



Highly Sensitive, Safe and
reliable. Sensor Technology
for Pneumatic Cylinders

AVENTICS™ Sensor Technology

Intelligent sensor technology –
the foundation for precision and reliability



Intelligent sensor technology – the foundation for precision and reliability

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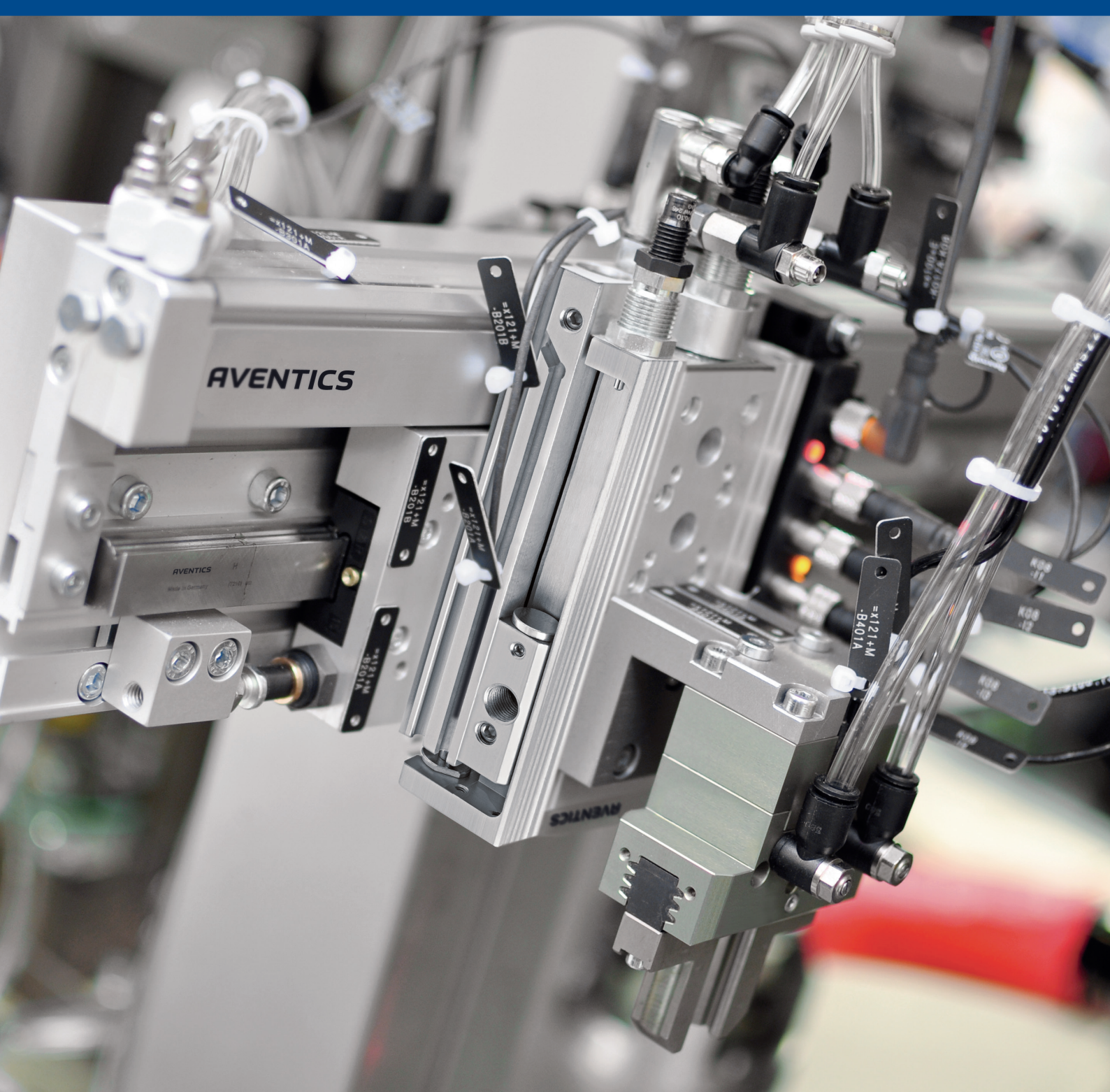
There is no such thing as semi-precise. In our work, we accept nothing less than absolute precision. Anything else would be a contradiction in terms. In automation technology, tolerance has its limits, which are extremely narrow. Processes demand precision; controls require accurate signals. These tasks are a perfect fit for sensor technology from Emerson.

The right sensor solutions for every cylinder application

- Broad range of first-class components
- Specific application experience and cross-technology expertise in different industries

Together with our customers, we have worked for decades to develop our experience and a product portfolio that is precisely tailored to meet the needs of the respective industry. Take advantage of our experience and talk to our industry experts – available around the world wherever you need them!





The choice is yours. We offer a wide range of sensors for pneumatic cylinders with complex, highly innovative sensor solutions and unparalleled operating ease of use, as well as many sensors for standard tasks. Always perfectly matched to your application.

