



X101 STAND-ALONE LINEAR POSITION SENSOR INTRINSICALLY SAFE FOR HAZARDOUS GAS/VAPOUR ATMOSPHERES

- **Intrinsically safe for Gas to:** Ex II 1G
- Non-contacting inductive technology to eliminate wear
- Travel set to customer's requirement
- High durability and reliability
- High accuracy and stability
- Sealing to IP65/IP67 as required

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.

intrinsically safe X101 incorporates electronics system EX07 which is ATEX / İECEx / UKEX approved for use in potentially explosive The X101 is gas/vapour atmospheres. designed for industrial and scientific feedback applications and is ideal for OEMs seeking good sensor performance for arduous applications in hazardous areas. The unit is highly compact and space-efficient, being responsive along almost its entire length.

The X101, like all Positek® sensors, 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 The sensor is very robust, the body and push rod being made of stainless steel for long service life and environmental resistance.

Overall performance, repeatability and stability are outstanding over a wide temperature range. The sensor is easy to install with mounting options including M5 rod eye bearings and body The push rod can be supplied free or captive with female M5 thread, an M5 rod eye, dome end or magnetic tip. 1/4" Rod eye option available. Captive push rods can be sprung loaded, in either direction, on sensors up to 300mm of travel. The X101 also offers a wide range of mechanical options, environmental sealing is to IP65 or IP67, depending on selected cable or connector options.



SPECIFICATION

Dimensions Body diameter Body length (Axial version) Body length (Radial version) calibrated travel + 163 mm calibrated travel + 186 mm calibrated travel + 9 mm, OD 9.5 mm

Body length (Noble).

Push rod extension calibrateu u aver 1,5 mm,

For full mechanical details see drawing X101-11

+5V dc nom. ± 0.5V, 10mA typ 20mA max

-5 of the retinant of the retinan **Power Supply** 0.5-4.5V dc ratiometric, Load: $5k\Omega$ min. $2 \pm 0.25\%$ FSO @ 20°C - up to 450 mm $2 \pm 0.5\%$ FSO @ 20°C - over 450 mm $2 \pm 0.1\%$ FSO @ 20°C available upon request. **Output Signal** Independent Linearity

*Sensors with calibrated travel from 10 mm up to 400 mm. **Temperature Coefficients**

< \pm 0.01%/°C Gain & < \pm 0.01%FS/°C Offset **Frequency Response** > 10 kHz (-3dB) Resolution Infinite < 0.02% FSO Noise Intrinsic Safety Ex II 1G

Ex ia IIC T4 Ga (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 \leq 21% Sensor Input Parameters

Ui: 11.4V, Ii: 0.20A, Pi: 0.51W. Ci: 1.16µF, Li: 50µH Ci: 1.36µF, Li: 860µH with 1km max. cable (connector option/s) (cable option/s)

Environmental Temperature Limits Operating

-40°C to +80°C -40°C to +125°C IP65/IP67 depending on connector / cable option EN 61000-6-2, EN 61000-6-3 Storage Sealing EMC Performance

IEC 68-2-6: 10 g IEC 68-2-29: 40 g Vibration 350,000 hrs 40°C Gf **MTBF**

Drawing List Sensor Outline X101-11 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.





X101 STAND-ALONE LINEAR POSITION SENSOR INTRINSICALLY SAFE FOR HAZARDOUS GAS/VAPOUR ATMOSPHERES

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 / UKEX approved to;

Ex II 1G

Ex ia IIC T4 Ga (Ta= -40°C to 80°C)

Designates the sensor as belonging to; Group II: suitable for all areas **except mining**, Category 1 G: can be used in areas with continuous, long or frequent periods of exposure to hazardous gas / vapour (Zones 2 to 0).

Gas / Vapour:

Protection class ia, denotes intrinsically safe for all zones Apparatus group IIC: suitable for IIA, IIB and IIC explosive gas / vapour.

Temperature class T4: 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:-

*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: 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 / UKEX approved sensors suitable for dust (E series) and mining (M series) applications, are also available from Positek.

TABLE OF OPTIONS

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

ELECTRICAL INTERFACE OPTIONS

Axial sensors supplied with access to output 'zero' and 'span' calibration adjustments as standard. No access option available.

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 OPTIONSConnector - Hirschmann GD series Axial, IP65 Connector - Hirschmann ELWIKA 4102 Radial, IP67 Cable[†] with M12 gland or short gland Axial, IP67 Cable[†] with PG9 gland Radial, 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

MOUNTING OPTIONS

M5 rod eye bearing (radial versions), Body Tube Clamp/s (axial or radial versions). 1/4" Rod eye option available

PUSH ROD OPTIONS – Retained[†] or Free with M5x0.8 female thread, M5 rod eye bearing or Magnetic tip, Spring loaded - retract or extend, Dome end*.

standard, retained with female thread.

with spring extend.









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.

