level developments

LCH-A-S : Low Cost Single Axis Inclinometer 0-10V Output

Features

- Single axis measurement
- Full scale range from ±10° to ±180°
- Solid state MEMS sensor
- 0-5V or 0-10V differential analogue output
- Frequency response 1Hz
- Small size, 46 x 39 x 10.5mm
- Sealed to IP67
- PUR cable rated for continuous outdoor use
- Factory configurable to suit most applications

Applications

- Single axis PV Solar Trackers
- Security systems
- Platform levelling and monitoring
- GPS compensation
- Agricultural and industrial vehicle tilt monitoring
- Telescopic and scissor lift platform monitoring
- Can be readily customised for most applications

Description

The LCH-A-S is a low cost single axis inclinometer sensor supplied in a sealed machined Aluminium housing. It has a dual analogue voltage interface configurable for 0.5-4.5 or 0.5-9.5V range. A PCB only version is also available (part number LCP-A-S). These devices are manufactured and calibrated in our UK factory to guarantee performance to the stated specification.

Specifications

Parameter	Value	Unit	Notes
Supply Voltage	7-30 12-30	V V	For 0.5-4.5V analogue output range devices For 0.5-9.5V analogue output range devices Internal circuit protects from transients and reverse polarity, however use of a low noise DC supply is recommended to ensure the best performance.
Operating Current	15	mA	Maximum value
Output Impedance	100	Ω	
Operating Temperature	-40 to 85	°C	
Size: Width Length Height	46.0 39 10.5	mm	
Measuring range	±10 to ±180	°	Full scale measuring range is selected by part numbering (see page 4)
Zero Output Voltage	2.5 5	V V	For 0.5-4.5V analogue output range devices For 0.5-9.5V analogue output range devices Nominal output voltage when device is placed vertically
Zero Bias Error	±0.1	°	Maximum zero offset angle when unit is placed on a level surface. For optimum zero point accuracy, the mounting angle of the part can be adjusted.
Zero Bias Temperature Error	0.02	°/°C	The maximum change in zero position output per °C of temperature change
Sensitivity Temperature Error	0.01	%/°C	% Change in sensitivity per °C of temperature change
Accuracy (20°C)	±0.3 ±0.5	°	up to ±45° up to ±180° The maximum error between the measured and displayed value at any point in the measurement range at room temperature (20°C)
Long Term Stability	0.1	°	1 year stability when device is powered continuously at 20°C
Resolution (@1Hz BW)	0.05	°	Smallest measurable change in output
Frequency Response	1	Hz	Frequency at which the output is -3dB from input. Filter is 2 pole, and can be factory set to different values on request.
Mechanical shock	3000 (0.5ms)	g	Shock survival limit for MEMS sensor.
Cable Length	2	m	Other lengths available on request
Weight	24	g	Not including cable

