



mm **G111**

APPLICATION

- Intrinsically safe for Gas to:
Class I, Zone 0 Ex ia / AEx ia
Class 1 Division 1
- 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, Althen has the expertise to supply a sensor to suit a wide variety of applications. Our G111 incorporates electronics system EX08 which is CSA approved for use in potentially explosive **gas/vapour** atmospheres. This heavy-duty version of the G101 sensor with a stronger 12.6mm push rod, recommended for applications where vibration is an issue or there is a need for longer travel sensors, mounted horizontally, and supported between rod eyes. It remains an affordable, durable, high-accuracy position sensor designed for industrial and scientific feedback applications. The unit is highly compact and space-efficient, being responsive along almost its entire length. Like all Althen sensors, the G111 provides a linear output proportional to travel. Each sensor 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 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 M8 rod eye bearings and body clamps. The push rod can be supplied free or captive with female M8 thread, an M8 rod eye, dome end or magnetic tip. M12 and 1/2" rod eye options available. Captive push rods can be sprung loaded, in either direction, on sensors up to 300mm of travel. The G111 also offers a wide range of mechanical options, environmental sealing is to IP65 or IP67, depending on selected cable or connector options.

SPECIFICATIONS

Dimensions¹ Body diameter Body length (Axial version) Body length (Radial version) Push rod extension	35 mm calibrated travel + 163 mm calibrated travel + 186 mm calibrated travel + 7 mm, OD 12.6 mm
Independent Linearity	$\leq \pm 0.25\%$ FSO @ 20°C - up to 450 mm $\leq \pm 0.5\%$ FSO @ 20°C - over 450 mm
Temperature Coefficients	$< \pm 0.01\%/^{\circ}\text{C}$ Gain & $< \pm 0.01\%$ FS/ $^{\circ}\text{C}$ Offset
Frequency Response	> 10 kHz (-3dB)
Resolution	Infinite
Noise	$< 0.02\%$ FSO
Intrinsic Safety²	Class I, Zone 0 Ex ia IIC T4 Ga AEx ia IIC T4 Ga Class I, Division 1, Groups A, B, C, D; T4 (Ta = -40°C to +80°C)
Sensor Input Parameters (connector option/s) (cable option/s)	Ui: 11.4V, Ii: 0.20A, Pi: 0.51W. Ci: 1.16μF, Li: 50μH Ci: 1.36μF, Li: 710μH with 1km max. cable
Environmental Temperature Limits Operating Storage	-40°C to +80°C -40°C to +125°C
Sealing	IP65/IP67 depending on connector / cable option

SPECIFICATIONS (CONTINUED)

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 ³ G111-11	Sensor Outline
¹ For full mechanical details see drawings G111-11 ² Approval only applies to the specified ambient temperature range and atmospheric conditions in the range 0.80 to 1.10 Bar, oxygen ≤ 21% ³ 3D models, step or .igs format, available on request	

INTRINSICALLY SAFE EQUIPMENT

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.” CSA approved to;

Class I, Zone 0 Ex ia IIC T4 Ga AEx ia IIC T4 Ga
Class I, Division 1, Groups A, B, C, D; T4
(Ta = -40°C to +80°C)

Designates the sensor as belonging to; Class I, Zone 0: can be used in areas with continuous, long or frequent periods of exposure to hazardous gas / vapours.

Protection class ia IIC, denotes intrinsically safe for Zones 0, 1 & 2 and IIA, IIB and IIC explosive gases.

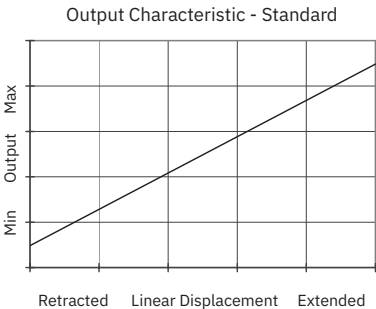
Temperature class T4: maximum sensor surface temperature under fault conditions 135°C.