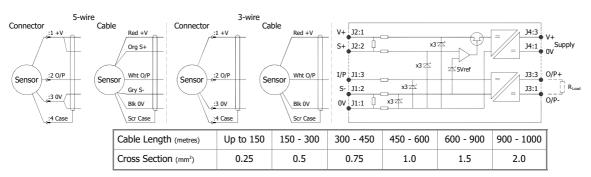
This is important because the effects of volts drop can significantly alter the perceived accuracy of the sensor which is ratiometric i.e. the output signal is directly affected by the voltage across the sensor. Changes in temperature will also be seen as gain variation in the sensor output.

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 0.25mm^2 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.



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 $\pm 1\%$ 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



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 $^{^{\}dagger}$ R = ρ L/A ρ is the resistivity of the conductor (Ω m) L is the length of conductor (m) A is the conductor cross-sectional area (m^2).

^{*}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.

Intrinsically Safe - Gas/Vapour Atmospheres X101 Stand-Alone Linear Position Sensor



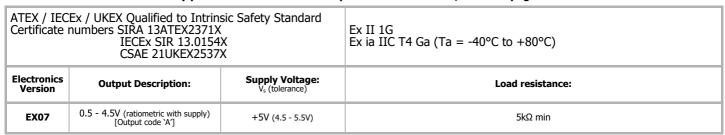
a Displacement (mm)		Value			
Displacement in mm	e.g. 0 - 254 mm	254			
b Output					
Supply V dc V_s (tolerance)	Output	Code			
+5V (4.5 - 5.5V)	0.5 - 4.5V (ratiometric with supply)	A			
c Calibration Adjustments Code					
Accessible - default [†]	[†] Axial body style only. Radial body	blank			
Sealed	style sealed by default.	Y			
d Connections Cable or Connector Code					
	IP67 metal - 3-core cable	Ixx			
Cable Gland - Radial	IP67 metal - 5-core cable	IQxx			
	IP65 DIN 43650 'C'	j			
Connector - Axial	pre-wired - 3-core cable	Jxx			
	pre-wired - 5-core cable	JQxx			
	IP67 M12 IEC 60176-2-101 nylon	K			
Connector - Radial	pre-wired - 3-core cable	Kxx			
Connector - Radiai	•				
	pre-wired - 5-core cable	KQxx			
Cable Gland - Axial	IP67 nylon - 3-core cable	Lxx			
	IP67 nylon- 5-core cable	LQxx			
Cable Gland [†] - Axial	IP67 Short - 3-core cable	Mxx			
	IP67 Short - 5-core cable	MQxx			
Specify required cable length 'xx' 50 cm supplied as standard. †Nb:	' in cm. e.g. L2000 specifies cable gland with 20 r restricted cable pull strength.	n of cable,			
e Body Fittings		Code			
None - default		blank			
M5 Rod-eye Bearing	Radial body style only	N			
f Body Clamps		Code			
Body Clamps - 1 pair		Р			
Body Clamps - 2 pairs		P2			
g Sprung Push Rod		Code			
None - default		blank			
Spring Extend	Up to 300mm displacement.	R			
Spring Retract	Captive push rod only.	S			
h Push Rod Fittings		Code			
None - default	Female Thread M5x0.8x9 deep	blank			
Dome end	Requires option 'R'	т			
M5 Rod-eye Bearing		U			
Magnetic Tip		WA			
j Push Rod Options		Code			
Captive - default	Push rod is retained	blank			
Non-captive	Push rod can depart body	V			
	1				

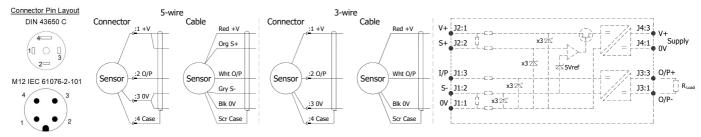
j Z-code	Code
Calibration to suit X005 - Default	Z000
Connector IP67 M12 IEC 60176-2-101 must have options 'Y' & 'J'	Z600
Connector IP67 M12 IEC 60176-2-101 must have option 'J'	Z601
$\leq \pm 0.1\%$ @20°C Independent Linearity displacement between 10mm & 400mm only!	
1/4 Rod eye options available	Z827



Installation Information X101 STAND-ALONE LINEAR POSITION SENSOR INTRINSICALLY SAFE FOR HAZARDOUS GAS/VAPOUR ATMOSPHERES

For certificate number and safety parameters information for product marked EX04, see next page.





Putting Into Service: The sensor must be used with a galvanic isolation barrier designed to supply the sensor with a nominal 5V and to transmit the sensor output to a safe area. The barrier parameters must not exceed:-