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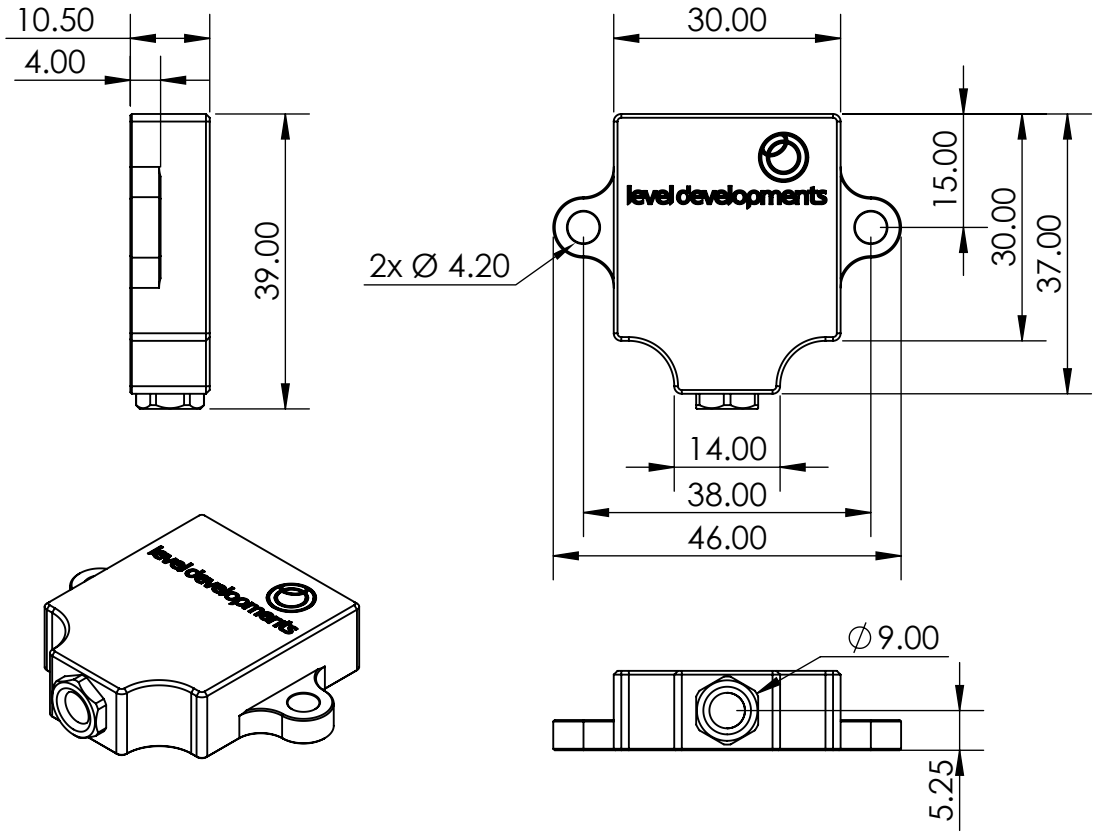
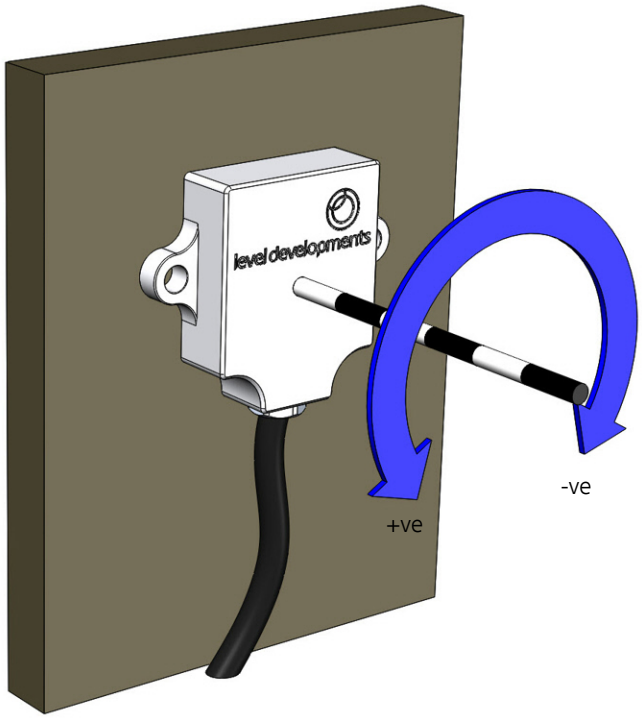
Dimension Drawing



Axis Direction and Mounting Orientation For Single Axis Use

Mounted on Vertical Surface



Voltage Output Change With Angle

All inclinometers measure a change in the effect of the gravitational field on a proof mass to derive angle. As the inclinometer sensor is rotated, the sensing element is subject to gravitational forces which move the mass, and this movement is measured. In this inclinometer there are two sensing elements mounted perpendicular to one another so that the devices range can extend through the full 360° range. Internally these two sensors are measured and a processor derives the angular position. This angle is then converted to a voltage which is linear with the change in angle. In this device there are two output voltage stages, V1 and V2. As the angle is varied over the full scale measurement range, one gives an output voltage of 0.5 to 4.5V (or 0.5 to 9.5V depending on part), and the other gives an inverted signal of 4.5 to 0.5V (or 9.5 to 0.5V. Either of these signals can be used on their own to measure the angle, however by measuring both in differential mode the measurement sensitivity and resolution is increased, and certain common mode errors are reduced.

