level developments

SOLAR-2 : Dual Axis Inclinometer, RS232 or RS485 Output

Features

- Dual axis measurement, range from ±5 to ±45°
- High resolution and accuracy
- Low temperature drift, with optional temperature compensation to further improve temperature performance
- Single-drop RS232, RS485 or multi-drop RS485 interface with ModBus protocol
- RS232/RS485 (non-ModBus) models feature an additional user-selectable NMEA0183 format
- Tough sealed anodised aluminium housing (IP67)
- CE certified and RoHS compliant
- 4 core 2m PUR cable with 4 pin M12 Connector

Description

The SOLAR-2 inclinometers are range of high performance low cost dual axis tilt sensors for measurement of angle in both the pitch and roll axes. Through a flexible configuration and calibration program we can supply this device with any measurement range from ±5° to ±45°. It can also be supplied compensated for a specific operating temperature range. The housing is a small, low profile Aluminium housing, hermetically sealed to IP67. The cable is a shielded black PUR cable and is suitable for continuous outdoor use. They utilise a very high performance MEMS sensor which exhibits low long term drift compared with many competitive devices. It has an RS232 and RS485 interface option with our standard communication protocol as well as a version with RS485 multi drop ModBus communication protocol. They are CE and RoHS certified, and are manufactured, calibrated and tested in our UK factory to guarantee performance to the stated specification.

General Specifications

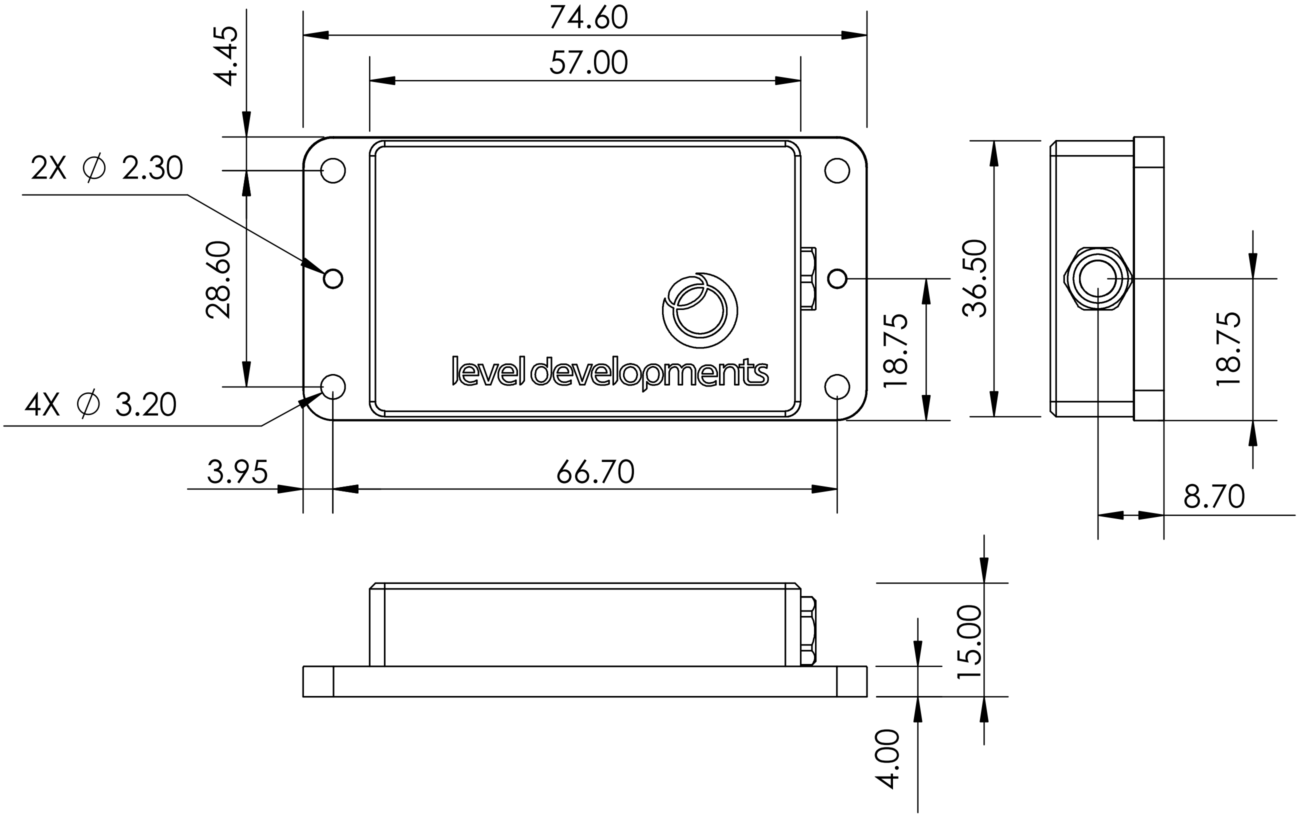
Parameter	Value	Unit	Notes
Supply Voltage	9-30	V dc	Supply is filtered, suppressed and regulated internally, however we recommend the use of a low noise supply to prevent noise coupling to the sensor.
Operating Current	30mA (@ 9V) 20mA (@ 12V) 10.5mA (@ 24V)	mA	Supply current depends on supply voltage.
Operating Temperature	-40 to 85	°C	Maximum operating temperature range. Units can be calibrated between -20 and 70°C on request.
RS232/485 Output Rate	38400	bps	Bit rate is adjustable between 115.2k, 57.6k, 38.4k, 19.2k, 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
RS485 & ModBus 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 16Hz & 0.125Hz via the control commands, see pages 7 & 12 for more details. The default setting is 1Hz.
Mechanical shock	5000	G	Shock survival limit for internal sensor 5000G for 0.5ms
Weight	45	g	Not including cable
Cable & Connector	2m M12	-	2m 4 Core braided screen cable with black PUR jacket and M12 male connector
Sealing	IP67	-	Seal rating applies to housing and cable gland. Gland is not designed for flexible cable installation, as this may compromise seal rating

