POSITEK LIMITED

LIPS® E100 CYLINDER - LINEAR POSITION SENSOR
INTRINSICALLY SAFE FOR HAZARDOUS DUST ATMOSPHERES

- **Intrinsically safe for Gas and Dust to: Ex II 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 E100 LIPS® (Linear Inductive Position Sensor) incorporates electronics system EX07 which is ATEX / IECEx approved for use in potentially explosive **gas/vapour and dust** atmospheres. The E100 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 E100 provides a linear output proportional to travel. Each unit is supplied with the output calibrated to the travel required by the customer, any stroke from 0-5mm to 0-800mm and with full EMC protection built in.

The sensor is very rugged, being made of stainless steel with an inert fluoropolymer-sheathed probe with a 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)	calibrated travel + 58 mm
Target Tube Length	calibrated travel + 30 mm
For full mechanical details see drawing E100-11	
Power Supply	+5V dc nom. ± 0.5V, 10mA typ 20mA max
Output Signal	0.5-4.5V dc ratiometric, Load: 5kΩ min.
Independent Linearity	≤ ± 0.25% FSO @ 20°C - up to 450 mm
	≤ ± 0.5% FSO @ 20°C - over 450 mm
	≤ ± 0.1% FSO @ 20°C* available upon request.
*Sensors with calibrated travel from 10 mm up to 400 mm.	
Temperature Coefficients	< ± 0.01%/°C Gain &
	< ± 0.01%FS/°C Offset
Frequency Response	> 10 kHz (-3dB)
Resolution	Infinite
Noise	< 0.02% FSO
Intrinsic Safety	Ex II 1GD
	Ex ia IIC T4 Ga (Ta= -40°C to 80°C)
	Ex ia IIIC T135°C Da (Ta= -40°C to 80°C)
Approval only applies to the specified ambient temperature range and atmospheric conditions in the range 0.80 to 1.10 Bar, oxygen ≤ 21%	
Sensor Input Parameters	Ui: 11.4V, Ii: 0.20A, Pi: 0.51W.
(connector option/s)	Ci: 1.16µF, Li: 50µH
(cable option/s)	Ci: 1.36µF, Li: 860µH with 1km max. cable
Environmental Temperature Limits	
Operating	-40°C to +80°C
Storage	-40°C to +125°C
Sealing	IP67
Hydraulic Pressure	350Bar
EMC Performance	EN 61000-6-2, EN 61000-6-3
Vibration	IEC 68-2-6: 10 g
Shock	IEC 68-2-29: 40 g
MTBF	350,000 hrs 40°C Gf
Drawing List	
E100-11	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.

E100-17p

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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 / IECEx approved to;
Ex II 1GD
Ex ia IIC T4 Ga (Ta= -40°C to 80°C)
Ex ia IIIC T135°C Da (Ta= -40°C to 80°C)

Designates the sensor as belonging to; Group II: suitable for all areas **except mining**, Category 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).
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.

It is imperative Positek® intrinsically safe sensors be used in conjunction with a galvanic barrier to meet the requirements of the product certification. The Positek X005 Galvanic Isolation Amplifier is purpose made for Positek IS sensors making it the perfect choice. Refer to the X005 datasheet for product specification and output configuration options.

Safety Parameters:-
Ui: 11.4V, Ii: 0.20A, Pi: 0.51W
Ci = 1.36µF* Li = 860µH* (cable option/s)
Ci = 1.16µF Li = 50µH (connector option/s)

*Figures for 1km cable where: Ci = 200pF/m & Li = 810nH/m

Sensors can be installed with a maximum of 1000m of cable.
Cable characteristics must not exceed:-
Capacitance: ≤ 200 pF/m for max. total of: 200 nF.
Inductance: ≤ 810 nH/m for max. total of: 810 µH

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

ATEX / IECEx approved sensors suitable for gas (X series) and mining (M series) applications, are also available from Positek.

TABLE OF OPTIONS

CALIBRATED TRAVEL: Factory set to any length from 0-5mm to 0-800mm (e.g. 254mm)

ELECTRICAL INTERFACE OPTIONS

The Positek® **X005** Galvanic Isolation Amplifier is available with the following output options;
Standard: 0.5 - 9.5V or 4 - 20mA.
Reverse: 9.5 - 0.5V or 20 - 4mA.

