![level developments logo]

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

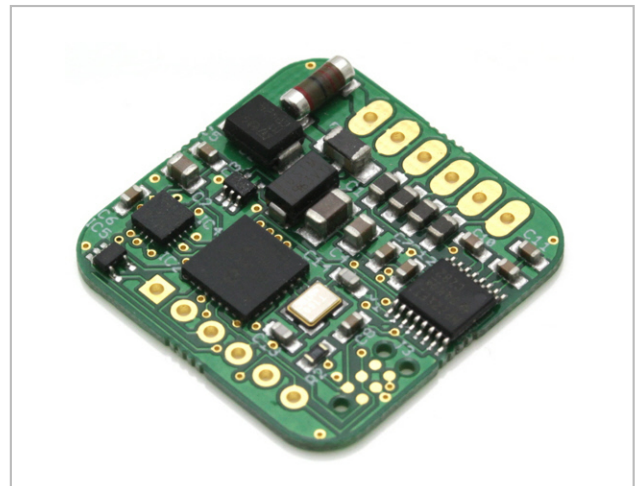## Features

- Dual axis measurement, range : ±45°
- Solid state MEMS sensor
- RS232 and TTL level UART full duplex communication
- Low cost relative to performance
- Zero offset position can be easily programmed and stored
- Programmable frequency response between 0.125 and 32Hz
- On board temperature sensor
- Small size, 25.4 x 25.4 x 5mm

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
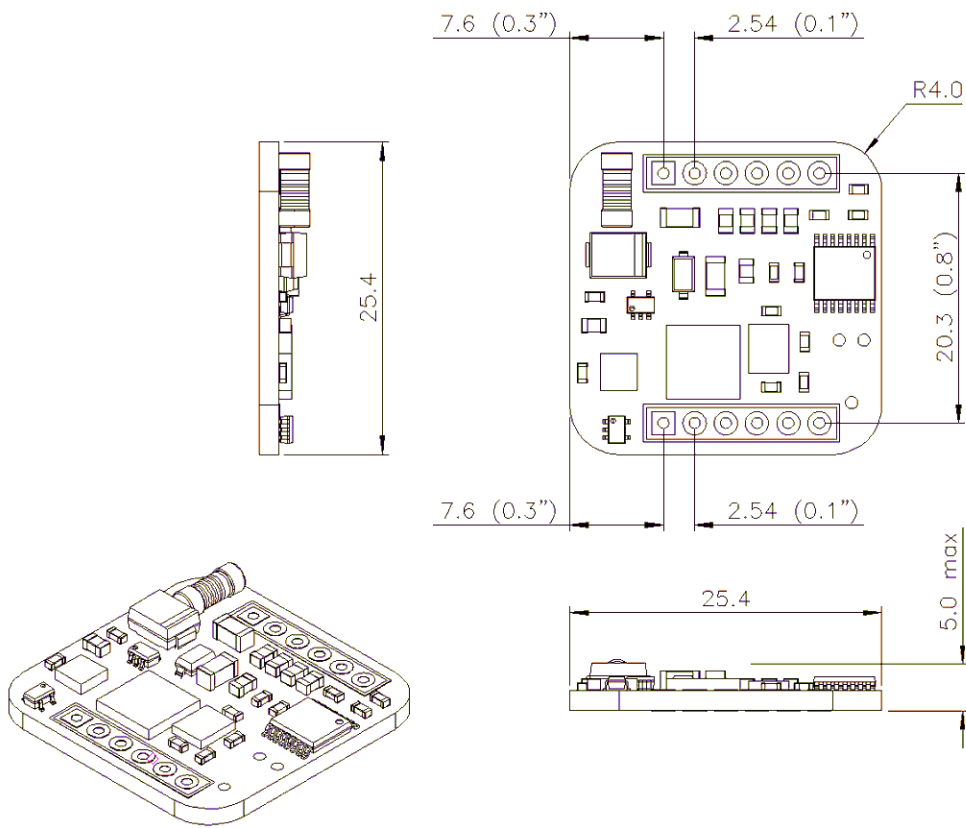
Description

The LCP-45 is a low cost dual axis inclinometer sensor supplied in a PCB format for mounting onto 0.1" PCB headers. It has a digital interface with a full duplex RS232 output as well as a TTL level (3.3V) UART for connection directly to a micro-controller serial port. A housed version with cable is also available (part number LCH-45). These devices are manufactured and calibrated in our UK factory to guarantee performance to the stated specification.