Performance Specifications

Parameter	SOLAR-05	SOLAR-15	SOLAR-30	SOLAR-45	Unit
Measuring range	±5	±15	±30	±45	°
Zero Bias Error	±0.005	±0.010	±0.015	±0.020	°
Accuracy (@20°C)	±0.010	±0.020	±0.030	±0.040	°
Temperature Errors (without compensation) Zero Drift Sensitivity Drift	±0.0015 ±0.0030	±0.0015 ±0.0030	±0.0015 ±0.0030	±0.0015 ±0.0030	°/°C %/°C
Temperature Errors (with compensation) Zero Drift Sensitivity Drift	±0.0003 ±0.0006	±0.0003 ±0.0006	±0.0003 ±0.0006	±0.0003 ±0.0006	°/°C %/°C
Accuracy -10 to 60°C (without compensation)	±0.070	±0.090	±0.120	±0.150	°
Accuracy -10 to 60°C (with compensation)	±0.025	±0.030	±0.050	±0.065	°
Long Term Stability	±0.007	±0.007	±0.007	±0.007	°
Resolution (@1Hz BW)	0.001	0.001	0.001	0.001	°

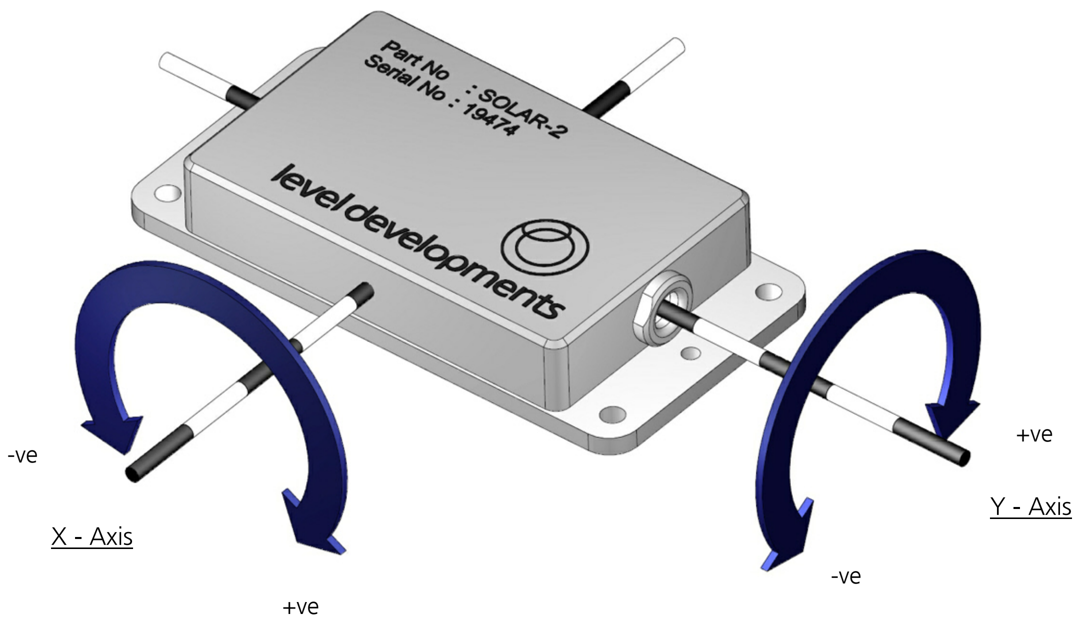
Parameter	Notes
Measuring range	Defines the calibrated measurement range. Direction of measurement can be reversed and zero position can be reset anywhere in range. Settings are stored in non volatile memory so are remembered after power down.
Zero Bias Error	This is the **maximum** angle from the device when it is placed on a perfectly level surface. The zero bias error can be removed from measurement errors either by mechanical adjustment, or as a fixed offset value after installation, or by using the 'setzcur' command to zero the device (see page 8)
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). This value includes cross axis errors.
Temperature Errors	These figures are for devices without additional temperature compensation. See part numbering options on page 7 for further details.
