing technologies and solutions. These sensors permit high-precision and dynamic position and/or speed measurement in state-of-the-art automation and safety-relevant applications.

With a versatile and ever increasing product portfolio, MTS Sensors cooperates closely with customers, to optimize performance and reduce downtimes. Outstanding quality associated with practical know-how ensures that customers achieve utmost productivity and success. Continuous research, development and production of sensor systems constantly enable new solutions for measuring tasks in the industrial, mobile hydraulics as well as process technology fields to be created.

MTS Sensors is a division of MTS Systems Corporation (NASDAQ:MTSC). In July 2016, MTS Systems Corporation (Eden Prairie, USA) purchased PCB Piezotronics Inc. (Depew, USA). The acquisition will continue MTS' and PCB's long history of growth. Our customers benefit from an extended, complementary product portfolio, while relying on the unwavering competence and diligence of our support team. MTS Sensors has 1600 employees worldwide who serve our global customers with a focus on superior regional support.

be certain.



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

MEASURING TECHNOLOGY

The absolute, linear position sensors provided by MTS Sensors rely on the company's proprietary Temposonics® magnetostrictive technology, which can determine position with a high level of precision and robustness.

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

The Temposonics® technology, based on magnetostriction, does not rely on moving parts and is not exposed to mechanical stress. Therefore, the sensors exhibit considerably longer lifespans and much higher reliability when compared to other technologies, even in harsh working conditions. Furthermore, since the output from sensors with Temposonics® technology corresponds to an absolute position, rather than a relative value, it is not required to recalibrate sensors.

THE NEW GENERATION

Temposonics® R-Series V position sensors are ready for Industry 4.0 applications. They support a variety of smart features that enable users to retrieve additional information from inside the application.
Users of the absolute, non-contact position sensors benefit from an improved performance as they have a higher resistance against shock, vibration, and high temperatures than ever before.
The backward compatibility of the R-Series V allows users to simply replace the current with the new generation of sensors. This means that also existing applications can benefit from the new features of Temposonics® R-Series V.

TRUST IN WHAT YOU KNOW. NOW EVEN BETTER.

“Temposonics® R-Series V is the follow up to our current fourth generation. Based on our long-standing experiences, R-Series V is the next step in the innovative evolution of our sensors. By maintaining the qualities we are well-known for and at the same time pushing the boundaries, we are able to provide our customers the best R-Series we ever made.”

André Beste, Technical Marketing Manager

SUPERIOR PERFORMANCE

Have a challenging application?
Need reliable performance combined with resistance to high temperature, dirt and vibration?

Extreme demands require extraordinary solutions. MTS Sensors responds to this with an extensive range of measuring stroke options, simultaneous measurement of multiple magnets, smart electronic designs with built-in diagnostics, innovative housing concepts and a wide variety of controller interfaces. Our Temposonics® magnetostrictive technology is maximized with powerful electronics and double-shielded construction that assures immunity against interference. The robust designs guarantee maximum reliability, high-precision position measurements and long-term operation in the harshest environments.

Success where others fail.

20 POSITIONS

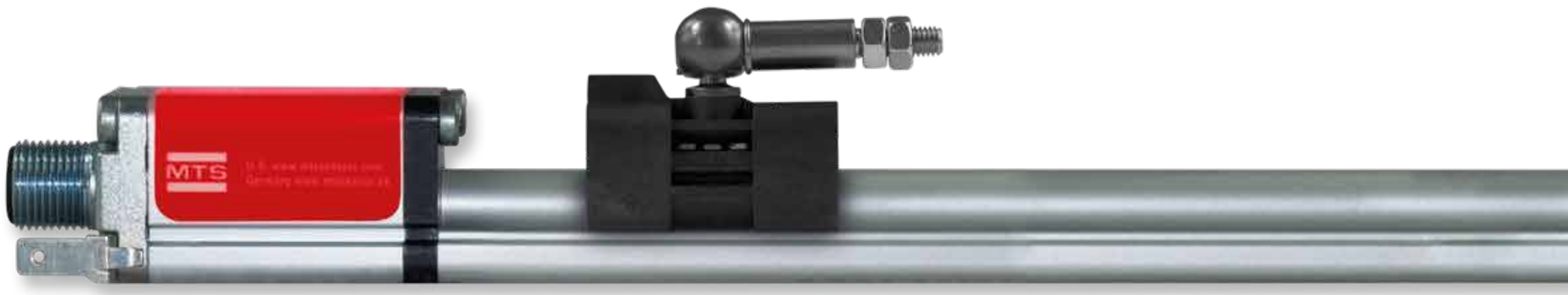
20 METERS

COMPACT SOLUTIONS

Need a reliable sensing solution designed for limited space or difficult access?

In line with your application requirements, MTS Sensors delivers solutions which fit your exact needs in terms of design and performance – from ultra-low profiles and detached electronics to compact hazardous area approved housings. In food & beverage, plastics, textiles and other industries, Temposonics® technology guarantees maximum productivity.

Always the smartest solution.



MAXIMUM SAFETY

Explosive environment or a dangerous area?

Temposonics® sensors from MTS Sensors are the first choice when it comes to meeting safety and hazardous area standards – including SIL 2, ATEX- (Europe), NEC- (USA), CEC- (Canada), EAC Ex- (russian market), IECEx- (global market), KCs (South Korea) and the Japanese approval for use in Class I, II, III, Division 1, Division 2 and Zone 0/1, Zone 1, Zone 2, Zone 21 and Zone 22. Optimized for applications where there is potential for exposure to flames and caustic substances, as well as the possibility of explosive atmospheres, our sensors are highly suited to implementation in chemical plants, offshore oil/gas rigs and other applications of this kind.

Maximum safety for machines and their operators.

