

Position Indicating Switches

For Hydraulic and Pneumatic Cylinders

aerospace
climate control
electromechanical
filtration
fluid & gas handling
hydraulics
pneumatics
process control
sealing & shielding



ENGINEERING YOUR SUCCESS.

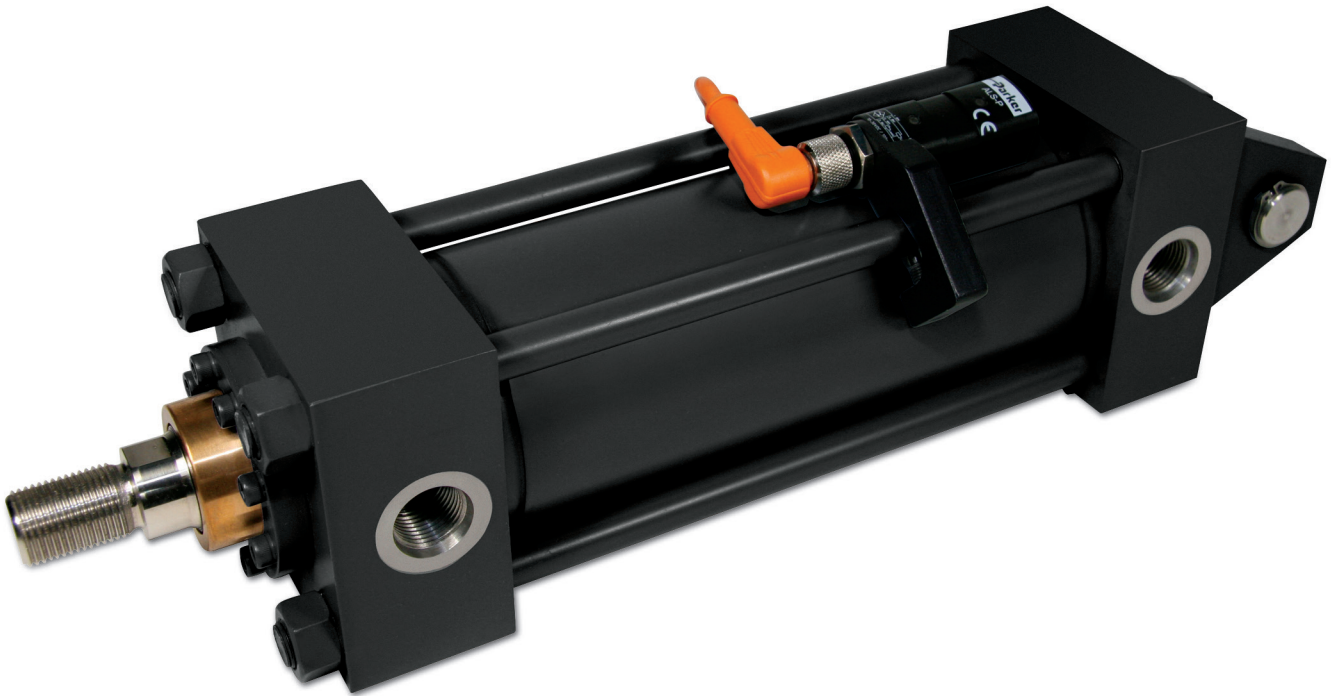
www.mfcp.com

Our New and Exclusive – **ALS Switch**

Position Sensing with a Magnetic Piston and Standard Steel Tube!

Tie rod mounted switch available in both PNP and NPN outputs –

See ALS Switch pages for details.



In line with our policy of continuing product improvement, specifications and information contained in this catalog are subject to change.

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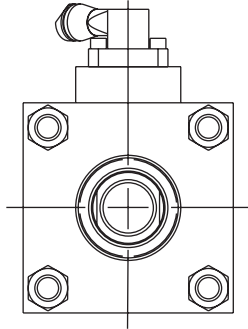
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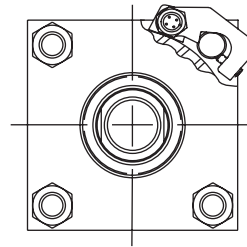
Choose the style that's right for your needs –

Tie Rod Mounted Switches – actuated by a magnetic piston

- Can be positioned at any location along the cylinder to indicate end-of-stroke or mid-stroke locations.
- Allow multiple switches to be installed with numbers only restricted by available tie rod mounting space.
- Are non-intrusive and maintain pressure envelope integrity.
- Available for PH-2 Series in 1.50" - 6.00" bores, PL-2, and PA-2 Series in 1.00" - 4.00" bores.



Head or Cap Mounted Switch



Tie Rod Mounted Switch

Tie rod mounted switches are lower profile than head and cap mounted styles.

ALS Switch –

Our exclusive innovative sensor detects a magnetic piston through a **standard steel tube**. They are an economical alternative to Global Switches for long stroke applications that require a stainless steel tube.

Global Solid State and Reed Switches –

Require a non-ferrous tube; stainless steel material in PH-2 and PL-2 maintain standard envelope pressure rating; aluminum tube in PL-2 offers economy with a reduction in envelope pressure rating (see Standard Specifications).

Head and Cap Mounted Switches

- Fixed mount design is actuated by proximity (without contact) of cushion sleeve or spear
- Provide an end-of-stroke signal with or without functional cushion
- Available up to 10.00" bore PA-2 Series and 8.00" bore PL-2 & PH-2 Series

EPS Inductive Switches –

Are suitable for general industrial as well as automotive applications requiring weld field immunity.

CLS Magnetic Principal Switches –

Are contact type switches with no leakage current and are better suited for series wiring, higher load current requirements and have higher temperature resistance.

Switches mounted on Schrader Bellows hydraulic cylinders add value to your machine design

- Switches and cylinder combine to form a compact package
- Tie rod switches are easily adjustable along cylinder stroke length
- Low profile switches are less prone to mechanical damage

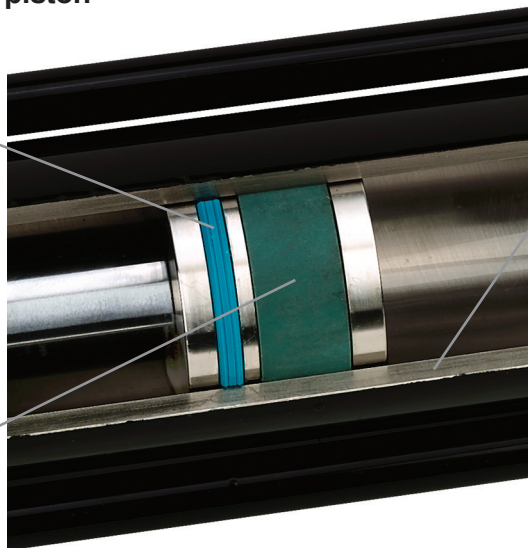
Magnetic Piston option for 1.50"-6.00" bore PH-2 Series and 1.00"-4.00" bore PL-2 Series cylinders

- Non-intrusive design eliminates the possibility of oil leakage
- Non-ferrous tube material for conventional solid state and reed switches
- Standard carbon steel tube for the ALS Switch

PH-2 and PL-2 Series Cylinder – with Hi-Load style magnetic piston

Durable polyurethane bi-directional seal – for positive sealing with no by-pass and long life.

WearGard™ wear band – improves resistance to bearing loads and provides support for magnet.



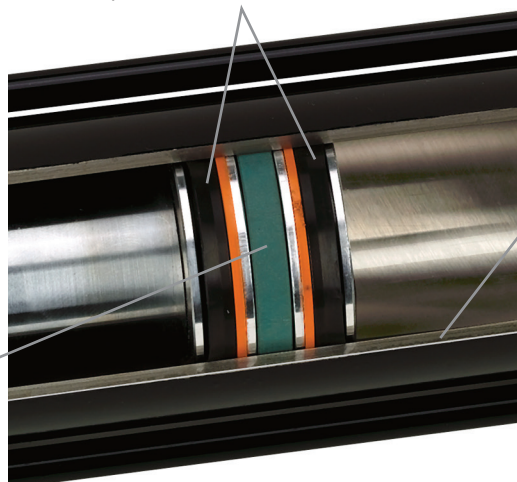
Cylinder Body – Standard steel carbon material for ALS Switch or 316 stainless steel for conventional solid state or reed switches. Aluminum¹ material available in PL-2 Series.

¹Reduced pressure ratings apply for aluminum body in PL-2 Series. See Standard Specifications page for ratings by bore size.

PA-2 Series Cylinder – with Lipseal Magnetic Piston

Piston Lipseals – are self-compensating to conform to pressure and wear.

WearGard™ wear band – improves resistance to bearing loads and provides support for magnet.