Zero Drift	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.
Sensitivity Drift	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 (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 (without compensation)	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 without individual temperature compensation.
Accuracy -10 to 60°C (with compensation)	This is the **maximum** error between the measured and displayed value at any point in the measurement range at any temperature over the calibrated temperature range with individual temperature compensation.
Long Term Stability	Stability depends on environment (temperature, shock, vibration and power supply). This figure is based on being powered continuously in an ideal environment.
Resolution (@1Hz bandwidth)	Resolution is the smallest measurable change in output.

Housing Drawing



Axis Direction and Mounting Orientation and Wiring Details

Mounted on a Horizontal Surface



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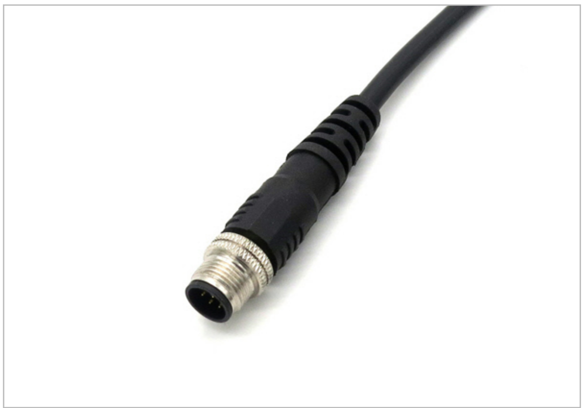
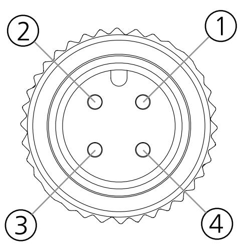
Cable and Connector Details

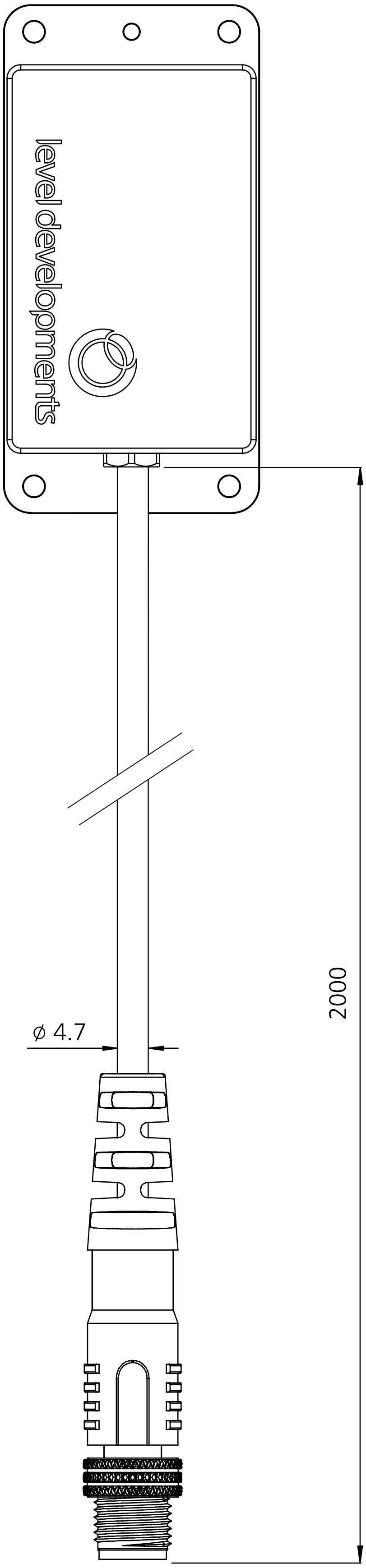
Parameter	Value
Connector description	M12 4-pin male
Connector make-up	Over-moulded
Coding	A-coded
Overall length	2 meters
Connector seal rating	IP67
Braided	Yes
Braid type	Tin plated Copper
Jacket material	PUR
Jacket diameter	4.7mm (max)
Wire Gauge	24 AWG
Conductor strands	41x0.08mm