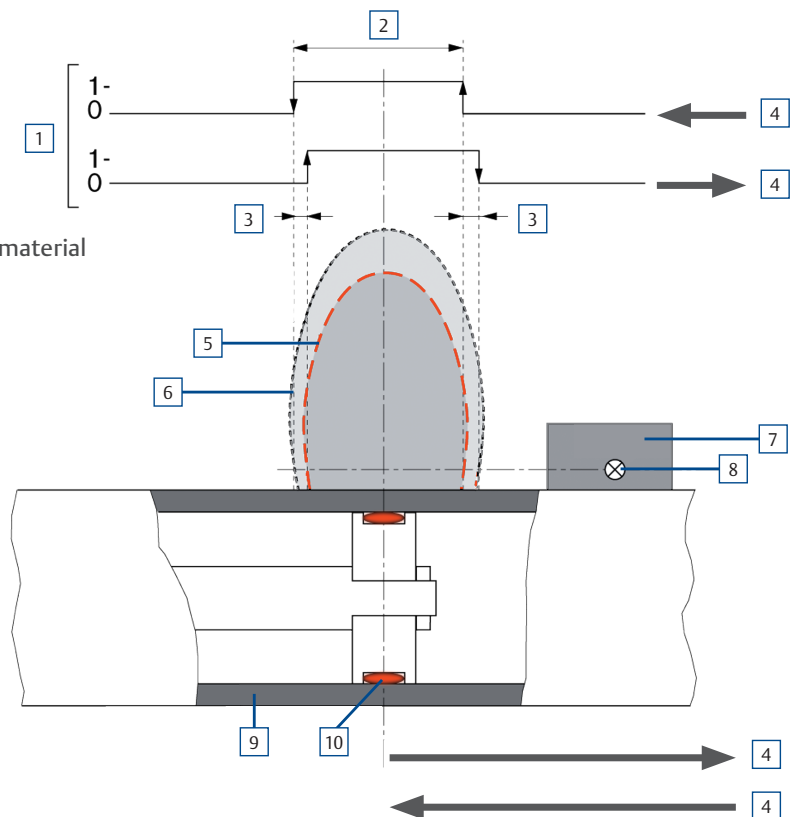
Invisible but detectable: Sensors measure changes in magnetic fields

Magnetic proximity switching in pneumatic drives

Different sensor technologies are used to confirm the piston position of a pneumatic cylinder and to input signals into the control system. Depending on the measurement task and application, simple electric magnetic sensors or complex non-contact electronic sensors may be the right choice. All sensor types use the measurability of changes in magnetic fields as their basic functional principle. On a cylinder with a non-ferromagnetic cylinder tube, a magnetically sensitive sensor is mounted externally and operated by the magnetic field of a permanent magnet integrated into the cylinder piston. With proximity sensors, piston movement within the sensor range intensifies magnetic induction, and the sensor reacts as soon as a specific threshold is reached. In contrast, distance measuring sensors work according to the Hall effect principle.

Sensor switching characteristics

- 1 | Sensor output signals
- 2 | Response travel
- 3 | Hysteresis
- 4 | Piston moving direction
- 5 | Switching threshold "ON"
- 6 | Switching threshold "OFF"
- 7 | Sensor
- 8 | Sensor element position
- 9 | Cylinder tube made from non-ferromagnetic material
- 10 | Permanent magnet (ring-shaped)



The travel difference between the switch-off and switch-on points after reversing the direction of travel is referred to as hysteresis.

The response travel is the difference between the switch-on and switch-off points when moving past the sensor in one direction of travel.

The reproducibility of the switch-on point when passing from the same direction is approx. 0.1 mm (at constant temperature).

The values for the hysteresis and response travel largely depend on the type of sensor and the cylinder diameter.

Fundamentals

Sensor technology uses the principle of magnetic proximity switching for non-contact measurements and signals

Various sensor technologies

Various sensor principles are used in automation technology. Depending on the application, you may choose from electrical cylinder sensors based on reed contacts with contact blades or fully electronic, absolutely contact-free sensors with semiconductor elements.

Electric sensors (Reed)

For the electric sensor with Reed contact, two contact studs in a small glass tube are oppositely magnetized by the magnetic field of the piston ring magnet. The Reed contact is closed and can be evaluated by the control.

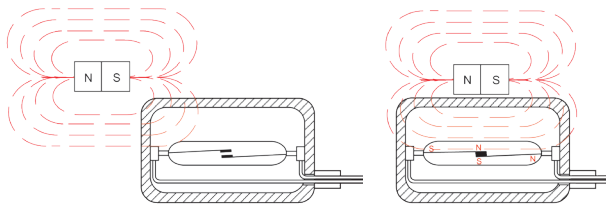
System display of different sensor technologies using the AVENTICS ST6 sensor series as an example

ST6 with Reed

Reed sensor



Reed contact



Electronic sensors (PNP, NPN)

Electronic sensors operate on a completely non-contact basis and consist of a magnetically sensitive semi-conductor sensor element and sensor electronics with a threshold value switch. When a certain magnetic induction value is exceeded, a signal is generated and transmitted to the control via an output stage.

