level developments

VSM : Vial Sensor Module, 0.1" Resolution, Linear Image

Features

- Ultra high precision levelling sensor
- Resolution less than 0.1 arc seconds
- Extremely low temperature drift (<0.5" per °C)
- Highly stable over time (<1" in one year)
- Measurement range ±10 arc minutes
- On board processor with digital UART interface
- Highly compact design with simple mounting arrangement.
- Self levelling performance <2 arc second
- 20 frames per second sample rate at full power with low power and sleep functions.

Description

The VSM sensor combines a precision ground glass bubble vial with a high resolution linear image sensor and all of the supporting electronics to give a digital output of the angular and level position. The bubble vials are manufactured in our UK facility to world leading standards to give the highest resolution and best stability over time and temperature. These modules are aimed primarily at the self-levelling precision laser level market. The module can mount to the laser block to provide feedback of tilt and level to the self levelling control system. With a measurement resolution of <0.1 arc seconds, and temperature stability of <0.5 arc seconds per °C, the price/performance ration of this product is unparalleled. Flexible power control options and output interfaces make it simple to integrate into any relevant application. They are manufactured, calibrated and tested in our UK factory to guarantee performance to the stated specification.

General Specifications

Parameter	Value	Unit	Notes
Supply Voltage **5V Version** **3.3V Version**	 5 3.3	V dc	The VSM can accept a 5V input using Pin 8 or a 3.3V input using pin 6, please see page 5 for pin out information.
Operating Current **Power Down** **10Hz** **20Hz**	 <0.5 15 31	mA	Power varies depending on operating mode and operating speed. Device needs 30ms after power up before new reading can be taken.
Operating Temperature	-20 to 65	°C	Maximum operating temperature range.
Storage Temperature	-40 to 85	°C	Maximum storage temperature range.
UART Output Rate	38.4	Kbps	Can be factory configured to other standard values on request
UART Data Format	38.4, 8,1,N		1 start bit, 8 data bits, 1 stop bit, no parity
Stabilisation time	2	s	This is the time it takes for the bubble position to stabilise after a 1 arc minute step to within 1 arc second of the final position (at 20°C)
Mechanical shock	5000	G	Shock survival limit 5000G for 0.5ms
Weight	10	g	Not including cable
Connection pins	8		0.5mm pitch 8 pin FFC

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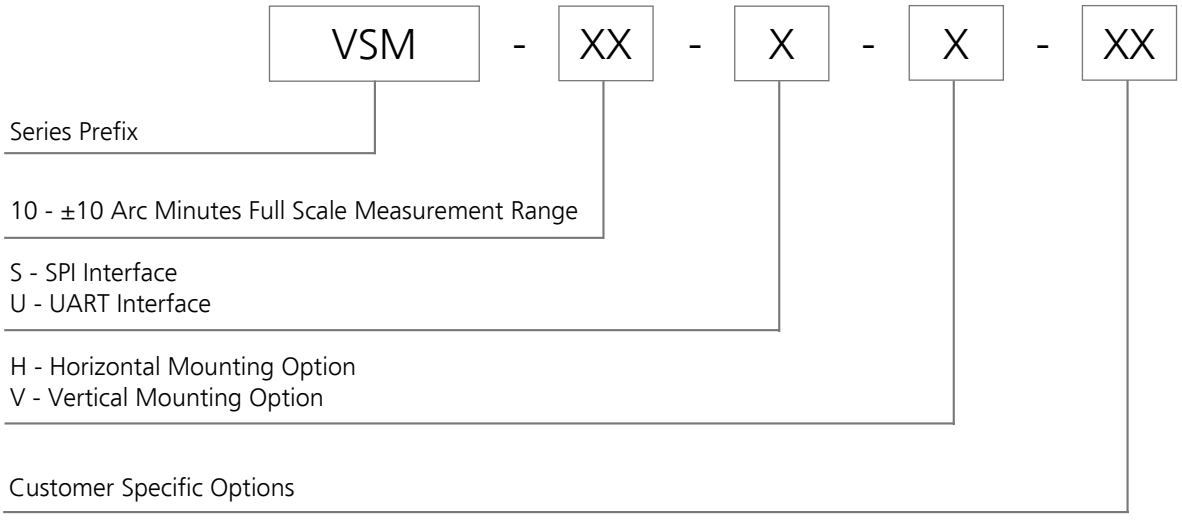
Performance Specifications