Pin Number	Internal Wire Colour	Function
1	Brown	+ve Supply
2	White	Gnd (0v)
3	Blue	RS485 A or RS232 Rxd
4	Black	RS485 B or RS232 Txd

M12 male connector
View from front:





Part Numbering

SOLAR - 2 - XX - X - X - XX

Series Prefix

05 - ±5° Full Scale Measurement Range
15 - ±15° Full Scale Measurement Range
30 - ±30° Full Scale Measurement Range
45 - ±45° Full Scale Measurement Range

1 - No additional temperature compensation
2 - Temperature compensation over -10 to 60°C

RS232 - RS232 Interface with LD standard communication protocol
RS485 - RS485 Interface with LD standard communication protocol
RS485M - RS485 Interface with ModBus communication protocol

Customer Specific Options (Optional)

Example:

SOLAR-2-15-2-RS485M
SOLAR-2 Series dual axis inclinometer
±15° Full Scale Measurement Range
Temperature compensated over the range -10 to 60°C
RS485 Interface with ModBus communication protocol

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.

Level Developments Simplified Control Command Set

Data is transmitted and received over RS232 in full duplex mode and for RS485 versions in half 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	0x 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	0x 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	0x 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	0x XX XX ±tt.t<CR>
`str9999`	Set continuous output transmission rate in milliseconds (25-9999ms) - `str0100` - 100ms (0.1s) 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	0x 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`
	Sets the low pass filter (damping) frequency to 0.125Hz
	Sets the low pass filter (damping) frequency to 0.25Hz
	Sets the low pass filter (damping) frequency to 0.5Hz
	Sets the low pass filter (damping) frequency to 1Hz
	Sets the low pass filter (damping) frequency to 2Hz
	Sets the low pass filter (damping) frequency to 4Hz
	Sets the low pass filter (damping) frequency to 8Hz
	Sets the low pass filter (damping) frequency to 16Hz
		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

NMEA0183 Compatibility mode.

NMEA0183 is a widely used standard for communication between marine electronic devices. It stands for "National Marine Electronics Association 0183" and defines a set of protocols and message formats for transmitting data between various marine navigation systems and communication equipment. Any SOLAR-2 Inclinometer using the Level Developments Simplified Control Command Set ("LD mode" as shown on the previous page) can optionally be changed into "NMEA0183 compatible output" mode as described in the following section. Please note that the settings shown on the previous page can only be changed while the sensor is in LD mode, they cannot be adjusted while the sensor is in NMEA mode.

While the sensor is in LD mode, the following command is used to change into NMEA0183 compatible mode:

Command	Description	Response Length	Response
`setnmea`	Exits LD mode and enters NMEA0183 mode. (see note below)	35	`$PLDLB,±xxx.xxx,±yyy.yyy,±tt.t*CS<CR><LF>`

Note: Upon entering NMEA0183 mode, the sensor will begin continuously outputting data. The interval between automatic transmissions is controlled by the "`str9999`" setting which is adjustable while in LD mode, (see previous page). If no user-defined transmission rate is selected, the default interval (1000ms) will be used. The continuous output format is X angle, Y angle and Temperature as described in the "Sensor Response Formats" overleaf.