Cylinder Body – Standard steel material for ALS Switch or 316 stainless steel or aluminum for conventional solid state or reed switches.

Model Ordering Code / Specifications

Model Ordering Code for Cylinders with Magnetic Piston

Specify – Seal Code 'J' when using ALS Switches with standard steel tube and Buna N¹ seals

– Seal Code 'F' or 'A' when using Global Switches with stainless steel or aluminum tube and Buna N¹ seals

¹See field 5 tables below for additional codes to specify fluorocarbon³ seals or aluminum tube.

1	Type	Model Number
See Catalog SB0106 for appropriate PA-2, PL-2, PH-2 code to specify desired single rod end/double rod end and port type.		

2	Bore Dia.	Rod Dia.	Model Number Code
See Catalog SB0106 for appropriate PA-2, PL-2, PH-2 code to specify desired bore & rod combination.			

3	Mounting Style	NFPA Style	Model Number Code			
			Non-Cush.	Cush. Head	Cush. Cap	Cush. Head
See Catalog SB0106 for appropriate PA-2, PL-2, PH-2 code to specify desired mounting style & cushion combination.						

4	Rod End Style	Model Number Code
See Catalog SB0106 for appropriate PA-2, PL-2, PH-2 code to specify desired rod end style.		

5	Seal Type	Model Number Code	Series
Magnetic piston with Buna N seals, aluminum tube.		A	PA-2, PL-2 ²
Magnetic piston with fluorocarbon ³ seals, aluminum tube.		D	PA-2, PL-2 ²
Magnetic piston with Buna N seals, stainless steel tube.		F	PA-2, PL-2, PH-2
Magnetic piston with fluorocarbon ³ seals, stainless steel tube.		G	PA-2, PL-2, PH-2
Magnetic piston with Buna N seals, standard steel tube.		J	PA-2, PL-2, PH-2
Magnetic piston with fluorocarbon ³ seals, standard steel tube.		K	PA-2, PL-2, PH-2
See Catalog SB0106 for additional PA-2, PL-2, PH-2 codes to specify non-magnetic piston and seal options.			

² Reduced pressure rating applies. See table below.

³ Fluorocarbon seals for fluid compatibility only.

6	Stroke Length	Specify
----------	----------------------	----------------

⁴ See ALS switch Part Numbers page for minimum stroke.

Model Number Example
PH AAO 08 2 J Stroke⁴
W/6"

Piston Magnet Availability by Series, Bore and Seal Type Code

Bore Ø	Available Seal Type Code		
	PH-2	PL-2	PA-2
1.00 ⁵	None	A, D, F, G	A, D, F, G
1.50	F, G, J, K	A, D, F, G, J, K	A, D, F, G, J, K
2.00	F, G, J, K	A, D, F, G, J, K	A, D, F, G, J, K
2.50	F, G, J, K	A, D, F, G, J, K	A, D, F, G, J, K
3.25	F, G, J, K	A, D, F, G, J, K	A, D, F, G, J, K
4.00	F, G, J, K	A, D, F, G, J, K	A, D, F, G, J, K
5.00	J, K	None	None
6.00	J, K	None	None

⁵ Global Reed Switch cannot sense end of stroke on 1.00" bore. When positioned up against the head or cap approx. 0.200" stroke-to-go results after switch provides output. Global Solid State switch stroke-to-go is approx. 0.030".

Maximum Pressure Rating for PL-2 Cylinder with Aluminum Tube

Bore Ø	Pressure Rating (psi) ⁶
1.00	1900
1.50	1500
2.00	1100
2.50	950 ⁷
3.25	750
4.00	600

⁶ When using PL-2 Series cylinders with aluminum bodies, do not introduce any shock or high inertia loading conditions. Pressure spikes must be avoided.

⁷ Maximum pressure for aluminum tube in 2.50" bore with 0.625" rod is 700 psi.

Standard Specifications

- Bore diameters – 1.00" to 6.00" (See table above for Series, Bore, and Seal Type magnetic piston code availability.)
- Strokes – up to 120" (Contact factory for longer strokes.)
- Piston rod diameters – 0.500" to 4.000"
- Temperature range – -10°F (-23°C) to +250°F (+121°C) (depending on seal class).
- Switch position may be restricted on mounting style MT4.

- Working pressure – series and tube material dependent
 - PH-2 Series** – 3000 psi with either carbon steel or stainless steel tube
 - PL-2 Series** – 1000 psi nominal (dependent on bore size) with either carbon steel or stainless steel tube; reduced pressure with aluminum tube per table.
 - PA-2 Series** – 250 psi regardless of tube material

Additional product specifications, application information and safety guidelines are available in Schrader Bellows Industrial Cylinder Product catalogs.

Specifications

Hydraulic and Pneumatic Cylinders Position Indicating Switches

ALS Switch

- For magnetic piston sensing through steel tube material
- Cost effective alternative to stainless steel tube for longer strokes
- 4 wire DC connection

Switch Operation

The switch detects a change in polarity of the magnetic field as a piston with magnet moves through the cylinder.

Formatting

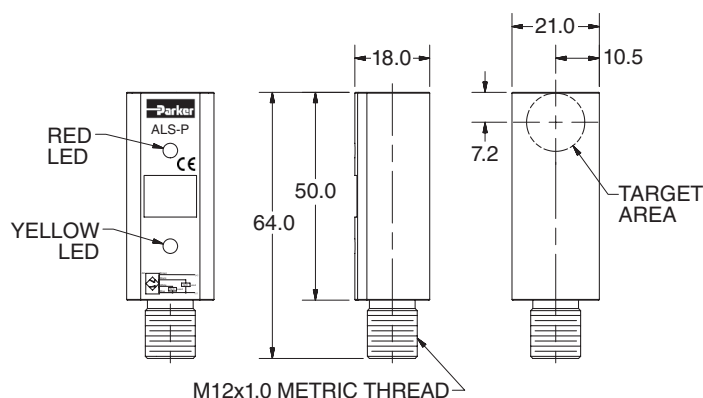
Before the switch is used for the first time, the piston with magnet should be run in and out of the cylinder to format the cylinder tube. The switch will detect the polarity of the residual magnetic field created by the movement of the magnetic piston during formatting.

Field Direction with Magnetic Piston

Single rod end cylinders are assembled with the piston magnet's North Pole facing the rod end. As the magnetic piston moves through the cylinder, it creates a stronger field opposite in polarity to the residual magnetism in the cylinder tube. As it moves under the switch, the change in polarity of the magnetic field in the cylinder tube is detected.

Switch Zone

Switch actuation occurs as the piston enters a switching 'zone'. The switching point is highly repeatable, in either direction, under conditions of constant piston speed and operating temperature.



ALS Switch output states may be influenced by an external magnetic field. Care must be taken to avoid external magnetic field exposure.

- PNP and NPN versions can be wired N.O. or N.C.
- The ALS Switch is not designed for use with non-ferrous tubes

The switching zone may be up to 21mm wide depending on tube wall thickness and piston speed.

LED Indicators

There are two LED's (yellow and red) to indicate that the piston is inside or outside the switching zone. The sequence of the LED's is determined by the orientation of the north pole of the magnet system (rod end side of single rod end cylinders) to the connector.

When the ALS switch connector faces the rod side of single rod end cylinders the red LED turns ON when the piston is within the switching zone. The yellow LED is ON otherwise.

When the ALS switch connector faces the cap side of single rod end cylinders the yellow LED turns ON when the piston is within the switching zone. The red LED is ON otherwise.

Performance

Schrader Bellows ALS Switches have been designed to operate at a maximum piston speed of 0.5m/s, and a maximum cylinder operating temperature of 85°C.

Specifications

Switching Output:	PNP or NPN
Hysteresis¹:	5mm
Repeatability¹:	0.5mm
Load Current:	100mA
Leakage Current:	≤ 10μA
Voltage Drop:	≤ 1.5 VDC
Short Circuit and Overload Protection:	Yes
Reverse Polarity Protection:	Yes
Supply Voltage:	10 - 30 VDC
LED(s):	Yes (2)
Current Consumption:	≤ 30 mA
Operating Temperature Range:	-25°C to +85°C (-13°F to +185°F)
Housing Material:	Black Polyamide (PA)
Enclosure Rating:	IP67

¹Hysteresis and repeatability based on measurements with a cylinder outer diameter of 46mm, wall thickness of 3mm and piston speed of 0.5m/s.