Specifications

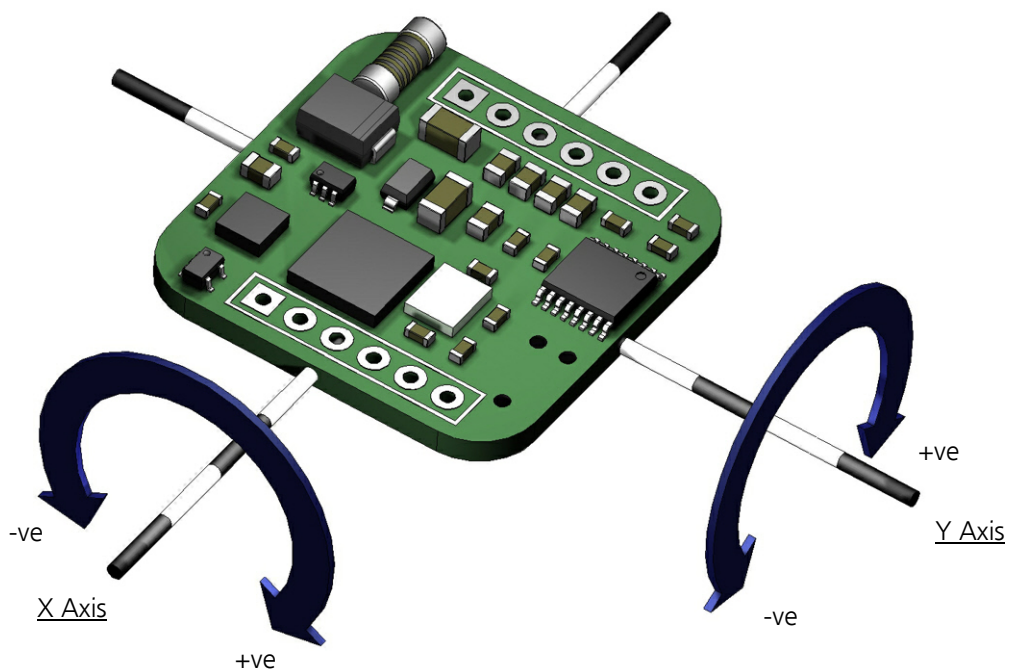| Parameter	Value	Unit	Notes
Supply Voltage	3.3 or 5 to 15	V dc	Supply voltage can be either a regulated 3.3V to drive board directly via connector 2 (pin 1), or a 5 to 15V supply via connector 1 (pin 1) which is then regulated by the on board 3.3V LDO regulator.
Operating Current	20	mA	Maximum value 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 BW)	0.1	°	Resolution is the smallest measurable change in output.
Accuracy (@20°C)	±0.5	°	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 and displayed value at any point in the measurement range at any temperature over the specified 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
Frequency Response	1	Hz	This is the frequency at which the output is 3dB less than the input value. This is adjustable between 0.125Hz and 32Hz via the RS232 control commands
Mechanical shock	3000 (0.5ms) 10000 (0.1ms)	g	Shock survival limit for MEMS sensor.
Weight	3	g	Not including cable

Dimension Drawing

Axis Direction and Mounting Orientation

Mounted on Horizontal Surface

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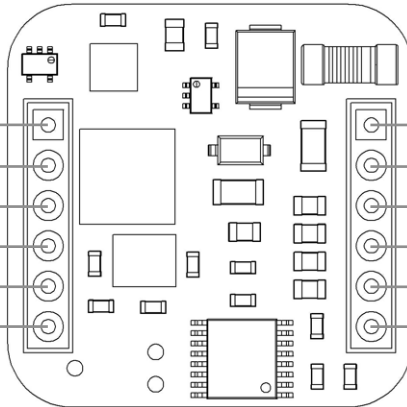
Connection Details

The LCP-45 is designed to be mounted in the horizontal plane using two 6 pin 0.1" headers onto another PCB. Alternatively it can be clamped or bonded in place with a header for connection. The connection details are shown below.

