TDR-2 : Inclinometer, 0.5-4.5 Voltage Output, ±25, ±45 or ±90°

Description

These sensors are built using the technology from our high accuracy DAS inclinometer sensors, but packaged and cabled for compatibility with the DOG2 sensors. They utilise a very high performance MEMS sensor which exhibits low long term & temperature drift compared with the original DOG2 sensor. Each sensor is packaged in a small, robust, sealed Aluminium housing and is supplied with a 0.5m screened PUR cable terminated with an overmoulded 4 pin Superseal 1.5 series connector. The high resolution (16 bit) output voltage varies from 0.5-4.5V over the range of the sensor. There are three measurement range options available: ±25°, ±45° & ±90°, and a wide range of supply voltage from 7 to 32V. These sensors are CE certified, and are manufactured and individually calibrated in our UK factory to guarantee performance.

Features

- Dual axis, measuring ranges : ±25°, ±45° or ±90°
- Input supply voltage 7 to 32V dc
- Sealed to IP67
- High performance ceramic packaged MEMS sensor
- High resolution (16 bit) 0.5-4.5V voltage output
- Low cost relative to performance
- Direct drop in replacement for the DOG2
- 0.5m screened PUR cable with SuperSeal connector

Typical Applications

- Position feedback for solar tracking systems
- Platform levelling and monitoring
- GPS compensation
- Agricultural and industrial vehicle tilt monitoring
- Telescopic and scissor lift platform monitoring
- Platform scales and weigh bridge levelling
- Robotics position sensing
- Can be readily customised to suit most applications

Specifications

Parameter	Value	Unit	Notes
Supply Voltage	7-32	V dc	Supply is filtered, suppressed and regulated internally, however we recommend the use of a low noise supply to prevent noise coupling to the sensor.
Operating Current	20 15 10	mA	The supply current will vary depending on the Voltage supplied to the sensor. at 7V at 12V at 24V
Operating Temperature	-40 to 85	°C	This is the maximum operating temperature range.
Low Pass Filter Frequency Response	3	Hz	Includes a 2nd order low pass filter on the output with a 3Hz -3dB cut-off. This is factory configurable for OEM applications
Mechanical shock	5000	G	Shock survival limit for internal sensor 5000G for 0.5ms.
0° Output Level	2.5	V	For optimum zero point accuracy, mounting of the part can be adjusted.
Output Impendence	100	Ω	
Output Range	0.5 - 4.5	V	See page 4 for more details.
Cable	0.5	m	4 core braided screen cable with black PUR jacket (see page 6 for details).
Connector	Superseal	-	Over-moulded AMP Superseal 1.5 series 4 pole connector (see page 6 for details).
Sealing	IP67	-	Applies to housing, cable, gland & connector. The gland is not designed for flexible cable installation which may compromise the seal.
Weight	120	g	Including cable.
Size Width Length Height	 70.5 45 14.5	 mm mm mm	See dimension drawing on page 3