GMR effect sensors

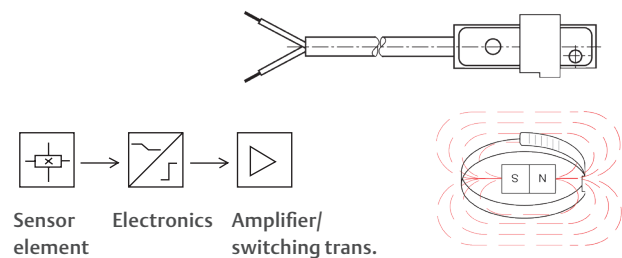
A GMR sensor element consists of two oppositely magnetized conductive layers separated by an insulating layer. If a magnetic field acts on these layers, the magnetic fields align themselves in the same direction. This results in a change in the electric resistance, which can be measured and used as signal information.

ST6 with GMR

Electronic magnetic field sensor



The electronic magnetic field sensor



Hall effect sensors

Electrical current flows through a thin semi-conductor wafer. A magnetic field is applied at a right angle to the wafer surface. This causes the charge carrier in the element to be diverted from the current flow direction, which can be measured as Hall voltage at a right angle to the direction of current.

AVENTICS High-tech sensors from Emerson – providing new impulses in automation technology

Quality and reliability

Nothing gets past AVENTICS high-tech sensor technology. Inquisitive and diligent, honest and confident. Always the right impulses for reliable process control, precisely when you need it: the fundamental prerequisite for reliable quality and process repeatability.

Perfectly matched sensors and cylinders

Perfect harmony for excellent system operation. Well –acquainted products communicate with ease; information never goes missing. The AVENTICS sensor range has it all – practical experience, reliable quality and cutting-edge innovations:

- Distance measuring sensors that not only measure piston positions, but also distances traveled
- Two-point sensors with “eyes” in the front and back of their “heads”

Precision. Down to the last millisecond

Highly sensitive sensor technology is increasingly important in factory automation. Ever faster processes, shorter cycle times and the trend toward greater precision, especially in small handling, require uncompromising accuracy. AVENTICS sensors set standards in this area. Some control technologies are actually not able to process their measurements quickly enough, so the sensors have to be slowed down through artificial signal stretching.



Systematic, user-oriented, proven – the AVENTICS sensor range

Cylinder sensors with comprehensive technology for targeted use

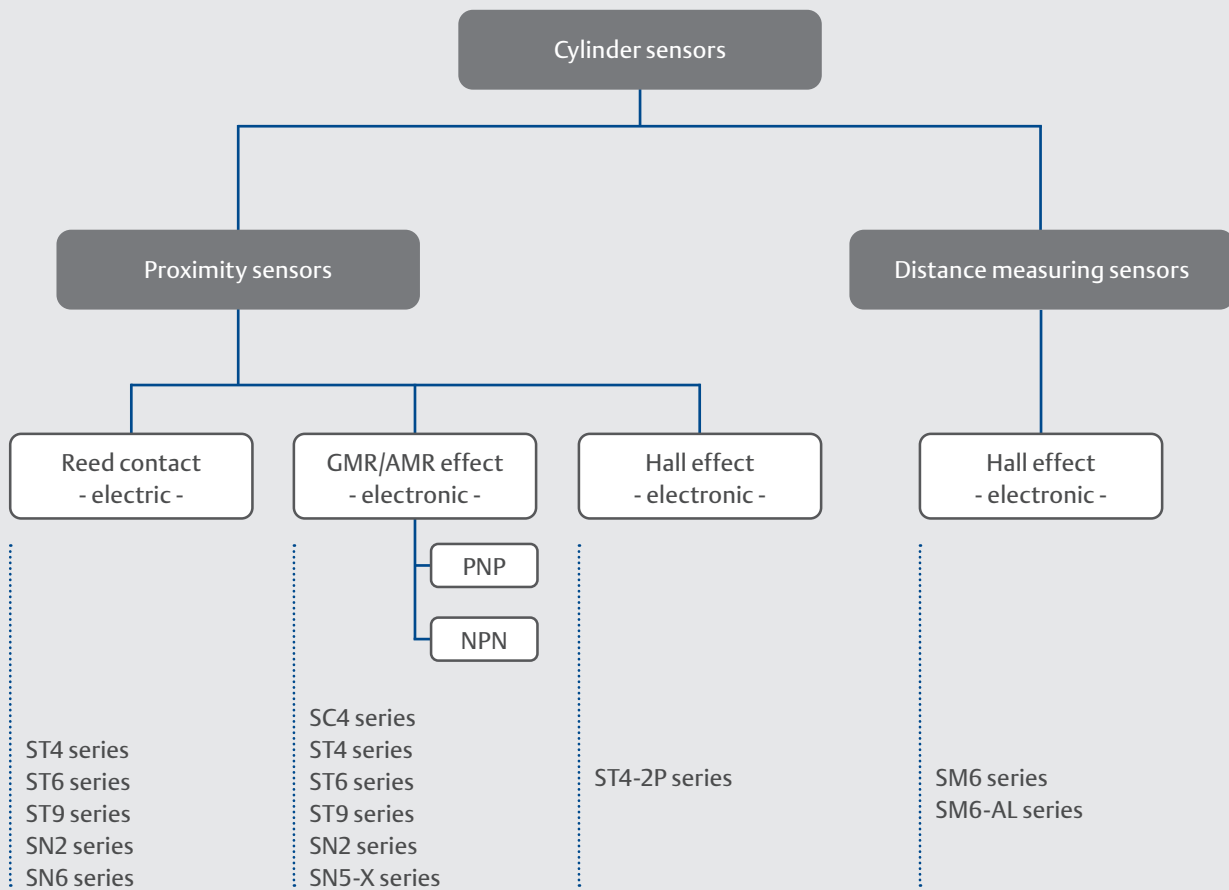
An extensive range of sensor technologies needs to reflect a multitude of applications, as well as highly individual machine designs, control systems and working environments. AVENTICS product range is well equipped to meet diverse requirements and always has the right solutions at hand. Whether you need distance measuring sensors or proximity sensors, electronic or electric solutions – with an optimum sensor/magnet combination tailored to the AVENTICS cylinder series, reliable functioning is a given.