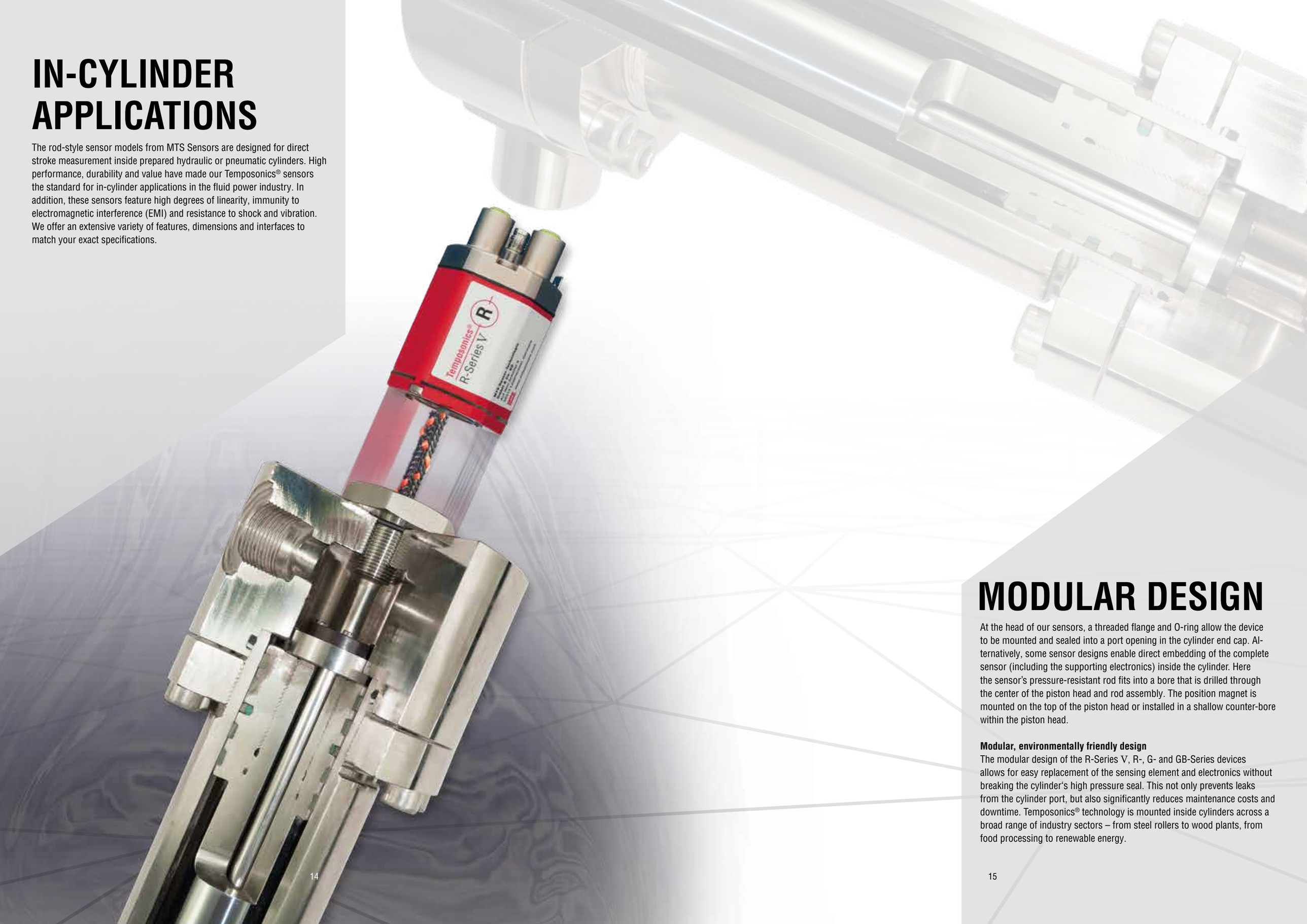
INNOVATIVE TECHNOLOGY

Our mission at MTS Sensors is to provide outstanding quality and application knowledge. We focus on understanding your requirements so you can attain the highest levels of productivity and that success is assured. Our resources are dedicated to the continual development of new products and delivering unparalleled application-oriented solutions to market with speed and agility. It is no coincidence that the engineering team at MTS Sensors is the largest professional team within our organization.

Pioneers and innovators.

IN-CYLINDER APPLICATIONS

The rod-style sensor models from MTS Sensors are designed for direct stroke measurement inside prepared hydraulic or pneumatic cylinders. High performance, durability and value have made our Temposonics® sensors the standard for in-cylinder applications in the fluid power industry. In addition, these sensors feature high degrees of linearity, immunity to electromagnetic interference (EMI) and resistance to shock and vibration. We offer an extensive variety of features, dimensions and interfaces to match your exact specifications.



MODULAR DESIGN

At the head of our sensors, a threaded flange and O-ring allow the device to be mounted and sealed into a port opening in the cylinder end cap. Alternatively, some sensor designs enable direct embedding of the complete sensor (including the supporting electronics) inside the cylinder. Here the sensor's pressure-resistant rod fits into a bore that is drilled through the center of the piston head and rod assembly. The position magnet is mounted on the top of the piston head or installed in a shallow counter-bore within the piston head.

Modular, environmentally friendly design
The modular design of the R-Series V, R-, G- and GB-Series devices allows for easy replacement of the sensing element and electronics without breaking the cylinder's high pressure seal. This not only prevents leaks from the cylinder port, but also significantly reduces maintenance costs and downtime. Temposonics® technology is mounted inside cylinders across a broad range of industry sectors – from steel rollers to wood plants, from food processing to renewable energy.

SERIES QUICK GUIDE

	E-Series Compact Solutions	G-Series High Durability	GB-Series Innovative Design	R-Series V The New Generation	R-Series Superior Performance	T-Series Rugged Design
FEATURES						
Velocity measurement				●	●	
Multi-position measurement	●	●		●	●	●
Programmable sensor parameters		●	●	●	●	●
Diagnostic LEDs		●		●	●	
Redundant version		●			●	
OUTPUT						
Analog – Current	●	●	●	●	●	●
Analog – Voltage	●	●	●	●	●	
Start/Stop	●	●				
PWM		●				
SSI	●		●	●	●	●
Profibus					●	
CANbus	●				●	●
DeviceNet					●	
EtherCAT®				●	●	
EtherNet/IP™				●	●	
POWERLINK				●	●	
PROFINET				●	●	
IO-Link	●					
MINIMUM STROKE LENGTH						
25 mm (1 in.)			●	●	●	●
50 mm (2 in.)	●	●				
MAXIMUM STROKE LENGTH						
1500 mm (60 in.)	ER					TH (SIL 2)
2540 mm (100 in.)	EH, EE	GTE			RT4	
2900 mm (114 in.)		GT				
3000 mm (118 in.)	EP, EL, EP2, ET					
3250 mm (128 in.)			GB			
5080 mm (200 in.)		GP			RP, RD4	
6350 mm (250 in.)				RP5		
7620 mm (300 in.)		GH		RH5	RH, RS	TH
20000 mm (787 in.)					RF	

