

LIPS[®] M114 SUBMERSIBLE STAND-ALONE 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**
- **Compact and self-contained**
- **High durability and reliability**
- **High accuracy and stability**
- **Sealing to IP68 10Bar**

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 M114 LIPS[®] (Linear Inductive Position Sensor) incorporates electronics system EX07 which is ATEX / IECEx approved for use in potentially explosive **gas/vapour, dust** atmospheres and **mining** environments. The M114 is an affordable, durable, high-accuracy position sensor. Derived from the M101, it is designed for applications where the sensor would be completely submerged during normal operation, it retains desirable features such as compact size, good sensor performance yet capable of working at pressure. The M114, 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 5 to 800mm and with full EMC protection built in. 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 stainless steel rod eye bearings and body clamps. The push rod can be supplied free or captive, with female M5 thread, an M5 rod eye, or dome end. Captive push rods can be sprung loaded, in either direction, on sensors up to 300mm of travel. The M114 also offers a selection of mechanical and electrical options, environmental sealing is to IP68 10Bar.



SPECIFICATION

Dimensions

Body diameter	35 mm
Body length (Axial version)	calibrated travel + 168 mm
Body length (Radial version)	calibrated travel + 189 mm
Push rod extension	calibrated travel + 9 mm, OD 9.5 mm

For full mechanical details see drawing M114-11

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 I/II M1/1GD
 Ex ia IIC T4 Ga (Ta= -40°C to 80°C)
 Ex ia IIIC T135°C Da (Ta= -40°C to 80°C)
 Ex ia Ma (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.

(without cable)

Ci: 1.16µF, Li: 50µH

(with cable)

Ci: 1.36µF, Li: 860µH with 1km max. cable

Environmental Temperature Limits (Non Icing)

Operating

-40°C to +80°C

Storage

-40°C to +125°C

Sealing

IP68 10 Bar

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

M114-11

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.

LIPS[®] M114 SUBMERSIBLE STAND-ALONE 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 / IECEx approved to;
 Ex I/II M1/GD
 Ex ia IIC T4 Ga (Ta= -40°C to 80°C)
 Ex ia IIIC T135°C Da (Ta= -40°C to 80°C)
 Ex ia I Ma (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 surface temperature under fault conditions 135°C.

Dust:
 T135°C: maximum 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* (with cable)
 Ci = 1.16µF Li = 50µH (without cable)

*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 dust (E series) applications, are also available from Positek.

TABLE OF OPTIONS

CALIBRATED TRAVEL: Factory-set to any length from 5 to 800 mm in increments of 1 mm.

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

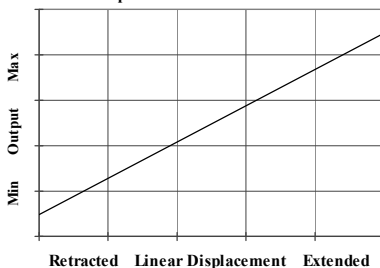
Cable with Pg 7 gland Axial or Radial, IP68 10 Bar
 Three core (black jacket) or five core (blue jacket) cable options available.
 Cable length >50 cm – please specify length in cm up to 15000 cm max.
 We recommend all customers refer to the 3 or 5-Wire Mode Connection page.

MOUNTING OPTIONS

M5 rod eye bearing (radial versions), Body Tube Clamp/s (axial or radial versions).

PUSH ROD OPTIONS – standard retained with M5x0.8 female thread, M5 rod eye bearing, Dome end, Sprung loaded (retraction or extension) or Free.

Output Characteristic - Standard



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® Intrinsicly 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.

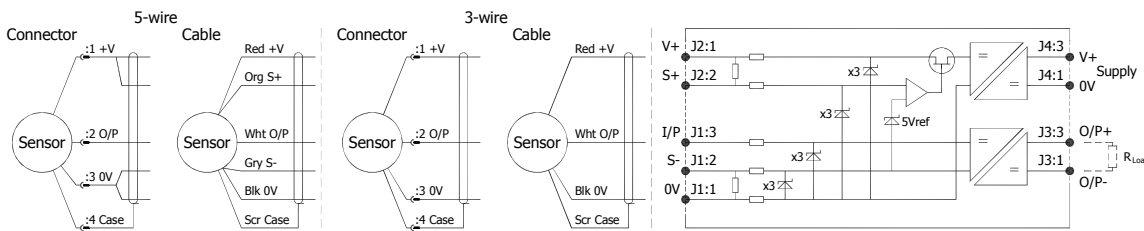
This is important because the effects of volts drop can significantly alter the perceived accuracy of the sensor which is ratiometric i.e. the output signal is directly affected by the voltage across the sensor. Changes in temperature will also be seen as gain variation in the sensor output.

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 be 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 (mm ²)	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

[†] $R = \rho L/A$ 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 direct current flow is uniform across the cross-section of the wire, the galvanic isolation amplifier and sensor are a dc system.