Changing back to LD mode

An NMEA0183 type command can be sent to the sensor to change it from NMEA Mode to LD Mode; the following command is used to do this:

*$PLDL100,1*38<CR><LF>*

The command above is comprised of the following parts:

Value	Length	Description
$	1	String identifier
P	1	Proprietary message format
LDL	3	Manufacturer Code - (LDL = Level Developments Limited)
100	3	Holding register to write/read - See table below
1	1	Value to write to the holding register: "1" = Sets LD mode to Enabled - See table below
*38	3	Checksum - Xor of all data after $ and before "*" (B2PLDL1001 = 38)
<CR><LF>	2	Carriage return and line feed

NMEA0183 Holding registers

The table below shows all available settings which can be modified while the sensor is in NMEA0183 mode:

Register Address	Name	Description
100	SetCommsMode	Set LD mode to "Enabled"(1) or "Disabled"(0)

NMEA0183 Compatibility mode (continued).

Sensor's Response Formats

The following example shows the default output format when the device is set to NMEA0183 mode:

*$PLDLB,±xxx.xxx,±yyy.yyy,±tt.t*CS<CR><LF>*

The command above is comprised of the following parts:

Value	Length	Description
$	1	String identifier
P	1	Proprietary message format
LDL	3	Manufacturer Code - (LDL = Level Developments Limited)
B	1	Identifier to show the response type/format - See table below
±xxx.xxx	8	Data frame 1 - X axis angle
±yyy.yyy	8	Data frame 2 - Y axis angle
±tt.t	5	Data frame 3 - Temperature
*CS	3	Xor of all data after $ and before "*"
<CR><LF>	2	Carriage return and line feed

Message Format Identifiers - Sensor output formats (A-F)

The table below shows the different output formats used while the sensor is in NMEA0183 mode:

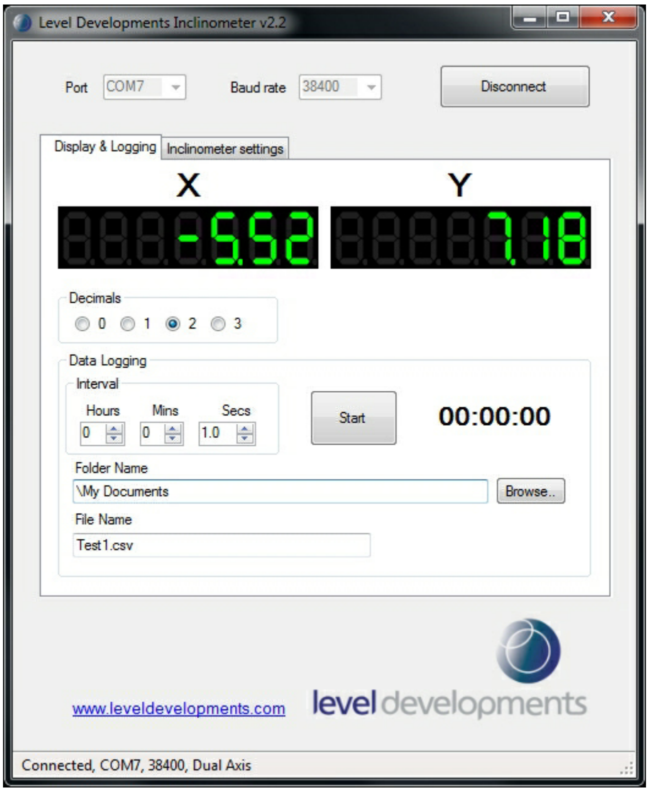
Value	Name	Description
A	Reserved	Not currently used
B	XYangle&Temp	Shows that the message contains X, Y, & Temperature data as follows ±xxx.xxx,±yyy.yyy,±tt.t