Comprehensive product range

To account for all possibilities, in addition to sensors from its core series, Emerson offers a wide range of additional sensor series and sensors with specific extra features.

- Sensors for all conventional sensor nuts
- Special sensor mountings for all cylinder series for assembly without a slot
- ATEX sensors, welding-proof sensors, sensors with pulse stretching, heat and cold-resistant sensors, sensors with UL approval
- Optional connection types M8, M12, and open cable ends
- Versions with “+” output switching (PNP) or “-” output switching (NPN)

AVENTICS sensor concept




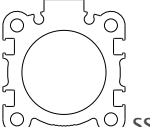
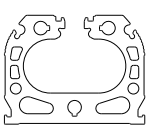
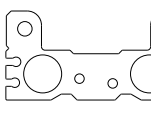
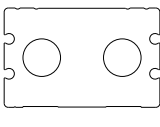

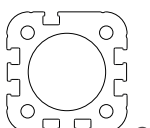
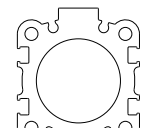
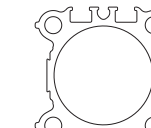
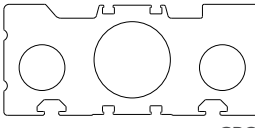

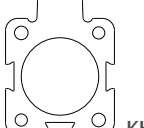
For further information on these or any other AVENTICS product, visit Emerson.com



Mountings, nut geometries and compatibility

From the cylinder to the right sensor

From rodless cylinders with large travel distances to the smallest short-stroke cylinders, or from guided slides and pneumatic grippers of a handling system to sturdy ISO standard cylinders – it's good to know that suitable sensors are available for every type of pneumatic actuator. An additional major advantage is being able to rely on sensors from the same product family that can be used in a wide variety of contexts. Just like the sensors offered by Emerson.

Examples of AVENTICS nut geometries				
Sensor nut	Cylinder series			
 <p>4 mm C-nut</p>	 <p>SSI</p>	 <p>RTC</p>	 <p>MSC</p>	 <p>RCM</p>
 <p>6 mm T-nut</p>	 <p>CCI</p>	 <p>SSI</p>	 <p>PRA</p>	 <p>GPC</p>
 <p>Dovetail nut</p>	 <p>KHZ</p>			


























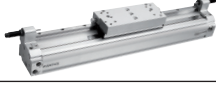
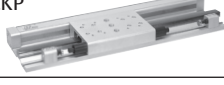




Installation in nuts or with sensor mountings

The most elegant method to position sensors in the cylinder profile is to use the sensor nuts provided for mounting. They require no additional installation space and can be easily positioned and secured with only a single turn. For mounting independent from the nut geometry, specifically developed sensor mountings are available for all sensors, cylinders and application conditions.

Examples of sensor mountings								
CB1 series								
Sensors	ST6, SN1, SN2	ST6, SM6	ST4, ST6	ST6	SN1, SN2	SM6, SM6-AL, ST6, SN2	ST6	SM6-AL
Cylinders	TRB, CVI, 523	MNI, ICM	MNI, ICM, CSL-RD	KHZ	MNI	ITS	ICL	RTC

Nut geometries

Overview of the basic compatibility between the sensor series and cylinder series

Recommended sensors for on-cylinder mounting: - via the nut: ● - via sensor mounting: ○							
							
	SM6 series Page 10	SM6-AL series Page 11	ST4 series Page 12	ST4-2P series Page 13	ST6 series Page 14	ST9 series Page 15	SN2 series Page 16
MNI  ICM  ISO ISO	○		○	○	○		○
CSL 			○	○	○		
RPC 					○		
CCI/KPZ  ISO	●				●		
SSI 	●		●	●	●		
KHZ 					○	●	
PRA/CVI  ISO	●	○	●	●	●		○
TRB/CVI  ISO	○				○		○
ITS  ISO	○	○			○		○
ICL  ISO					○		
RTC 		○	●	●	○		
GSU/CKP 			●	●			
GPC 	●		●	●	●		
MSC 			●	●			
MSN 			●	●			
RCM 			●	●			

SM6 sensor series

SM6 sensor series – analog distance measuring sensors for cylinders with 6 mm T-nut

Excellent sensor technology with a flexible measurement range.