CERTIFICATES

	CE	UL/cUL	SIL 2	ATEX	NEC/CEC	NEC/CEC	IECEx	EAC	EAC Ex	KCs	Japanese Approval
E-SERIES											
EH	●	●						●			
ET	●			●	●		●	●			
EP	●	●						●			
EL	●	●						●			
EP2	●	●						●			
ER	●	●						●			
EE	●							●			
G-SERIES											
GH	●	●		●				●			
GP	●	●		●				●			
GT2 / GT3	●							●			
GTE	●			●			●	●			
GB-SERIES											
GB	●							●			
R-SERIES V											
RH5	●	●						●			
RP5	●	●						●			
R-SERIES											
RH	●	●		●				●			
RP	●	●		●				●			
RF	●							●			
RD4								●			
RT4								●			
RS	●							●			
T-SERIES											
TH (Analog)	●			●	●		●	●	●	●	●
TH (SSI, CANbus)	●			●	●		●	●	●		●
TH (SIL 2)	●		●	●	●		●	●	●	●	●
HPH FOR G-/R-SERIES											
GH	●			●		●	●				
RH	●			●		●	●				

SAVE YOUR TIME FOR THE THINGS YOU LOVE.

…trust the experts!

Have you ever thought about how much time you're wasting waiting for adequate support or your order?

Our commitment at MTS Sensors is to consistently deliver quality products on time to meet your schedules and provide first-class service. Trust in our continuous product development of high-performance position sensors and rely on our highly qualified personnel. At MTS Sensors, we live by the promise of unparalleled service that enables us to take all available means to exceed your expectations. Our goal is to support you optimizing your productivity and we love the idea to make you save your valuable time.

Your MTS Sensors Team

be certain.

E-SERIES
(EH, ET, EP, EL, EP2, ER, EE)

The Temposonics® E-Series are very compact sensor models suitable for situations where space-constrained mounting is a critical factor. MTS Sensors offers different designs to meet the needs of various industrial applications.

This series features three rod models for in-cylinder integration: EH, ET, EE (embedded in cylinder) and three profile models with a slim housing: EP, EL and EP2. On the EP2 sensor, the position magnet can travel along the entire flat housing profile.
The ER sensor has an aluminum cylinder with a guided driving rod which contains both the sensor element and the electronics. The position is detected via the solid extractable driving rod.

Typical applications for E-Series sensors are plastics processing, food & beverage processing, control systems and packaging.

Output (resolution)

	EH	ET	EP / EL	EP2	ER	EE
Current	Infinite	16 bit*	Infinite	Infinite	Infinite	Infinite
Voltage	Infinite	16 bit*	Infinite	Infinite	Infinite	–
Start/Stop	**	**	**	**	**	–
SSI	20 µm	5 µm	20 µm	20 µm	20 µm	–
CANopen	10 µm	–	10 µm	10 µm	10 µm	–
IO-Link	5 µm	–	5 µm	5 µm	5 µm	–

Operating conditions

Temperature	EH / EP / EL / EP2 / ER:	–40…+75 °C (–40…+167 °F)
	ET (Analog):	–40…+85 °C (–40…+185 °F)
	ET (SSI):	–40…+90 °C (–40…+194 °F)
	ET (Start/Stop):	–40…+105 °C (–40…+221 °F)
	EE:	–40…+85 °C (–40…+185 °F)
Shock test	100 g (single shock), IEC standard 60068-2-27	
Vibration test	EH / EP / EL / EE:	15 g / 10…2000 Hz
	ET:	20 g / 10…2000 Hz
	EP2:	8 g / 10…2000 Hz
	ER:	5 g / 10…2000 Hz
	IEC standard 60068-2-6 (excluding resonant frequencies)	

Design

Stroke length	EH / EE:	50…2540 mm (2…100 in.)
	ET / EP / EL / EP2 :	50…3000 mm (2…118 in.)
	ER:	50…1500 mm (2…60 in.)

Accuracy

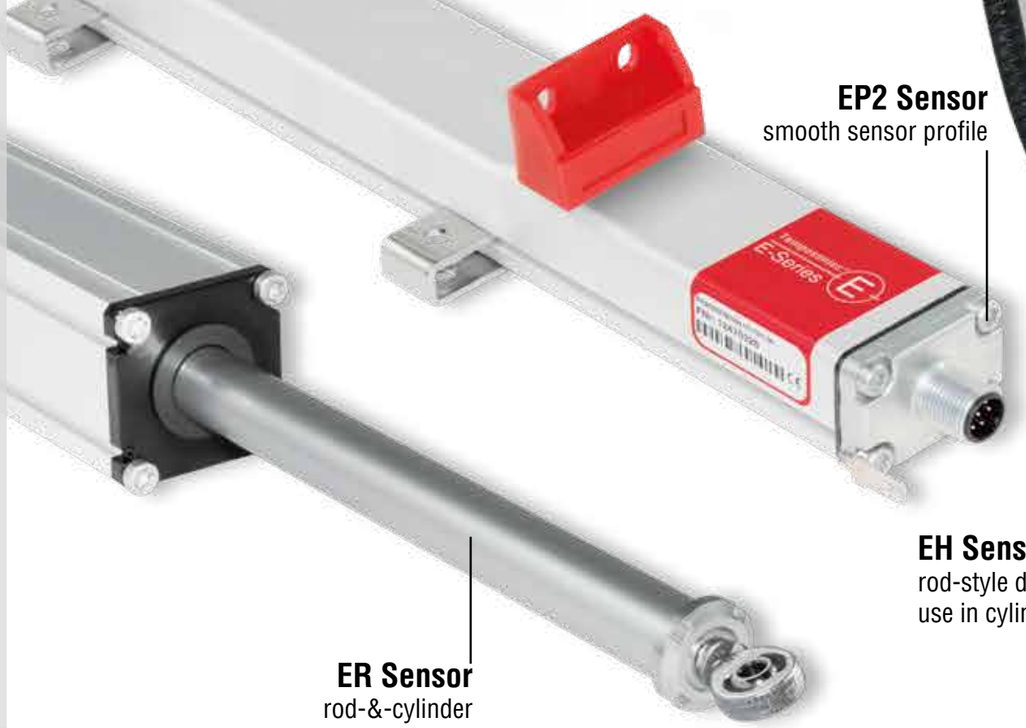
Linearity	≤ ±0.02 % F.S.