Ambient temperature range extended to -40°C to +80°C.

It is imperative Althen intrinsically safe sensors be used in conjunction with a galvanic barrier to meet the requirements of the product certification. The Althen G005 Galvanic Isolation Amplifier is purpose made for Althen IS sensors making it the perfect choice. Refer to the G005 datasheet for product specification and output configuration options.

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

CSA approved sensors suitable for dust (H series) applications, are also available from Althen.



G111	a	b	c	d	e	f	g	h	j	k
	Displacement	A	Y	Connections	Option	Option	Option	Option	Option	Z000

a Displacement		Value
Factory set to any length from 0-5 mm to 0-800 mm (e.g. 0- 254 mm)		254
b Output		
Supply V _{dc} (tolerance)	Output	Code
+5V (4.5 - 5.5V)	0.5 - 4.5V (ratiometric with supply)	A
Supply Current: 10mA nominal, 12mA max.		
c Calibration Adjustments		Code
Accessible default†		blank
†Axial version only. Radial version sealed by default.		
Sealed		Y
d Connections		Code
Cable gland radial IP67 Pg9, metal, 3-core cable		Ixx
Cable gland radial IP67 Pg9, metal, 5-core cable		IQxx
Connector axial IP65 4 pin (3+earth) DIN 43650 'C'		J
Connector axial IP65 4 pin (3+earth) DIN 43650 'C', pre-wired 3-core cable		Jxx
Connector axial IP67 IP65 4 pin (3+earth) DIN 43650 'C', pre-wired 5-core cable		JQxx
Connector radial IP67 4 pin M12 IEC 61076-2-101, nylon		K
Connector radial IP67 4 pin M12 IEC 61076-2-101, nylon, pre-wired 3-core cable		Kxx
Connector radial IP67 4 pin M12 IEC 61076-2-101, nylon, pre-wired 5-core cable		KQxx
Cable gland axial IP67 M12, nylon, 3-core cable		Lxx
Cable gland axial IP67 M12, nylon, 5-core cable		LQxx
Cable gland, short† axial IP67, metal, 3-core cable		Mxx
Cable gland, short† axial IP67, metal, 5-core cable		MQxx
Specify required cable length 'xx' in cm. e.g. L2000 specifies axial cable gland with 20 m of cable, 50 cm supplied as standard. Note! maximum length supplied 15000cm. †Nb: restricted cable pull strength.		

e Body Fittings	Code
None default	blank
M8 Rod-eye bearing radial version only	N
f Body Clamps	Code
Body Clamps 1 pair	P
Body Clamps 2 pairs	P2
g Sprung Push Rod	Code
Not sprung default	blank
Spring extend	300 mm maximum displacement and captive push rod only. R
Spring retract	S
h Push Rod Fittings	Code
Female thread M8x1.25x12 deep default	blank
Dome end with spring extend option 'R'	T
M8 Rod-eye Bearing	U
Magnetic Tip	WA
j Push Rod	Code
Captive push rod retained default	blank
Non-captive push rod can depart body	V
k Z-code	Code
Calibration to suit G005 required	Z000
Option 'J' with IP67 M12 IEC 61076-2-101 conn. No access to cal. Adjustments, must include option 'Y'	Z600
Option 'J' with IP67 M12 IEC 61076-2-101 conn. with access to cal. adjustments	Z601
Tighter Independent Linearity; $\leq \pm xx\%$ FSO @20°C $\leq \pm 0.1\%$ 0 - 10 mm min. to 0 - 450 mm $\leq \pm 0.25\%$ 0 - 451 mm to 0 - 600 mm $\leq \pm 0.5\%$ 0 - 601 mm to 0- 800 mm max.	Z650
½" Rod eyes with options 'N' and/or 'U'	Z825
M12Rod eyes with options 'N' and/or 'U'	Z826

THREE OR FIVE-WIRE MODE CONNECTION

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 Althen 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.

