level developments

DAS-R : Inclinometer, ±10, ±30 or ±90°, 0.5-4.5V Out, 5V Supply

Description

The DAS-R series inclinometers are range of high performance low cost dual axis tilt sensors for measurement of angle in both the pitch and roll axes. They utilise a very high performance MEMS sensor which exhibits low long term & temperature drift compared with many competitive devices. Each sensor is packaged in a small, robust, sealed Aluminium housing and is supplied with a 2m screened PUR cable terminated with a 4 pin M12 connector. The high resolution output voltage varies from 0.5-4.5V over the range of the sensor. There are three measurement range options available: ±10°, ±30° & ±90°. The supply voltage is 5V (DC). These sensors are manufactured and individually calibrated in our UK factory to guarantee performance to the stated specifications.

Features

- Dual axis, measuring ranges : ±10°, ±30° or ±90°
- Input supply voltage: 5Vdc
- Sealed to IP67
- Solid state MEMS sensor
- High resolution 0.5-4.5V voltage output
- Low cost relative to performance
- Small size, 46 x 43.5 x 13.5mm
- 2 meter cable with braided screen & M12 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

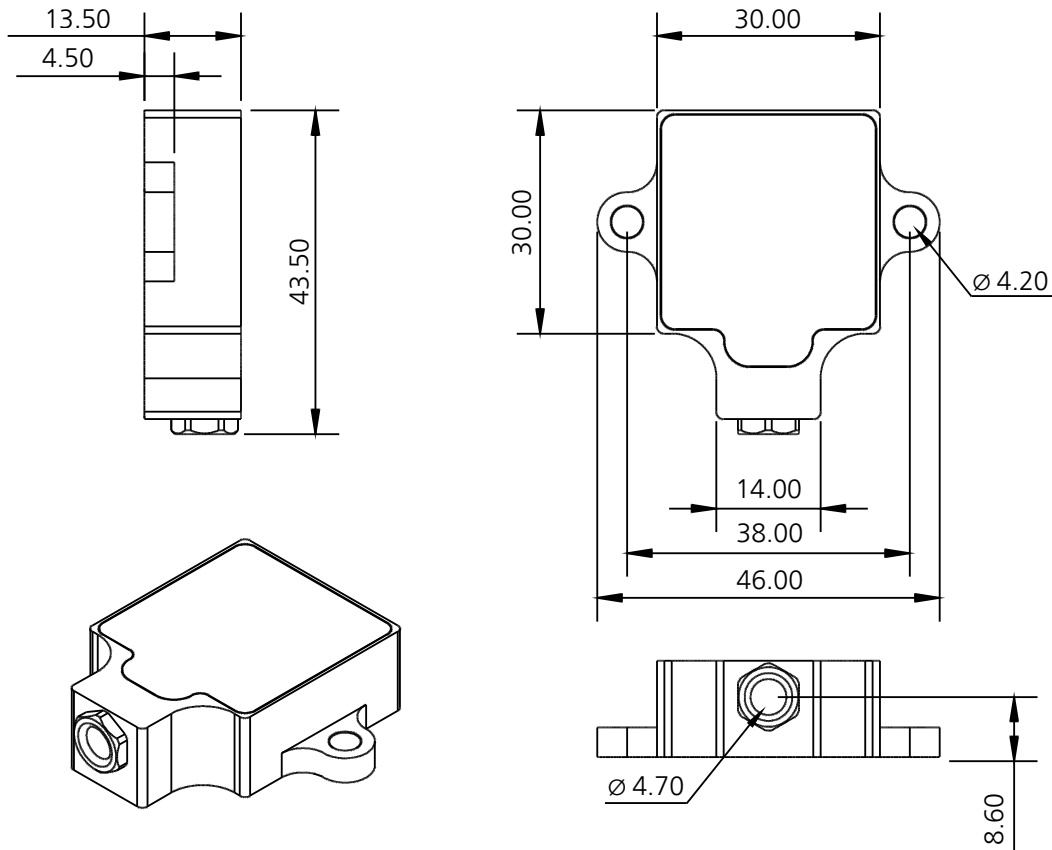| Parameter	Value	Unit	Notes
Supply Voltage	5.00	V dc	A clean and stable input supply should be used, DAS-XX-R models are not regulated internally. For greatest accuracy, the supply voltage level must account for the resistance of the cable.
Operating Current	18	mA	The values shown are maximum.
Operating 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	2	m	4 core braided screen cable with black PUR jacket (see page 5 for details).
Connector	M12	-	4 pole M12 male connector (see page 5 for details).
Sealing	IP67	-	Applies to housing, cable gland & connector (while attached to female M12). Gland is not designed for flexible cable installation which may compromise the seal.
Weight	90	g	Including cable.
Size Width Length Height	46.0 43.5 13.5	mm mm mm	

