level developments

LCH-45 : Dual Axis Inclinometer, ±45° range, RS232 Output

Features

- Dual axis measurement, range : ±45°
- Solid state MEMS sensor
- RS232 full duplex communication (TTL level UART output available on request)
- Low cost relative to performance
- User-programmable low pass damping filter, with multiple settings from 0.125 to 32Hz
- User-programmable zero offset position
- Onboard temperature sensor
- Small size, 46 x 39 x 10.5mm
- Sealed to IP67
- 4 core 2m PUR cable with 4 pin M12 Connector

Applications

- PV solar tracker control systems
- Platform levelling and monitoring
- GPS compensation
- Platform scales and weigh bridge levelling
- Agricultural and industrial vehicle tilt monitoring
- Telescopic and scissor lift platform monitoring
- Can be readily customised to suit most applications
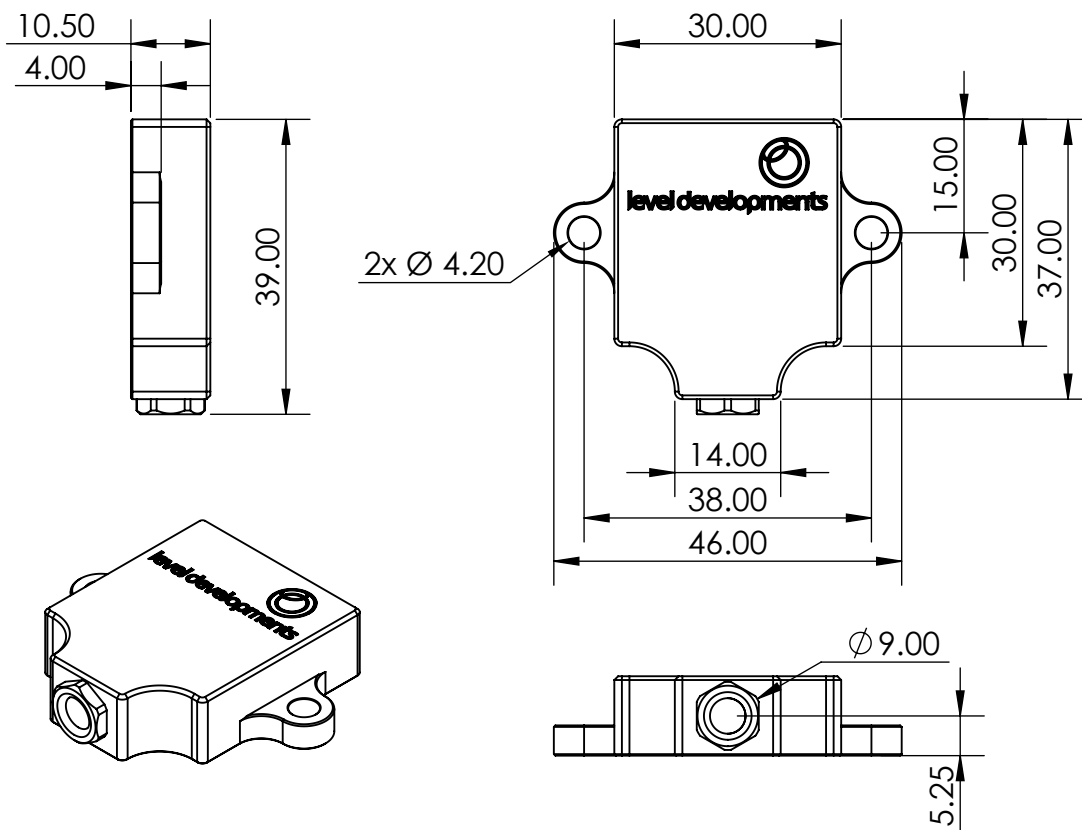
Description

The LCH-45 is a low cost dual axis inclinometer sensor supplied in a sealed machined Aluminium housing. It has a digital interface with a full duplex RS232 output for connection directly to a serial port. A PCB only version is also available (part number LCP-45). These devices are manufactured and calibrated in our UK factory to guarantee performance to the stated specification.