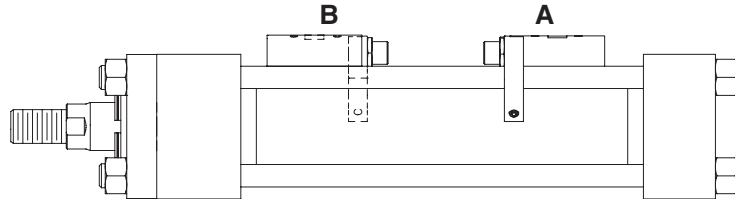
ALS Switch

Because the ALS switch detects change in polarity as the magnet moves through the cylinder, wiring connections are dependent on switch mounting orientation to the magnet's North Pole. The two possible orientations are:

- A – connector facing toward the rod end
(rod end 1 if K-type)
- B – connector facing toward the cap end
(rod end 2 if K-type)

Connections to Pin 1 (+VDC) and Pin 3 (-VDC) are the same for either switch orientation. But, as outlined in the table and wiring schematic diagrams below, the normal output state of Pins 2 & 4 flip between mounting orientations A & B. To sense the retracted position of the cylinder the cap end switch must be mounted in orientation A, and to sense the extended position of the cylinder the rod end switch must be mounted in orientation B. Note that ALS Switches allow a .38 - .50 inch stroke-to-go piston travel for end-of-stroke mounting locations.

Switch Orientations



Example: An application requires that ALS switches sense the retract and extend positions of the cylinder with normally closed logic at both ends. How would the switches be wired?

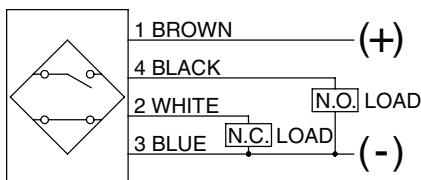
Answer: The two switches would not be installed or wired the same way. The cap end switch would be installed in orientation A with Pin 1 (+VDC), Pin 2 (Load), Pin 3 (-VDC), Pin 4 (not used). The rod end switch would be installed in orientation B with Pin 1 (+VDC), Pin 2 (not used), Pin 3 (-VDC), Pin 4 (Load).

LED Function and Pin Wiring

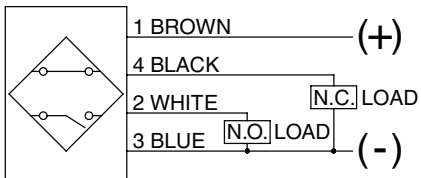
Switch Mounting Orientation	Connector Facing Toward		LED indicator (on/off) when magnet is:				Pin	Wire	Function
	Single Rod Cylinder	Double Rod Cylinder	Out of Switch Zone		In Switch Zone				
			Red	Yellow	Red	Yellow			
A	Rod End	Rod End #1	off	on	on	off	1	Brown	+VDC
			off	on	on	off	2	White	N.C.
			off	on	on	off	3	Blue	-VDC
			off	on	on	off	4	Black	N.O.
B	Cap End	Rod End #2	on	off	off	on	1	Brown	+VDC
			on	off	off	on	2	White	N.O.
			on	off	off	on	3	Blue	-VDC
			on	off	off	on	4	Black	N.C.

PNP

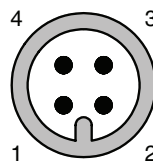
Switch Orientation A



Switch Orientation B

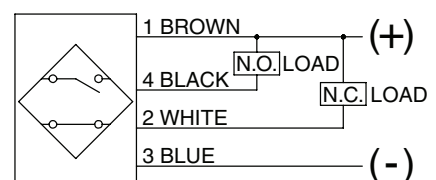


ALS Switch – Wiring Connection
12mm Connector

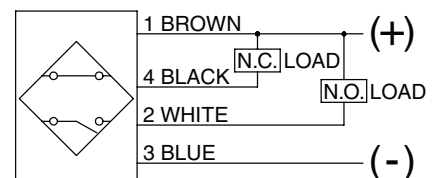


NPN

Switch Orientation A



Switch Orientation B



ALS Switch Part Numbers

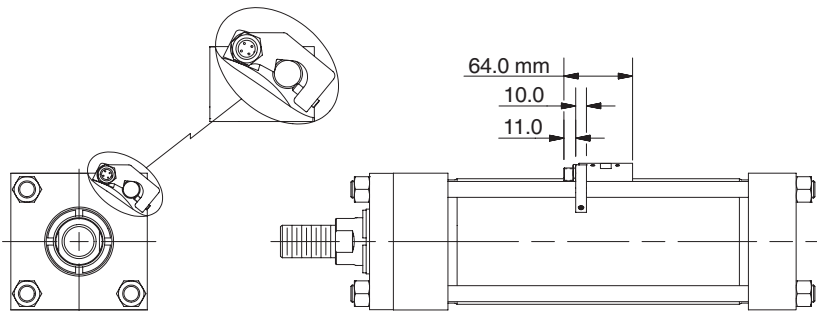
All switches are packaged with tie rod mounting bracket and have a 4-pin male M12x1 threaded connector.

Part Number		Switch Bracket Usage
PNP	NPN	
ALS-PL	ALS-NL	PL-2 & PA-2 Series 1.50 – 4.00 Bore
ALS-PH	ALS-NH	PH-2 Series 1.50 - 4.00 Bore
ALS-PHA	ALS-NHA	PH-2 Series 5.00 - 6.00 Bore

Note: Specify piston code '7' in cylinder model number when using ALS Switches.

Minimum Stroke for ALS Switch

Bore Ø	PL-2 & PA-2	PH-2
1.50	3.13	3.00
2.00	3.13	3.00
2.50	3.13	2.88
3.25	3.13	2.75
4.00	3.13	2.63
5.00	N/A	2.38
6.00	N/A	2.19



ALS Switches allow a .38 - .50 inch stroke-to-go piston travel for end-of-stroke mounting locations.

12mm Cordset for ALS & Global Switches

12mm Cordset with Female Quick Connect

M12 Straight Connector	
Cable Length	Part Number
5 meters	9126487205
2 meters	9126487202

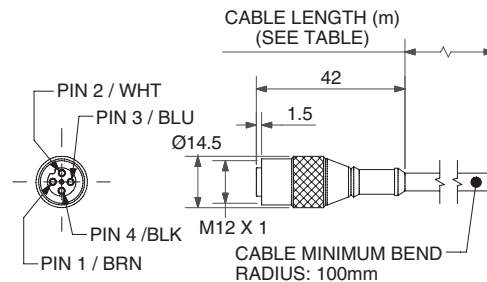
M12 Right Angle Connector	
Cable Length	Part Number
5 meters	9126487305
2 meters	9126487302

A female connector is available for all switches with the male 12mm quick connect option. The cordsets are available with a right angle or straight connector. Cordset part numbers are listed above.

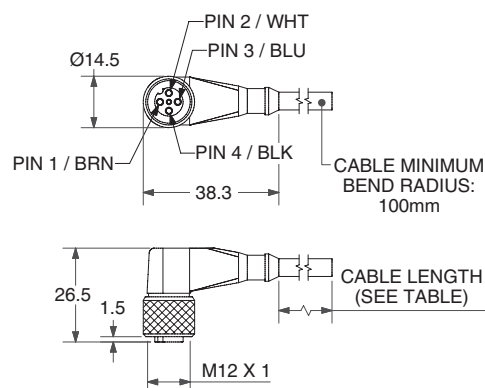
Cordset Specifications

- Connector..... Polyvinylchloride (PVC) body material, PVC contact carrier, spacing to VDE 0110 Group C, (250VAC / 300VDC)
- Contacts Gold Plated Copper Tin (CuSn), stamped from stock.
- Coupling Method..... Threaded nut: Chrome plated brass.
- Cord Construction ... PVC non-wicking, non-hygroscopic, 250VAC / 300VDC. Cable end is stripped.
- Conductors..... Extra high flex stranding with PVC insulation
- Temperature..... -13°F to 158°F (-25°C to 70°C)
- Protection NEMA 1, 3, 4, 6P and IEC 1P67
- Cable Length..... 6.56 ft (2m) or 16.4 ft (5m)

Straight Connector



Right Angle Connector



Global Drop-In Solid State Switches  



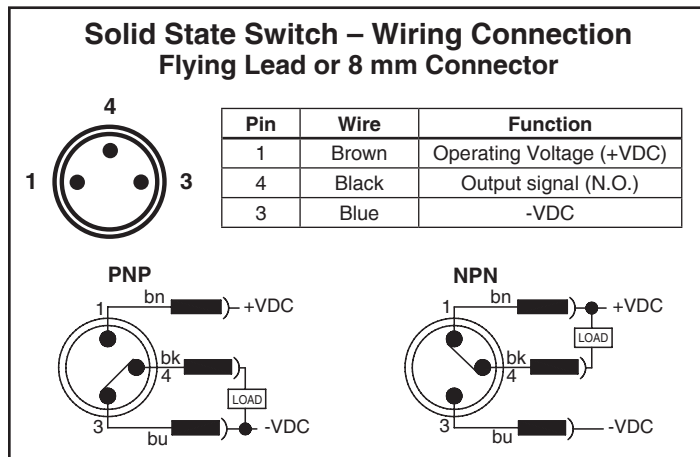
Wiring	PNP Switch	NPN Switch	PNP Switch ATEX Certified	PNP Switch High Temperature
3m Flying Leads	P8SAGPFAX	P8SAGNFAX	P8SAGPFAXS	P8S-GPFLH ¹
10m Flying Leads	P8SAGPFDX	P8SAGNFDX	N/A	N/A
0.3m Lead with 8mm Connector	P8SAGPCHX	P8SAGNCHX		

¹ High Temperature switch is not UL Listed.