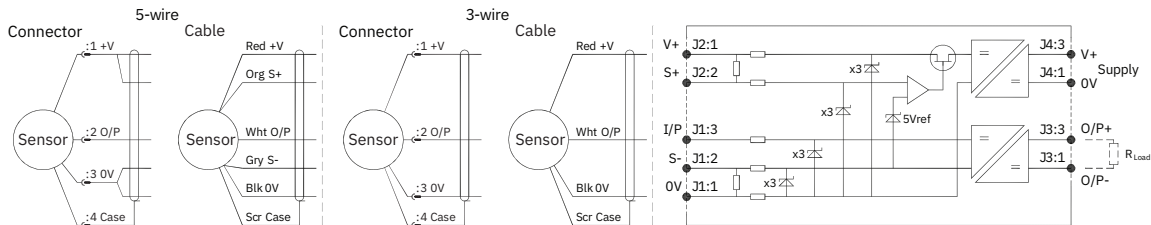
This is important because the effects of volts drop can significantly alter the perceived accuracy of the sensor which is ratiometric i.e. the output signal is directly affected by the voltage across the sensor. Changes in temperature will also be seen as gain variation in the sensor output.

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 Althen 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.

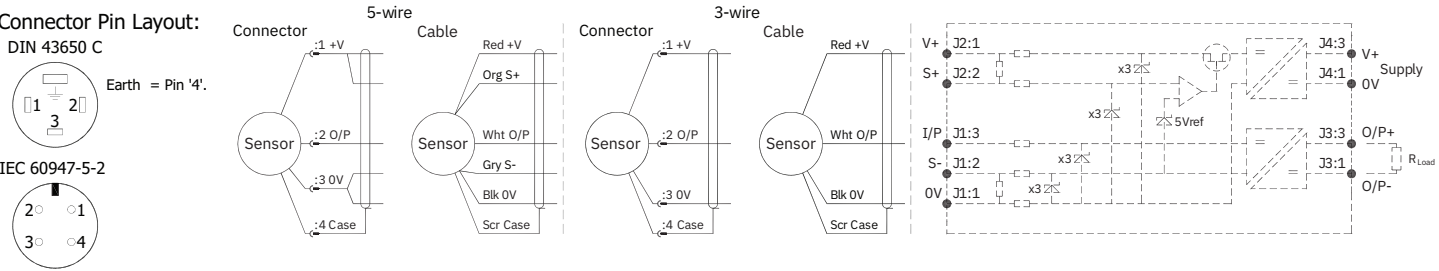
Althen sensors are supplied with three core 0.25 mm² cable as standard, however five core 0.25 mm² cable can be supplied on request. The galvanic isolation amplifier is available as;

- 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.

INSTALLATION INFORMATION

Table with 4 columns: Electronics Version, Output Description, Supply Voltage: Vs (tolerance), Load resistance. Row 1: EX08, 0.5 - 4.5V (ratiometric with supply), +5V (4.5 - 5.5V) 10mA Nom., 5kΩ min.



PUTTING INTO SERVICE

This sensor must only be installed, operated and maintained by competent and suitably trained personnel. The installation and maintenance must be carried out in accordance with all appropriate international, national and local standard codes of practice and site regulations for intrinsically safe apparatus. The use, installation, or maintenance of the sensor, in any other way than intended, may impair its operation or the protection it provides. 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:-

Table with 3 columns: Ui = 11.4V, Ii = 0.20A, Pi = 0.51W. Row 2: Ci = 1.36µF*, Li = 860µH* (with maximum length integral cable). Row 3: Ci = 1.16µF, Li = 50µH (without integral cable).

*Figures for 1km cable where: Ci = 200pF/m & Li = 810nH/m
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%.
Markings and safety parameter information for product marked EX06, see annex 1.