Specifications

| Parameter	Value	Unit	Notes
Supply Voltage	4.9 to 15	V dc	Supply voltage is protected internally against reverse polarity, and supply transients. On request this unit can be supplied configured for 3.3V operation.
Operating Current	18	mA	Maximum value at any operating voltage in range. Low power version (<2mA) can be configured on request.
Operating Temperature	-40 to 85	°C	Maximum operating temperature range. Temperature variation will cause measurement errors as defined below.
Measuring range	±45	°	Direction of measurement can be reversed and zero position can be reset anywhere in range. Settings are stored in non volatile memory so are remembered after power down.
Resolution (@ 1Hz filter)	0.05	°	Resolution is the smallest measurable change in output.
Zero Bias Error	±0.1°	°	This is the maximum error when the device is mounted on a level surface when the device is at room temperature (20°C)
Accuracy (@20°C)	±0.3	°	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)
Temperature Error	0.01	°/°C	This is the maximum change in output per °C change of temperature.
Accuracy (-20 to 70°C)	±1	°	This is the maximum error between the measured & displayed value at any point in the measurement range at any temperature within the temperature range.
RS232 Output Rate	38400	bps	Bit rate is adjustable between 115.2k, 57.6k, 38.4k, 19.2k and 9.6k, 4.8k and 2.4k via the digital interface
RS232 Data Format	38.4, 8,1,n		1 start bit, 8 data bits, 1 stop bit, no parity
Low Pass Filter Freq.	1	Hz	Features a low pass filter which is adjustable between 32Hz & 0.125Hz via the control commands, see page 4 for more details. The default setting is 1Hz.
Mechanical shock	3000 (0.5ms) 10000 (0.1ms)	g	Shock survival limit for MEMS sensor.
Cable Length	2	m	With 4 pin M12 Connector, Other lengths available on request
Weight	24	g	Not including cable

Dimension Drawing

Axis Direction and Mounting Orientation

Mounted on Horizontal Surface
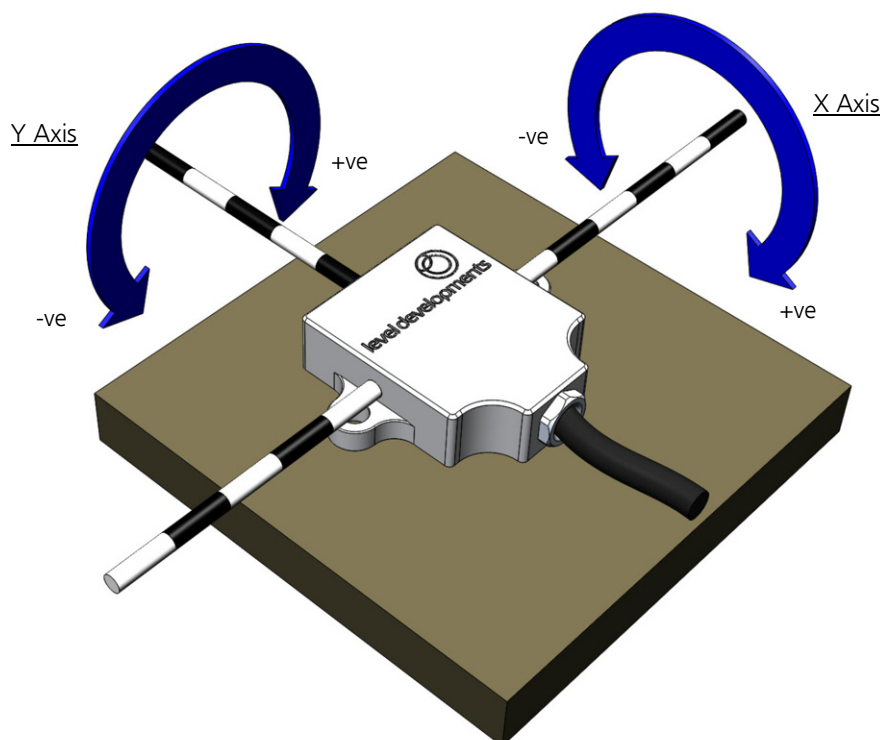
Wire Colour	Function
Brown	+Ve Supply
White	GND
Blue	RS232 Rx
Black	RS232 Tx