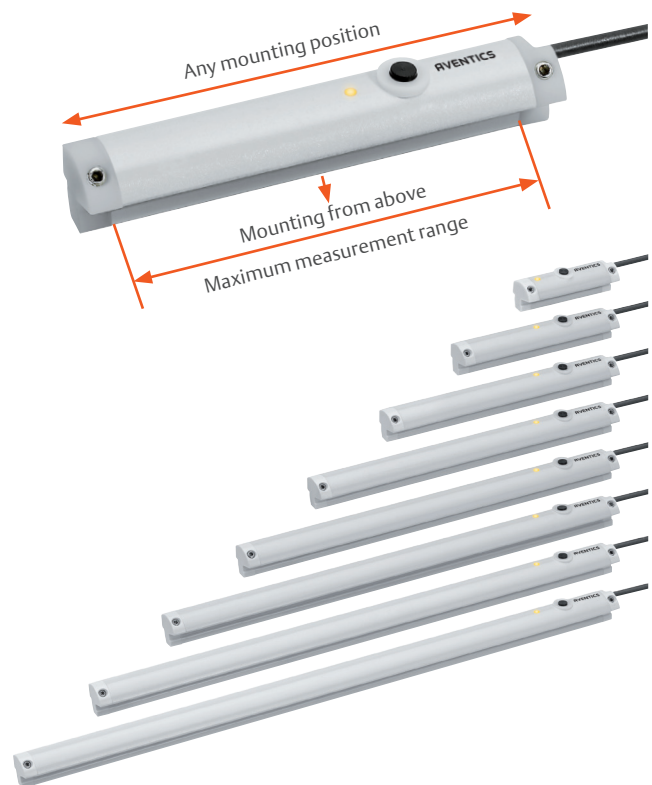
The sensors from the SM6 series allow the piston position on a pneumatic cylinder to be measured with high precision and ease. The SM6 can be used with all standard cylinders – special cylinders are not required. Thanks to simple mounting in the nut from above, flexible settings within the maximum distance measurement range and an extremely high proximity switching rate, the SM6 sensor is ideal for demanding automation solutions.

- Suitable for 6 mm nut
- Zero point and measurement range settings via teach-in button
- Choice of any mounting position and cable exit
- Mounting from above in the nut (“drop-in” mounting)
- High accuracy and linearity
- Excellent repeatability and reliability through proven Hall sensors
- Eight different sizes offered in the series to meet all required distance measurement ranges



SM6 sensor series

Series	SM6
Type of contact	Hall, electronic
Max. distance meas. range	32, 64, 96, 128, 160, 192, 224, 256 mm
Electric version	4-pin
Supply voltage	DC 15 to 30 V DC
Proximity switching interval	1 ms
Typical distance resolution	0.05 mm
Reproducibility	$\leq \pm 0.1$ mm
Linearity deviation	0.3 mm
Analog output, current	4 to 20 mA
Analog output, voltage	0 to 10 V DC
Typical idle current	25 mA
Protection class	IP65, IP67
Ambient temperature	-20 to +70 °C
Connection variants	Free wire ends, M8



Connection variants:



SM6-AL sensor series

SM6-AL sensor series – perfect distance measurement and high operating comfort

Sensor for continuous recording of piston movements

The analog SM6-AL distance measuring sensor enables high-resolution distance measurement and exact positioning in measurement ranges from 107 to 1007 millimeters. The distance measuring sensor is thus perfectly suited for the continuous recording of piston movements in pneumatic cylinders and is an ideal solution for cylinders with medium and long strokes. The robust, chemical-resistant aluminum housing, as well as a cable sleeve support, guarantee a long sensor service life and reduce maintenance costs.

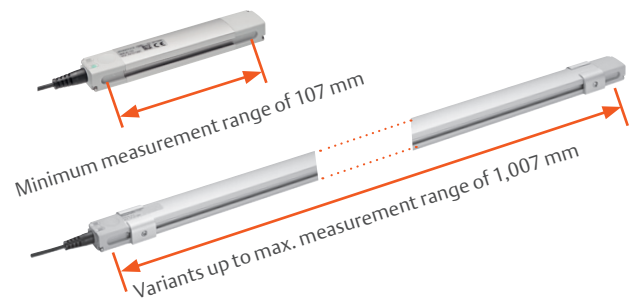
- Zero point and measurement range settings via teach-in button
- Choice of any mounting position and cable exit
- High accuracy and linearity
- Excellent repeatability and reliability through proven Hall sensors
- A flexible selection of sizes is offered in the series to meet all required distance measurement ranges
- Convenient communication via IO-Link with teach pad and 4-color LED display