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. 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 or rotary displacement and provide a proportional analogue output signal.
Assembly and Dismantling: The unit is not to be serviced or dismantled and re-assembled by the user.
WARNING: Substitution of components may impair intrinsic safety.
AVERTISSEMENT: La substitution de composants peut altérer la sécurité intrinsèque.
Maintenance: No maintenance is required.

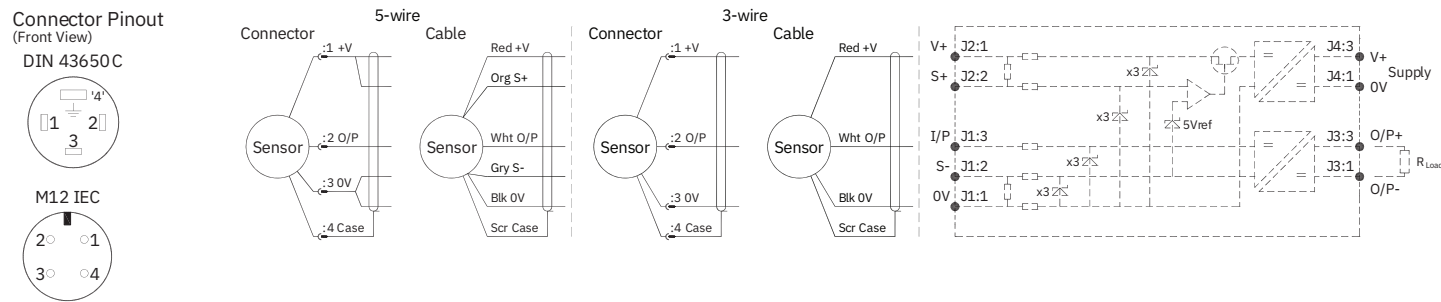
ENVIRONMENTAL CONDITIONS

Pollution degree: 2
Installation category: I
Humidity 80% to temperatures up to 31 °C decreasing linearly to 50% rh at 40 °C; /// max 80% rh, non condensing.
The sensor has been assessed for indoor use only. Where used outdoors suitable environmental protection must be provided.

Annex 1 - Markings and Entity Parameters for product with EX06 electronics system.
Ex ia IIC T4 (Ta= -40 to 80°C)
AEx ia IIC T4 (Ta= -40 to 80°C)

Table with 3 columns: Ui = 11.4V, Ii = 0.20A, Pi = 0.51W; Ci = 1.36µF*, Li = 710µH*; Ci = 1.16µF, Li = 50µH. Includes notes about integral cable and figures for 1km cable.

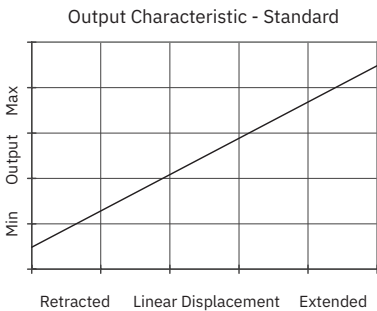
*Figures for 1km cable where: Ci = 200pF/m & Li = 660nH/m
Cable characteristics must not exceed:-
Capacitance: ≤ 200 pF/m or max. total of: 200 nF
Inductance: ≤ 660 nH/m or max. total of: 660 µH



N.b. sensors supplied with cable, the free end must be appropriately terminated.
Warning - The M12 IEC 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!

OUTPUT CHARACTERISTIC

Target is extended 7 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.

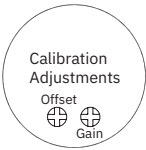


INCORRECT CONNECTION PROTECTION LEVELS

Table with 2 columns: A (Not protected) and description: 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.