Performance & Output Specifications

Parameter	DAS-10-R	DAS-30-R	DAS-90-R	Unit
Measuring range	±10	±30	±90	°
Zero Bias Error	±0.01	±0.03	±0.06	°
Accuracy (20°C)	±0.1	±0.2	±0.3	°
Sensitivity For first 1° For 1g range	201 11.518	70 4	35 2	mV/° V/g
Temperature Errors Zero Drift Sensitivity Drift	±0.002 ±0.0030	±0.002 ±0.0030	±0.002 ±0.0030	°/°C %/°C
Accuracy (-10 to 60°C)	±0.18	±0.3	±0.5	°
Long Term Stability	±0.01	±0.01	±0.01	°
Resolution (@3Hz bandwidth)	0.001	0.002	0.003	°

| 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.
Accuracy (20°C)	This is the **maximum** error between the measured and displayed value at any point in the measurement range (up to ±45°) when the device is at room temperature (20°C).
Sensitivity	This is the **nominal** amount that the voltage will change with when tilted throughout the range specified. The output is proportional to the Sine of the input, so the sensitivity changes throughout the range. 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: $E_{sd} = SD \times \Delta T \times \theta$ Where: E_{sd} is the change in output (in degrees) due to sensitivity temperature change **SD** is the sensitivity drift specification from the above table (0.003) **ΔT** is the change is temperature in °C **θ** is the current angle of the inclinometer axis in question in degrees.
Accuracy (-10 to 60°C)	This is the **maximum** error between the measured and displayed value at any point in the measurement range (up to ±45°) at any temperature over the specified temperature range.
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 in output.

Housing Drawing

Axis Direction and Mounting Orientation and Wiring Details

Horizontal surface is the zero plane

Y Axis

X Axis

-ve

-ve

+ve

+ve
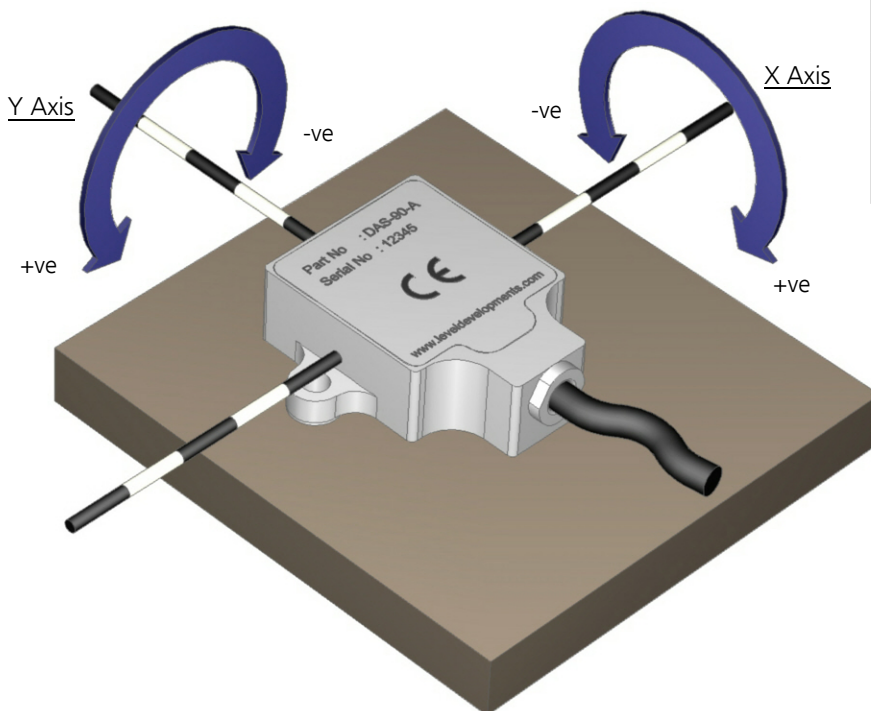
Pin #	Internal Wire Colour	Function
1	Brown	+ve Supply
2	White	Y Axis Output
3	Blue	Gnd (0V)
4	Black	X Axis Output