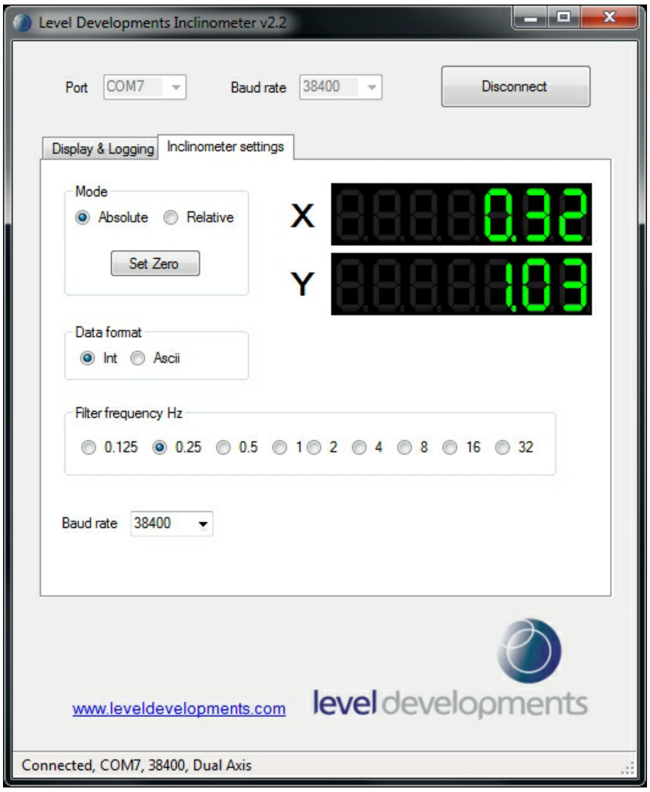
Software

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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ModBus Control Command Set

Data is transmitted and received over RS485 in half duplex mode using the ModBus RTU protocol. The following section provides some basic information about the serial communication between the host PC or PLC and the SOLAR-2. The full ModBus specification can be obtained from http://www.modbus.org. ModBus is a command/response protocol over a serial bus.

The default ModBus serial parameters are: 38400 baud, 1 start bit, 8 data bits, no parity and 1 stop bit. The 8 data bits are sent LSB first. The baud rate can be changed to 115200, 57600, 38400, 19200, 9600, 4800 or 2400 by sending the appropriate command.

The byte order for all 16-bit values is Big Endian (most significant byte first).

Read and write access to the SOLAR-2 is done using ModBus Function Code 3 (read holding registers) and ModBus Function Code 6 (write single register) commands. These two function codes provide the basic functionality needed by most users of the SOLAR-2. A user defined ModBus function code 110 is provided for less commonly used, off-line functions such as setting serial port parameters and changing the device address.

ModBus device address must be in the range 1 to 247. All devices are shipped with a default address of 100 (decimal). Address 0 is the ModBus broadcast address. With this address all devices will perform the action of the function code. The maximum number of these devices that can be connected on a single network is 128.

All ModBus commands and responses have a 16-bit CRC for error detection. ModBus RTU data is in binary format rather than ASCII, so it cannot be viewed properly on a text terminal.

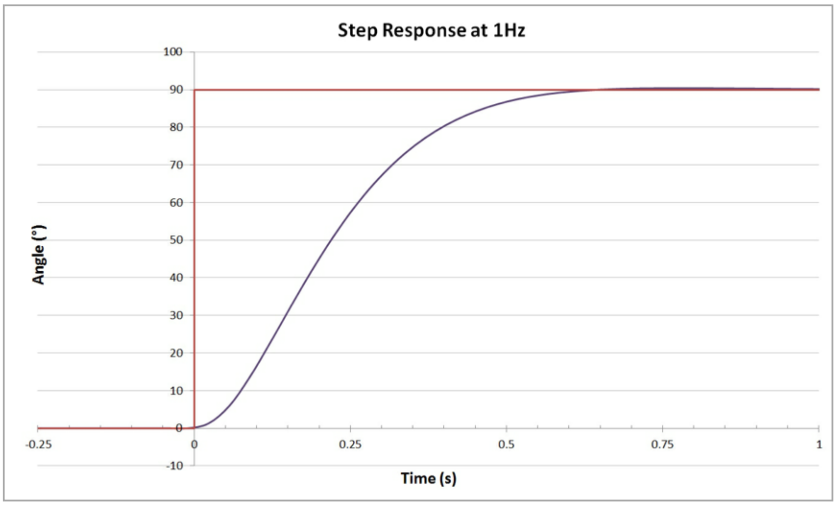
Below is a list of the register locations for reading and writing:

ModBus Registers

Parameter	Address	ModBus Register Address	Description	Read/Write
X Axis Angle	0x00	40,001	Address 0x00 returns the upper 16 bits of the sensor X axis angle. This combines with address 0x01 to form a 32 bit signed integer value equal to the measured angle x 1000.	Read Only
	0x01	40,002		
Y Axis Angle	0x02	40,003	Address 0x02 returns the upper 16 bits of the sensor Y axis angle. This combines with address 0x03 to form a 32 bit signed integer value equal to the measured angle x 1000.	Read Only
	0x03	40,004		
Sensor Temperature	0x06	40,007	Returns a 16 bit signed integer value equal to the temperature of the sensor in degrees Celsius x 100	Read Only
Sensor Filter Index	0x09	40,010	Returns a 16 bit integer value between 1 and 7 which relates to a table of filter responses from 0.125 to 16Hz	Read / Write
Tare Function	0x14	40,021	When set to '1' the device is zeroed at the current position (relative mode). When set to '0' the device is returned to absolute measurement mode (tare cancelled)	Read / Write