Using the output from V1:

$$\textbf{Angle} = \frac{(V1_{out} - V_{offset}) \times 1000}{SF}$$

Using the output from V2:

$$\textbf{Angle} = \frac{(V_{offset} - V2_{out}) \times 1000}{SF}$$

Using the differential outputs (V1-V2):

$$\textbf{Angle} = \frac{(V1_{out} - V2_{out}) \times 500}{SF}$$

Where

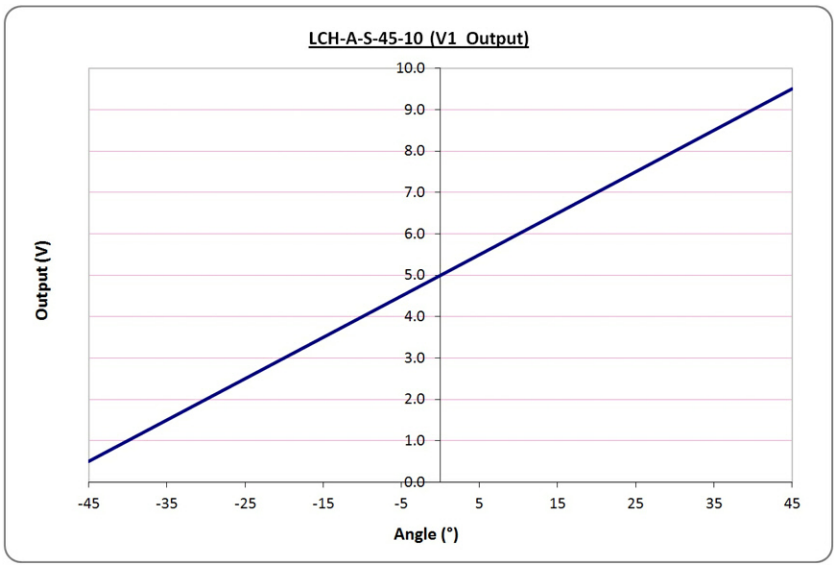
V_{out} is the measured voltage from the V1 or V2 inclinometer output.

V_{offset} is the voltage a 0° which is 2.5V or 5V depending on product option (see table)

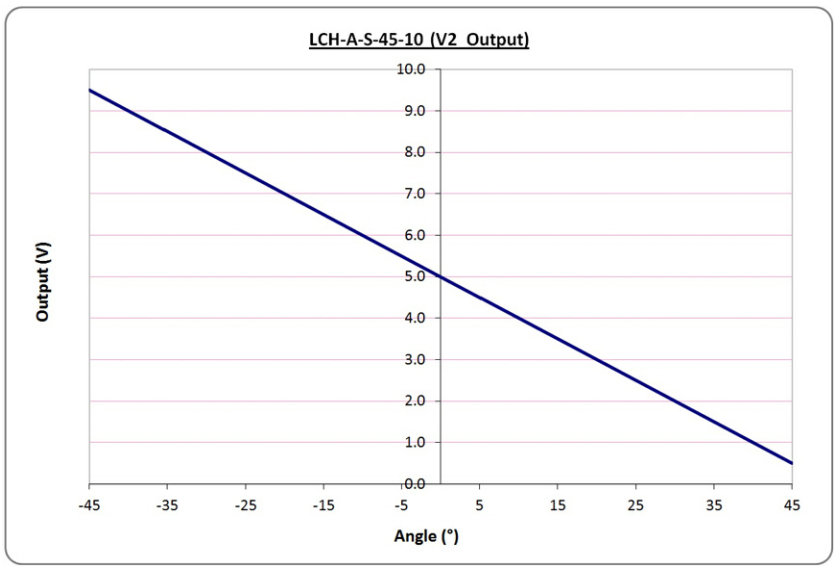
SF is the Scale Factor in mV per degree (see table)