Voltage Output Change With Angle

All inclinometers measure a change in gravitational field 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 detected and converted to a voltage. In this sensor the output is linear with the change in acceleration (g), which means that the output is a Sine function of the change in angle (°). The graphs below show the output voltage vs. angle.
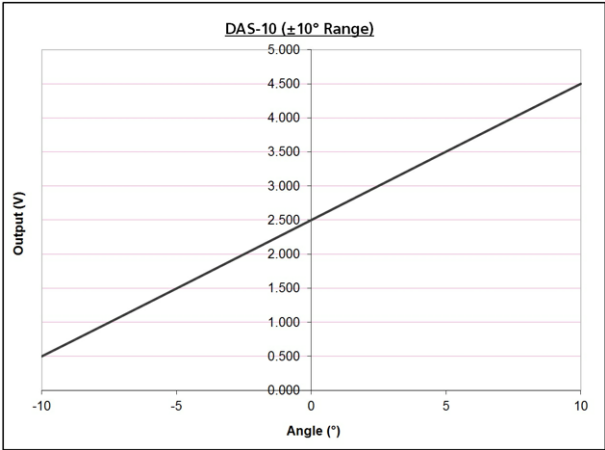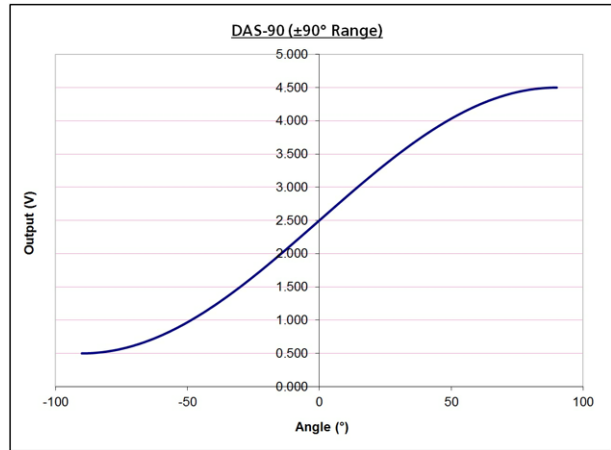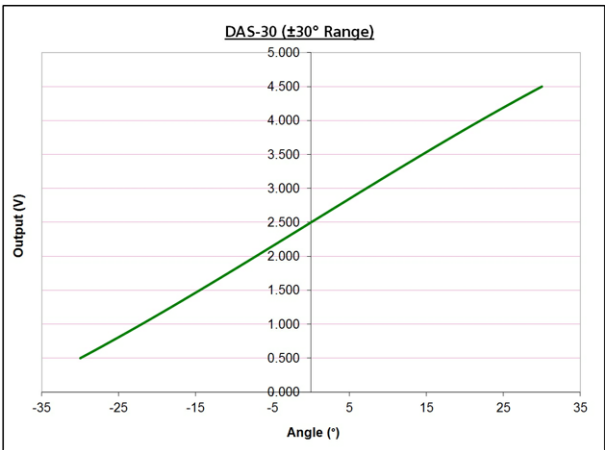

The formula to calculate the angle from the voltage is given by :

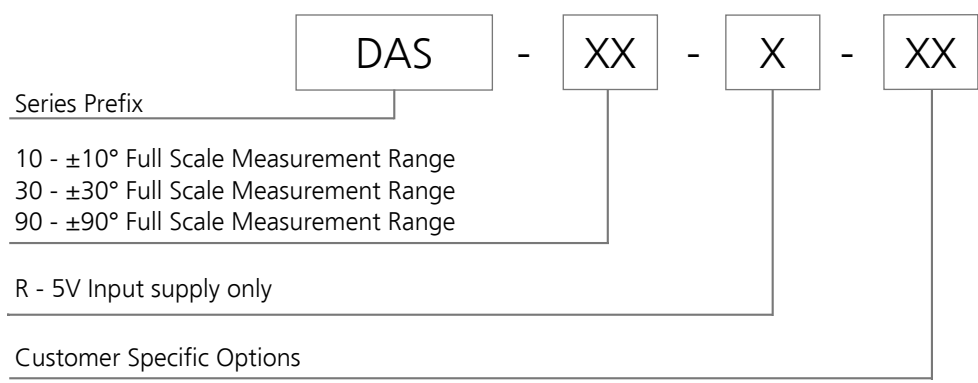$$Angle = \sin^{-1}\left(\frac{(Vout - Voffset)}{Sensitivity}\right)$$

