POSITEK LIMITED

LIPS® M100 CYLINDER - LINEAR POSITION SENSOR

INTRINSICALLY SAFE FOR HAZARDOUS MINING ENVIRONMENTS

- **Intrinsically safe for Mining to:**
  Ex I/II M1/1GD
- **Non-contacting inductive technology to eliminate wear**
- **Travel set to customer's requirement**
- **High durability and reliability**
- **High accuracy and stability**
- **Sealing to IP67**

As a leading designer and manufacturer of linear, rotary, tilt and intrinsically safe position sensors, Positek® has the expertise to supply a sensor to suit a wide variety of applications.

Our intrinsically safe M100 LIPS® (Linear Inductive Position Sensor) is ATEX approved for use in potentially explosive **gas/vapour, dust** atmospheres and **mining** environments. It is designed for demanding hydraulic or pneumatic cylinder position feedback applications where service life, environmental resistance and cost are important and is ideal for OEMs seeking good sensor performance for arduous applications in hazardous areas.

Overall performance, repeatability and stability are outstanding over a wide temperature range. The unit is highly compact and space-efficient, being responsive along almost its entire length. Like all Positek sensors, the M100 provides a linear output proportional to displacement. Each unit is supplied with the output calibrated to the travel required by the customer, from 20 to 600mm and with full EMC protection built in.

The sensor is very rugged, being made of stainless steel with an inert fluoropolymer-sheathed probe with the option of either an aluminium or stainless steel target tube. The sensor is easy to install in cylinders and has a range of mechanical options. Environmental sealing is to IP67.

SPECIFICATION

DIMENSIONS	
Body diameter	35 mm
Body Length (to seal face)	43 mm
Probe Length (from seal face)	measurement length + 58 mm
Target Tube Length	measurement length + 30mm
	ID 7.7mm, OD 9.45mm
For full mechanical details see drawing M100-11	
Independent linearity	< ± 0.25% up to 450mm @ 20°C
	< ± 0.5% over 450mm @ 20°C
Temperature coefficients	< ± 0.01%/°C Gain &
	< ± 0.01%FS/°C Offset
Typical overall accuracy	< ± 0.75%/ FSO
Frequency response	> 10 KHz (-3dB)
Resolution	Infinite
Noise	< 0.02% FSO
Intrinsic Safety	Ex I/II M1/1GD
	EEx ia I/IIC T4 (Ta = -40°C to +80°C)
	Ex iaD 20 T135°C (Ta = -40°C to +80°C)
maximum limits	Ui: 11.4V, Ii: 0.46A, Pi: 0.51W.
Environmental Temperature Limits	
Operating	-40 to +80°C
Storage	-40 to +125°C
Sealing	IP67
Hydraulic Pressure	350Bar
EMC Performance	EN 61000-6-2, EN 61000-6-3
Vibration	IEC 68-2-6: 10g
Shock	IEC 68-2-29: 40 g
MTBF	350,000 hrs 40°C Gf
Drawing List	
M100-11	Sensor Outline
P100-12	Typical Target Installation details
P100-15	Mounting Thread details
TG24-11	Optional Target Tube Flange details

Drawings, in AutoCAD® dwg or dxf format, available on request.

Do you need a position sensor made to order to suit a particular installation requirement or specification? We'll be happy to modify any of our designs to suit your needs - please contact us with your requirements.

For further information please contact:
www.positek.com sales@positek.com
Tel: +44(0)1242 820027 fax: +44(0)1242 820615
Positek Ltd, Andoversford Industrial Estate, Cheltenham GL54 4LB U.K.

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LIPS® M100 CYLINDER - LINEAR POSITION SENSOR

INTRINSICALLY SAFE FOR HAZARDOUS MINING ENVIRONMENTS

Intrinsically safe equipment is defined as *"equipment which is incapable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of a specific hazardous atmosphere mixture in its most easily ignited concentration."*

ATEX approved to Ex I/II M1/1GD
EEx ia IIC T4
Ex iaD 20 T135°C (Ta = -40°C to +80°C)

Designates the sensor as belonging to; Groups I and II: suitable for all areas **(including mining)**, Category M1/1 GD: can be used in areas with continuous, long or frequent periods of exposure to hazardous gas (Zones 2 to 0) and dust (Zone 20), equipment remains energised.