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

Pin Number	Internal Wire Colour	Function
1	Brown	+ve Supply
2	White	Gnd (0v)
3	Blue	RS232 Rxd
4	Black	RS232 Txd

M12 male connector
View from front:

② ①

③ ④

2000

⌀ 4.7
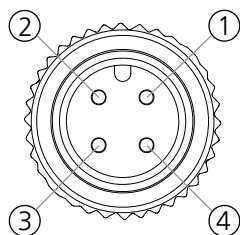
M12 4-Pole Male
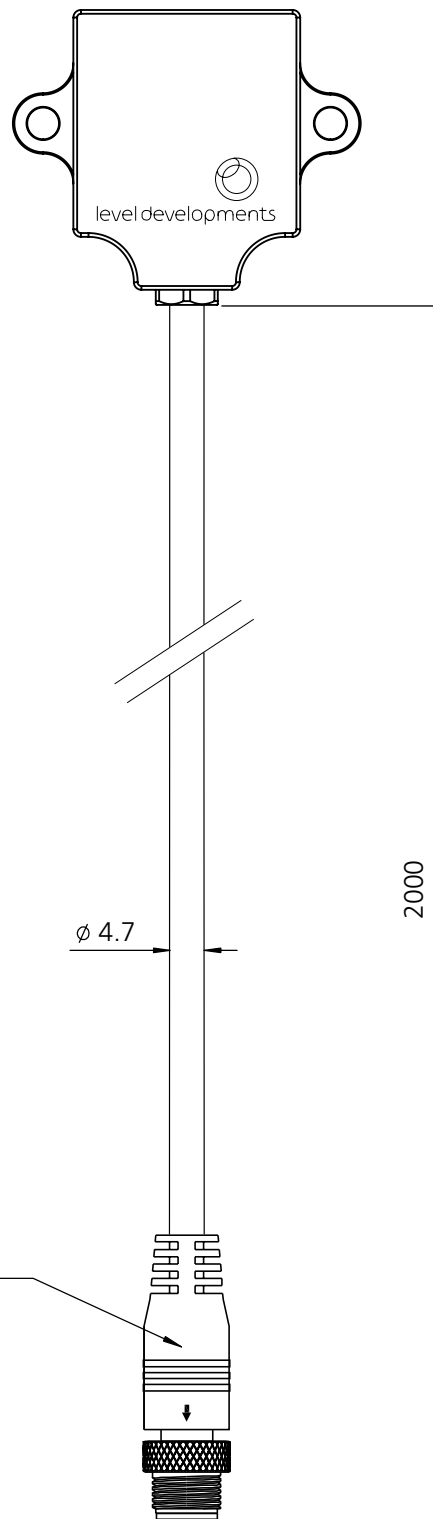
Control Command Set

Data is transmitted and received over RS232 in full duplex mode. The default configuration is with the baud rate set to 38.4kbps, with 8 data bits, 1 stop bit and no parity. All commands are lower case and 7 bytes long. The time between each character of the command must be less than 100ms otherwise the device will discard the command. The settings are all stored in non volatile memory.