Electrical connection

Operating voltage	+24 VDC (–15 / +20 %)

* Minimum 1 µm depending on stroke length
** Controller dependent

More information available at:
www.mtssensors.com



EP2 Sensor
smooth sensor profile

ER Sensor
rod-&-cylinder housing with strong piston for flexible mounting

EL Sensor
ultra low profile-style

EP Sensor
profile-style

ET Sensor
ATEX certified & high temperature resistant

EH Sensor
rod-style designed for use in cylinders

EE Sensor
for embedded cylinder applications

G-SERIES
(GH, GP, GT2 / GT3, GTE)

The Temposonics® G-Series provides high durability and accurate position measurement solutions in harsh industrial settings. The sensor element is installed in a pressure-resistant stainless steel rod or aluminum profile. A double-shielded housing protects the electronics and offers excellent EMI immunity.

The GT2 / GT3 and GTE models feature multiple independent measuring systems contained in one compact housing. Each measuring system has its own channel with sensor element, power and evaluation electronics and output signal. The GTE model is embedded in a cylinder for added robustness. Example applications include control valves, fluid cylinders, turbine pitch control, ship control systems and floodgates.

Output (resolution)

	GH	GP	GT2 / GT3	GTE
Current	Infinite	Infinite	Analog	Infinite
Voltage	Infinite	Infinite	Analog	Infinite
Start/Stop	*	*	–	–
PWM	*	*	–	–

Operating conditions

Temperature	GH / GP:	–40…+80 °C (–40…+176 °F)
	GT2 / GT3:	–40…+75 °C (–40…+167 °F)
	GTE:	–20…+75 °C (–4…+167 °F)
Shock test	100 g (single shock), IEC standard 60068-2-27	
Vibration test	GH**:	15 g / 10…2000 Hz
	GP:	15 g / 10…2000 Hz
	GT2 / GT3:	5 g / 10…2000 Hz
	GTE:	10 g / 10…2000 Hz
	IEC standard 60068-2-6 (excluding resonant frequencies)	

Design

Stroke length	GH:	50…7620 mm (2…300 in.)
	GP:	50…5080 mm (2…200 in.)
	GT2 / GT3:	50…2900 mm (2…114 in.)
	GTE:	50…2540 mm (2…100 in.)

Accuracy

Linearity	< ±0.02 % F.S.

Electrical connection

Operating voltage	+24 VDC (–15 / +20 %)

* Controller dependent
** Option: High vibration resistant

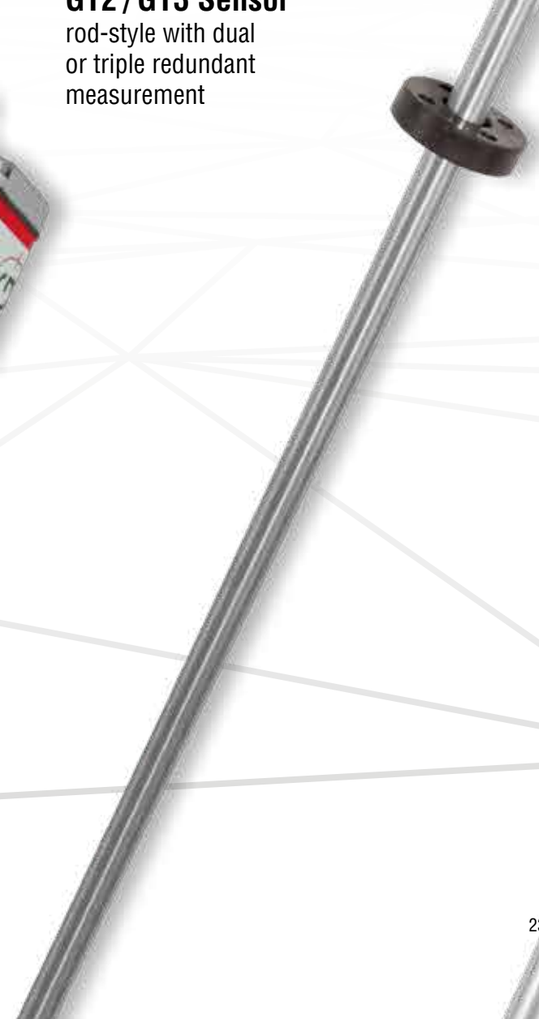
More information available at:
www.mtssensors.com

GTE Sensor
embedded rod-style with redundant measurement

GH Sensor
rod-style designed for use in cylinders

GP Sensor
profile-style

GT2 / GT3 Sensor
rod-style with dual or triple redundant measurement



GB-SERIES
(with threaded flange or pressure fit flange)

The Temposonics® GB-Series is designed to be incorporated into hydraulic cylinders, such as those typically used in power generation plants. The flat, compact electronics housing facilitates deployment in restricted spaces.

The operational advantages of these sensors are: high pressure resistance (the new GB-J sensor offers up to 800 bar operating pressure), strong immunity to EMI and ability to operate in temperatures up to +100 °C (+212 °F). High durability and increased resistance to rust is achieved by using 316L stainless steel (GB-N model). GB-Series sensors can be programmed using a hand-programmer unit, through the USB port.

The GB with threaded flange (GB-M / GB-T) offers further advantages such as a sensor electronics housing with its electrical connection that can be rotated 360 degrees to easily achieve the necessary connection orientation. If needed, the sensor element and electronics can be replaced while the flange is still installed in the cylinder. This means that the hydraulic circuit is not interrupted which results in lower maintenance costs and reduced downtime.

