



## mm E112 Gauge Head Position Sensor

Intrinsically Safe For Hazardous Dust Atmospheres

### FEATURES

- Intrinsically safe for Gas and Dust to: Ex II 1GD
- Gauge head positioning for industrial and scientific applications
- Non-contacting inductive technology to eliminate wear
- Travel set to customer's requirement
- Compact 19 mmdiameter body
- Sealing to IP67



Our E112 LIPS® (Linear Induction Position Sensor) incorporates electronics system EX07 which is ATEX / IECEx approved for use in potentially explosive gas / vapour and dust atmospheres.

The E112 is designed for gauge head positioning in industrial and scientific applications and is ideal for OEMs seeking good sensor performance for arduous applications in hazardous areas. The E112 sensors, provides a linear output proportional to travel. Each sensor is supplied with the output calibrated to the travel required by the customer, from 5mm to 50mm and with full EMC protection built in.

Overall performance, repeatability and stability are outstanding over a wide temperature range. The sensor is very robust, the body and plunger being made of stainless steel for long service life and environmental resistance.

The plunger is spring loaded with a domed end. The E112 is easy to install with a long ½ inch UNF mounting thread and is supplied with two lock nuts for positioning. Environmental sealing is to IP67.

### SPECIFICATION

#### Dimensions

Body diameter	19 mm
Body Length (excluding thread)	
(Axial version)	160.7 mm
(Radial version)	169.5 mm
Mounting Thread Length	59 mm

For full mechanical details see drawing E112 -11

<b>Spring Force</b>	1.5 - 4.5 N approx.
<b>Power Supply</b>	+5V dc nom. $\pm$ 0.5V, 10mA typ 20mA max
<b>Output Signal</b>	0.5-4.5V dc ratiometric, Load: 5k $\Omega$ min.
<b>Independent Linearity</b>	$\leq \pm 0.25\%$ FSO @ 20°C $\leq \pm 0.1\%$ FSO @ 20°C * available upon request.

\*Sensors with calibrated travel of 10 mm and above.

<b>Temperature Coefficients</b>	$< \pm 0.01\%$ /°C Gain & $< \pm 0.01\%$ FS/°C Offset
<b>Frequency Response</b>	$> 10$ kHz (-3dB)
<b>Resolution</b>	Infinite
<b>Noise</b>	$< 0.02\%$ FSO
<b>Intrinsic Safety</b>	Ex II 1GD Ex ia II C 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  $\leq 21\%$

<b>Sensor Input Parameters</b> (connector option/s) (cable option/s)	Ui: 11.4 V, Ii: 0.20A, Pi: 0.51W. Ci: 1.16 $\mu$ F, Li: 50 $\mu$ H Ci: 1.36 $\mu$ F, Li: 860 $\mu$ H with 1km max. cable
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#### Environmental Temperature Limits

Operating	-40°C to +80°C
Storage	-40°C to +125°C

<b>Sealing</b>	IP67
<b>EMC Performance</b>	EN 61000-6-2, EN 61000-6-3
<b>Vibration</b>	IEC 68-2-6: 10 g
<b>Shock</b>	IEC 68-2-29: 40 g
<b>MTBF</b>	350,000 hrs 40°C Gf

#### Drawing List

E112-11	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.

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 intrinsically safe sensors be used in conjunction with a galvanic barrier to meet the requirements of the product certification. The X005 Galvanic Isolation Amplifier is purpose made for 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.

## TABLE OF OPTIONS

**CALIBRATED TRAVEL:** Factory set to any length from 0-5mm to 0-50mm (e.g. 36mm).

### ELECTRICAL INTERFACE OPTIONS

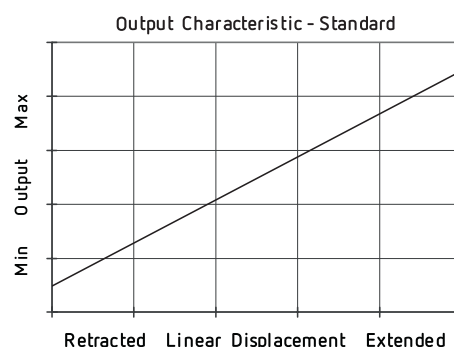
The X005 Galvanic Isolation Amplifier is available with the following output options;

Standard: 0.5 - 9.5V or 4 - 20mA.  
Reverse: 9.5 - 0.5V or 20 - 4mA.