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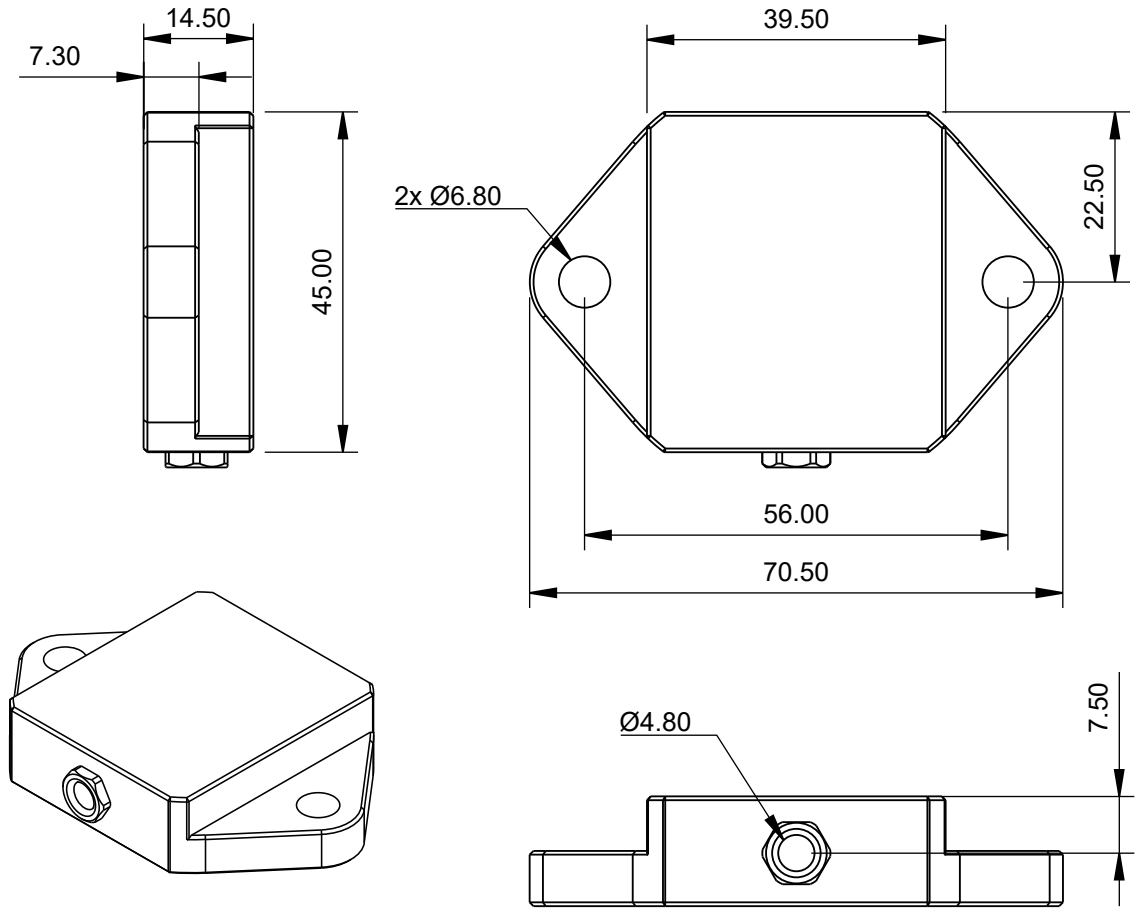
Performance & Output Specifications

Parameter	TDR-2-25	TDR-2-45	TDR-2-90	Unit
Measuring range	±25	±45	±90	°
Zero Bias Error	±0.02	±0.03	±0.04	°
Accuracy (20°C)	±0.05	±0.1	±0.15	°
Scale Factor	80	44.44	22.22	mV / °
Temperature Errors Zero Drift Sensitivity Drift		±0.002 ±0.002		 ° / °C % / °C
Accuracy (-10 to 60°C)	±0.12	±0.18	±0.25	°
Long Term Stability	±0.01	±0.01	±0.01	°
Resolution (@3Hz bandwidth)	0.002	0.003	0.005	°