Output (resolution)	
Current	16 bit
Voltage	16 bit
SSI	5 µm

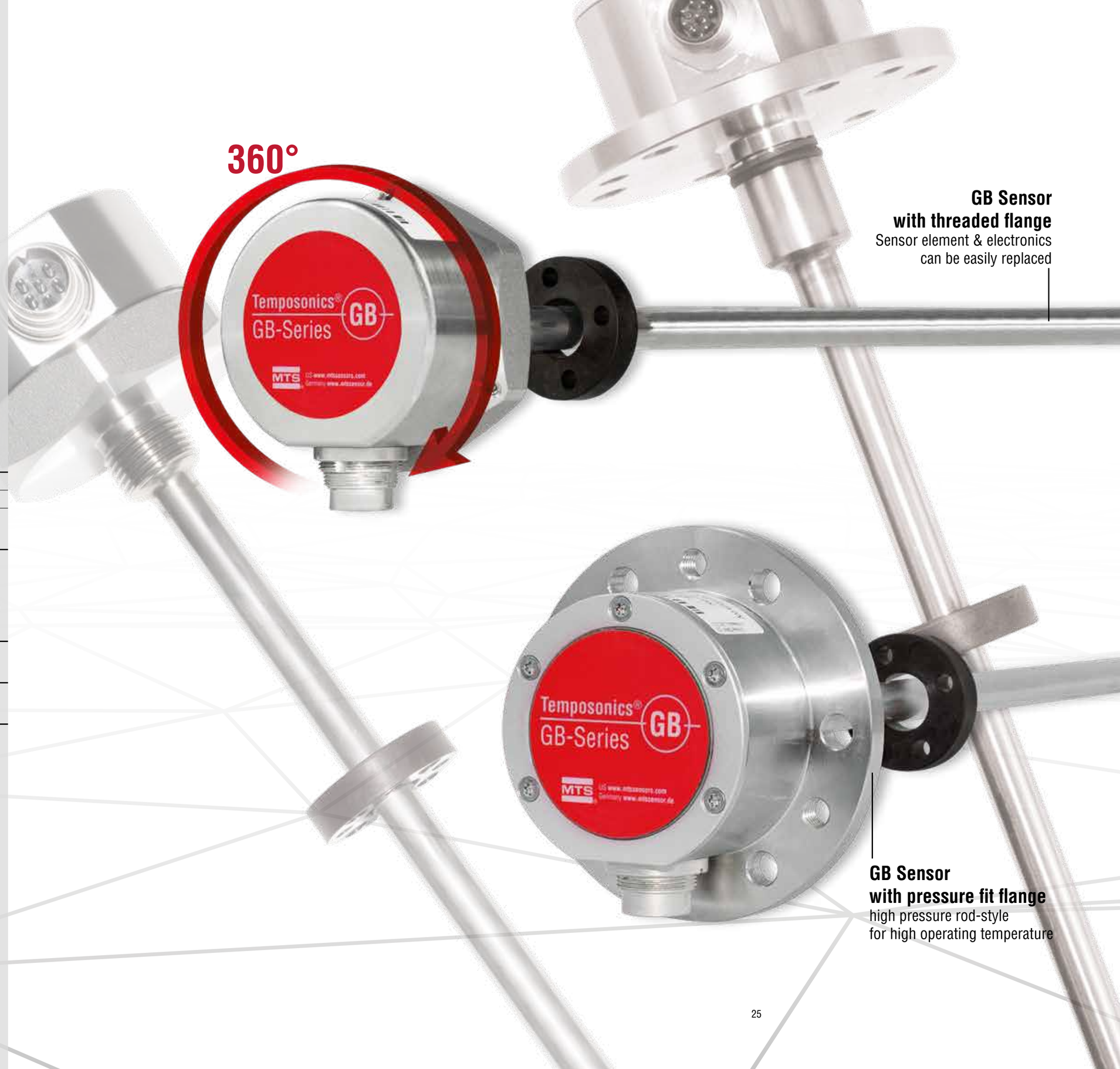
Operating conditions	
Temperature	–40…+100 °C (–40…+212 °F)
Shock test	100 g (single shock), IEC standard 60068-2-27
Vibration test	15 g / 10…2000 Hz IEC standard 60068-2-6 (excluding resonant frequencies)

Design	
Stroke length	25…3250 mm (1…128 in.)

Accuracy	
Linearity	< ±0.02 % F.S.

Electrical connection	
Operating voltage	+24 VDC (–15 / +20 %)

More information available at:
www.mtssensors.com



GB Sensor
with threaded flange
Sensor element & electronics
can be easily replaced

GB Sensor
with pressure fit flange
high pressure rod-style
for high operating temperature

R-SERIES V
The new generation
(RH5, RP5)

R-Series V is the successor to our current fourth generation. The new sensors have higher resistance to vibration and high temperatures, are ready for Industry 4.0 and fit perfectly into existing applications.

The new Industry 4.0 features for all outputs offer users unique advantages, as they provide additional information about the process in addition to the pure process data (position/speed). Status and statistical data are recorded and processed during operation and can be used to better understand the processes within the application.

In combination with the increased performance and improved robustness, the user is offered the certainty that existing applications work even more reliably and that future requirements are already being met.

Output (resolution)

	RH5	RP5
Current	16 bit	16 bit
Voltage	16 bit	16 bit
SSI	0.1 µm	0.1 µm
EtherCAT®	0.5 µm	0.5 µm
EtherNet/IP™	1 µm	1 µm
POWERLINK	0.5 µm	0.5 µm
PROFINET	0.5 µm	0.5 µm

Operating conditions

Temperature	–40…+85 °C (–40…+185 °F)
Shock test	150 g / 11 ms, IEC standard 60068-2-27
Vibration test	30 g / 10…2000 Hz IEC standard 60068-2-6 (excluding resonant frequencies)