Gas:

Protection class ia, denotes intrinsically safe for all zones
Apparatus group IIC: suitable for IIA, IIB and IIC explosive gases.
Temperature class T4: maximum sensor surface temperature under fault conditions 135°C.

Dust:

T135°C: maximum sensor surface temperature under fault conditions 135°C.

Ambient temperature range extended to -40°C to +80°C.

Positek intrinsically safe sensors are designed to be used with a galvanically isolated barrier with safety parameters not exceeding:-

Ui: 11.4V, Ii: 0.46A, Pi: 0.51W.

Sensor can be installed with a cable length up to 150m maximum from the barrier, capacitance and inductance can be up to:-

Capacitance: 550 nF max, Inductance: 99 µH max.

For cable lengths exceeding 10 metres a five wire connection is recommended to eliminate errors introduced by cable resistance and associated temperature coefficients.

Approved barriers are available from Positek®; there is a choice of 0.5-9.5V or 4-20mA transmission outputs.

0.5-9.5V barrier option - BX002.
4-20mA barrier option - BX003.

ATEX approved sensors suitable for gas (X series) and dust (E series) applications, are also available from Positek.

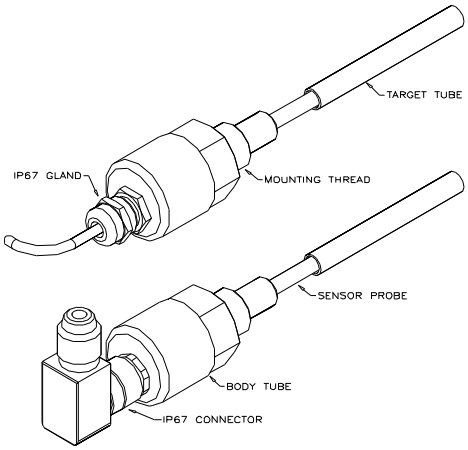


TABLE OF OPTIONS

MEASUREMENT RANGE: Factory-set to any length from 20 to 600 mm in increments of 1mm.

ELECTRICAL INTERFACE OPTIONS

A galvanic isolation barrier is required to meet IS approval - 0.5-9.5V or 4-20mA options, see barrier data sheet overleaf.

CONNECTOR/CABLE OPTIONS

Connector - Binder 713 series	IP67
Cable with PG9 gland	IP67

Cable length >50cm – please specify length in cm up to 15000cm maximum.

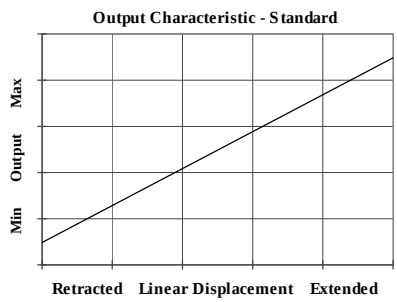
We recommend all customers refer to the 3 & 5-Wire Connection Information.

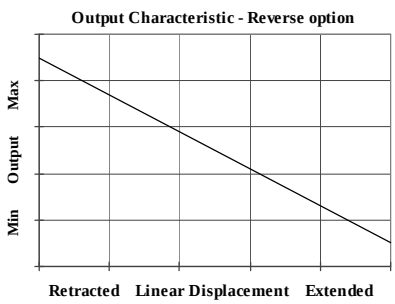
MOUNTING THREAD OPTIONS

M18, M20, ¾ UNF 30mm hex AF, Ø30mm seal face.
Supplied with O-ring seal.

FLANGE OPTIONS

Penny & Giles HLP100, Temposonics (M4 fixing) and Parker Hannifin cylinders versions available.





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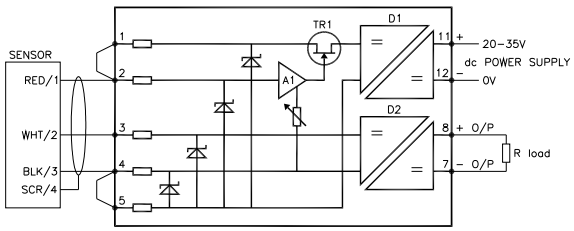
INTRINSICALLY SAFE
BX002 and BX003 Sensor Barrier

Intrinsic safety means limiting the electrical energy in a system to a level incapable of causing ignition in any normal or fault condition. This can only be accomplished by installing an energy-limiting interface in the wiring between hazardous and non-hazardous areas.