Part Number	Description	Scale Factor (SF)	Zero Output (V_{offset})
LCH-A-S-10-05	±10° Full scale range, 0.5 to 4.5V output	200mV/°	2.5V
LCH-A-S-15-05	±15° Full scale range, 0.5 to 4.5V output	133mV/°	
LCH-A-S-30-05	±30° Full scale range, 0.5 to 4.5V output	66.7mV/°	
LCH-A-S-45-05	±45° Full scale range, 0.5 to 4.5V output	44.4mV/°	
LCH-A-S-60-05	±60° Full scale range, 0.5 to 4.5V output	33.3mV/°	
LCH-A-S-90-05	±90° Full scale range, 0.5 to 4.5V output	22.2mV/°	
LCH-A-S-180-05	±180° Full scale range, 0.5 to 4.5V output	11.1mV/°	
LCH-A-S-10-10	±10° Full scale range, 0.5 to 9.5V output	450mV/°	5V
LCH-A-S-15-10	±15° Full scale range, 0.5 to 9.5V output	300mV/°	
LCH-A-S-30-10	±30° Full scale range, 0.5 to 9.5V output	150mV/°	
LCH-A-S-45-10	±45° Full scale range, 0.5 to 9.5V output	100mV/°	
LCH-A-S-60-10	±60° Full scale range, 0.5 to 9.5V output	75mV/°	
LCH-A-S-90-10	±90° Full scale range, 0.5 to 9.5V output	50mV/°	
LCH-A-S-180-10	±180° Full scale range, 0.5 to 9.5V output	25mV/°	