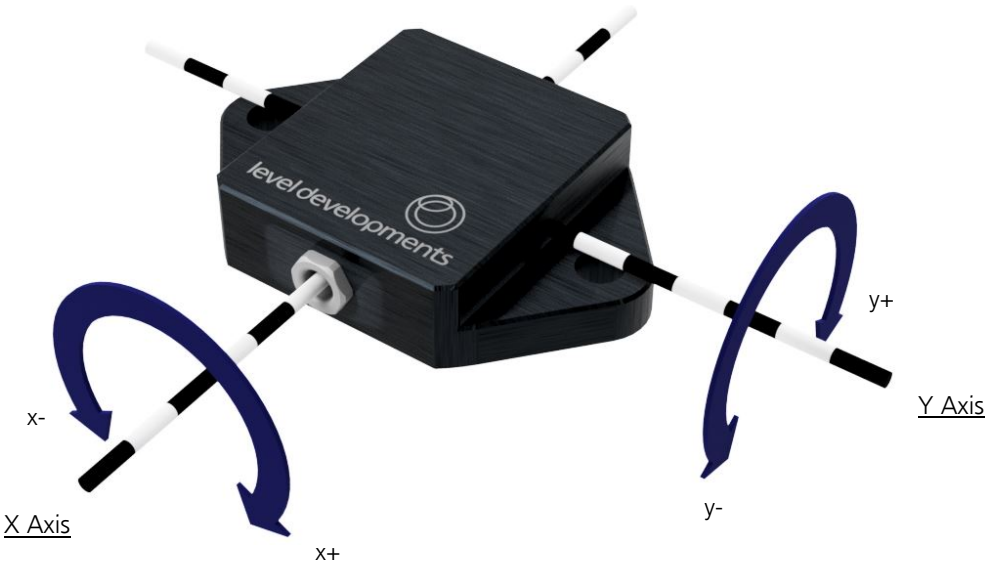
Parameter	Notes
Measuring range	Defines the calibrated measurement range.
Zero Bias Error	This is the maximum angle from the device when it is placed on a perfectly level surface. For optimum zero point accuracy, the mounting angle of the part can be adjusted or the offset can be electronically compensated.
Accuracy (20°C)	This is the **maximum** error between the measured and displayed value at any point in the measurement range when the device is at room temperature (20°C). Most manufacturer's datasheets quote 'typical' values. Typical values are usually less than half of the maximum values.
Sensitivity	This is the **nominal** amount that the voltage will change with when tilted throughout the range specified. The output voltage is linear to the input angle. See page 4 for more details.
Temperature Errors Zero Drift Sensitivity Drift	Temperature variation can affect the output of the sensor as described below: If the device is mounted to a level surface in the zero position, this value is the **maximum** drift of the output angle per °C change in temperature. When the temperature changes there is a change in sensitivity of the sensor's output. The error this causes in the measurement is calculated from the formula: $\mathbf{E_{sd} = SD \times \Delta T \times \theta}$ Where: $\mathbf{E_{sd}}$ is the change in output (in degrees) due to sensitivity temperature change **SD** is the sensitivity drift specification from the above table **ΔT** is the change is temperature in °C **θ** is the current angle of the inclinometer axis in question in degrees. These values are derived from the maximum drift data of 20 sensors sampled at random (see page 5 fore more details). Typical values are much lower than this. Most manufacturer's datasheets quote 'typical' values rather than maximum.
Accuracy (-10 to 60°C)	This is the **maximum** error between the measured and displayed value at any point in the measurement range at any temperature over the specified temperature range. Most manufacturer's datasheets quote 'typical' values. Typical values are usually less than half of the maximum values.
Long Term Stability	Stability depends on environment (temperature, vibration & power supply). This figure is based on being powered continuously in an ideal environment, and is independent from accuracy specifications.
Resolution (@3Hz bandwidth)	Resolution is the smallest measurable change with the default 3Hz low pass filter.

