X133 MID STROKE 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**
- **Short body length**
- **Accurate, stable, durable and reliable**
- **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.

Our intrinsically safe X133 incorporates electronics system EX07 which is ATEX / IECEx / UKEX approved for use in potentially explosive **gas/vapour** atmospheres. The X133 is designed for a wide range of industrial applications and is ideal for OEMs seeking good sensor performance in situations where a short-bodied sensor is required for operation in hazardous areas. The unit is compact and space-efficient, being responsive along almost its entire length, and 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, from 51 to 100mm and with full EMC protection built in.

Overall performance, repeatability and stability are outstanding over a wide temperature range.

The sensor has a rugged stainless steel body and plunger. It is easy to install and set up, mounting options include flange, M5 rod eye bearings and body clamps. The plunger can be supplied free or captive, with a female M4 thread, an M5 rod eye, magnetic tip, or spring-loaded with a dome end. The X133 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	35 mm	
Body Length (Axial version):	Dependant on calibrated travel & mounting option	
Calibrated Travel	Standard	Flange mounted
51 mm to 70 mm	125 mm	141.3 mm
71 mm to 100 mm	155 mm	171.3 mm
Body Length (Radial version):	Dependant on calibrated travel & mounting option	
Calibrated Travel	Standard	Flange mounted
51 mm to 70 mm	143.5mm	159.8 mm
71 mm to 100 mm	173.5 mm	189.8 mm
Plunger	Ø 6mm	
For full mechanical details see	drawing X133-11	
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	
	≤ ± 0.1% FSO @ 20°C available upon request.	
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 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 ≤ 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	IP65/IP67 depending on connector / cable option
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	
X133-11	Sensor Outline

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.

X133 MID STROKE 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:-

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

TABLE OF OPTIONS

CALIBRATED TRAVEL: Factory set to any length from 0-51mm to 0-100mm (e.g. 76mm).

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 - 4-pole DIN 43650 C	Axial, IP65
Connector - 4-pole M12 IEC 61076-2-101	Radial, IP67
Cable with M12 gland or short gland	Axial, IP67
Cable with Pg 9 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.

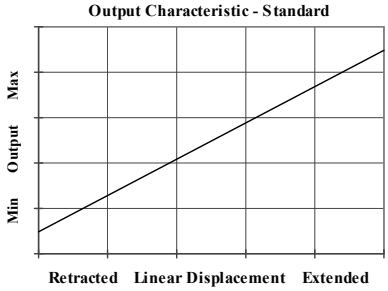
We recommend all customers refer to the 3 or 5-Wire Mode Connection page.

MOUNTING OPTIONS

Flange, Body Tube Clamp (axial or radial versions),
M5 rod eye bearings (radial versions only).

PUSH ROD OPTIONS – Retained† or Free with M4x0.7 female thread, M5 rod eye bearing or Magnetic tip, Spring loaded with or without# Dome end.

† standard, retained with female thread.
# spring supplied loose.



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.

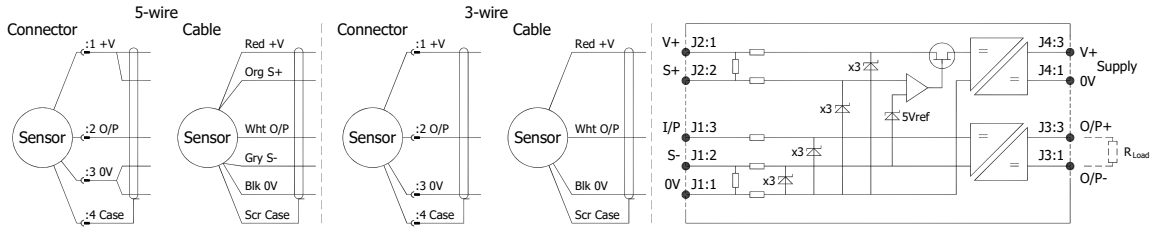
This is important because the effects of volts drop can significantly alter the perceived accuracy of the sensor which is ratiometric i.e. the output signal is directly affected by the voltage across the sensor. Changes in temperature will also be seen as gain variation in the sensor output.

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 (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

X133 Mid Stroke Position Sensor

PM Instrumentation

	a	b	c	d	e	f	g	h	j	k
X133	.	Displacement	A	Adjustments	Connections	Option	Option	Option	Option	Option	Z-code

a **Displacement** (mm)		**Value**
Displacement in mm	e.g. 0 - 66 mm	**66**

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 style sealed by default.	blank
Sealed		**Y**

d **Connections** Cable or Connector		**Code**
Cable Gland - Radial	IP67 metal - 3-core cable	**Ixx**
	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**
	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'** in cm. e.g. L2000 specifies cable gland with 20 m of cable, 50 cm supplied as standard. †Nb: restricted cable pull strength.

e **Housing**		**Code**
Standard - default		blank
Flange Mount		**N**
M5 Rod-eye Bearing	Radial body style only	**S**

f **Body Fittings**		**Code**
None - default		blank
Body Clamps - 1 pair		**P**

g **Sprung Plunger**		**Code**
None - default		blank
Spring Extend	Captive plunger only.	**R**

h **Plunger Fittings**		**Code**
None - default	Female Thread M4x0.7x7 deep	blank
Dome end	Requires option 'R'	**T**
M5 Rod-eye Bearing		**U**
Magnetic Tip		**WA**

j **Plunger Options**		**Code**
Captive - default	Plunger is retained	blank
Non-captive	Plunger can depart body	**V**

k **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**
≤± 0.1% @20°C Independent Linearity displacement between 10mm & 50mm only!	**Z650**

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.