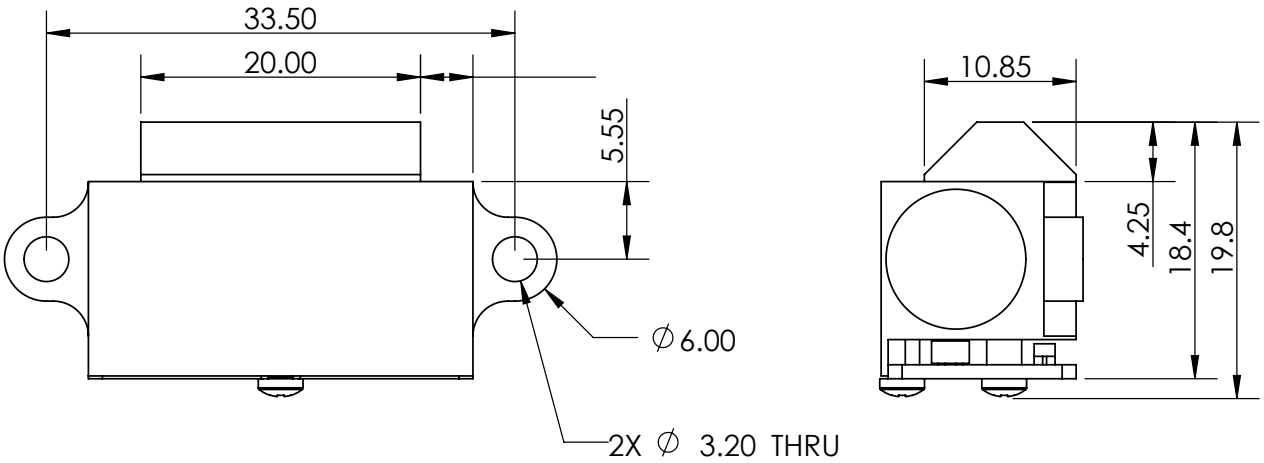
Parameter	Value	Unit
Measurement Range (Linear)	±7.5	' (arc minutes)
Measurement Range (Non-Linear)	±10	' (arc minutes)
Resolution	0.1	" (arc seconds)
Temperature Drift	<0.5	"/°C (arc seconds per °C)
Accuracy (Sensitivity Tolerance)	±15	%
Zero Bias Error	±3	' (arc minutes)
Long Term Stability	<1	" (arc seconds)

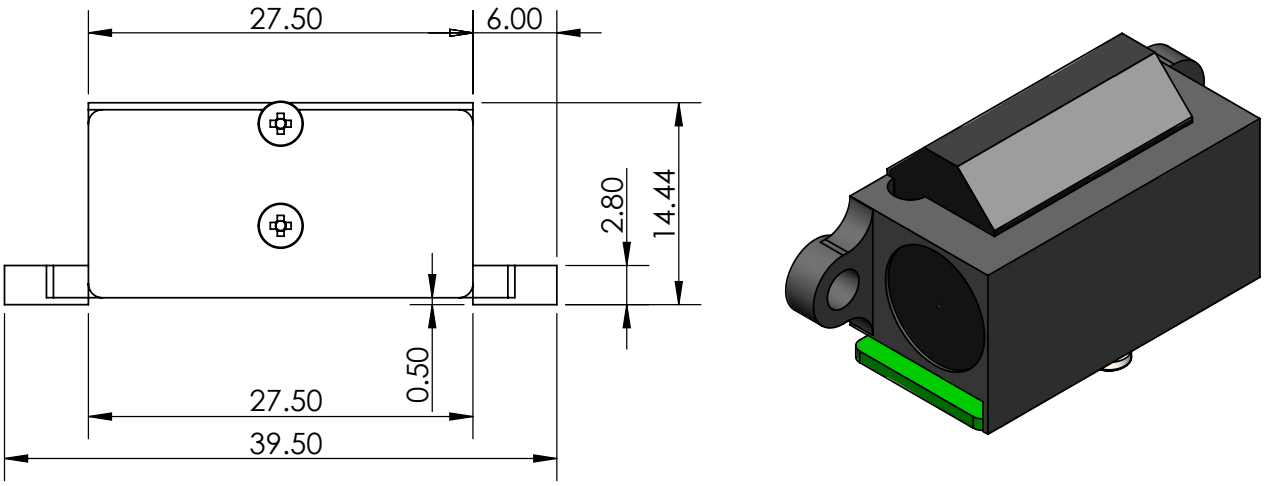
Parameter	Notes
Measurement Range	Defines the linear measurement range of the sensor.
Resolution	The resolution of the device is the smallest measurable change in output.
Temperature Drift	When the sensor is in the null position (i.e. the bubble position is central to the linear array sensor) this is the maximum drift in position that will occur due to a change in temperature throughout the operating temperature range.
Accuracy (Sensitivity Tolerance)	This is the maximum error between the measured and displayed value at any point in the linear measurement range.
Zero Bias Error	If the sensor is mounted in the absolute horizontal axis (with respect to the aluminium housing), the sensor output at this position is the zero bias error. This is made from a combination of the vials parallelism and the mounting parallelism and centricity in the housing.
Long term stability	The maximum change in zero bias of the device when used in normal operating conditions over a 1 year period.