Housing Drawing



Axis Direction and Mounting Orientation

Horizontal surface is the zero plane



Part Numbering

TDR-2 - XX - XX

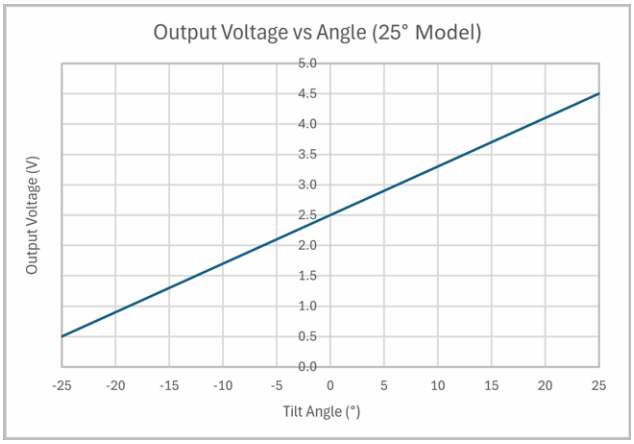
Series Prefix

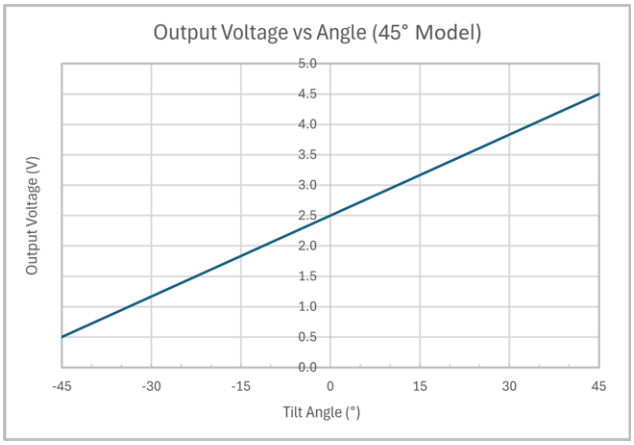
25 - ±25° Full Scale Measurement Range
45 - ±45° Full Scale Measurement Range
90 - ±90° Full Scale Measurement Range

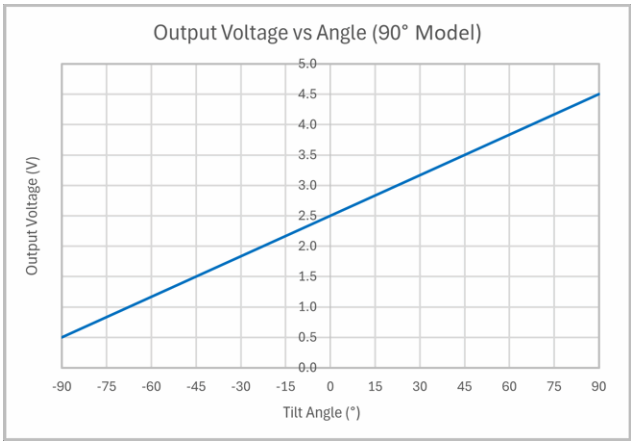
Customer Specific Options

Voltage Output Change With Angle

All inclinometers measure a change in gravitational field on a mass to derive angle. As the inclinometer sensor is rotated, the sensing element is subject to gravitational forces which move the proof mass, and this movement is measured, compensated and converted to an analogue output voltage. The output voltage is linearly proportional to the change in angle.