GAIN AND OFFSET ADJUSTMENT

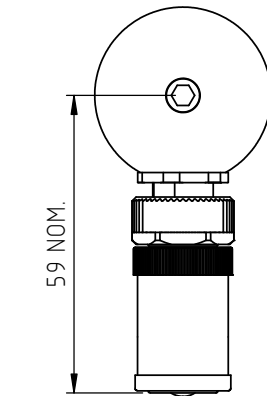
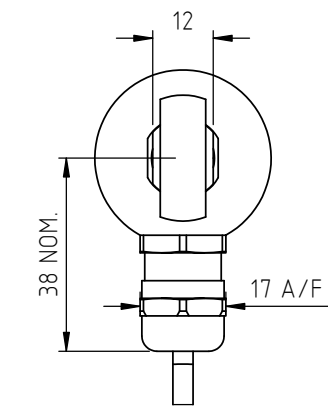
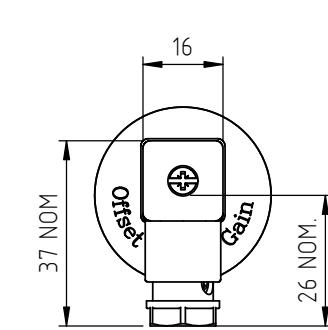
(Where accessible - Typically ± 10% Min available)
To adjust the gain or offset use a small potentiometer adjuster or screwdriver 2mm across. Do not apply too much force on the potentiometers.



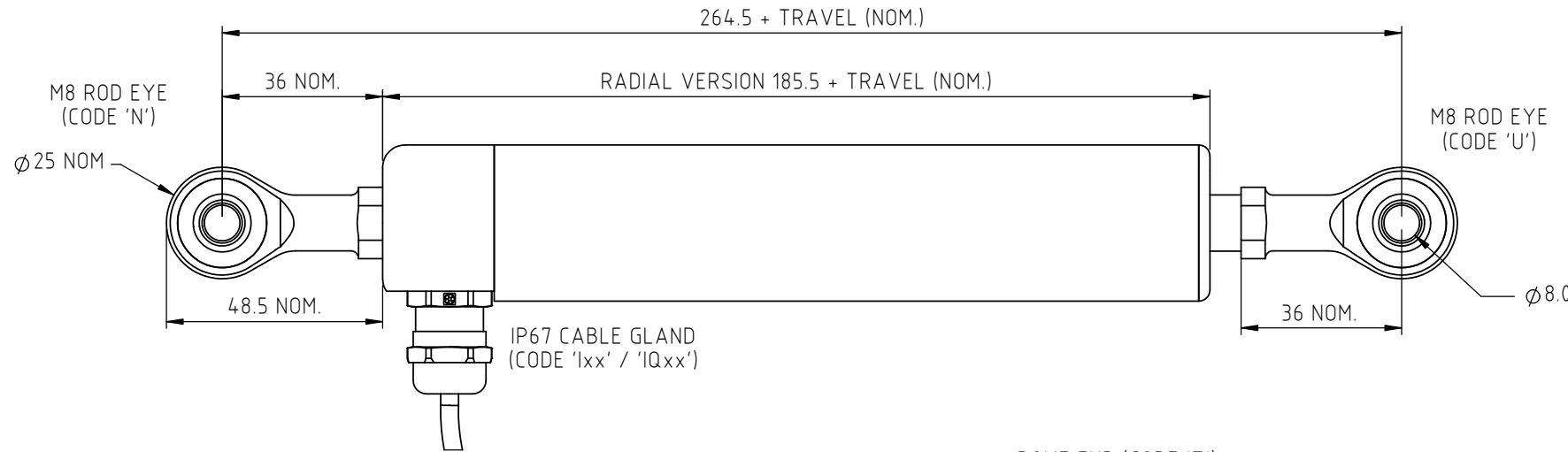
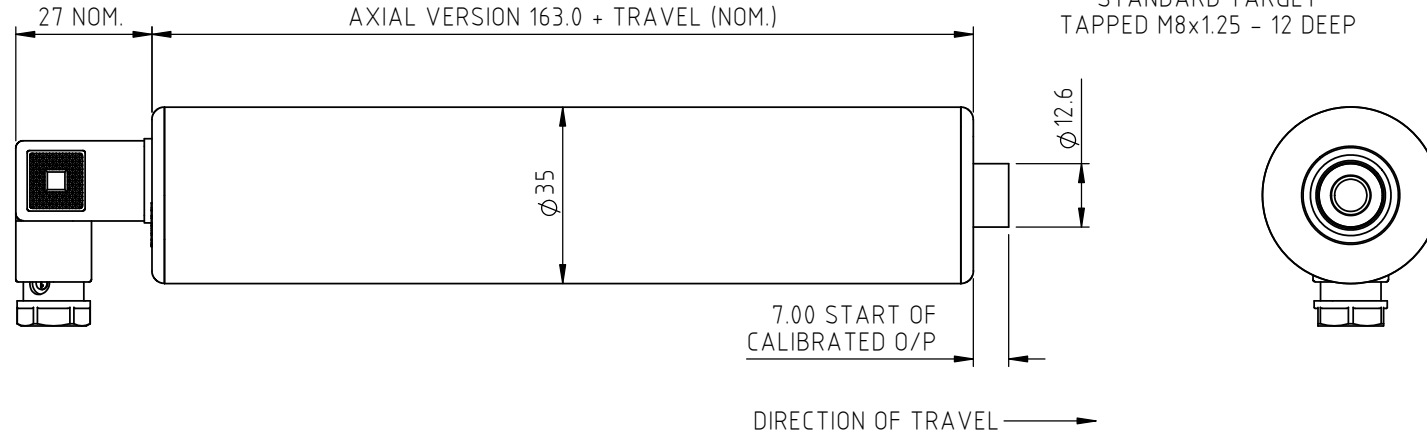
MECHANICAL MOUNTING