SM6-AL sensor series

Series	SM6-AL
Type of contact	Hall, electronic
Max. distance meas. range	107 to 1,007 mm
Electric version	4-pin
Supply voltage	DC 15 to 30 V DC
Proximity switching interval	<1.15 ms
Typical distance resolution	<0.03 % FSR
Reproducibility	≤ 0.06 % FSR
Linearity deviation	0.5 mm
Analog output, current	4 to 20 mA
Analog output, voltage	0 to 10 V DC
Typical idle current	35 mA
Protection class	IP65, IP67
Ambient temperature	-20 to +70 °C
Connection variants	M8

FSR = Full Scale Range, max. measurement range



Connection variants:



ST4 sensor series

ST4 sensor series – our smallest sensor for handling technology

Precise, reliable, flexible, and user-friendly

High-tech in the smallest of spaces. Minimum dimensions the sensors in the ST4 series the right choice when every millimeter counts. They can be integrated in all pneumatic actuators and are ideal for small handling. The ST4 can be assembled quickly and easily with just a ¼ turn of the combination screw.

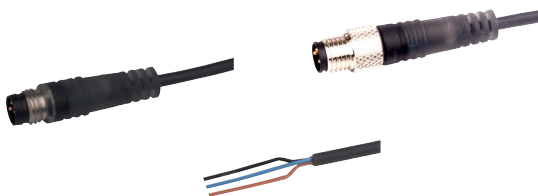
- Suitable for 4 mm C-nut
- Mounting from above in the nut (“drop-in” mounting)
- Robust housing, LED display
- Combined mounting screw with hexagon socket and slotted screw
- Captive screw, fixing via quarter turn



Series	ST4
Type of contact	Reed, electronic PNP, NPN, 3-pin
Dimensions in mm (LxHxW)	Approx. 23,7/26,3 x 4,7 x 2,9
Supply voltage	10-30 V AC/DC
Continuous current	100 mA
Switching point precision	± 0.1 mT
Protection class	IP65, IP67
Ambient temperature	-30 to +80°C
Connection variants	Free wire ends, M8, M12
Certificates	cULus, CE



Connection variants:



ST4 sensor series



ST4-2P sensor series

ST4-2P sensor series – the two-point sensor makes so many things even easier

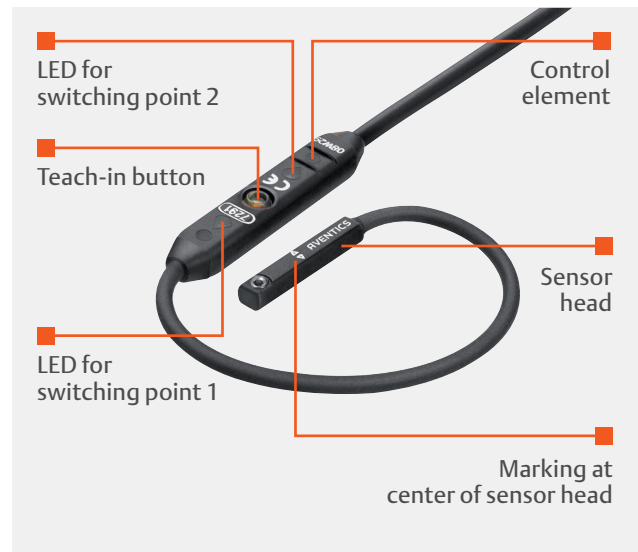
ST4-2P series with two switching points

ST4-2P series sensors make it possible to measure any two switching points in a 50 mm range using just one sensor in a 4 mm C-slot. As a result, there is no need to install a second sensor, making the process easier, faster, and more precise. Assembly and cabling effort is also halved. A serial interface is provided for diagnosis and configuration.

- Suitable for 4 mm C-nut
- Zero point and measurement range settings via teach-in button or IO-Link
- Versions with or without I/O link interface



Series	ST4-2P
Type of contact	Hall, make-contact 2 x PNP, 4-pin
Dimensions in mm (LxHxW)	Approx. 19,5 x 2,9 x 3,8
Supply voltage	12-30 V DC
Continuous current	≤ 100 mA
Reproducibility	≤ ± 0.1 mT at constant T
Protection class	IP65, IP67
Ambient temperature	-20 to +75 °C
Connection variants	Free wire ends, M8, M12



Connection variants:



ST4 sensor series



ST6 sensor series

ST6 sensor series – the classic sensor in automation for the 6 mm T-nut

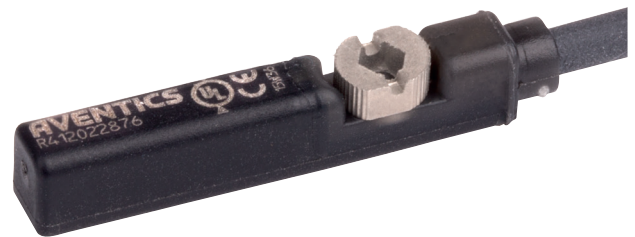
Universal use, flexible integration, and excellent form
ST6 series sensors are suitable for mounting in the 6 mm T-slot as well as sensor mounting to the cylinder. They are perfectly suited for mounting to all round cylinders, tie rod cylinders, and profile cylinders. With their optimized, compact shape, the sensors can be flush-fit into existing slots and integrated into any machine environment, even with sensor mounting. Retaining ribs on the side of the sensor enable simple mounting, including in hard-to-reach locations or for overhead assembly. The durable mounting screw holds the sensor in the desired position and can withstand shocks or vibrations.