Specifications

Switch Classification	Standard PNP or NPN	ATEX Certified PNP	High Temperature PNP
Type	Electronic	Electronic	Electronic
Output Function	Normally Open	Normally Open	Normally Open
Switch Output	PNP/NPN	PNP	PNP
Operating Voltage	10 - 30VDC	10 - 30VDC	10 - 30VDC
Continuous Current	100 mA max.	50 mA max.	200 mA max.
Magnetic Field Sensitivity	2.6 - 3.3mT	2.8 mT	25 Gauss
Switching Frequency	1 kHz	1 kHz	10 kHz
Power Consumption	8 mA max.	10 mA max.	15 mA max.
Voltage Drop	2 VDC max.	2.2 VDC max.	3.1 VDC max.
Ripple	10% of Operating Voltage	10% of Operating Voltage	15% of Operating Voltage
Hysteresis	1.5 mm max.	1.5 mm max.	1.5 mm max.
Repeatability	0.1 mm max.	0.1 mm max.	0.1 mm max.
EMC	EN 60 947-5-2	EN 60 947-5-2	EN 60 947-5-2
Short-circuit Protection	Yes	Yes	Yes
Power-up Pulse Suppression	Yes	Yes	Yes
Reverse Polarity Protection	Yes	Yes	Yes
Enclosure Rating	IP67	IP67	IP67
Shock and Vibration Stress	30g, 11 ms, 10 to 55Hz, 1 mm	30g, 11 ms, 10 to 55Hz, 1 mm	30g, 11 ms, 10 to 55Hz, 1 mm
Operating Temperature Range	-30°C to +80°C (-22°F to +176°F)	-20°C to +50°C (-4°F to +122°F)	-25°C to +105°C (-13°F to +221°F)
Housing Material	PA 12 Black	PA 12 Black	Aluminum
Connector Cable	PUR	PUR	PUR
Connector	PUR	-	-
Approval for ATEX	-	3D/3G	-

Global solid state switch outputs may be influenced by an external magnetic field. Care must be taken to avoid external magnetic field exposure.



Global Drop-In Reed Switches  

Wiring	Reed Switch
3m Flying Leads	P8SAGRFAX
10m Flying Leads	P8SAGEFRX
0.3m Lead with 8mm Connector	P8SAGRCHX

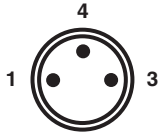
Specifications

- Type.....2-Wire Reed
- Output FunctionNormally Open
- Operating Voltage.....5 - 30 VDC
- Switching Power6 W
- Continuous Current.....100 mA max.
- Response Sensitivity2.1 - 3.4mT
- Switching Frequency400 Hz
- Voltage Drop3.5 VDC max.
- Ripple10% of Operating Voltage
- Hysteresis1.5 mm max.
- Repeatability0.2 mm max.
- EMCEN 60 947-5-2
- Reverse Polarity Protection.....No
- Enclosure Rating.....IP 67
- Shock and Vibration Stress.....30g, 11 ms, 10 to 55 Hz, 1 mm
- Operating Temperature Range.....-30°C to +80°C (-22°F to 176°F)
- Housing Material.....PA 12 Black
- Connector Cable.....PUR
- ConnectorPUR

Global Reed Switch output may be influenced by external magnetic fields.
Care must be taken to avoid external magnetic field exposure.

Reed Switch – Wiring Connection

Flying Lead or 8 mm Connector

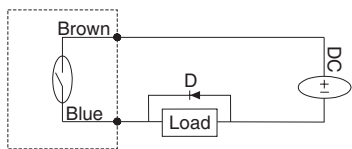


Pin	Wire	Function
1	Brown	Operating Voltage (+V)
4	Black	Not Used
3	Blue	Output Signal (-V or Ground)

Circuit for Switching Contact Protection (Inductive Loads)

(Required for proper operation 24V DC)

Put Diode parallel to loads following polarity as shown below.



D: Diode: select a Diode with the breakdown voltage and current rating according to the load.

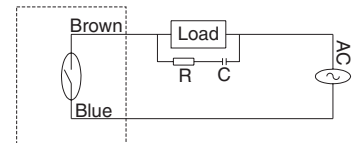
Typical Example—100 Volt, 1 Amp Diode
CR: Relay coil (under 0.5W coil rating)

(Recommended for longer life 120 VAC)

Put a resistor and capacitor in parallel with the load. Select the resistor and capacitor according to the load.

Typical Example:

- CR: Relay coil (under 2W coil rating)
- R: Resistor 1 K Ω - 5 K Ω , 1/4 W
- C: Capacitor 0.1 μ F, 600 V



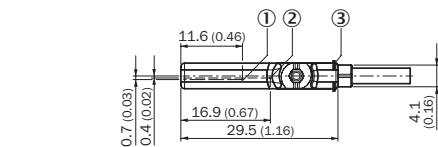
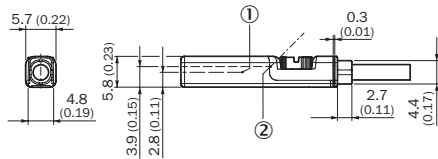
⚠ Caution

- Use an ammeter to test reed switch current. Testing devices such as incandescent light bulbs may subject the reed sensor to high in-rush loads.
- **NOTE:** When checking an unpowered reed switch for continuity with a digital ohmmeter the resistance reading will change from infinity to a very large resistance (2 M ohm) when the sensor is activated. This is due to the presence of a diode in the reed switch.
- Anti-magnetic shielding is recommended for reed switches exposed to high external RF or magnetic fields.
- The magnetic field strength of the piston magnet is designed to operate with our switches. Other manufacturers' switches may not operate correctly in conjunction with these magnets.
- Use relay coils for reed switch contact protection.

- The operation of some 120 VAC PLC's (especially some older Allen-Bradley PLC's) can overload the reed switch. The switch may fail to release after the piston magnet has passed. This problem may be corrected by the placement of a 700 to 1K OHM resistor between the switch and the PLC input terminal. Consult the manufacturer of the PLC for appropriate circuit.
- Switches with long wire leads (greater than 15 feet) can cause capacitance build-up and sticking will result. Attach a resistor in series with the reed switches (the resistor should be installed as close as possible to the switches). The resistor should be selected such that R (ohms) > E/0.3.
- Global reed switch outputs may be influenced by an external magnetic field. Care must be taken to avoid external magnetic field exposure.

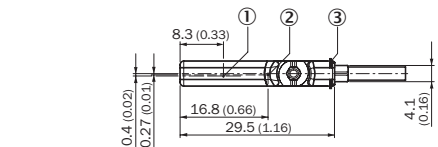
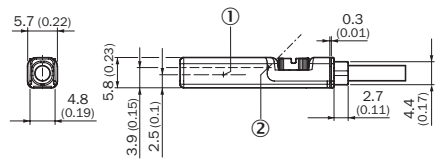
Dimensions in mm (inch)

PNP, NPN Output 10 to 30 V DC



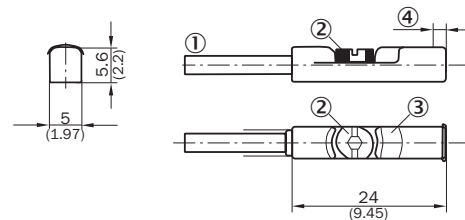
- ① Position sensor element
- ② Indication LED
- ③ Retaining ribs

Reed Output 5 to 30 V AC/DC



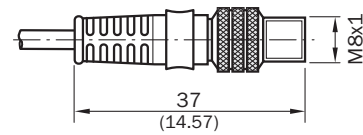
- ① Position sensor element
- ② Indication LED
- ③ Retaining ribs