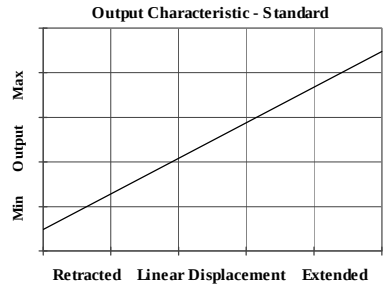
CONNECTOR/CABLE OPTIONS

Connector - Binder 713 series	IP67
Cable† with Pg 9 gland or short gland	IP67

†Three core (black jacket) or five core (blue jacket) cable options available.
Cable length >50 cm – please specify length in cm up to 15000 cm max.
We recommend all customers refer to the 3 or 5-Wire Mode Connection page.

MOUNTING THREAD OPTIONS
M18, M20, ¾ UNF 30 mm hex A/F, Ø30 mm 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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Three or Five-Wire Mode Connection

FOR INTRINSICALLY SAFE SENSORS IN HAZARDOUS ATMOSPHERES

The aim of this document is to help readers who do not understand what is meant by three or five wire modes of connection between the galvanic isolation amplifier and sensor, and the factors behind them. It is by no means an in-depth technical analysis of the subject.

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 careful consideration.

Interconnecting cables are not perfect conductors and offer resistance to current flow, the magnitude of resistance† depends on conductors resistivity, which changes with temperature, cross sectional area‡ and length. If the voltage were to be measured at both ends of a length of wire it would be found they are different, this is known as volts drop. Volts drop changes with current flow and can be calculated using Ohm's law, it should be noted that volts drop occurs in both positive and negative conductors. The effects of volts drop can be reduced by increasing the conductors cross sectional area, this does not however eliminate the effects due to temperature variation. There are instances where large cross-section cables are not practical; for example most standard industrial connectors of the type used for sensors have a maximum conductor capacity of 0.75mm², copper prices and ease of installation are other considerations.

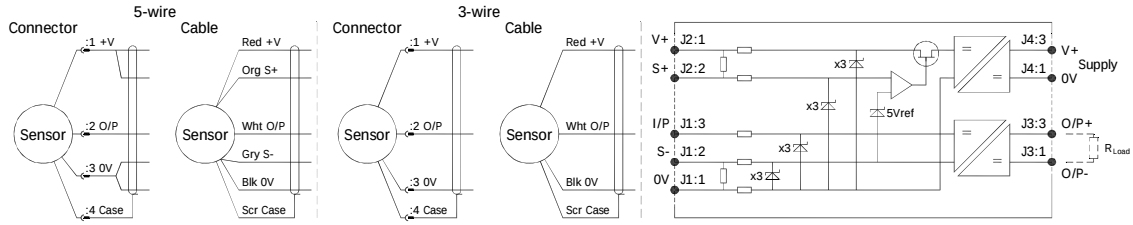
This is important because the effects of volts drop can significantly alter the perceived accuracy of the sensor which is ratiometric i.e. the output signal is directly affected by the voltage across the sensor. Changes in temperature will also be seen as gain variation in the sensor output.

Three wire mode connections are common and are suitable in most cases with short or moderate cable runs. Applications that do not require a high degree of accuracy but have cable runs, say in excess of 10m, volts drop can reduced by introducing a terminal box close to the sensor and using a larger cross-section cable for a majority of the cable run. Sensors supplied with three core cable are calibrated with the cable fitted which largely eliminates errors due to conductor resistance at room temperature however, as mentioned above, small gain errors due to temperature fluctuations should be expected.

Five wire mode connections have significant benefits as losses in the positive and negative conductors are compensated for by the galvanic isolation amplifier which can 'sense' the voltage across the sensor and dynamically adjust the output voltage so that the voltage across the sensor is correct. The effects of cable resistance and associated temperature coefficients are eliminated allowing for smaller conductors than a three wire connection for the same cable run. The amplifier can compensate for up to 15Ω per conductor with a current flow of 15mA, which is more than adequate for 150m of 0.25 mm² cable, longer lengths will require larger conductors.