Low Pass Filter Frequency Indexes

The SOLAR-2 features a user-selectable low pass filter which can be used (for example) to reduce the effect of vibrations if they are present in the sensor's environment. The filter setting can be changed to any of the response times shown in the table below. The strongest filter (0.125Hz) will provide the greatest damping and stability, however it will also take the longest time to respond to changes in angle (and vice versa). The filter configuration is a 2nd order Bessel low pass filter implemented in a IIR algorithm. It should be noted that this setting does not relate to output data rate (ODR).



Filter Index	Filter Freq. (Hz)	Damping Time (ms)
1	0.125	8000
2	0.25	4000
3	0.5	2000
4	1	1000
5	2	500
6	4	250
7	8	125
8	16	62.5

Reading a Holding Register

The data from the device is stored in holding registers as detailed on page 4. Function code 0x03 is used to read these registers. Below is the command and response message format, including the error response in the even there is an error.

<table>
<tr><th></th><th>Byte Data</th><th>No Of Bytes</th><th>Description</th></tr>
<tr><td rowspan="5">Command</td><td>0x64</td><td>1</td><td>Slave address 100</td></tr>
<tr><td>0x03</td><td>1</td><td>Function code for read register</td></tr>
<tr><td>0x0000</td><td>2</td><td>Starting register (0x0000 is X axis angle)</td></tr>
<tr><td>0x0002</td><td>2</td><td>Number of registers to read</td></tr>
<tr><td>0xCDFE</td><td>2</td><td>CRC-16 of all bytes</td></tr>
<tr><td rowspan="6">Response</td><td>0x64</td><td>1</td><td>Slave address 100</td></tr>
<tr><td>0x03</td><td>1</td><td>Function code for read register</td></tr>
<tr><td>0x04</td><td>1</td><td>Byte count (2 x number of regsiters)</td></tr>
<tr><td>0x0000</td><td>2</td><td rowspan="2">First and second register data :
0x0000A69C = 42652 (decimal)</td></tr>
<tr><td>0xA69C</td><td>2</td></tr>
<tr><td>0xB4FC</td><td>2</td><td>CRC-16 of all bytes</td></tr>
<tr><td rowspan="4">Error Response</td><td>0x64</td><td>1</td><td>Slave address 100</td></tr>
<tr><td>0x83</td><td>1</td><td>ModBus error function code</td></tr>
<tr><td>0x01</td><td>1</td><td>Exception Code (0x01 invalid function code, 0x02 invalid register address)</td></tr>
<tr><td>0x90EF</td><td>2</td><td>CRC-16 of all bytes</td></tr>
</table>

Writing to a Holding Register

Data can be written to some registers, such as the registers that store the filter indexes for each axis frequency response. Function code 0x06 is used to write these registers as detailed below.

	Byte Data	No Of Bytes	Description
Command	0x64	1	Slave address 100
	0x06	1	Function code for write register
	0x0009	2	Register to write (0x0009 is axis filter)
	0x0003	2	Data to write (16 bit). 0x0003 = 0.5Hz
	0x103C	2	CRC-16 of all bytes

Response (same as command)	0x64	1	Slave address 100
	0x06	1	Function code for write register
	0x0009	2	Register to write (0x0009 is axis filter)
	0x0003	2	Data to write (16 bit). 0x0003 = 0.5Hz
	0x103C	2	CRC-16 of all bytes

Error Response	0x64	1	Slave address 100
	0x83	1	ModBus error function code
	0x01	1	Exception Code (0x01 invalid function code, 0x02 invalid register address, 0x03 parameter out of range)
	0x90EF	2	CRC-16 of all bytes

Changing the BAUD Rate

The BAUD rate of the device can be changed using the special function code 0x6E and special command code 0x8F.

	Byte Data	No Of Bytes	Description
Command	0x64	1	Slave address 100
	0x6E	1	Function code - 0x6E
	0x8F	1	LD command - 0x8F = set baud
	0x03	1	1 = 2400
			2 = 4800
			3 = 9600
			4 = 19200
			5 = 38400
			6 = 57600
			7 = 115200
	0x5AF8	2	CRC-16 of all bytes

Changing the Device Address

The Address of the device can be changed using the special function code 0x6E and special command code 0x91. The device will reply with the original address in the response, and will change internally after the response has been sent.