- Universal sensors for the standardized 6 mm nut
- Mounting from above in the nut (“drop-in” mounting)
- Wide range of versions with different line lengths and connections
- Combined mounting screw with hexagon socket and slotted screw
- Captive screw, fixing via ¼ turn
- Reed and electronic PNP or NPN sensor versions
- Versions with ATEX certification or temperature resistance
- Protected against polarity reversal, short-circuit-resistant



Series	ST6
Type of contact	Reed, electronic PNP, NPN
Dimensions in mm (LxHxW)	Approx. 29.5/32.5 x 5.8 x 4.8/5.7
Supply voltage	10-30 V AC/DC, variants up to 230 V AC/DC
Continuous current	100 mA, 130 mA (Reed)
Switching point precision	± 0.1 mT
Protection class	IP65, IP67, IP68, IP69K
Ambient temperature	-40 to +80 °C, Heat-resistant variants up to 120 °C
Connection variants	Free wire ends, M8, M12
Electronic version	2-wire, 3-wire
Cable material	PUR/PVC/TPI
Certificates	cULus, CE, variant with ATEX 3G/3D

ST6 sensor series



Connection variants:



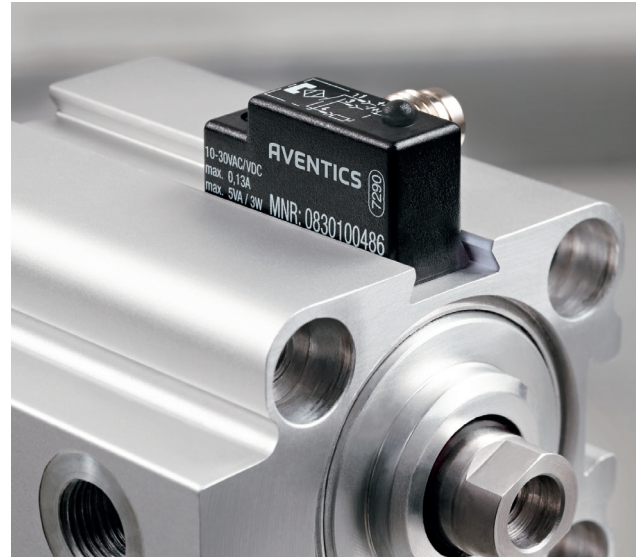
ST9 sensor series

ST9 sensor series – versatile sensor for cylinders with dovetail nuts

Ideal sensor solution for short-stroke cylinders

The sensors in the ST9 series are specifically developed for short-stroke cylinders and offer a lean design and practical handling. They slide easily into the 9 mm dovetail nut and can be securely fastened with a single screw. Especially with extremely short cylinders, the electrical connection located at the side of the housing enables easy tightening and removal of the lines.

- Suitable for 9 mm dovetail nut
- Wide range of versions with different line lengths and connections
- With M8 plug directly on the sensor housing or free wire ends
- Service-friendly, since the line can be mounted directly on the housing
- Reed and electronic PNP sensor versions



Series	ST9
Type of contact	Reed, electronic PNP
Dimensions in mm (LxHxW)	Approx. 26.6 x 14 x 9.5
Supply voltage	10-30 V AC/DC
Continuous current	130 mA
Switching point precision	± 0.1 mT
Protection class	IP65, IP67
Ambient temperature	-20 to +80 °C
Connection variants	Free wire ends, M8



ST9 sensor series



Connection variants:



SN2 sensor series

SN2 sensor series – universal sensor, highly compatible with different cylinders

Wide variety of functions, compact design

With their universal functionality and form, the sensors in the SN2 series are at home in nearly every industry and application. They are designed as an especially robust reed sensor for a wide voltage range of up to 240 V AC. With their wide range of mounting options, they can be assembled on almost all cylinder series. Matching sensor mountings are available for all cylinder forms and profiles to guarantee secure mounting.

- Cubic sensor solution for universal applications
- A wide variety of sensor mountings for use with many different cylinders
- With M8 plug (2-, 3-, and 4-pin) directly on the sensor housing or free wire ends
- Service-friendly, since the line can be mounted directly on the housing
- Reed and electronic PNP sensor versions
- Additional variant with pulse stretching



Series	SN2
Type of contact	Reed, electronic PNP
Dimensions in mm (LxHxW)	Approx. 22 x 26 x 16
Supply voltage	10-30 V (PNP), up to 240 V AC (Reed)
Continuous current	130 mA
Switching point precision	± 0.1 mT
Ambient temperature	-20 to +80 °C, also up to +120 °C
Connection variants	Free wire ends, M8

SN2 sensor series



Connection variants:



Selection criteria

Finding the optimum sensors for your application

Not better, not worse, just different. All AVENTICS sensors work reliably and precisely. Which specific sensor is right for your application depends solely on the cylinders used, the machine design, the specific measurement tasks and the desired operating ease of use.