 $\begin{array}{lll} \textbf{Ui} = \textbf{11.4V} & \textbf{Ii} = \textbf{0.20A} & \textbf{Pi} = \textbf{0.51W} \\ \textbf{Ci} = \textbf{1.36} \mu \textbf{F}^* & \textbf{Li} = \textbf{860} \mu \textbf{H}^* & \textbf{('Ixx', 'IQxx', 'Lxx', 'LQxx', 'Mxx' or 'MQxx' options)} & \text{*Figures for 1km cable} \\ \textbf{Ci} = \textbf{1.16} \mu \textbf{F} & \textbf{Li} = \textbf{50} \mu \textbf{H} & \textbf{('Ixx', 'IQxx', 'Lxx', 'LQxx', 'Mxx' or 'MQxx' options)} & \text{*Figures for 1km cable} \\ \textbf{('J' or 'K' options)} & \textbf{('Ixx', 'IQxx', 'Lxx', 'LQxx', 'Mxx' or 'MQxx' options)} & \textbf{('Ixx', 'IQxx', 'Lxx', 'LQxx', 'Mxx' or 'MQxx' options)} & \textbf{('Ixx', 'IQxx', 'Lxx', 'LQxx', 'Mxx' or 'MQxx' options)} & \textbf{('Ixx', 'IQxx', 'Lxx', 'LQxx', 'Mxx' or 'MQxx' options)} & \textbf{('Ixx', 'IQxx', 'Lxx', 'Lxx', 'LQxx', 'Mxx' or 'MQxx' options)} & \textbf{('Ixx', 'IQxx', 'Lxx', '$

The sensor is certified to be used with up to 1000m of cable, cable characteristics must not exceed:-

Capacitance: ≤ 200 pF/m or max. total of: 200 nF Inductance: ≤ 810 nH/m or max. total of: 810 µH

Approval only applies to specified ambient temperature range and atmospheric conditions in the range: 0.80 to 1.10 Bar, oxygen ≤ 21%.

The performance of the sensor may be affected by voltage drops associated with long cable lengths; For cable lengths exceeding 10 metres a five wire connection is recommended to eliminate errors introduced by cable resistance and associated temperature coefficients.

Warning - The M12 IEC 60176-2-101 connector may be rotated for purposes of convenient orientation of the connector and cable, however rotating the connector more than one complete revolution is not recommended. **Repeated rotation of the connector will damage the internal wiring!**

Special Condition for Safe Use:

The apparatus does not meet the 500 V r.m.s dielectric strength test between circuit and frame, in accordance with clause 6.3.13 of IEC 60079-11:2011. This must be taken into consideration on installation.

When using a Sensor that has an integral cable in a dust application, the free end of the cable shall be appropriately terminated for the zone of use.

Under certain extreme circumstances, the non-metallic and isolated metal parts incorporated in the enclosure of this equipment may generate an ignition-capable level of electrostatic charge. Therefore the equipment shall not be installed in a location where the external conditions are conducive to the build-up of electrostatic charge on such surfaces. This is particularly important if the equipment is installed in a zone 0 location. In addition, the equipment shall only be cleaned with a damp cloth.

Use: The sensor is designed to measure linear displacement and provide an analogue output signal.

Assembly and Dismantling: The unit is not to be serviced or dismantled and re-assembled by the user.

Maintenance: No maintenance is required.

Gain and Offset Adjustment: (Where accessible - Typically ± 10% Min available)

To adjust the gain or offset use a small potentiometer adjuster or screwdriver 2mm across. Do not apply too much force on the potentiometers.

Mechanical Mounting: Depending on options; Body can be mounted by M5x0.8 male thread, rod eye bearing or by clamping the sensor body - body clamps are available, if not already ordered. Target by M5x0.8 female thread, rod eye bearing or magnetic tip. It is assumed that the sensor and target mounting points share a common earth.

Output Characteristic: Target is extended 9 mm from end of body at start of normal travel. The output increases as the target extends from the sensor body, the calibrated stroke is between 5 mm and 800 mm.

Standard Output Characteristic

XE

Retracted

Linear Displacement

Extended

Calibration

Adjustments

0

Incorrect Connection Protection levels: Not protected – the sensor is **not** protected against either reverse polarity or over-voltage. The risk of damage should be minimal where the supply current is limited to less than 50mA.



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Installation Information X101 STAND-ALONE LINEAR POSITION SENSOR INTRINSICALLY SAFE FOR HAZARDOUS GAS/VAPOUR ATMOSPHERES

For certificate number and safety parameters information for product marked EX07, see previous page.

ATEX Qualified to Intrinsic Safety Standard Certificate numbers SIRA 00ATEX2076X		ard	Ex II 1G EEx ia IIC T4 (Ta = -40°C to +80°C)
Electronics Version	Output Description:	Supply Voltage: V _s (tolerance)	Load resistance:
EX04	0.5 - 4.5V (ratiometric with supply) [Output code 'A']	+5V (4.5 - 5.5V)	5kΩ min

The barrier parameters must not exceed:-

Ui = 11.4V Ii = 0.20APi = 0.51W

 $Ci = 1.36 \mu F^*$ $Li = 710\mu H^*$ ('Ixx', 'Lxx' or 'Mxx' options) *Figures for 1km cable $Li = 50\mu H$ ('J' or 'K' options)

 $Ci = 1.16 \mu F$

The sensor is certified to be used with up to 1000m of cable, cable characteristics must not exceed:-

Capacitance: \leq 200 pF/m for max. total of: 200 nF Inductance: \leq 660 nH/m for max. total of: 660 μ H

With the exception of the certificate number and safety parameters above, all other notes regarding Putting Into Service, Use, Assembly and Dismantling etc. on previous page apply to sensors marked EX04 or EX07.