Part Numbering



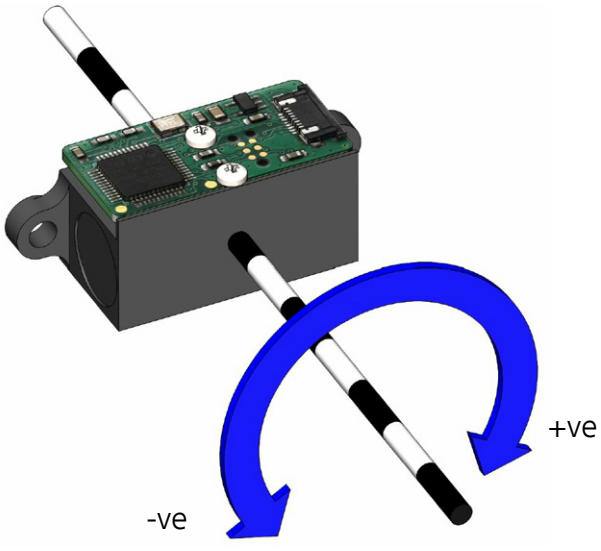
Vertical Mounting Option - Housing Drawing



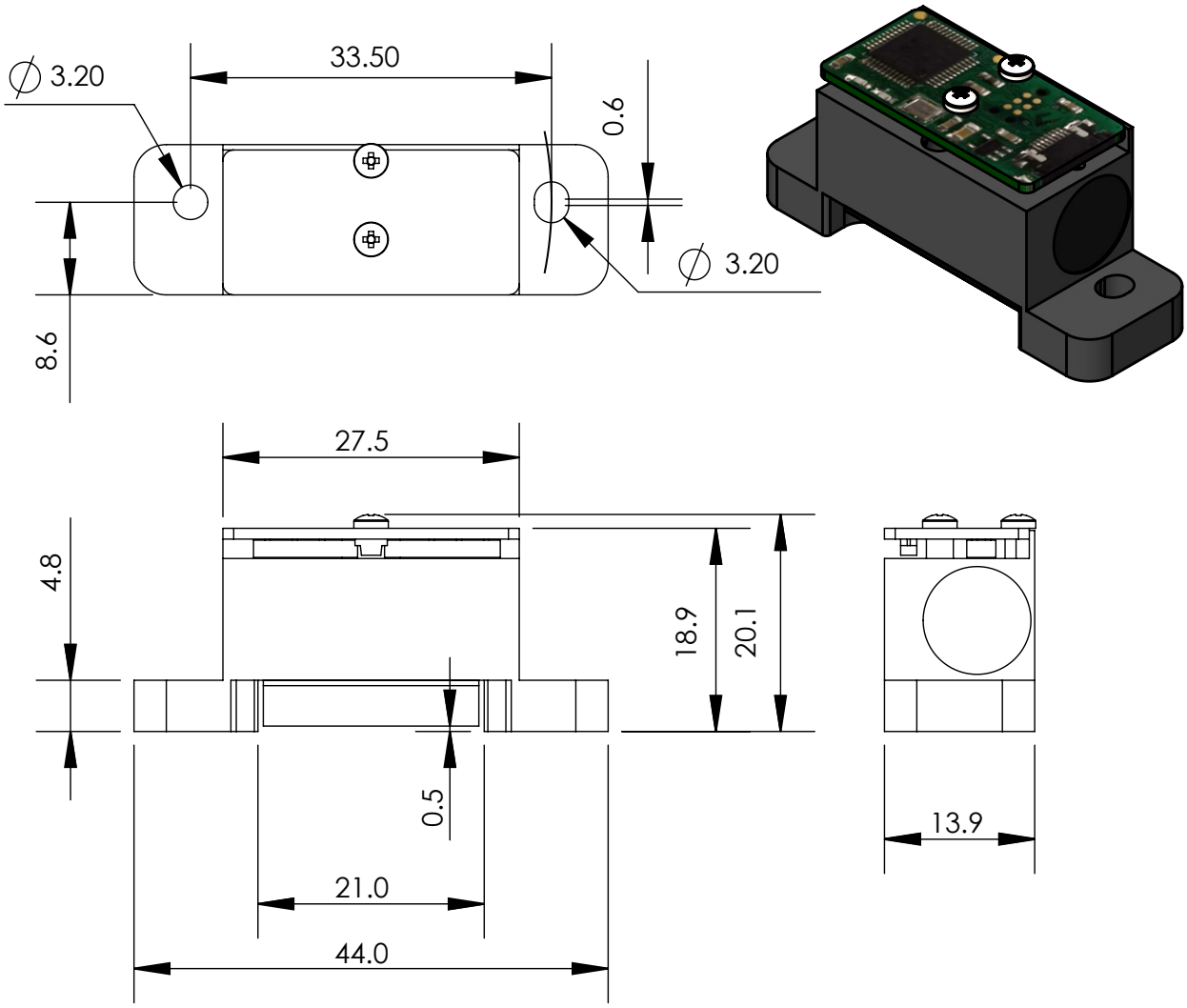


Vertical Mounting Option - Axis Direction and Mounting Orientation

Mounted on Vertical Surface

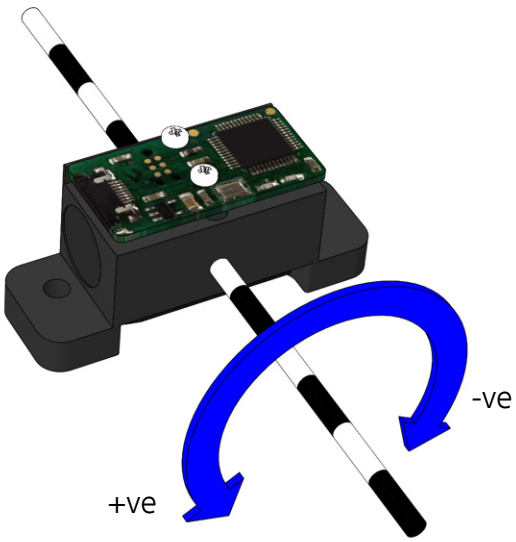


Horizontal Mounting Option - Housing Drawing

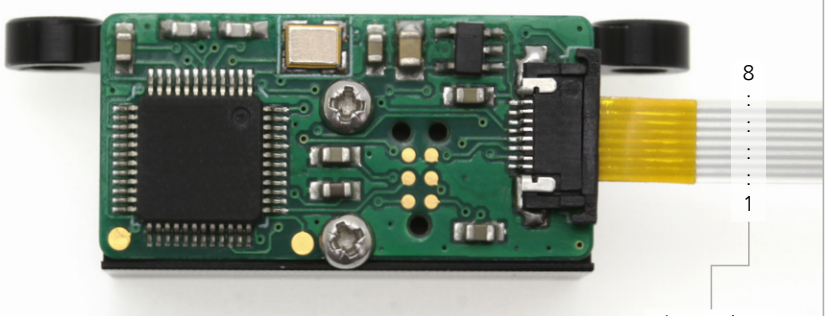


Horizontal Mounting Option - Axis Direction and Mounting Orientation

Mounted on Horizontal Surface



Connection details



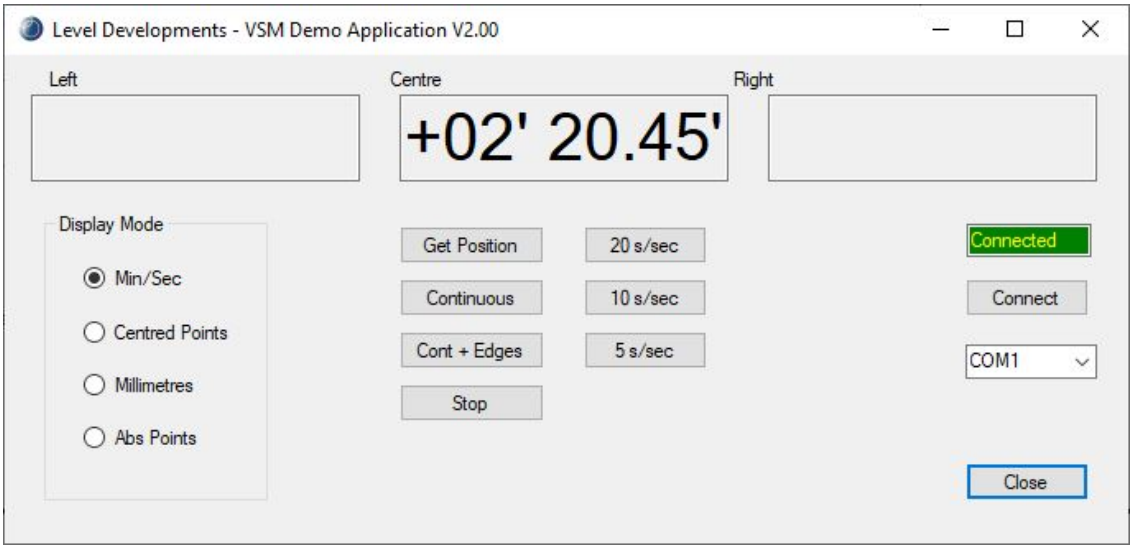
Supply should be either 3.3V or 5V, not both.
Signal levels on UART pins MUST NOT exceed 3.3V

Pin	Function
8	5V
7	0V
6	3.3V
5	Do Not Connect
4	Do Not Connect
3	Do Not Connect
2	UART Rxd
1	UART Txd

Software