NAMUR ATEX 1G, 1D, ATEX 3G, 3D



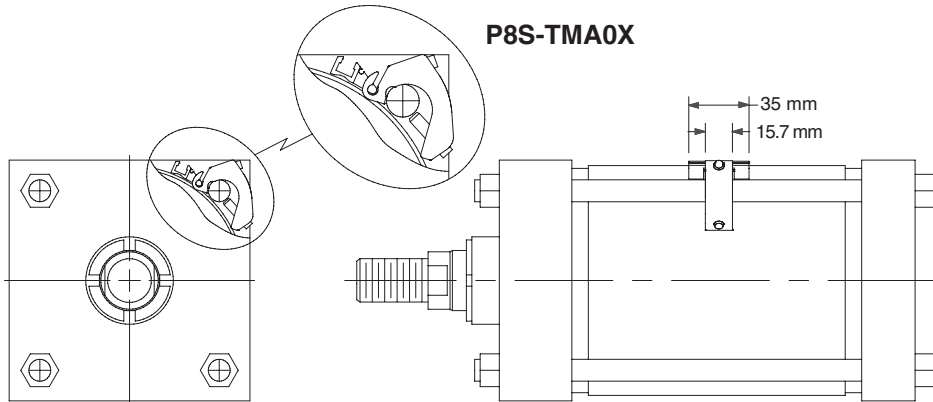
- ① Connection
- ② Fixing screw
- ③ Indication LED
- ④ Position of sensor element; short overrun distance: 2 mm; long overrun distance: 1.7 mm

Connector M8R



Tie Rod Bracket Assembly Part Number and Dimensions

Global switch bracket fits 1.00" - 4.00 bore cylinders. Global switches and bracket assemblies must be ordered separately.



**Cordsets – 8mm Cordset for Global Switches
8mm Cordset with Female Quick Connect**

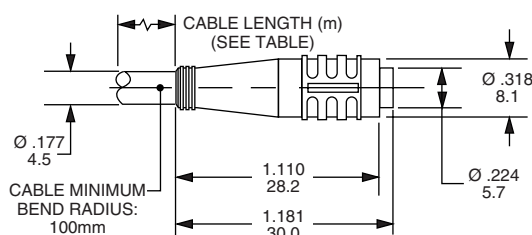
A female connector is available for all sensors with the male 8mm quick connect option. The male plug will accept a snap-on or threaded connector. Cordset part numbers are listed below.

Cable Length	Threaded Connector	Snap On Connector
5 meters	086620T005	086620S005
2 meters	086620T002	086620S002

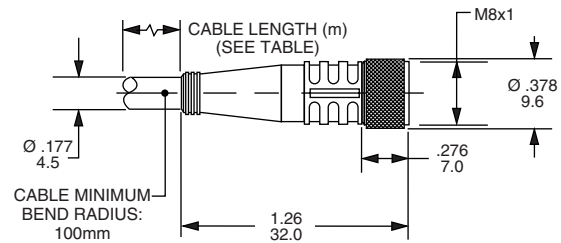
Cordset Specifications

- Connector..... Oil resistant polyurethane body material, PA 6 (Nylon) contact carrier, spacings to VDE 0110 Group C, (150 AC/DC)
- Contacts Gold plated beryllium copper, machined from solid stock
- Coupling Method..... Snap-Lock or chrome plated brass nut
- Cord Construction .. Oil resistant black PUR jacket, non-wicking, non-hygroscopic, 300V. Cable end is stripped and tinned.
- Conductors..... Extra high flex stranding, PVC insulation
- Temperature..... -40 to 194°F (-40 to 90°C)
- Protection NEMA 1, 3, 4, 6P and IEC 1P67
- Cable Length..... 6.56 ft (2m) or 16.4 ft (5m)

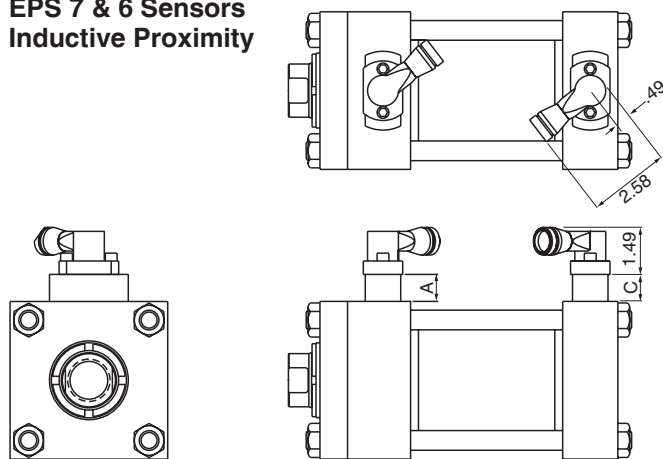
Snap-On Straight Connector



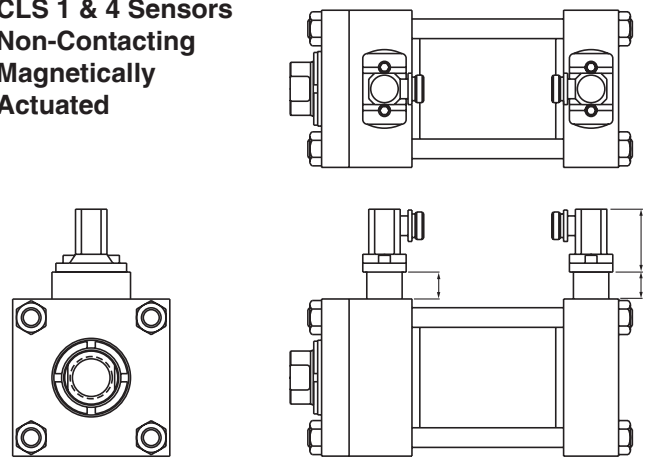
Threaded Straight Connector



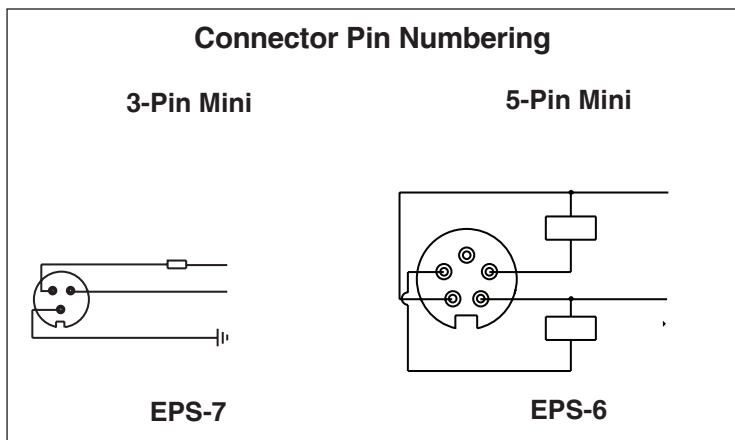
**EPS 7 & 6 Sensors
Inductive Proximity**



**CLS 1 & 4 Sensors
Non-Contacting
Magnetically
Actuated**



Series	A max.	C max.
PH-2	.86"	1.75"
PL-2	1.55"	1.05"
PA-2	1.55"	1.30"
SHM	1.19"	1.05"



Series and Parallel Wiring

When Schrader Bellows EPS-6 or 7 proximity switches are used as inputs to programmable controllers the preferred practice is to connect each switch to a separate input channel of the PLC. Series or parallel operations may then be accomplished by the internal PLC programming.

EPS-6 or 7 switches may be hard wired for series operation, but the voltage drop through the switches (see specifications) must not reduce the available voltage below what is needed to actuate the load.

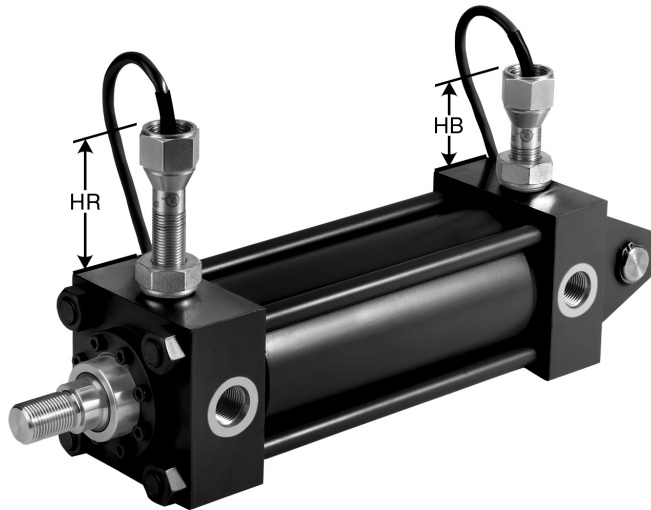
EPS-6 or 7 switches may also be hard wired for parallel operation. However, the leakage current of each switch will pass through the load. The total of all leakage currents must not exceed the current required to actuate the load. When wiring EPS-6 sensors in parallel it is recommended that decoupling diodes be used.