Connector 2

Function	Pin
+ve Supply 3.3V	1
Ground (0V)	2
Do Not Connect	3
Do Not Connect	4
Do Not Connect	5
Do Not Connect	6

Connector 1 (J1)

Pin	Function
1	+ve Supply 5-15V
2	Ground (0V)
3	RS232 Rx
4	RS232 Tx
5	UART Rx
6	UART Tx

The power can be supplied either to Connector 2 (3.3V) or to Connector 1 (5-15V).
DO NOT CONNECT POWER TO BOTH SUPPLIES AT THE SAME TIME

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 EN61326-1:2006   Electrical equipment for measurement, control and laboratory use – EMC Requirements

BS EN55011:2007, Group 1 Class B

Certification is available on request.

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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 tranmitted first) as either:
	- A pair of INT32 value equal to the angle x 1000
	- A fixed length comma seperated 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 requires Windows XP SP3, Windows 7 or Windows 8, and works with 32 and 64 bit systems. It also requires the .net framework V3.5 or higher, and will prompt you to download and install this from Microsoft if it is not already installed on your system. A COM port is also required, and can either be a built in COM port, or a USB to Serial COM port.

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
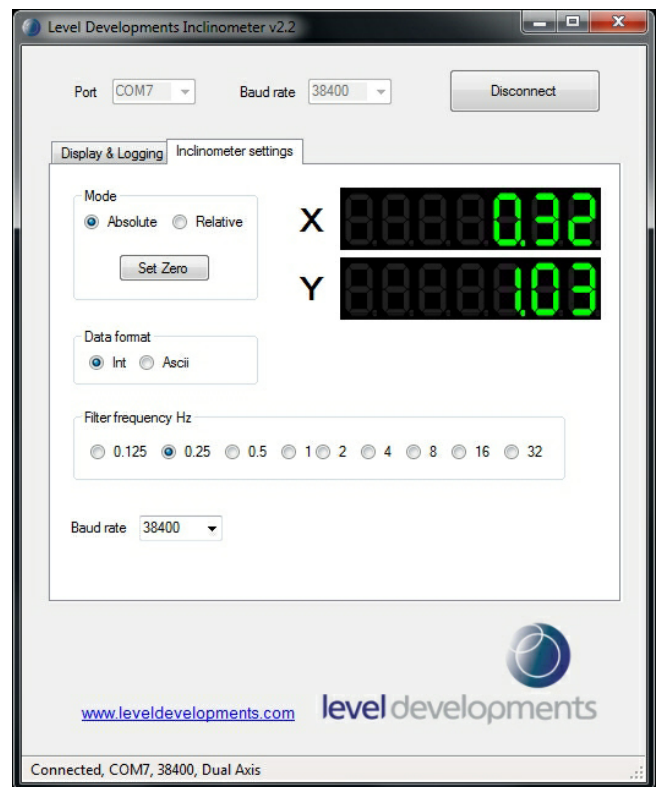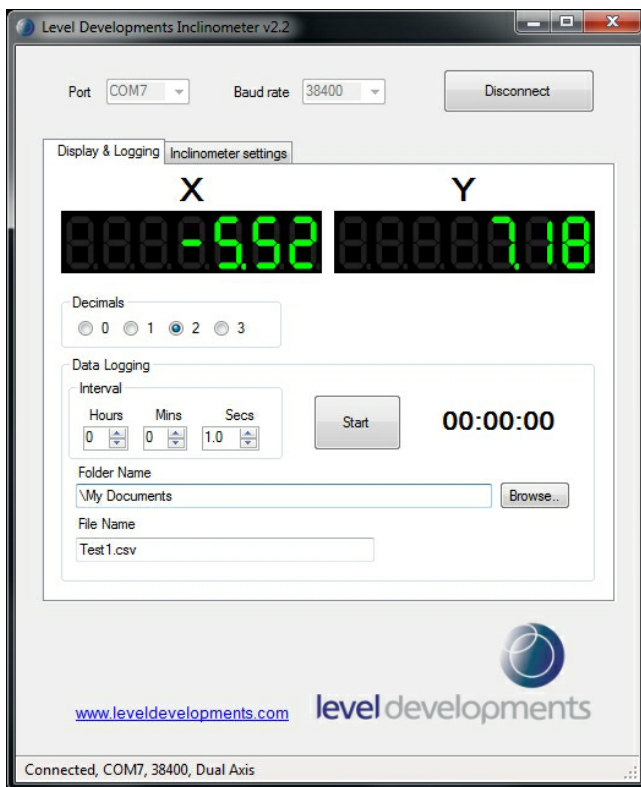
We can also offer custom software development services, please contact us for further information.

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