Design

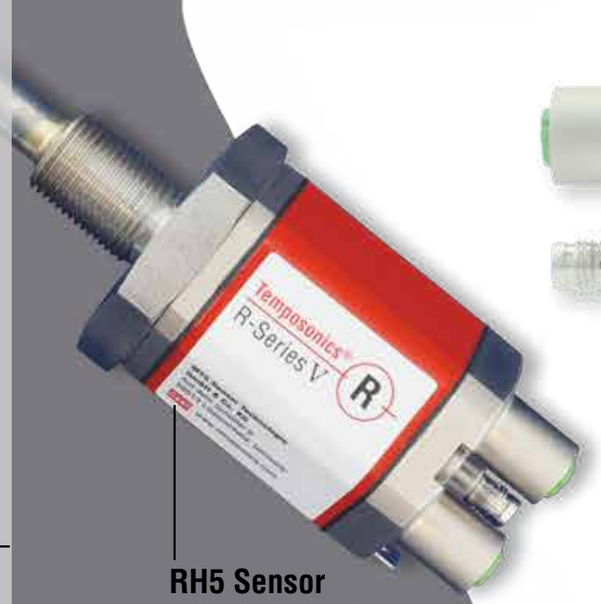
Stroke length	RH5: 25… 7620 mm (1…300 in.) RP5: 25… 6350 mm (1…250 in.)

Accuracy

Linearity deviation	< 0.01 % F.S. (minimum ≤ ±50 µm)

Electrical connection

Operating voltage	+12…30 VDC ±20 % (9.6…36 VDC)



RH5 Sensor
rod-style designed
for use in cylinders

RP5 Sensor
profile-style

TempoLink Smart Assistant for R-Series V

The TempoLink smart assistant supports the integration of the sensor into the application and the transfer of additional information to the user. With the assistant, the user can call up data such as the current sensor status, the internal sensor temperature, the number of operating hours and the distance travelled by the position magnets. An evaluation of these values can help in the creation of predictive maintenance plans and thus lead to an optimization of production.

The connection and communication between the Temposonics® R-Series V sensor and the TempoLink smart assistant is via the power supply. The assistant can transfer the various sensor parameters wirelessly or via the USB port while the sensor continues to operate.

Because the TempoLink smart assistant provides its own WiFi access point, WiFi-enabled devices such as smartphones, tablets or laptops can access it very easily. No software installation or app is required, nor is access to a company network.

R-SERIES
(RH, RP, RF, RD4, RT4, RS)

The Temposonics® R-Series features the highest performance, accuracy and reliability in magnetostrictive linear position sensors designed for advanced motion control implementations. With a variety of housing styles and electrical interfaces, the R-Series can be integrated into a wide range of applications. They have a modular construction and are extremely robust. The double-shielded design assures the best immunity against EMI. Whether it is a rod version (RH), profile version (RP), has detached electronics (RD4), built-in redundancy (RT4) or a flexible rod (RF), the R-Series is a highly compelling sensor solution. For extremely harsh environments MTS Sensors offers the RS sensor with IP69K protective housing.

Output (resolution)

	RH	RP	RF	RD4	RT4	RS
Current	16 bit	16 bit	16 bit	16 bit	–	16 bit
Voltage	16 bit	16 bit	16 bit	16 bit	–	16 bit
SSI	0.5 µm	0.5 µm	2 µm	1 µm	1 µm	0.5 µm
Profibus	1 µm	1 µm	1 µm	1 µm	–	1 µm
CANbus	2 µm	2 µm	2 µm	2 µm	–	2 µm
DeviceNet	2 µm	2 µm	2 µm	2 µm	–	–
EtherCAT®	1 µm	1 µm	1 µm	1 µm	–	1 µm
EtherNet/IP™	1 µm	1 µm	1 µm	1 µm	–	–
POWERLINK	1 µm	1 µm	1 µm	1 µm	–	–
PROFINET	1 µm	1 µm	1 µm	1 µm	–	–

Operating conditions

Temperature	–40…+75 °C (–40…+167 °F)
Shock test	100 g (single shock), IEC standard 60068-2-27
Vibration test	RH / RP*: 15 g / 10…2000 Hz RF: 5 g / 10… 150 Hz RD4: 10 g / 10…2000 Hz RT4: 5 g / 10…2000 Hz IEC standard 60068-2-6 (excluding resonant frequencies)

Design

Stroke length	RH: 25… 7620 mm (1…300 in.) RP / RD4: 25… 5080 mm (1…200 in.) RF: 150…20000 mm (6…787 in.) RT4: 25… 2540 mm (1…100 in.) RS: 50… 7620 mm (1…300 in.)

Accuracy

Linearity	RH / RP / RS: < ±0.01 % F.S. RF / RD4 / RT4: < ±0.02 % F.S.

Electrical connection

Operating voltage	+24 VDC (–15 / +20 %)

*Option: High vibration resistant

More information available at:
www.mtssensors.com

RT4 Sensor
redundant sensor with detached electronics

RH Sensor
rod-style designed for use in cylinders

RF Sensor
flexible sensor rod for stroke lengths up to 20 m

Diagnostics LEDs

RP Sensor
profile-style

RS Sensor
with IP69K protective housing

RD4 Sensor
with detached sensor electronics

T-SERIES
(TH)

The Temposonics® T-Series sensors are designed for hazardous working environments, where they may have to deal with flames, caustic substances and potentially explosive atmospheres (such as chemical plants, offshore oil/gas rigs, etc.).

They are the first linear position sensors in the industry to meet SIL 2 standards. In addition to this, all T-Series sensors carry the ATEX certification for Europe, the NEC and CEC certificates for the US and Canada, the EAC Ex certificate for the Russian market, the IECEx certificate for the global market, the KCs certificate for the south korean market as well as the Ex certificate for Japan for use in Class I, II, III, Division 1, Division 2 and Zone 0/1, Zone 1, Zone 2, Zone 21 and Zone 22.