Cylinder and mounting

When selecting the right sensor, the initial criteria are the cylinder and mounting options. For pneumatic drives equipped with sensor nuts, sensors specifically designed for this configuration should always be the first choice. This enables simple, secure and rapid assembly at any time, without additional sensor mountings.

Measurement task, accuracy level and ease of adjustment

A variety of specially designed sensor mountings enables variable use of the sensor series with many different cylinders and profiles from the AVENTICS product range. You are free to choose the sensor you wish, whether you need a special sensor type or highly specific functions. In addition, the differences between electric and electronic sensors, described below, should be taken into account.



Electric sensors (Reed)	Electronic sensors (PNP, NPN)
Not protected against short circuits	Short circuit protected
For AC/DC voltage	For DC voltage only
Wide voltage range (0-240 V AC/DC)	Voltage range generally limited (typically 0-36 V)
Residual ripple not critical	Permissible residual ripple of supply voltage limited
No current consumption in non-switched state	Low current consumption, even in non-switched state
Affected by wear (especially with inductive and capacitive loads)	Wear-free
At high acceleration, false switching possible due to vibration or shocks	Switching function not affected by vibration or shocks
Bounce possible (in μs range)	Bounce free
Potential-free	Not potential-free
Long service life, average of 10 million switching cycles	"Unlimited" service life

Configured for your application online

Use the interactive tools – save time and money

The AVENTICS sensor concept offers a perfectly coordinated system consisting of cylinders, sensors, and other accessories. Our customers are able to configure a complete product (cylinders, sensors, and accessories) at any time according to their individual needs and order it using a single material number. At the same time, all of the required documents are displayed and can be directly taken over in your own construction. You can reach the online configurator tool via the online catalog and the catalog pages for the product in question. Program navigation is intuitive and easy to understand.

Matching sensors are shown after you select your specially configured cylinder. You make a decision and receive one order number for the complete product, including the catalog price, parts list with item drawing, circuit diagram, and dimensioned drawing. 2-D and 3-D CAD data is also included.

The screenshot displays the AVENTICS online configurator interface. At the top, it shows the product name "Pneumatic cylinder SSI-DA-020-0100-4-00-2-000" and the "Sensor configuration" section. The configuration options include "With Sensor" and "Without Sensor", with sub-options for Series (ST6, ST4, ST4-2P, SM6), Function (REED, PNP, Distance measuring), and Cable length (0.3 m + M8x1 with knurled screw).

Below the configuration options, a detailed specification table is shown for the selected product:

Pneumatic cylinder SSI-DA-020-0100-4-02-3-000-PC3-01	
List price: 127.93 EUR	
Description	
Series	SSI Series SSI
Piston diameter	020 Diameter 20
Stroke	0100 Stroke in mm
Function	4 Double acting with magnet
Piston rod end	02 Internal (male) thread
Piston rod	3 Through rod
Piston rod extension	000 Piston rod extension in mm
Sensor type	PC3 ST 6 M8x1 w. knurled screw PNP
Sensor position	01 End position front 12h
Series parts	
Base cylinder	SSI-DA-020-0100-4-02-3-000-000-00
Sensor	R412019493 ST4-PN-M8T-030

The interface also includes a "Product information" sidebar with options like "New", "Open", "Import", and "Configuration". Below the configuration options, there is a "Sensor arrangement" section with a 3D view of the cylinder and sensor, and a "Technical drawing" section with a 2D dimensioned drawing of the cylinder and sensor. The drawing shows the cylinder with a sensor mounted on the front, and dimensions for the sensor position and cylinder length.

At the bottom of the interface, there is a "Product Configurator Pneumatics" section with a search bar and navigation links. The "Engineering Tools" section includes options for "Choose configurator", "Choose calculator", "CAD CAD Search", "Scheme Editor", and "Cross Reference Tool".

The homepage for non-stop service



AVENTICS' Engineering Tools bundle the entire pneumatics range and comprehensive expertise at one convenient location – www.engineering-tools.com

CAD



Objects can be issued here directly as a CAD file in various formats, as a PDF file, or for further configuration in our customers' software.

Configurators



To create customized products matching their individual requirements, customers can set their parameters in the configuration program, which then presents a product tailored to their specifications.

Calculation programs



With transparent calculations, our customers can determine the size or durability needed for their products and can even keep an eye on energy consumption.

Circuit diagram software



With the Scheme Editor, our customers can quickly and easily create circuit diagrams that are based on their components and linked their your catalog selection.

Cross Reference Tool



This tool shows our customers the right alternatives to competitor products from within the AVENTICS catalog.

CylinderFinder



This free online tool helps our customers find the right cylinder for their application with just a few clicks.

Sales Partner Portal



The Sales Partner Portal establishes a direct connection between AVENTICS and our sales partners and speeds up communication. It also contains a great deal of valuable information.

Smart shopping for pneumatics professionals



In the new Online Shop, you can easily, quickly and securely order your pneumatics products – www.pneumatics-shop.com
Your advantages:

- Intelligent search and filter functions
- Spare parts and accessories available for every product
- Track your orders online
- Transparent pricing

Simply register with your e-mail address, password and order directly.

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