Depending on options; Body can be mounted by rod eye or by clamping the sensor body - body clamps are available, if not already ordered. Target by M8x1.25 female thread, rod eye or magnetic tip. It is assumed that the sensor and target mounting points share a common earth.

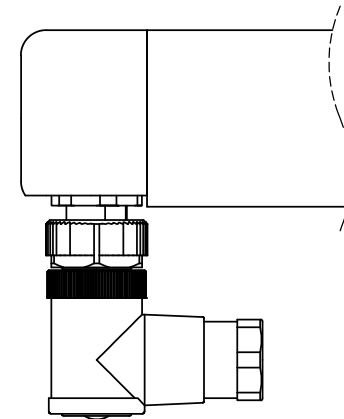
NOTE. ROD-EYE ORIENTATION NOT GUARANTEED



IP65 CONNECTOR
DIN 43650 C
(CODE 'J')



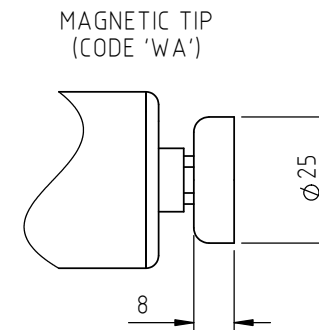
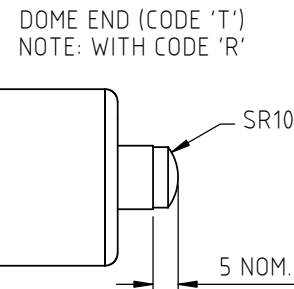
IP67 M12 CONNECTOR
IEC 60176-2-101
(CODE 'K')



IP67 CABLE GLAND
(CODE 'Lxx' / 'LQxx')

GAIN & OFFSET
ADJUSTMENTS SEALED
(CODE 'Y')

IP67 SHORT CABLE GLAND
(CODE 'Mxx' / 'MQxx')



ELECTRICAL OPTIONS/ SPECIFICATIONS
OUTPUT
'A' 0.5 - 4.5V RATIOMETRIC
SUPPLY CURRENT 12mA TYP. 20mA MAX.