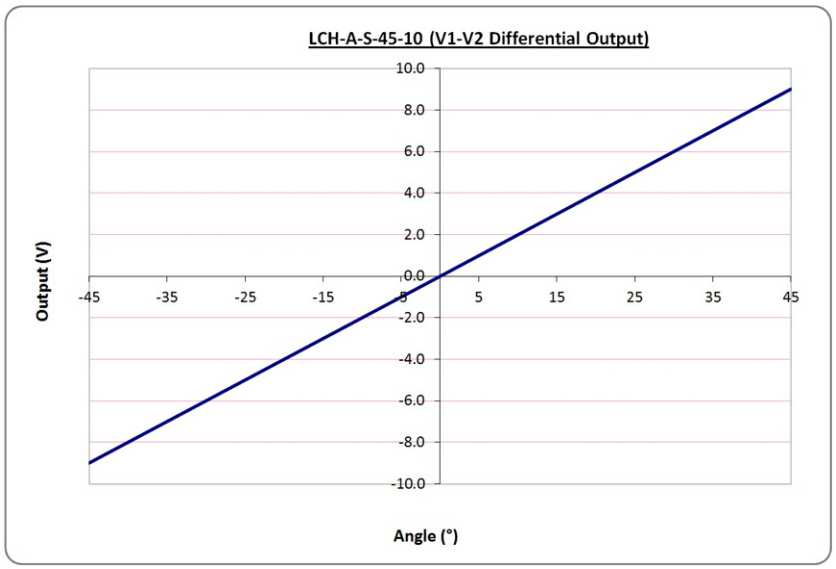
Voltage Output Change With Angle



Voltage Output from V1 for a ±45° device with a 0.5-9.5V output interface

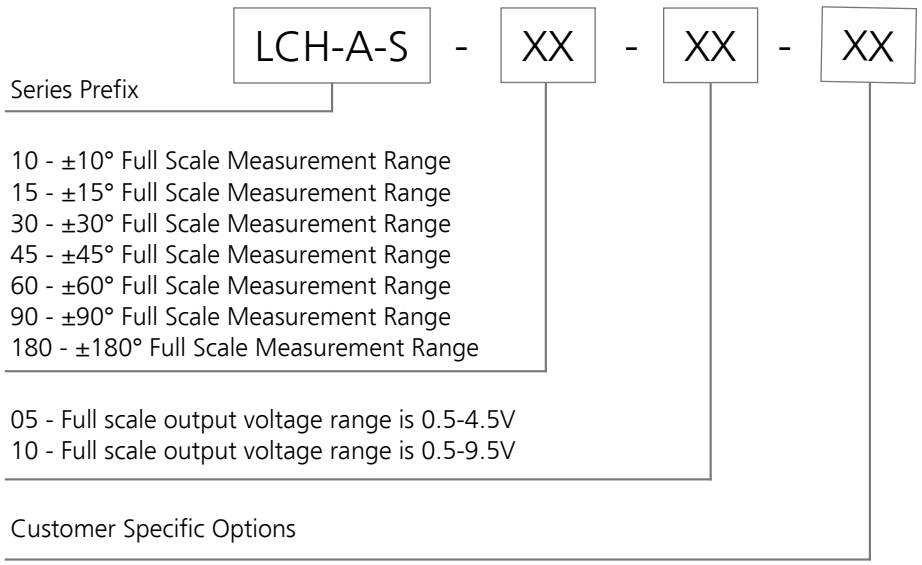


Voltage Output from V2 for a ±45° device with a 0.5-9.5V output interface



Differential Voltage output between V1 and V2 for a ±45° device with a 0.5-9.5V output interface

Part Numbering



Example:

LCH-A-S-45-10
LCH-A-S Series Single Axis Inclinometer
±45° Full Scale Measurement Range
0.5 to 9.5V full scale output

Product Options

1. Output Voltage range can be factory modified to suit most requirements
2. Output Voltage can be factory modified to be a Sine function of angle.
3. Standard cable length is 2m, others are available on request.
4. Frequency response can be factory adjusted between 0.125 and 32Hz
5. Axis Orientation and directions can be factory modified.
6. Cable can be pre-assembled with mating connector for customers application.

Special order versions are generally only available for volume orders or ongoing requirements.

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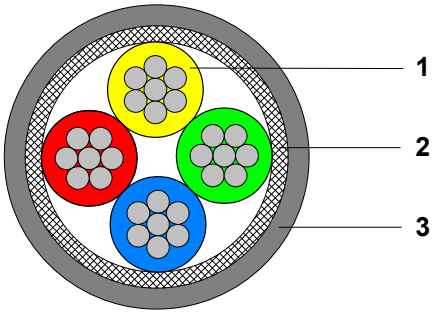
Connection Details

Standard cable is 2m long. Cables can be supplied in any length up to 100m.

1. Core wires, tin plated copper, 18x0.1mm strands per conductor (26 AWG). 4 conductors, colours red, blue, yellow and green with PVC core insulation.
2. Braided screen of tin copper wire with minimum 85% coverage.
3. Black PUR (Polyurethane) Solar jacket. Flame retardant, reduced smoke generation, zero halogen, excellent for use in water and oil, good for use in acids and fuels, radiation tolerance: 10E6 Gy, UV stable, suitable for continuous outdoor use.



Parameter	Value	Unit	Notes
Approximate Weight	35	g/m	
Operating Temperature	-40 to 85	°C	Static operation
Conductor Resistance	100	Ω/Km	Maximum resistance
Insulation Resistance	1500	MΩ/Km	Minimum resistance
Test Voltage	1.5	KV DC	
Voltage Rating	440	V	
Core Current Rating	1	A	At 40°C air temperature
Individual Core Diameter	1.1	mm	
Overall Diameter	4.6	mm	

Internal Wire Colour	Function
Red	+ve Supply
Blue	Ground
Yellow	V1 Vout
Green	V2 Vout

Certification

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

CE

EMC Directive 2004/108/EC

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

BS EN61326-1:2006	Electrical equipment for measurement, control and laboratory use – EMC Requirements
BS EN55011:2007, Group 1 Class B	