Minimum Stroke

The minimum stroke for EPS-6 or 7 and CLS-1 or 4 sensors, utilizing standard components, is the cushion sleeve or spear length for the cylinder series in which the sensor is installed. See the individual Industrial Cylinder series catalog for cushion length details. Contact the factory if a shorter stroke is required.

CLS-2 Threaded Style Switches

Spacers are not required. Threaded switches can be adjusted for small changes to end of stroke position sensing.



As shown in the illustrations below, these switches are magnetically operated. Dual magnets provide a dependable “snap action” for positive position sensing.

In the “Unoperated” position, the magnet assembly is attracted in the opposite direction of the arrow, causing a finely ground stainless steel connecting rod to hold the contacts open.

In the “Operated” position a ferrous part (cushion or piston) enters the sensing area and attracts the magnet assembly which causes the rod to draw the contacts together.

Switch Height – PL-2 & PA-2 Series

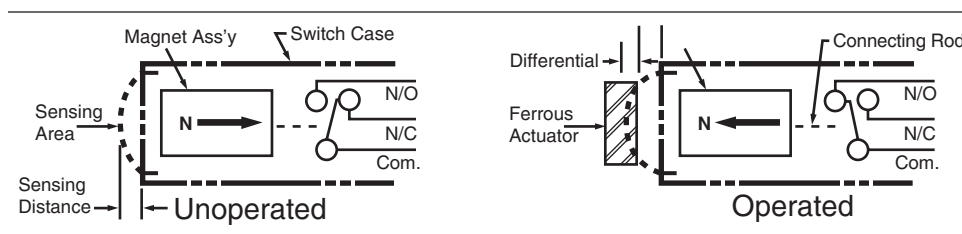
Bore Ø	HR Max.	HB Max	Bore	HR Max.	HB Max
1.50	3.00	2.63	5.00	2.81	1.94
2.00	2.94	2.38	6.00	3.44	3.06
2.50	2.94	2.13	7.00 ¹	3.44	2.56
3.25	3.19	2.81	8.00	3.38	2.06
4.00	3.13	2.44			

¹7.00 bore not available in PL-2 Series

Switch Height – PH-2 Series

Bore Ø	Rod Ø	HR	HB
1.50	0.625	2.56	3.31
	1.000	2.75	
2.00	1.000	2.56	3.25
	1.375	2.69	
2.50	1.000	2.31	2.94
	1.375	2.50	
	1.750	2.69	
3.25	1.375	2.94	2.56
	1.750	3.13	
	2.000	3.31	
4.00	1.750	2.88	2.44
	2.000	3.06	
	2.500	2.50	
5.00	2.000	2.31	2.31
	2.500	2.63	
	3.000	2.88	
	3.500	3.13	
6.00	2.500	2.13	3.00
	3.000	2.38	
	3.500	2.63	
	4.000	2.88	
7.00	3.000	3.38	2.69
	3.500	2.13	
	4.000	2.38	
	4.500	2.63	
	5.000	3.00	
8.00	3.500	3.13	2.25
	4.000	3.38	
	4.500	2.13	
	5.000	2.50	
	5.500	2.69	

Operating Principle



Sensing gap: .030" to .060"

Trip point: Factory set with piston bottomed out.

Release point: Approx. 0.25" piston travel.

Minimum cylinder stroke is .50" on 1.50" & 2.00" bores; and .75" on 2.50" bore and larger.

See the CLS Specification table for additional details.

Specifications – EPS Limit Switches

Switch Type:	Inductive Proximity	
Style:	EPS-7	EPS-6
Code Designator:	H	D
Description:	Economical, General Purpose, 2 wire device, primarily for AC applications. (Not suitable for 3 wire 24 volt Sinking or Sourcing applications.) Also for automotive industry applications.	Economical General Purpose, 3 wire, DC sensor, dual output: sinking and sourcing.
Supply Voltage:	20 to 250 VAC/DC	10 to 30 VDC
Load Current, min.:	8 mA	NA
Load Current, max.:	300 mA	200 mA
Leakage Current:	1.7 mA max.	10 micro amps max.
Voltage Drop:	7 V, max.	2 VDC max.
Operating Temperature:	-14° to +158° F	-14° to +158° F
Switch Type:	Inductive proximity	Inductive proximity
Part Number:	148897 _ _ _ _	148896 _ _ _ _
4 Digit Part Number Suffix:	Add 4-digit part number suffix to indicate probe length: 0125=1.25", 0206=2.06", 0288=2.875", 0456=4.562"	
Connection:	3 pin mini	5 pin mini
Enclosure Rating:	IEC IP67	IEC IP67
LED Indication:	Yes	Yes
Short Circuit Protection:	Yes	Yes
Weld Field Immunity:	Yes	Yes
Output:	2 wire, Normally Open with leakage current	Dual output: DC Sinking and DC Sourcing, user selectable via wiring
Approvals/Marks:	CE, UL, CSA	CE, UL, CSA
Make/Break Location:	0.13" from end of stroke, typical. Tolerance is +0/- .13"	
Wiring Instructions:	Pin 1: AC Ground (Green) Pin 2: Output (Black) Pin 3: AC Line (White)	Pin 1) +10 to 30 VDC (White) Pin 2) Sourcing Output (Red) Pin 3) Grounded (not connected or required) Pin 4) Sinking Output (Orange) Pin 5) DC Common (Black)
Standard Cable: 6'	0853550006	0859170006
Standard Cable: 12'	0853550012	0859170012
Cable: 6', Right Angle	0875470006	-

Specifications – CLS Limit Switches

Switch Type:	Non-Contacting Magnetically Actuated		
Style:	CLS-1	CLS-4	CLS-2
Code Designator:	F	B	G
Description:	For applications where the customer needs NC contacts, zero leakage, zero voltage drop, higher or lower load current than EPS-style.	For applications where the customer needs NC contacts, zero leakage, zero voltage drop, higher or lower load current than EPS-style.	For applications where the customer needs NC contacts, zero leakage, zero voltage drop, higher or lower load current than EPS style. Threaded style permits small adjustability of make/break location.
Supply Voltage:	24 to 240 VAC/DC	24 to 240 VAC/DC	24 to 240 VAC/DC
Load Current, min.:	NA	NA	NA
Load Current, max.:	4 AMPS @ 120 VAC 3 AMPS @ 24 VDC	4 AMPS @ 120 VAC 3 AMPS @ 24 VDC	4 AMPS @ 120 VAC 3 AMPS @ 24 VDC
Leakage Current:	None	None	None
Voltage Drop:	None	None	None
Operating Temperature:	-40° F to +221° F	-40° F to +400° F	-40° F to +221° F
Switch Type:	Non-contacting magnetically actuated	Non-contacting magnetically actuated	Non-contacting magnetically actuated
Part Number:	148275 _ _ _ _	149109 _ _ _ _	117000, 117017, 117034
4 Digit Part Number Suffix:	Add 4-digit part number suffix to indicate probe length: 0125=1.25", 0206=2.06", 0288=2.875", 0456=4.562"		Switch selection is application dependent – Contact Factory
Connection:	3 pin mini	144" PTFE Coated Flying Leads with 1/2" conduit hub	36" Potted-in PVC cable (most sizes also with 1/2" conduit hub)
Enclosure Rating:	NEMA 1, 2, 3, 4, 4X, 5, 6, 6P, 11, 12, 12K, 13	NEMA 1, 2, 3, 4, 4X, 5	NEMA 4, 4X, 6, 6P, 7, 9
LED Indication:	No	No	No
Short Circuit Protection:	No	No	No
Weld Field Immunity:	Yes	Yes	Yes
Output:	SPDT (Single Pole Double Throw), Normally Open/Normally Closed, Form C	SPDT (Single Pole Double Throw), Normally Open/Normally Closed, Form C	SPDT (Single Pole Double Throw), Normally Open/Normally Closed, Form C
Approvals/Marks:	UL or CSA†	UL or CSA†	UL or CSA†
Make/Break Location:	0.13" from end of stroke, typical. Tolerance is +/- .13"		
Wiring Instructions:	Pin 1: Common (Green) Pin 2: Normally Closed (Black) Pin 3: Normally Open (White)	Common (Black) Normally Open (Blue) Normally Closed (Red)	Common (Black) Normally Open (Blue) Normally Closed (Red)
Standard Cable: 6'	0853550006	–	–
Standard Cable: 12'	0853550012	–	–
Cable: 6', Right Angle	0875470006	–	–

†CSA available upon request – consult factory

How to Specify EPS & CLS Switches

EPS & CLS proximity switches may be ordered on PA-2, PL-2, PH-2, PH-3 and SHM Series cylinders as follows:

- 1) Complete the basic model number
- 2) Place an "S" in the model number to denote switches and/or special features.
- 3) Mounting styles MT1, MT2, ME5, MF1 and MF2 should be used with caution because of possible mounting interferences.
- 4) Special modifications to cylinders other than switches must have a written description.