	Byte Data	No Of Bytes	Description
Command	0x64	1	Slave address 100
	0x6E	1	Function code - 0x6e
	0x91	1	LD command - 0x91 = change address
	0x01	1	New Address = 1
	0xD299	2	CRC-16 of all bytes

Response	0x64	1	Slave address 100
	0x6E	1	Function code - 0x6e
	0x91	1	LD command - 0x91 = change address
	0x00	1	0 = success 1 = failed
	0x1359	2	CRC-16 of all bytes

Examples of Reading Angle

Example 1: Read the angle from the sensor X axis with address 100 (0x64):

Command

```
address (0x64 = 100 decimal)
|  function code
|  |  starting reg. to read (0x0000)
|  |  |     number of reg. to read (0x0002)
|  |  |     |
|  |  |     |     CRC-16
|  |  |     |     |
64 03 00 00 00 02 cd fe
```

Response (positive angle)

```
address (0x64 = 100 decimal)
|  function code
|  |  byte count
|  |  |  angle (0x0000a69c = 42652 decimal (42.652 degrees)
|  |  |  |           CRC-16
|  |  |  |           |
64 03 04 00 00 a6 9c b4 fc
```

Response (negative angle)

```
address (0x64 = 100 decimal)
|  function code
|  |  byte count
|  |  |  angle (0xfffda7d7 = -153641 decimal (-153.641 degrees)
|  |  |  |           CRC-16
|  |  |  |           |
64 03 04 ff fd a7 d7 54 bf
```

Example 2: Read the angle from the Y axis with address 100 (0x64):

Command

```
address (0x64 = 100 decimal)
|  function code
|  |  starting reg. to read (0x0002)
|  |  |     number of reg. to read (0x0002)
|  |  |     |
|  |  |     |     CRC-16
|  |  |     |     |
64 03 00 02 00 02 6c 3e
```

Response (positive angle)

```
address (0x64 = 100 decimal)
|  function code
|  |  byte count
|  |  |  angle (0x00005ba3 = 23459 decimal (23.459 degrees)
|  |  |  |           CRC-16
|  |  |  |           |
64 03 04 00 00 5b a3 b4 7c
```

Response (negative angle)

```
address (0x64 = 100 decimal)
|  function code
|  |  byte count
|  |  |  angle (0xffffa54d = -23219 decimal (-23.219 degrees)
|  |  |  |           CRC-16
|  |  |  |           |
64 03 04 ff ff a5 4d 74 74
```

Example 3: Change the frequency response to 0.5Hz:

Command

```
address (0x64 = 100 decimal)
|  function code
|  |  register to write to (0x0009)
|  |  |     data to write (0x0003 = 0.5Hz)
|  |  |     |
|  |  |     |     CRC-16
|  |  |     |     |
64 06 00 09 00 03 10 3c
```

Response

```
address (0x64 = 100 decimal)
|  function code
|  |  register written to (0x0009)
|  |  |     data written (0x0003 = 0.5Hz)
|  |  |     |
|  |  |     |     CRC-16
|  |  |     |     |
64 06 00 09 00 03 10 3c
```

Example 4: Setting the tare function (current position to zero):

Command

```
address (0x64 = 100 decimal)
|  function code
|  |  register to write to (0x0014)
|  |  |     data to write (0x0001 = set tare on)
|  |  |     |
|  |  |     |     CRC-16
|  |  |     |     |
64 06 00 14 00 01 01 fb
```

Response

```
address (0x64 = 100 decimal)
|  function code
|  |  register written to (0x0014)
|  |  |     data written (0x0001 = set tare on)
|  |  |     |
|  |  |     |     CRC-16
|  |  |     |     |
64 06 00 14 00 01 01 fb
```

Example 5: Change the device address from 100 to 1:

Command

```
address (0x64 = 100 decimal)
|  special function code
|  |  LD command for change address
|  |  |  new address (0x01)
|  |  |  |
|  |  |  |  CRC-16
|  |  |  |  |
64 6e 91 01 d2 99
```

Response

```
address (0x64 = 100 decimal)
|  special function code
|  |  LD command for change address
|  |  |  Success/Fail (0x00 = success)
|  |  |  |
|  |  |  |  CRC-16
|  |  |  |  |
64 6e 91 00 13 59
```