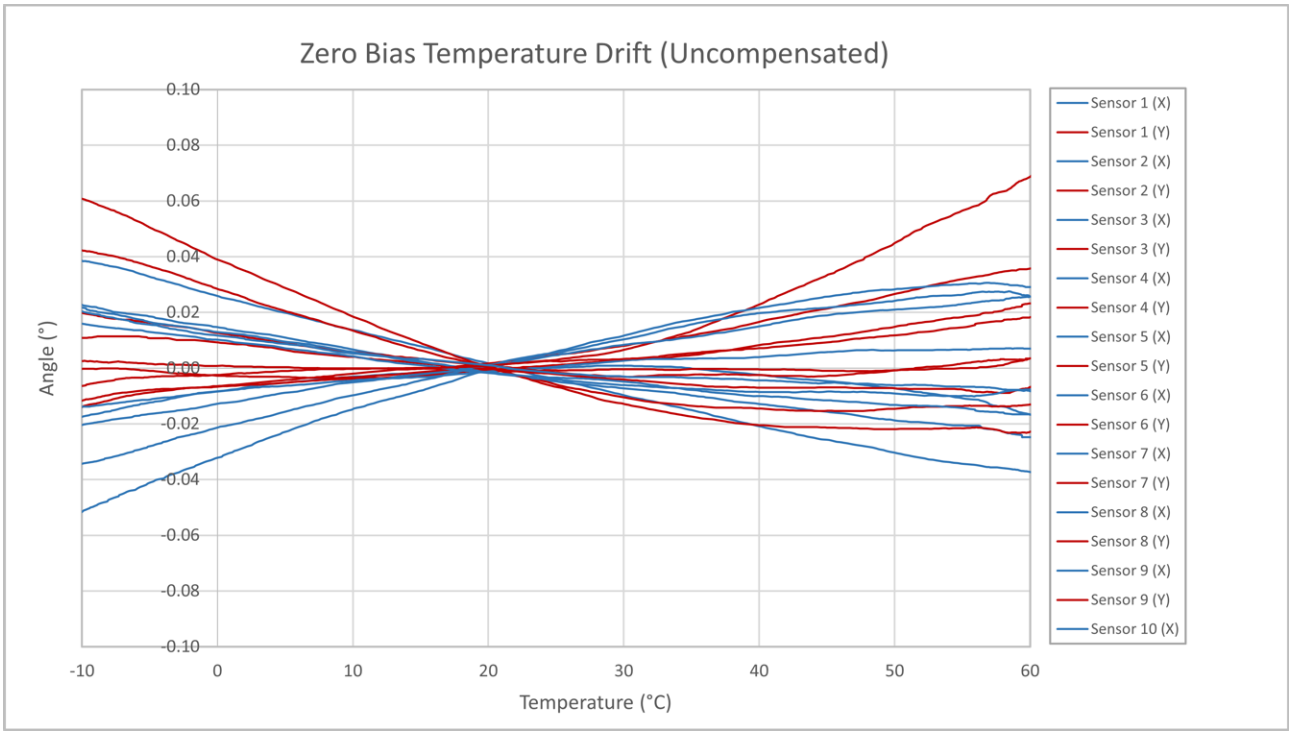
The formula to calculate the angle from the voltage is given by :

$$angle = \left(\frac{(Vout - Voffset) \times 1000}{SF}\right)$$

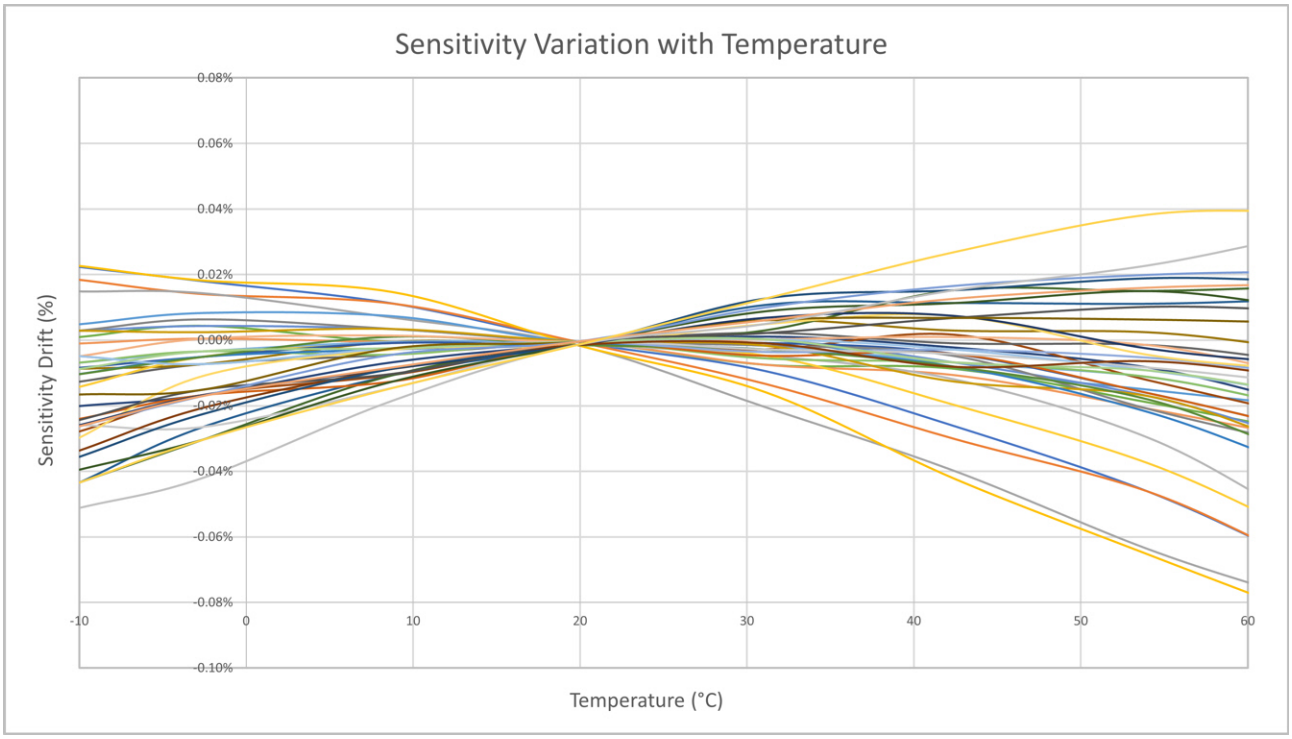
Where :
Vout = Measured voltage from the sensor
Voffset = Measured voltage from the sensor when the sensor is at 0° (usually 2.5V)
SF = Scaling of the device in mV / ° (see specification table on page 2)