- 5) Specify letter prefix "H" for EPS-7, "D" for EPS-6, "F" for CLS-1, "B" for CLS-4, or "G" for CLS-2, then fill in the four blanks specifying port location, switch orientation and actuation point for both head and cap. If only one switch is used, place "XXXX" in the unused blanks.

Example = H13AGG-XXXX denotes a switch on the head end only, EPS-7

Example = XXXX-B42AGG denotes a switch on the cap end only, CLS-4

Head End

H	1	3	A	GG
Specify: "H" = EPS-7 "D" = EPS-6 "F" = CLS-1 ¹ "B" = CLS-4 ¹ "N" = Prep for EPS-6 and EPS-7 switches "P" = Prep for CLS-1 and CLS-4 switches "T" = Prep for CLS-2 switch	Port Location See Figure 1.	Switch Location See Figure 1.	Switch Orientation See Figure 2 for CLS-1, CLS-4, EPS-6 and EPS-7 only.	Actuation Point GG = End of Stroke FF = Stroke to Go; See Bulletins 0840-G-E1, 2 or 3 for stroke remaining.

Cap End

H	4	2	A	GG
Specify: "H" = EPS-7 "D" = EPS-6 "F" = CLS-1 "B" = CLS-4 "N" = Prep for EPS-6 and EPS-7 switches "P" = Prep for CLS-1 and CLS-4 switches "T" = Prep for CLS-2 switch	Port Location See Figure 1.	Switch Location See Figure 1.	Switch Orientation See Figure 2 for CLS-1, CLS-4, EPS-6 and EPS-7 only.	Actuation Point GG = End of Stroke FF = Stroke to Go; See Bulletins 0840-G-E1, 2 or 3 for stroke remaining.

Note: All specified switch and port locations are as seen from rod end of cylinder.

¹CLS-1 and CLS-4 proximity switches are not available on the head end of 1.50" bore with 1.00" rod and 2.00" bore with 1.375" rod

Figure 1

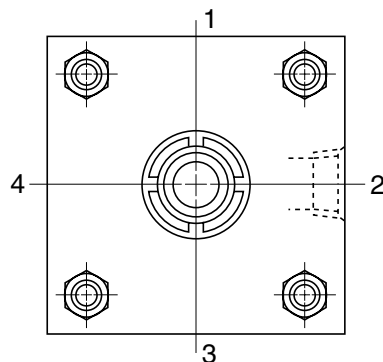
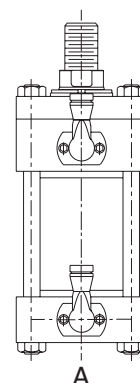


Figure 2



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2. Price; Payment. The Products set forth in the Quote are offered for sale at the prices indicated in the Quote. Unless otherwise specifically stated in the Quote, prices are valid for thirty (30) days and do not include any sales, use, or other taxes or duties. Seller reserves the right to modify prices at any time to adjust for any raw material price fluctuations. Unless otherwise specified by Seller, all prices are F.C.A. Seller's facility (INCOTERMS 2020). All sales are contingent upon credit approval and full payment for all purchases is due thirty (30) days from the date of invoice (or such date as may be specified in the Quote). Unpaid invoices beyond the specified payment date incur interest at the rate of 1.5% per month or the maximum allowable rate under applicable law.

3. Shipment; Delivery; Title and Risk of Loss. All delivery dates are approximate, and Seller is not responsible for damages resulting from any delay. Regardless of the manner of shipment, delivery occurs and title and risk of loss or damage pass to Buyer, upon placement of the Products with the carrier at Seller's facility. Unless otherwise agreed prior to shipment and for domestic delivery locations only, Seller will select and arrange, at Buyer's sole expense, the carrier and means of delivery. When Seller selects and arranges the carrier and means of delivery, freight and insurance costs for shipment to the designated delivery location will be prepaid by Seller and added as a separate line item to the invoice. Buyer shall be responsible for any additional shipping charges incurred by Seller due to Buyer's acts or omissions. Buyer shall not return or repackage any Products without the prior written authorization from Seller, and any return shall be at the sole cost and expense of Buyer.

4. Warranty. The warranty for the Products is as follows: (i) Goods are warranted against defects in material or workmanship for a period of eighteen (18) months from the date of delivery or 2,000 hours of use, whichever occurs first; (ii) Services shall be performed in accordance with generally accepted practices and using the degree of care and skill that is ordinarily exercised and customary in the field to which the Services pertain and are warranted for a period of six (6) months from the date of completion of the Services; and (iii) Software is only warranted to perform in accordance with applicable specifications provided by Seller to Buyer for ninety (90) days from the date of delivery or, when downloaded by a Buyer or end-user, from the date of the initial download. All prices are based upon the exclusive limited warranty stated above, and upon the following disclaimer: **EXEMPTION CLAUSE: DISCLAIMER OF WARRANTY, CONDITIONS, REPRESENTATIONS: THIS WARRANTY IS THE SOLE AND ENTIRE WARRANTY, CONDITION, AND REPRESENTATION, PERTAINING TO PRODUCTS. SELLER DISCLAIMS ALL OTHER WARRANTIES, CONDITIONS, AND REPRESENTATIONS, WHETHER STATUTORY, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THOSE RELATING TO DESIGN, NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE. SELLER DOES NOT WARRANT THAT THE SOFTWARE IS ERROR-FREE OR FAULT-TOLERANT. OR THAT BUYER'S USE THEREOF WILL BE SECURE OR UNINTERRUPTED. UNLESS OTHERWISE AUTHORIZED IN WRITING BY SELLER, THE SOFTWARE SHALL NOT BE USED IN CONNECTION WITH HAZARDOUS OR HIGH RISK ACTIVITIES OR ENVIRONMENTS. EXCEPT AS EXPRESSLY STATED HEREIN, ALL PRODUCTS ARE PROVIDED "AS IS".**

5. Claims; Commencement of Actions. Buyer shall promptly inspect all Products upon receipt. No claims for shortages will be allowed unless reported to Seller within ten (10) days of delivery. Buyer shall notify Seller of any alleged breach of warranty within thirty (30) days after the date the non-conformance is or should have been discovered by Buyer. Any claim or action against Seller based upon breach of contract or any other theory, including tort, negligence, or otherwise must be commenced within twelve (12) months from the date of the alleged breach or other alleged event, without regard to the date of discovery.

6. LIMITATION OF LIABILITY. IN THE EVENT OF A BREACH OF WARRANTY, SELLER WILL, AT ITS OPTION, REPAIR OR REPLACE THE NON-CONFORMING PRODUCT, RE-PERFORM THE SERVICES, OR REFUND THE PURCHASE PRICE PAID WITHIN A REASONABLE PERIOD OF TIME. **IN NO EVENT IS SELLER LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES INCLUDING ANY LOSS OF REVENUE OR PROFITS, WHETHER BASED IN CONTRACT, TORT OR OTHER LEGAL THEORY. IN NO EVENT SHALL SELLER'S LIABILITY UNDER ANY CLAIM MADE BY BUYER EXCEED THE PURCHASE PRICE PAID FOR THE PRODUCTS.**

7. Confidential Information. Buyer acknowledges and agrees that any technical, commercial, or other confidential information of Seller, including, without limitation, pricing, technical drawings or prints and/or part lists, which has been or will be disclosed, delivered or made available, whether directly or indirectly, to Buyer ("Confidential Information"), has been and will be received in confidence and will remain the property of Seller. Buyer further agrees that it will not use Seller's Confidential Information for any purpose other than for the benefit of Seller.

8. Loss to Buyer's Property. Any tools, patterns, materials, equipment or information furnished by Buyer or which are or become Buyer's property ("Buyer's Property"), will be considered obsolete and may be destroyed by Seller after two (2) consecutive years have elapsed without Buyer ordering the Products manufactured using Buyer's Property. Furthermore, Seller shall not be responsible for any loss or damage to Buyer's Property while it is in Seller's possession or control.

9. Special Tooling. "Special Tooling" includes but is not limited to tools, jigs, fixtures and associated manufacturing equipment acquired or necessary to manufacture Goods. Seller may impose a tooling charge for any Special Tooling. Such Special Tooling shall be and remain Seller's property notwithstanding payment of any charges by Buyer. In no event will Buyer acquire any interest in the Special Tooling, even if such Special Tooling has been specially converted or adapted for manufacture of Goods for Buyer and notwithstanding any charges paid by Buyer. Unless otherwise agreed, Seller has the right to alter, discard or otherwise dispose of any Special Tooling or other property owned by Seller in its sole discretion at any time.