SUPPLY (NOM)
5V

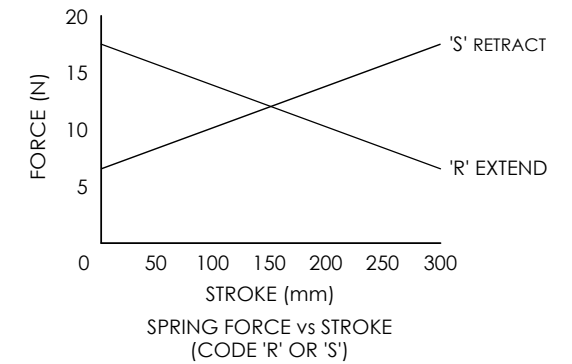
CONNECTIONS:	CABLE	CONNECTOR
+Ve	3-CORE RED	5-CORE RED :1
+SENSE (5-WIRE ONLY)	-	ORANGE :1
0V	BLACK	BLACK :3
-SENSE (5-WIRE ONLY)	-	GRAY :3
OUTPUT	WHITE	BLUE :2
BODY	SCREEN	SCREEN :4

CABLE: 0.2mm², O/A SCREEN, PUR JACKET, SUPPLIED WITH 50cm OR REQUIRED LENGTH IN cm (15000cm MAX).
STANDARD 3-CORE: BLACK Ø4mm JACKET e.g. L50
OPTIONAL 5-CORE: BLUE Ø4.6mm JACKET e.g. LQ50
CONNECTORS; MAXIMUM CONDUCTOR CROSS SECTION 0.75mm²

RANGE OF DISPLACEMENT FROM 0-5mm TO 0-800mm e.g. 76.
BODY MATERIAL:- STAINLESS STEEL.

FURTHER OPTIONS:
BODY CLAMP CODE 'P'
TWO BODY CLAMPS CODE 'P2'
CLAMP CONSISTS OF 2 PARTS AND
REQUIRES 2 OFF M6x55 (MIN.) CAPHEAD SCREWS.

SPRUNG PUSH-ROD, ≤300mm:
EXTENDED POSITION CODE 'R'. RETRACTED CODE 'S'
PUSH-ROD FREE CODE 'V' - NOT AVAILABLE WITH CODES 'R' OR 'S'
GAIN AND OFFSET ADJUSTMENTS NOT AVIALBLE WITH
RADIAL BODY , CODE 'lxx' AND 'K' OPTIONS.



NOTE:- READ INSTALLATION SHEET G000-19
FOR FULL INSTRUCTIONS FOR USE.

CSA APPROVED TO
Class I Zone 0
Ex/AEx ia IIC T4 (Ta= -40 to 80°C)
Ui 11.4V, li 0.2A, Pi 0.51W

APPROVED FOR USE IN CONJUNCTION
WITH A GALVANICALLY ISOLATED BARRIER.

NOTE: APPROVAL ONLY APPLIES AT NORMAL
ATMOSPHERIC PRESSURE!

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

REV	CHANGE HISTORY	DR'WN	DATE	CHK'D
G	RAN1311 - MAGNETIC TIP OPTION 'WA' ADDED	ASC	05/06/2023	ASC

THE PUSH-ROD RETRACTS 4mm NOM. BACK FROM THE START OF CALIBRATED TRAVEL.
THE PUSH-ROD EXTENDS 8mm NOM. BEYOND THE END OF CALIBRATED TRAVEL.
SPRUNG OPTIONS:- CODE 'R': 1mm, CODE 'S': 2mm.
CODE 'V': PUSH-ROD NOT RETAINED.

APPROVED BY RDM	REV G		X ±0.4 X.X ±0.2 X.XX ±0.1 DIMs mm
DESCRIPTION G111 INTRINSICALLY SAFE STAND ALONE LINEAR POSITION SENSOR			
SCALE A3	DRAWING NUMBER G111-11 SHEET 1 OF 1		