| Command	Description	Response Length	Response
get---x	Returns the X axis angle as either: - An INT32 value equal to the angle x 1000 - A fixed length ASCII string terminated with a carriage return depending on the setting of commands 'setoasc' or 'setoint' Shipping default is INT32.	4 bytes 9 bytes	&h XX XX XX XX +025.430<CR>
get---y	Returns the Y axis angle as either: - An INT32 value equal to the angle x 1000 - A fixed length ASCII string terminated with a carriage return depending on the setting of commands 'setoasc' or 'setoint' Shipping default is INT32.	4 bytes 9 bytes	&h YY YY YY YY +025.430<CR>
get-x&y	Returns the X and Y axis angle (X is transmitted first) as either: - A pair of INT32 value equal to the angle x 1000 - A fixed length comma separated ASCII string terminated with <CR> depending on the setting of commands 'setoasc' or 'setoint' Shipping default is INT32.	8 bytes 18 bytes	&h XX XX XX XX YY YY YY YY ±xxx.xxx,±yyy.yyy<CR>
gettemp	Returns the temperature of the sensor as either: - An INT16 value equal to the temperature x 100 - A fixed length ASCII string terminated with a carriage return depending on the setting of commands 'setoasc' or 'setoint' Shipping default is INT32.	2 bytes 6 bytes	&h XX XX ±tt.t<CR>
str9999	Set continuous output transmission rate in milliseconds (50-9999ms) - str0100 - 100ms (0.1s) between transmissions - str8500 - 8500ms (8.5s) between transmissions	2 bytes	OK
setcasc	Sets the output to transmit the X and Y angle continuously in ASCII format at the rate defined by strXXXX.	18 bytes	±xxx.xxx,±yyy.yyy<CR>
stpcasc	Stops the continuous transmission of ASCII data	2 bytes	OK
get-flt	Returns the value of the current filter time constant in ms as an INT16	2 bytes	&h XX XX
setdir1 setdir2 setdir3 setdir4	Sets the X axis measurement direction to positive clockwise Sets the X axis measurement direction to negative clockwise Sets the Y axis measurement direction to positive clockwise Sets the Y axis measurement direction to negative clockwise	2 bytes	OK
setzcur	Tare function to set the current position to zero	2 bytes	OK
setzfac	Cancels tare function and resets zero to factory setting	2 bytes	OK
setoasc	Sets the output to ASCII format	2 bytes	OK
setoint	Sets the output to Integer format	2 bytes	OK
setflt1 setflt2 setflt3 setflt4 setflt5 setflt6 setflt7 setflt8 setflt9	Sets the digital filter frequency response to 0.125Hz Sets the digital filter frequency response to 0.25Hz Sets the digital filter frequency response to 0.5Hz Sets the digital filter frequency response to 1Hz Sets the digital filter frequency response to 2Hz Sets the digital filter frequency response to 4Hz Sets the digital filter frequency response to 8Hz Sets the digital filter frequency response to 16Hz Sets the digital filter frequency response to 32Hz	2 bytes	OK
set-br1 set-br2 set-br3 set-br4 set-br5 set-br6 set-br7	Sets the BAUD rate to 2400bps Sets the BAUD rate to 4800bps Sets the BAUD rate to 9600bps Sets the BAUD rate to 19200bps Sets the BAUD rate to 38400bps Sets the BAUD rate to 57600bps Sets the BAUD rate to 115200bps	2 bytes	OK

Software

A free Windows based application for reading angle, logging and device configuration is available from our website. It is compatible with Windows 10 and works with 32 or 64 bit systems. A COM port is required, and can either be a built in COM port, or a USB to Serial COM port. The application is available to download free of charge at the following link: https://www.leveldevelopments.com/wp/wp-content/uploads/software/Inclinometer_App.zip

The basic features are shown below:

• Automatic or manual configuration of COM port parameters
• Compatible with single or dual axis sensors
• Adjustable number of decimal places on displays
• Logging of data at specified intervals into CSV file
• Setting device to absolute or relative measurement mode
• Switching the data transfer protocol between Integer and ASCII
• Changing the frequency response of the sensor
• Changing the Baud rate of the sensor
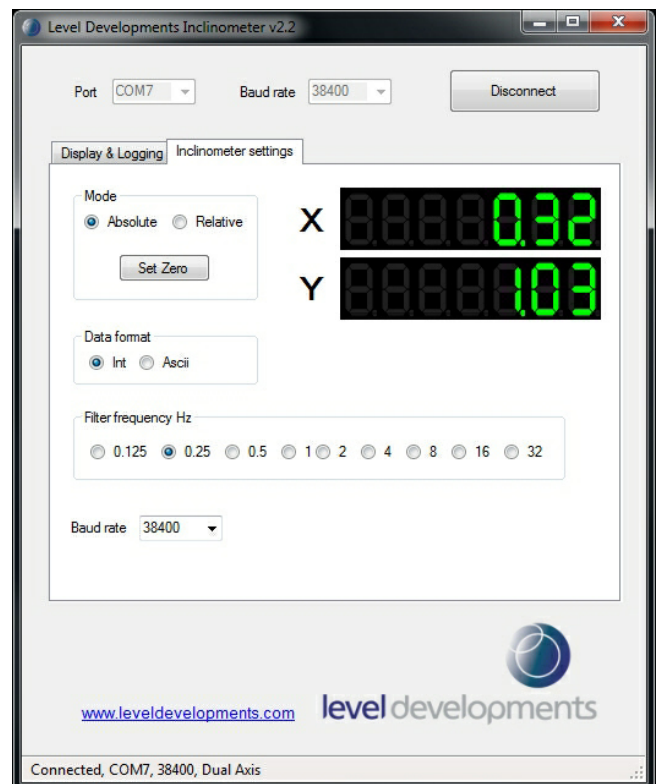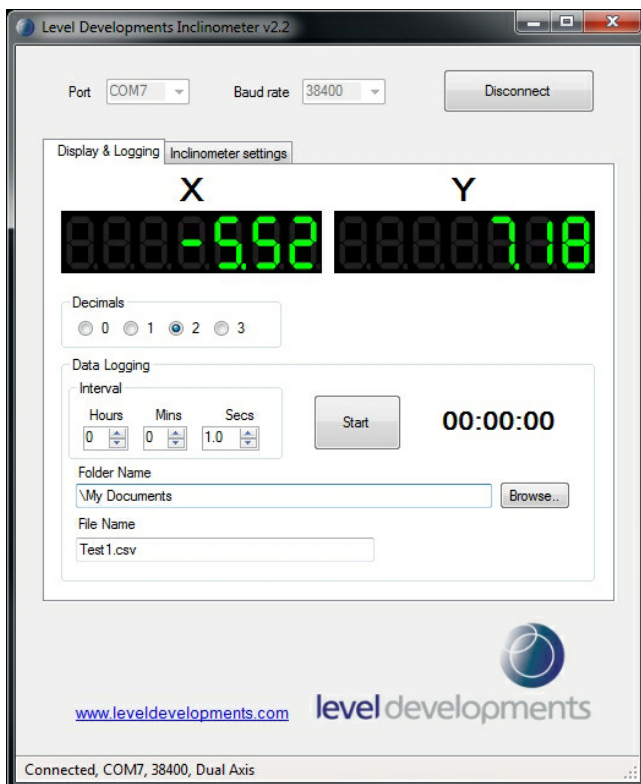
We can also offer custom software development services, please contact us for further information.

This software was designed using .NET framework V4.8, please ensure you have the latest version installed before use. It is provided 'as-is', without any express or implied warranty. In no event will the authors be held liable for any damages arising from the use of this software.

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Certification

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

EMC Directive 2004/108/EC
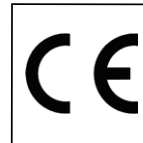
And it has been designed, manufactured and tested to the following specifications:

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

Tested For	Standard Tested To
Conducted RF Emissions	EN 55011: 2016 + A2: 2021 Class A Table 2 Rated Input power ≤ 20 kVA
Radiated Emissions	EN 55011: 2016 A2: 2021 Class A Table 4 Rated Input power ≤ 20 kVA
Electrostatic Discharge	EN 61326-1: 2021 Table 2 Performance criteria B
Radiated RF Immunity	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
Fast Transient and Burst Immunity	EN 61326-1: 2021 Table 2 Performance criteria B
Surge Immunity	EN 61326-1: 2021 Table 2 Performance criteria B
Conducted RF Immunity	EN 61326-1: 2021 Table 2 Performance criteria A 3 V, 80 % AM 1 kHz
Power Frequency Magnetic Field Immunity	EN 61326-1: 2021 Table 2 Performance Criteria A

EMC certification is available on request.

Product Options

1. The standard product has an RS232 interface, however an RS485 version is available as a special order item.
2. Standard cable is a 4 core 2m PUR cable with 4 pin M12 Connector, others are available on request as a special order item.
3. Standard supply voltage is 4.9-15Vdc. A 3.3V supply option is available on request as a special order item.
4. Standard communication protocol is with the Level Developments simplified command set (see page 4). A ModBus version is available as a special order item, and custom protocols can be configured on request.

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