Limiting the discharge of energy-stored devices in electrical equipment such as capacitors and inductors virtually eliminates the possibility of generating a spark and thus a source of ignition.

The **BX002** (0.5 to 9.5V) and **BX003** (4 to 20mA) Isolated Galvanic Barriers are the best choice for use with Positek Intrinsically Safe Position Sensors. The hazardous area circuits are certified intrinsically safe [EEx ia] IIC. Connections between hazardous and non-hazardous areas are transformer isolated, eliminating the requirement for a high-integrity intrinsically safe earth.

Choosing either a BX002 or BX003 barrier not only provides signal isolation but allows sensors to be calibrated to a specific barrier type before shipping, ensuring the respective barrier output corresponds to the sensor position over the calibrated range. The isolated power circuit limits the energy supply to the sensor to ensure the maximum safety parameters required for Positek sensors are not exceeded.



How it works; a 20-35V dc external power supply is connected to the dc/dc converter D1 which provides isolation. The output from D1 is regulated by A1 and TR1 to provide a nominal 5V supply for the sensor. The barrier and sensor can be connected by three wires; 5-wire connection capability is available to compensate for volts drop in long cable runs.
D2 provides isolation between the sensors output and the barriers 0.5-9.5V or 4-20mA current loop output.

- **ATEX approved**
- **Tri-port isolated**
- **DIN rail mounted**
- **Voltage and current output versions**

SPECIFICATION

POWER SUPPLY	Power rail terminals 11 and 12
Voltage	20-35V dc
Power consumption	ca. 0.7W for voltage output, 1.4W current output

INPUT CIRCUIT (terminals 1,2,3,4,5)

	Transformer isolated Intrinsically Safe [EEx ia] IIC BAS00ATEX7171 Umax out = 10.4V Imax out = 46mA
Voltage across sensor	ca. 4.8 volts
Lead resistance for 15mA	12Ω maximum (all connections)
Input resistance terminal 3	17MΩ min

OUTPUT CIRCUIT (terminals 7/8)

Output options	
Voltage	BX002 0.5 to 9.5V
Output resistance	< 30Ω
Current loop	BX003 4 to 20mA
Load resistance	0 - 1kΩ

TRANSFER CHARACTERISTICS

Non-linearity:	< ± 5mV for voltage outputs < ± 10µ A for current outputs
Temperature drift:	< 0.5mV/°C for voltage outputs < 1µA/°C for current outputs
Settling time to 1% of span:	< 25ms for 10-90% step change
Rise time:	< 8ms 10-90% of step change
Bandwidth	dc to 100Hz (-3dB)
Isolation:	2500V between safe area terminals and hazardous area terminals, 50V between power rail terminals and output terminals (7 and 8)

ELECTROMAGNETIC COMPATIBILITY

Emissions:	to EN50081-2
Immunity:	to EN50082-2
Ambient temperature range:	-20° to 60°C working, -40°C to +100°C storage
Protection class	IP20

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INTRINSICALLY SAFE
BX002 and BX003 Sensor Barrier
3 & 5-WIRE CONNECTION INFORMATION

The following discussion about 3 and 5 wire connections between sensors and the Galvanic Isolation Amplifiers is intended as an aid for end-users who are not familiar with the topic.

Whether opting for a pre-wired Positek® Intrinsically Safe sensor or one with a connector, choosing the right mode of connection and cable to suit the application requires consideration. Conductor resistance, a function of cross-section, length and current, causes volts drop across cable. This can significantly alter the perceived accuracy of the sensor which is ratiometric i.e. the output signal is directly affected by the supply voltage at the sensor.