Output (resolution)	
Current	Minimum 16 bit
SSI	Minimum 0.5 µm
CANbus	Minimum 2 µm

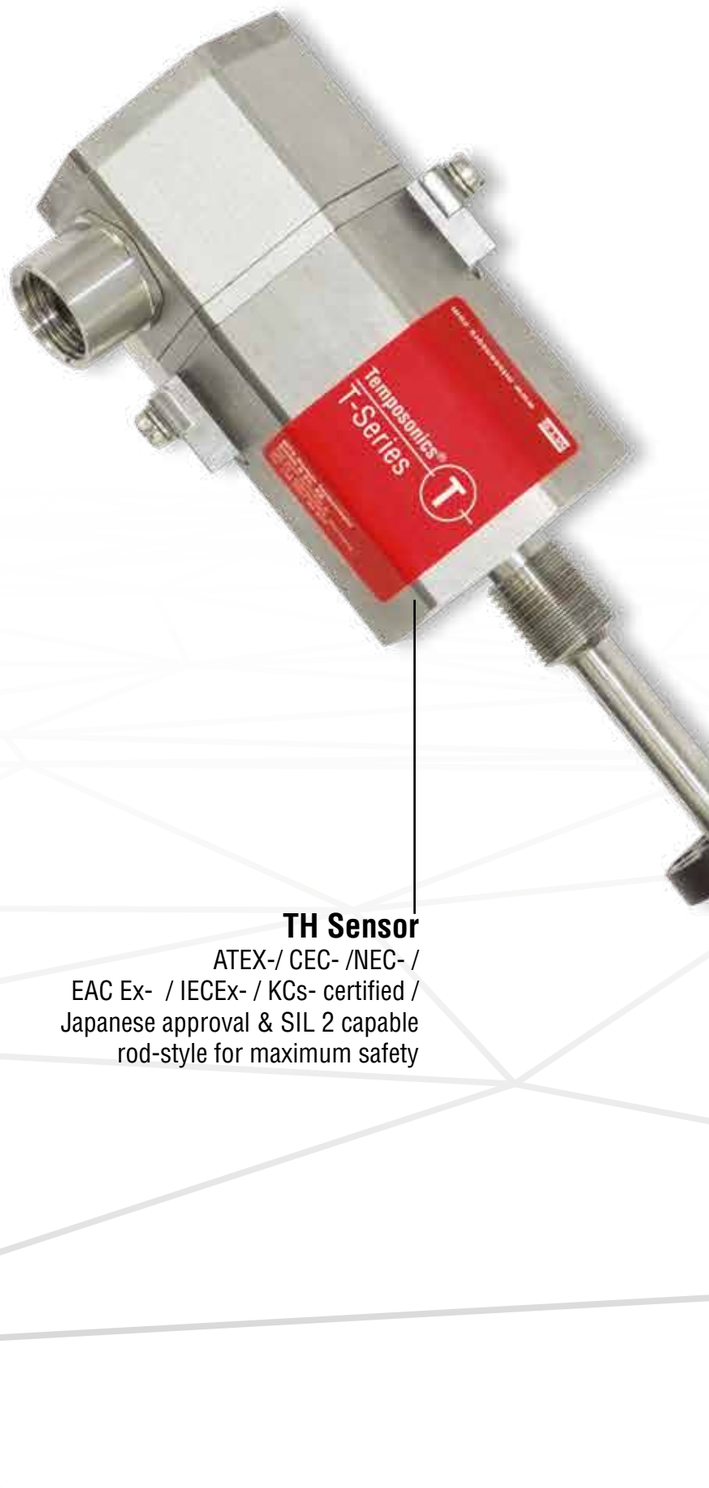
Operating conditions	
Temperature	Standard: –40…+75 °C (–40…+167 °F) SIL 2: –40…+85 °C (–40…+185 °F)
Shock test	100 g (single shock), IEC standard 60068-2-27
Vibration test	15 g / 10…2000 Hz IEC standard 60068-2-6 (excluding resonant frequencies)

Design	
Stroke length	Standard: 25…7620 mm (1…300 in.) SIL 2: 25…1500 mm (1…60 in.)

Accuracy	
Linearity	< ±0.01 % F.S.

Electrical connection	
Operating voltage	+24 VDC (–15 / +20 %)

More information available at:
www.mtssensors.com



TH Sensor
ATEX-/ CEC- /NEC- /
EAC Ex- / IECEx- / KCs- certified /
Japanese approval & SIL 2 capable
rod-style for maximum safety

HAZARDOUS AREAS

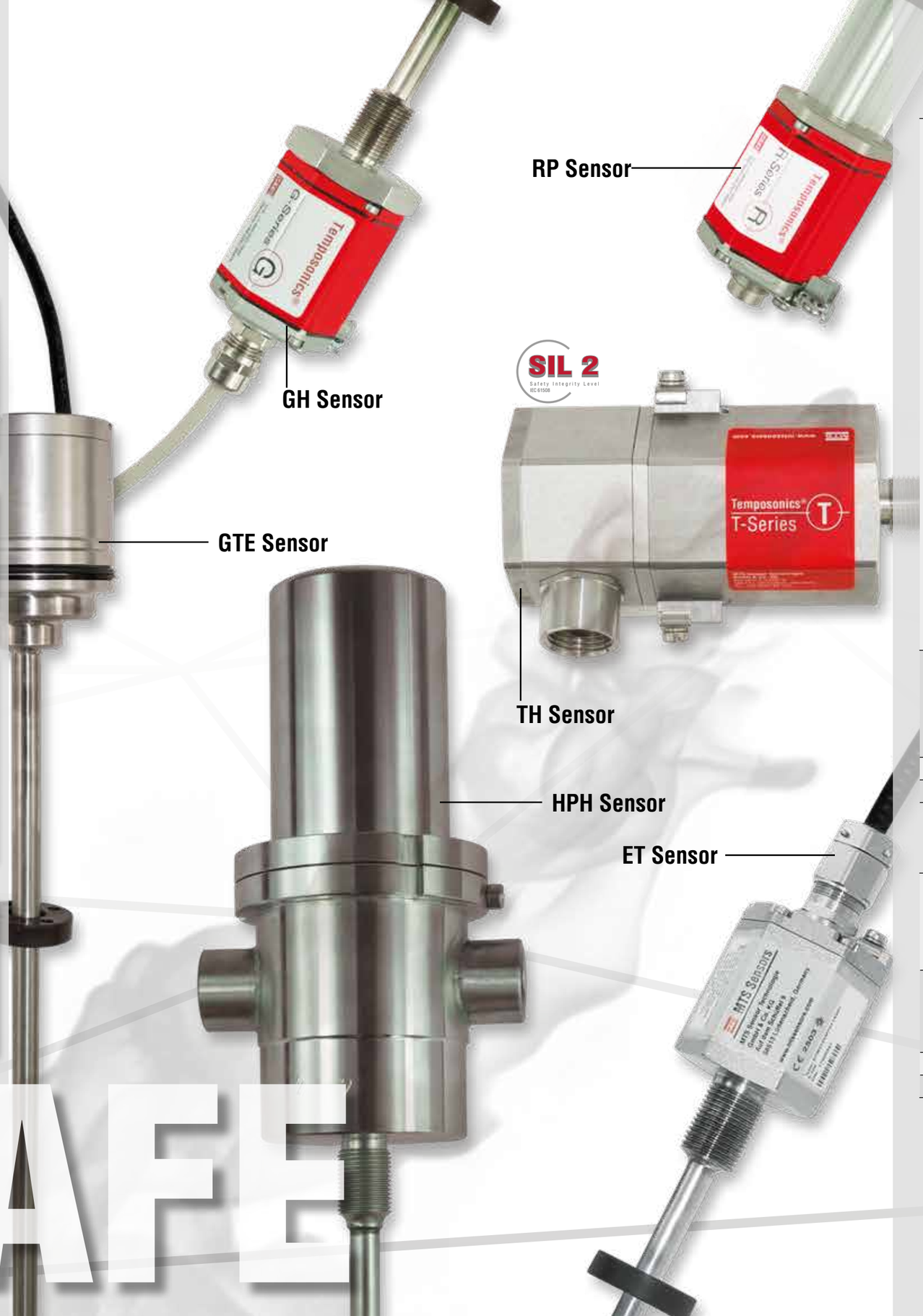
MTS Sensors responds to the user's need of maximum safety with sensor models specifically designed for applications found in hazardous (increased safety & flameproof) and functional safety (SIL) regulated environments.