### CONNECTOR/CABLE OPTIONS

Connector - Binder 713 series Axial or Radial, IP67  
Cable<sup>†</sup> with Pg 9 gland Axial, IP67

<sup>†</sup>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.

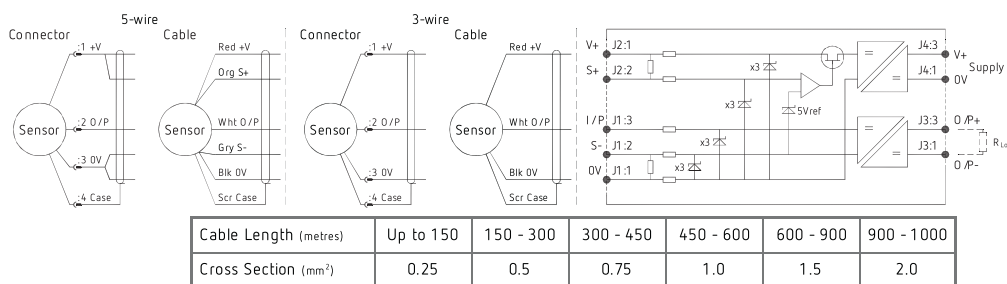


### THREE OR FIVE-WIRE MODE CONNECTION FOR INTRINSICALLY SAFE SENSORS IN HAZARDOUS ATMOSPHERES

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 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 0.75mm<sup>2</sup>, 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 mm<sup>2</sup> cable, longer lengths will require larger conductors. **For this reason recommends five wire connections for cable lengths exceeding 10 metres in 0.25 mm<sup>2</sup> cable to preserve the full accuracy of the sensor.** See illustrations below for examples of connecting a sensor to the galvanic isolation amplifier.





INTRINSICALLY SAFE - GAS/VAPOUR ATMOSPHERES

a	b	c	d
E11 2	Displacement	A	Connections Z-code

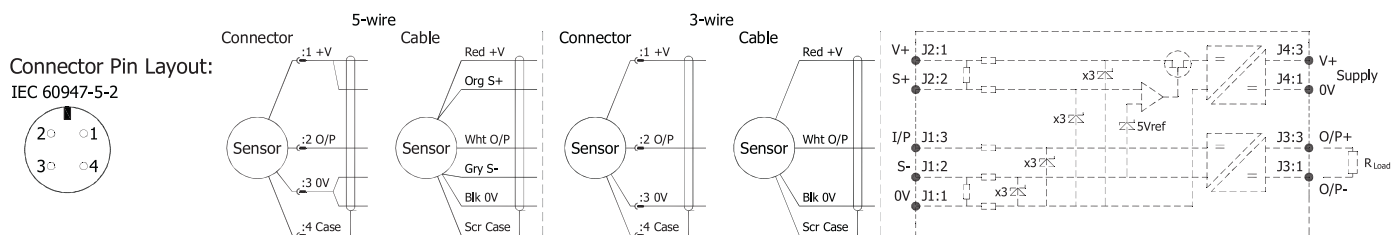
a Displacement (mm)		Value
Displacement in mm	e.g. 0 - 34 mm	34
b Output		
Supply V dc V <sub>s</sub> (tolerance)	Output	Code
+5V (4.5 - 5.5V)	0.5 - 4.5V (ratiometric with supply)	A
c Connections Cable* or Connector		Code
Connector - Axial	IP67 M12 IEC 60947-5-2	J
Connector - Radial	IP67 M12 IEC 60947-5-2	K
Cable Gland - Axial	IP67 Pg9 - 3-core cable	Lxx
Cable Gland - Axial	IP67 Pg9 - 5-core cable	LQxx
*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.		
d Z-code		Code
Calibration to suit X005 - Default		Z000
≤± 0.1% @20°C Independent Linearity displacement between 10mm & 50mm only!		Z650
Connector with cable option 'J', 'JQ', 'K' or 'KQ' 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.