For this reason Positek® recommends five wire connections for cable lengths exceeding 10 metres in 0.25 mm² cable to preserve the full accuracy of the sensor.

See illustrations below for examples of connecting a sensor to the galvanic isolation amplifier.



Cable Length (metres)	Up to 150	150 - 300	300 - 450	450 - 600	600 - 900	900 - 1000
Cross Section (mm²)	0.25	0.5	0.75	1.0	1.5	2.0

The table above shows recommended conductor sizes with respect to cable length for both three and five wire connections, based on copper conductors. Three wire connections will introduce a gain reduction of 5% and a ±1% temperature dependence of gain over the range -40°C to +80°C for the cable temperature. (i.e. about –150 ppm/°C for the maximum lengths shown and less pro rata for shorter lengths.)

It should be noted that the maximum cable length, as specified in the sensor certification, takes **precedence** and **must not** be exceeded.

Positek® sensors are supplied with three core 0.25 mm² cable as standard, however five core 0.25 mm² cable can be supplied on request. The galvanic isolation amplifier is available as;

G005-*** for 'G' and 'H' prefix sensors
X005-*** for 'E', 'M' and 'X' prefix sensors

† R = ρL/A ρ is the resistivity of the conductor (Ωm) L is the length of conductor (m) A is the conductor cross-sectional area (m²).
‡ It is presumed that **d**irect **c**urrent flow is uniform across the cross-section of the wire, the galvanic isolation amplifier and sensor are a dc system.

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Intrinsically Safe - Dust Atmospheres

LIPS® SERIES E100 Cylinder – Linear Position Sensor

	a	b	c	d	e	f	g	h
E100	. Displacement	A	Y	Connections	Option	R	Option	Z-code

a **Displacement** (mm)		**Value**
Displacement in mm	e.g. 0 - 254 mm	**254**

b **Output**		
Supply V dc V_s (tolerance)	**Output**	**Code**
+5V (4.5 - 5.5V)	0.5 - 4.5V (ratiometric with supply)	**A**

c **Calibration Adjustments**	**Code**
Sealed	**Y**

d **Connections** Cable* or Connector		**Code**
Connector	IP67 M12 IEC 60947-5-2	**J**
Cable Gland	IP67 M12 - 3-core cable	**Lxx**
Cable Gland	IP67 M12 - 5-core cable	**LQxx**
Cable Gland	IP67 Short - 3-core cable	**Mxx**
Cable Gland	IP67 Short - 5-core cable	**MQxx**

*Supplied with 50 cm as standard, specify required cable length specified in cm. e.g. L2000 specifies cable gland with 20 metres of cable. Nb: restricted cable pull strength.

e **Mounting Thread**		**Code**
M20 x 1.5	Hex. 30 mm A/F, Ø 30 mm seal face. Supplied with O-ring seal.	**N**
3/4 16 UNF		**P**
M18 x 1.5		**T**

See P100-15 Drawing for Mating Thread Details.

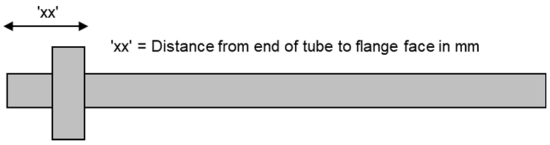
f **Target Tube**		**Code**
Stainless Steel 316	OD: 9.45 mm	**R**

See P100-12 Drawing for Typical Target Installation details.

g **Target Tube Mounting Flange**		**Code**
None		**U**
Penny & Giles HLP100	Please specify flange position in mm. eg. W17.5 specifies a Tempo style flange fitted 17.5 mm from the front face	**Vxx**
Temposonics (M4 fixing)		**Wxx**
Parker Hannifin		**Xxx**

See TG24-11 Drawing for Target Details.

h **Z-code**	**Code**
Calibration to suit X005 - Default	**Z000**
≤± 0.1% @20°C Independent Linearity displacement between 10mm & 400mm only!	**Z650**
Connector with cable option 'J' or 'JQ' with length required in cm i.e. J100 specifies connector with 100cm of cable.	**Z999**



Note!

All Intrinsically Safe (IS) sensors must have a Z-code suffix.
IS sensors must be used in conjunction with a Galvanic Isolation Amplifier - See X005 for Output options.

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