10. Security Interest. To secure payment of all sums due from Buyer, Seller retains a security interest in all Products delivered to Buyer and, Buyer's acceptance of these Terms is deemed to be a Security Agreement under the Uniform Commercial Code. Buyer authorizes Seller as its attorney to execute and file on Buyer's behalf all documents Seller deems necessary to perfect Seller's security interest.

11. User Responsibility. Buyer, through its own analysis and testing, is solely responsible for making the final selection of the Products and assuring that all performance, endurance, maintenance, safety and warning requirements of the application of the Products are met. Buyer must analyze all aspects of the application and follow applicable industry standards, specifications, and any technical information provided with the Quote or the Products, such as Seller's instructions, guides and specifications. If Seller provides options of or for Products based upon data or specifications provided by Buyer, Buyer is responsible for determining that such data and specifications are suitable and sufficient for all applications and reasonably foreseeable uses of the Products. In the event Buyer is not the end-user of the Products, Buyer will ensure such end-user complies with this paragraph.

12. Use of Products, Indemnity by Buyer. Buyer shall comply with all instructions, guides and specifications provided by Seller with the Quote or the Products. Unauthorized Uses. If Buyer uses or resells the Products in any way prohibited by Seller's instructions, guides or specifications, or Buyer otherwise fails to comply with Seller's

instructions, guides and specifications, Buyer acknowledges that any such use, resale, or non-compliance is at Buyer's sole risk. Further, Buyer shall indemnify, defend, and hold Seller harmless from any losses, claims, liabilities, damages, lawsuits, judgments and costs (including attorney fees and defense costs), whether for personal injury, property damage, intellectual property infringement or any other claim, arising out of or in connection with: (a) improper selection, design, specification, application, or any misuse of Products; (b) any act or omission, negligent or otherwise, of Buyer; (c) Seller's use of patterns, tools, equipment, plans, drawings, designs, specifications or other information or things furnished by Buyer; (d) damage to the Products from an external cause, repair or attempted repair by anyone other than Seller, failure to follow instructions, guides and specifications provided by Seller, use with goods not provided by Seller, or opening, modifying, deconstructing, tampering with or repackaging the Products; or (e) Buyer's failure to comply with these Terms. Seller shall not indemnify Buyer under any circumstance except as otherwise provided in these Terms.

13. Cancellations and Changes. Buyer may not cancel or modify, including but not limited to movement of delivery dates for the Products, any order for any reason except with Seller's written consent and upon terms that will indemnify, defend and hold Seller harmless against all direct, incidental and consequential loss or damage and any additional expense. Seller, at any time, may change features, specifications, designs and availability of Products.

14. Limitation on Assignment. Buyer may not assign its rights or obligations without the prior written consent of Seller.

15. Force Majeure. Seller is not liable for delay or failure to perform any of its obligations by reason of events or circumstances beyond its reasonable control. Such circumstances include without limitation: accidents, labor disputes or stoppages, government acts or orders, acts of nature, pandemics, epidemics, other widespread illness, or public health emergency, delays or failures in delivery from carriers or suppliers, shortages of materials, war (whether declared or not) or the serious threat of same, riots, rebellions, acts of terrorism, fire or any reason whether similar to the foregoing or otherwise. Seller will resume performance as soon as practicable after the event of force majeure has been removed. All delivery dates affected by force majeure shall be tolled for the duration of such force majeure and rescheduled for mutually agreed dates as soon as practicable after the force majeure condition ceases to exist. Force majeure shall not include financial distress, insolvency, bankruptcy, or other similar conditions affecting one of the parties, affiliates and/or sub-contractors.

16. Waiver and Severability. Failure to enforce any provision of these Terms will not invalidate that provision; nor will any such failure prejudice either party's right to enforce that provision in the future. Invalidation of any provision of these Terms shall not invalidate any other provision herein and, the remaining provisions will remain in full force and effect.

17. Termination. Seller may terminate any agreement governed by or arising from these Terms for any reason and at any time by giving Buyer thirty (30) days prior written notice. Seller may immediately terminate, in writing, if Buyer: (a) breaches any provision of these Terms, (b) becomes or is deemed insolvent, (c) appoints or has appointed a trustee, receiver or custodian for all or any part of Buyer's property, (d) files a petition for relief in bankruptcy on its own behalf, or one is filed against Buyer by a third party, (e) makes an assignment for the benefit of creditors; or (f) dissolves its business or liquidates all or a majority of its assets.

18. Ownership of Software. Seller retains ownership of all Software supplied to Buyer hereunder. In no event shall Buyer obtain any greater right in and to the Software than a right in the nature of a license limited to the use thereof and subject to compliance with any other terms provided with the Software.

19. Indemnity for Infringement of Intellectual Property Rights. Seller is not liable for infringement of any patents, trademarks, copyrights, trade dress, trade secrets or similar rights ("Intellectual Property Rights") except as provided in this Section. Seller will defend at its expense and will pay the cost of any settlement or damages awarded in an action brought against Buyer based on a third party claim that one or more of the Products sold hereunder infringes the Intellectual Property Rights of a third party in the country of delivery of the Products by Seller to Buyer. Seller's obligation to defend and indemnify Buyer is contingent on Buyer notifying Seller within ten (10) days after Buyer becomes aware of any such claim, and Seller having sole control over the defense of the claim including all negotiations for settlement or compromise. If one or more Products sold hereunder is subject to such a claim, Seller may, at its sole expense and option, procure for Buyer the right to continue using the Products, replace or modify the Products so as to render them non-infringing, or offer to accept return of the Products and refund the purchase price less a reasonable allowance for depreciation. Seller has no obligation or liability for any claim of infringement: (i) arising from information provided by Buyer; or (ii) directed to any Products provided hereunder for which the designs are specified in whole or part by Buyer; or (iii) resulting from the modification, combination or use in a system of any Products provided hereunder. The foregoing provisions of this Section constitute Seller's sole and exclusive liability and Buyer's sole and exclusive remedy for claims of infringement of Intellectual Property Rights.

20. Governing Law. These Terms and the sale and delivery of all Products are deemed to have taken place in, and shall be governed and construed in accordance with, the laws of the State of Ohio, as applicable to contracts executed and wholly performed therein and without regard to conflicts of laws principles. Buyer irrevocably agrees and consents to the exclusive jurisdiction and venue of the courts of Cuyahoga County, Ohio with respect to any dispute, controversy or claim arising out of or relating to the sale and delivery of the Products.

21. Entire Agreement. These Terms, along with the terms set forth in the main body of any Quote, forms the entire agreement between the Buyer and Seller and constitutes the final, complete and exclusive expression of the terms of sale and purchase. In the event of a conflict between any term set forth in the main body of a Quote and these Terms, the terms set forth in the main body of the Quote shall prevail. All prior or contemporaneous written or oral agreements or negotiations with respect to the subject matter shall have no effect. These Terms may not be modified unless in writing and signed by an authorized representative of Seller.

22. Compliance with Laws. Buyer agrees to comply with all applicable laws, regulations, and industry and professional standards, including those of the United States of America, and the country or countries in which Buyer may operate, including without limitation the U.S. Foreign Corrupt Practices Act ("FCPA"), the U.S. Anti-Kickback Act ("Anti-Kickback Act"), U.S. and E.U. export control and sanctions laws ("Export Laws"), the U.S. Food Drug and Cosmetic Act ("FDCA"), and the rules and regulations promulgated by the U.S. Food and Drug Administration ("FDA"), each as currently amended. Buyer agrees to indemnify, defend, and hold harmless Seller from the consequences of any violation of such laws, regulations and standards by Buyer, its employees or agents. Buyer acknowledges that it is familiar with all applicable provisions of the FCPA, the Anti-Kickback Act, Export Laws, the FDCA and the FDA and certifies that Buyer will adhere to the requirements thereof and not take any action that would make Seller violate such requirements. Buyer represents and agrees that Buyer will not make any payment or give anything of value, directly or indirectly, to any governmental official, foreign political party or official thereof, candidate for foreign political office, or commercial entity or person, for any improper purpose, including the purpose of influencing such person to purchase Products or otherwise benefit the business of Seller. Buyer further represents and agrees that it will not receive, use, service, transfer or ship any Products from Seller in a manner or for a purpose that violates Export Laws or would cause Seller to be in violation of Export Laws. Buyer agrees to promptly and reliably provide Seller all requested information or documents, including end-user statements and other written assurances, concerning Buyer's ongoing compliance with Export Laws. 08/2020



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