## INSTALLATION INFORMATION

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

ATEX/IECEX Qualified to Intrinsic Safety Standard Certificate numbers SIRA 13 ATEX2371X IECEX SIR 13.01 54X		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)	
Electronics Version	Output Description:	Supply Voltage: V <sub>s</sub> (tolerance)	Load resistance:
EX07	0.5 - 4.5V (ratiometric with supply) [Output code 'A']	+ 5V (4.5 - 5.5V)	5kΩ min



**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:

U<sub>i</sub> = 11.4V      I<sub>i</sub> = 0.20A      P<sub>i</sub> = 0.51W  
C<sub>i</sub> = 1.36μF\*      L<sub>i</sub> = 860μH\* ('Lxx' or 'LQxx' options) \*Figures for 1km cable  
C<sub>i</sub> = 1.16μF      L<sub>i</sub> = 50μH ('J' or 'K' options)

The sensor is certified to be used with up to **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

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.

N.b. sensors supplied with cable, the free end must be appropriately terminated.

**Warning** - The M12 IEC 60947 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!**

## ■ INSTALLATION INFORMATION

**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.

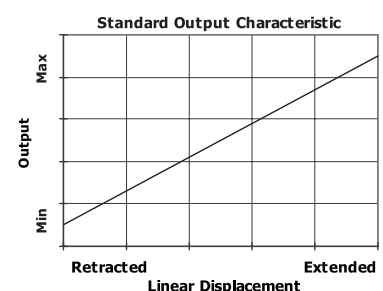
**Assembly and Dismantling:** The unit is not to be serviced or dismantled and re-assembled by the user.

**Maintenance:** No maintenance is required. Any cleaning must be done with a damp cloth.

**Mechanical Mounting:** Via ½"x20 UNF mounting thread, adjust sensor position and lock in place using lock nuts provided. Maximum tightening torque: 10Nm.

**Output Characteristic:** Plunger is extended 3.3 mm from end of body at start of normal travel. The output increases as the plunger extends from the sensor body, the calibrated stroke is between 5 mm and 50 mm.

**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.



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

ATEX Qualified to Intrinsic Safety Standard Certificate numbers SIRA 00ATEX2076X		Ex II 1GD EEx ia I/II C T4 (Ta = -40°C to +80°C) Ex ia D 20 T135 °C (Ta = -40°C to +80°C)	
Electronics Version	Output Description:	Supply Voltage: Vs (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      li = 0.20A      Pi = 0.51W

Ci = 1.36µF\*      Li = 710µH\* ('Lxx' option) \*Figures for 1km cable

Ci = 1.16µF      Li = 50µH ('J' or 'K' options)

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

Capacitance: ≤ 200 pF/m for max. total of: 200 nF

Inductance: ≤ 660 nH/m for max. total of: 660 µH

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.