	G-Series GH/GP
Stroke length	50…1650 mm (2…65 in.)
Marking	Ⓔx II 3G Ex nA IIC T4 Gc Ⓔx II 3D Ex tc IIIB T100°C Dc IP65/67
Operating temperature	–20 °C (–4 °F) ≤ Ta ≤ 75 °C (+167 °F)
IP ingress protection	GH: IP67 / GP: IP65
Outputs	Analog & Start/Stop

	G-Series GTE
Marking	Ⓔx II 3G Ex nA IIC T4 Gc
Operating temperature	–20…+75 °C (–4…+167 °F)
IP ingress protection	IP64
Output	Analog

	HPH (G-/R-Series)
Marking	Ⓔx II 2G Ex db IIC T5 Gb Ⓔx II 2D Ex tb IIIC T100°C Db Class 1, Div 1, Groups A, B, C, D
Operating temperature	–40…+75 °C (–40…+167 °F)
IP ingress protection	IP68
Outputs G-Series	Analog, Start/Stop & PWM
Outputs R-Series	Analog, Profibus, CANbus, SSI & DeviceNet

	R-Series RH/RP
Stroke length	50…1650 mm (2…65 in.)
Marking	Ⓔx II 3G Ex nA IIC T4 Gc Ⓔx II 3D Ex tc IIIB T100°C Dc IP65/67
Operating temperature	–20 °C (–4 °F) ≤ Ta ≤ 75 °C (+167 °F)
IP ingress protection	RH: IP67 / RP: IP65
Outputs	Analog, CANbus & SSI



	T-Series TH
Marking	**Enclosure type D/G:** Ⓔx II 1/2G Ex db IIC T4 Ga/Gb Ⓔx II 1G/2D Ex tb IIIC T130°C Ga/Db EAC Ga/Gb Ex db IIC T4 X Da/Db Ex tb IIIC T130°C X Ex d IIC T4 Ex tb IIIC T130°C Japanese approval: Ex d IIC T4 Ga/Gb Ex t IIIC T130°C Db **Enclosure type G:** Class I Div. 1 Groups A, B, C, D T4 Class II/III Div. 1, Groups E, F, G T130°C Class I Zone 0/1 AEx d / Ex d IIC T4 Class II/III Zone 21 AEx tb / Ex tb IIIC T130°C Group A is not approved for Canada **Enclosure type E:** Ⓔx II 1/2G Ex db eb IIC T4 Ga/Gb Ⓔx II 1G/2D Ex tb IIIC T130°C Ga/Db EAC Ga/Gb Ex db eb IIC T4 X Da/Db Ex tb IIIC T130°C X Ex d e IIC T4 Ex tb IIIC T130°C Japanese approval: Ex d e IIC T4 Ga/Gb Ex t IIIC T130°C Db **Enclosure type E with SIL 2** Class I Div. 2 Groups A, B, C, D T4 Class II/III Div. 2 Groups E, F, G T130°C Ex nA/AEx nA IIC T4 AEx tb/ Ex tb IIIC T130°C
Operating temperature	**Standard version:** –40 °C (–40 °F) ≤ Ta ≤ 75 °C (+167°F) **Enclosure type D / G SIL 2 version:** –40 °C (–40 °F) ≤ Ta ≤ 85 °C (+185 °F) **Enclosure type E SIL 2 version:** –40 °C (–40 °F) ≤ Ta ≤ 80 °C (+176 °F)
IP ingress protection	IP66 / IP67
Outputs	Analog, CANopen & SSI

	E-Series ET
Marking	Ⓔx II 3G Ex nC IIC T4 Gc Ⓔx II 3D Ex tc IIIC T130 °C Dc Class I/II/III Div 2 T4 ABCDFG Class I Zone 2 T4 IIC Zone 22 AEx tc / Ex tc IIIC T130 Dc
Operating temperature	–40 °C (–40 °F) ≤ Ta ≤ 85 °C (+185 °F) (Analog) –40 °C (–40 °F) ≤ Ta ≤ 105 °C (+221 °F) (Start/Stop) –40 °C (–40 °F) ≤ Ta ≤ 194 °C (+381 °F) (SSI)
IP ingress protection	IP66 / IP68
Outputs	Analog, Start/Stop & SSI

Ⓔx SAFE

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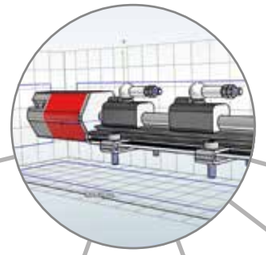

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