Temperature Performance

This sensor uses a ceramic packaged MEMS device which is very stable over temperature. The exact error introduced by temperature change varies from device to device. Below shows a random sample of temperature drift from 20 sensors. These values are uncompensated. The drift can be reduced by a factor of 5 with additional temperature compensation which can be offered for custom versions for OEM applications.



The sensor exhibits zero position drift (shown above) as well as a change in sensitivity (shown below). The change in sensitivity is shown as a percentage, and is applied to the measured value. As such, small angles are relatively unaffected by changes in sensitivity over temperature.

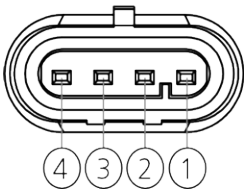


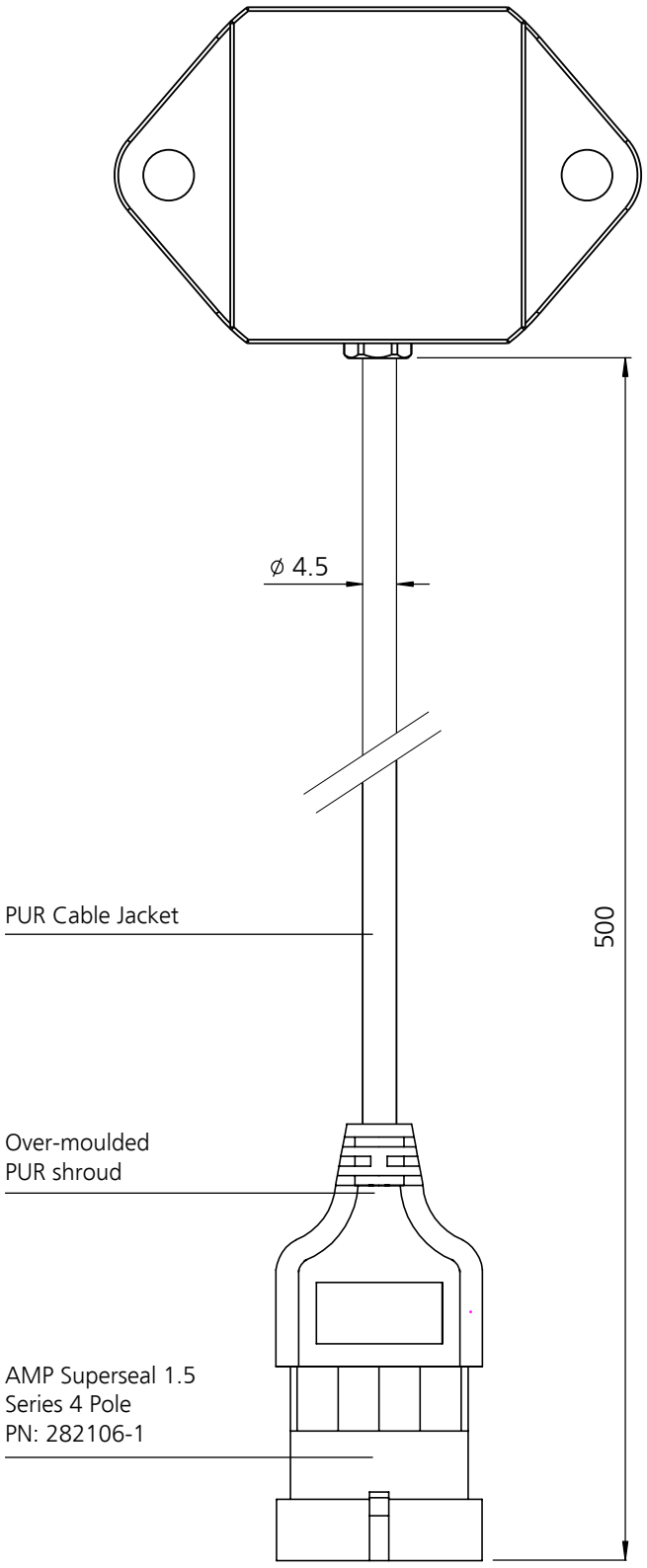
Cable and Connector Details

Parameter	Value
Connector description	AMP 282106-1 Male
Connector make-up	Connector boot
Overall length	0.5 meters
Connector seal rating	IP67
Braided	Yes
Braid type	Tin plated Copper
Jacket material	PUR
Jacket diameter	4.5mm
Wire Gauge	24 AWG
Conductor strands	41x0.08mm

Pin Number	Internal Wire Colour	Function
1	Blue	+ve Supply (7-32Vdc)
2	Brown	GND
3	White	0.5 to 4.5V - X Axis
4	Black	0.5 to 4.5V - Y Axis

AMP male connector
View from front:





Certification

The products are type approved to in accordance with the following directive(s):

EMC Directive 2004/108/EC

And it has been designed, manufactured and tested to the following specifications:

BS EN61326-1:2021 - Electrical equipment for measurement, control and laboratory use

Standard	Description
EN 55011: 2016 + A2: 2021 Class A Table 2 Rated Input power ≤ 20 kVA	Conducted RF Emissions
EN 55011: 2016 A2: 2021 Class A Table 4 Rated Input power ≤ 20 kVA	Radiated Emissions
EN 61326-1: 2021 Table 2 Performance criteria B	Electrostatic Discharge
EN 61326-1: 2021 Table 2 Performance criteria A 10 V/m, 80 % AM 1 kHz, 80 MHz to 1 GHz 3 V/m, 80 % AM 1 kHz, 1.4 GHz to 6 GHz	Radiated RF Immunity 80 MHz to 2.7 GHz
EN 61326-1: 2021 Table 2 Performance criteria B	Fast Transient and Burst Immunity
EN 61326-1: 2021 Table 2 Performance criteria B	Surge Immunity
EN 61326-1: 2021 Table 2 Performance criteria A 3 V, 80 % AM 1 kHz	Conducted RF Immunity
EN 61326-1: 2021 Table 2 Performance Criteria A	Power Frequency Magnetic Field Immunity

Product Options

1. Output voltage level and range can be factory modified to suit most requirements
2. Individual temperature compensation to further reduce the effect of temperature.
3. Standard cable length is 0.5m, others are available on request.
4. The low pass output filter frequency response can be factory adjusted between 0.125 and 32Hz
5. Axis Orientation and directions can be factory modified.
6. Various connector options, including moulded Deutsch DT04, M12 and M8.

Special order versions are generally only available for OEM customers with ongoing requirements.