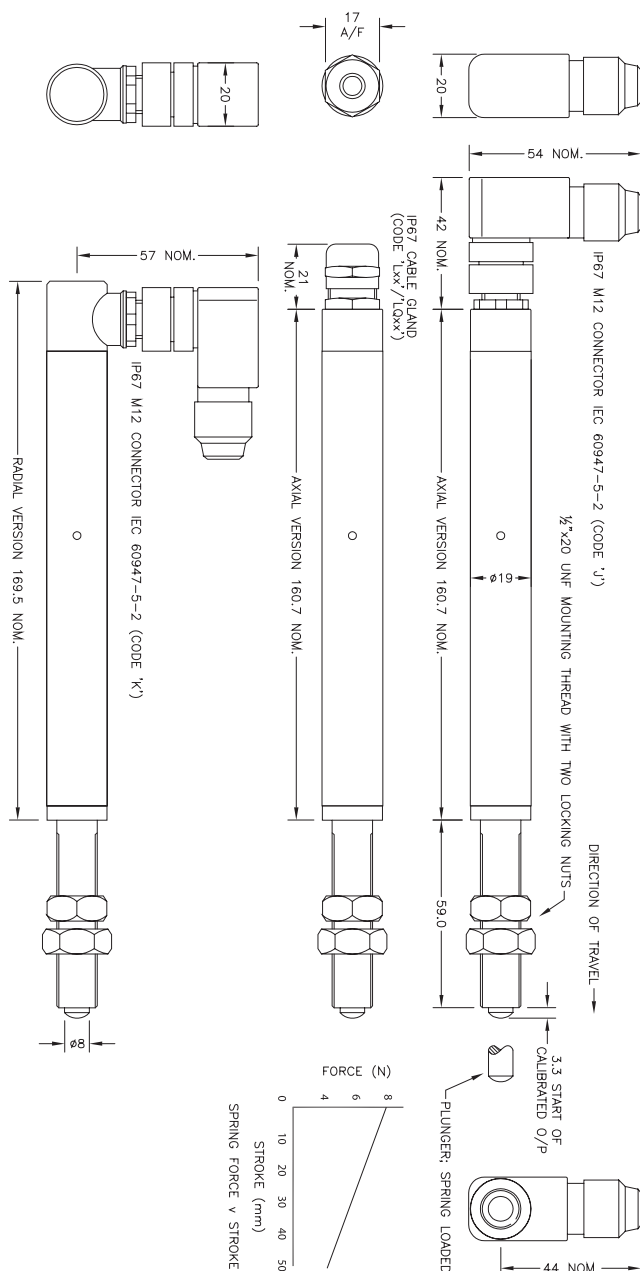


C	NEW ELECTRONICS, RADIAL BODY	PDM
D	ADDITIONAL DIMS/VIEWS ADDED	PDM
E	APPROVAL STANDARDS UPDATED - RAN465, PDM	RDS
F	RANGE WAS 10-50mm - RAN1056	PDM
G	5-CORE OPTION ADDED - RAN1102	PDM
H	RANGE NOTE AMENDED - RAN1200	PDM



THE PLUNGER WILL RETRACT FLUSH AND EXTENDS 2mm NOM. AT END OF CALIBRATED TRAVEL.

CHANGES NOT TO BE MADE WITHOUT REFERENCE TO THE CHANGE PROCEDURE.  
CHANGES TO PARTS USED IN INTRINSICALLY SAFE PRODUCT MUST BE APPROVED  
BY THE AUTHORIZED PERSON.  
THIS IS AN UNCONTROLLED PRINT AND WILL NOT BE UPDATED.



1/2" LOCK NUTS NOT SHOWN ON END VIEWS FOR CLARITY.

**ELECTRICAL OPTIONS / SPECIFICATIONS**  
OUTPUT SUPPLY  
0.5 TO 4.5V RATIO METRIC 5V  
SUPPLY CURRENT 12mA TYP. 20mA MAX.  
CABLE: 0.2mm<sup>2</sup> O/A SCREEN, PUR JACKET - SUPPLIED  
WITH 50cm OR REQUIRED LENGTH IN cm (15000cm MAX).  
STANDARD 3-CORE: JACKET Ø4mm BLACK e.g. '150'  
OPTIONAL 5-CORE: JACKET Ø4.6mm BLUE e.g. '1050'  
CABLE/CONNECTOR CONNECTIONS:  
3 CORE CONNECTOR: 3 CORE  
RED ORG. : 1 +VE  
BLACK ORG. : 2 +SENSE (G-WIRE ONLY)  
WHITE ORG. : 3 0V  
WHITE ORG. : 4 SENSE (G-WIRE ONLY)  
SCREEN : 5 BODY  
\*CONNECTORS: MAXIMUM CONDUCTOR CROSS SECTION 0.75mm<sup>2</sup>  
RANGE OF DISPLACEMENT FROM 0-5mm TO 0-50mm e.g.36,  
IN INCREMENTS OF 1mm.  
BODY MATERIAL: STAINLESS STEEL.

NOTE: - READ INSTALLATION SHEET E112-19  
FOR FULL INSTRUCTIONS FOR USE.  
ATEX /IECEx APPROVED TO  
Ex ia IIC T4 Ga T<sub>A</sub> = -40 to +80 °C  
Ex ia IIC T135 °C T<sub>A</sub> = -40 to +80 °C  
UL114V, II02A, P10.5IW  
APPROVED FOR USE IN CONJUNCTION  
WITH A GALVANICALLY ISOLATED BARRIER.  
NOTE: APPROVAL ONLY APPLIES AT NORMAL  
ATMOSPHERIC PRESSURE!

C	21/04/10	CHECKED BY X	#0.4
D	05/07/11	XX	#0.2
E	10/03/14	RDS	DIMS mm
F	09/11/15	DESCRIPTION	
G	12/04/17	E112 INTRINSICALLY SAFE	
H	05/09/17	GAUGE HEAD POSITION	
SCALE 5mm		REVISION	
		NUMBER	
		E112-11	REV H
		SHEET	OF