Where :

Vout = Measured voltage from the sensor

Voffset = Measured voltage from the sensor when the sensor is at 0° (usually 2.5V)

Sensitivity = Sensitivity of the device [V/g] (see specification table on page 2)

The output is very linear around the zero position, for example at ±10° the sine non linearity would only introduce an error of 0.05°. As the angle approaches 90° the sensitivity of the sensor drops significantly making measurements up to the full 90 degree range much less accurate.

Part Numbering

| DAS | - | XX | - | X | - | XX |

Series Prefix

10 - ±10° Full Scale Measurement Range
30 - ±30° Full Scale Measurement Range
90 - ±90° Full Scale Measurement Range

R - 5V Input supply only

Customer Specific Options

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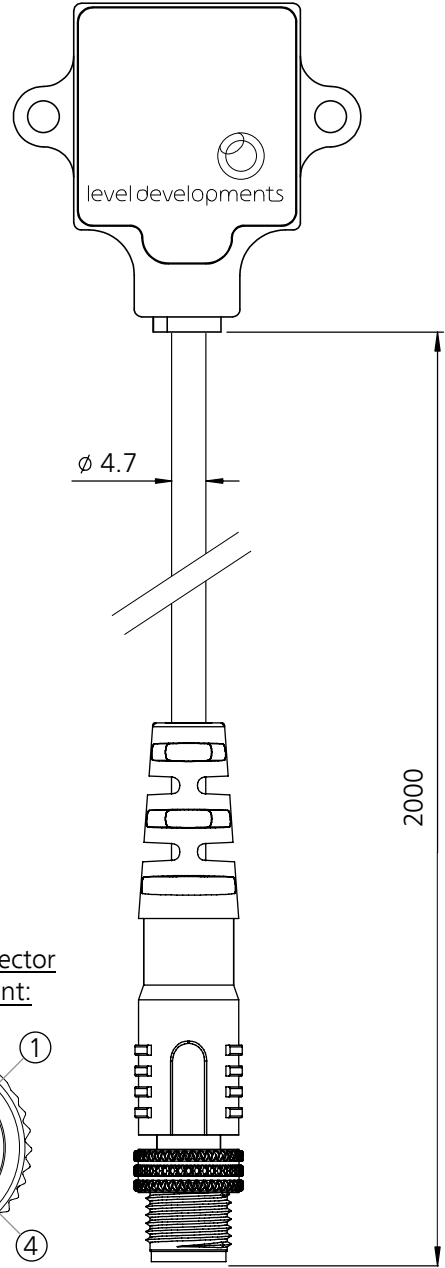Page 4 of 5   Rev 1

Cable and Connector Details

Parameter	Value
Connector description	M12 4-pin male
Connector make-up	Over-moulded
Coding	A-coded
Overall length	2 meters
Connector seal rating	IP67
Braided	Yes
Braid type	Tin plated Copper
Jacket material	PUR
Jacket diameter	4.7mm (max)
Wire Gauge	24 AWG
Conductor strands	41x0.08mm

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2000
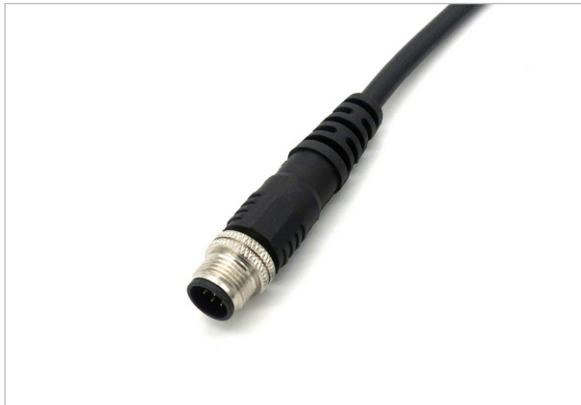
Pin Number	Internal Wire Colour	Function
1	Brown	+ve Supply
2	White	Y Axis Output
3	Blue	Gnd (0V)
4	Black	X Axis Output

M12 male connector
View from front:

② ①
③ ④

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