3-wire connections are common for connecting sensors but accuracy can become an issue. Increasing conductor cross-section reduces volts drop and is suitable for all but very long lengths or applications that require a high degree of accuracy. Another factor to consider is conductor temperature. Fluctuations in temperature also cause minor changes in resistance, the effects of which can be seen in the calculated examples below for 0.25mm^2 and 2.5mm^2 conductors at 20°C and 50°C.

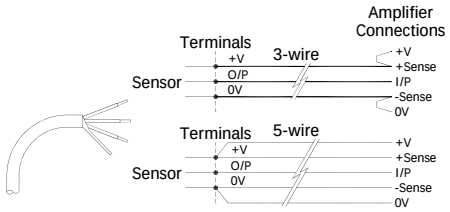
Sensors supplied with cable are calibrated with the cable fitted which negates errors due to conductor resistance at room temperature; however, small errors due to temperature fluctuations should be expected.

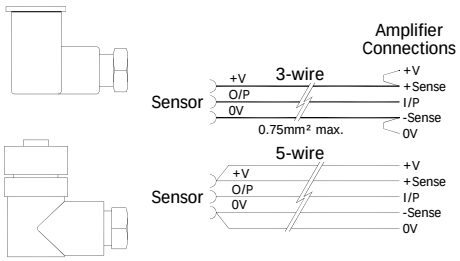
Large cross-section cables are not always practical. For example, sensors supplied with either the IP65 or IP67 connectors have a maximum conductor size of 0.75mm^2.

5-wire connections have significant benefits over three wire connections as losses in the power and ground conductors are compensated. The Galvanic Isolation Amplifier senses and dynamically adjusts the output voltage so that the voltage at the sensor is correct, the effects of cable resistance and associated temperature coefficients are eliminated. BX002 and BX003 amplifiers can compensate for up to 12Ω per conductor with a current flow of 15mA, which is more than adequate for 150m of 0.25mm^2 cable.

For this reason Positek® recommends five wire connections for cable lengths exceeding 10 metres.

See illustrations right for examples of connecting a sensor to the Galvanic Isolation Amplifier.





The following formulae can be used to calculate losses due to conductor cross-section and conductor temperature;

Resistance of the a single conductor is $R = \rho \times L / A \times (1 + TC \times (T - T_{amb}))$ where:

- ρ = resistivity of copper wire: $1.69 \times 10^{-8}\Omega m$
- L = length of the wire: in metres
- A = area of the conductor cross section of the wire in metres^2: e.g. 0.25mm^2 conductor $0.25/1000^2 = 2.5 \times 10^{-7} m^2$
- TC = copper temperature coefficient: 3.9×10^{-3}
- T = conductor temperature in °C
- T_{amb} = ambient temperature i.e. 20°C

Voltage at sensor $V_{sensor} = V - I \times 2 \times R$ where

- V = supply voltage from the amplifier
- I = the supply current: 10mA
- R = resistance of the a single conductor

Examples: (of 3-wire connections with the maximum 150 metres of cable, conductor sizes 0.25^2 and 2.5mm^2 at 20°C and 50°C)

0.25mm^2 cable at 20°C	$R=1.69\times10^{-8}\times150/2.5\times10^{-7}\times(1+3.9\times10^{-3}\times(20-20))$	= 10.14Ω
	$V_{sensor}=5-10\times10^{-3}\times2\times10.14$	= 4.79V or 4.0% loss
0.25mm^2 cable at 50°C	$R=1.69\times10^{-8}\times150/2.5\times10^{-7}\times(1+3.9\times10^{-3}\times(50-20))$	= 11.33Ω
	$V_{sensor}=5-10\times10^{-3}\times2\times11.33$	= 4.77V or 4.5% loss
2.5mm^2 cable at 20°C	$R=1.69\times10^{-8}\times150/2.5\times10^{-6}\times(1+3.9\times10^{-3}\times(20-20))$	= 1.01Ω
	$V_{sensor}=5-10\times10^{-3}\times2\times1.01$	= 4.98V or 0.4% loss
2.5mm^2 cable at 50°C	$R=1.69\times10^{-8}\times150/2.5\times10^{-6}\times(1+3.9\times10^{-3}\times(50-20))$	= 1.13Ω
	$V_{sensor}=5-10\times10^{-3}\times2\times1.13$	= 4.97V or 0.45% loss

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