A sample application compatible with Windows 7, 8, and 10 32 or 64-it systems is available free of charge. Note that the application requires version 3.5 or higher of the Microsoft .net framework that can be downloaded free of charge from Microsoft if required. Connection to the VSM must only be made using a serial interface presenting low voltage (UART) signal levels, connection of the VSM to a standard serial port will cause irreversible damage to the VSM. The Maximum UART signal level allowed is 3.3V.

- Reading of bubble centre and edge positions
- Change measurement units
- Adjustment of sample rate



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UART Command Set

Data is transmitted and received over a 3.3V UART interface 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. Voltages above 3.3V will damage the device.
The commands are all single byte commands to which the VSM will act and respond in ASCII format according to the table below:

Command	Description	Response Length	Response
S	Returns a one-time response of the bubble position in arc seconds x10. The ASCII readable response includes the original Command ('S') the bubble centre position (6 bytes), followed by a new-line (<LF>) character.	8 bytes	S[CCCCCC]<LF>
T	Returns a continuous response of the bubble position in arc seconds x 10 at the sample rate set using the commands below. The ASCII readable response includes the original Command ('T'), the bubble centre position (6 bytes), followed by a new-line (<LF>) character.	8 bytes	T[CCCCCC]<LF>
A	Returns a one-time response of the bubble position with pixels x 100. The ASCII readable response includes the original Command ('A') the bubble left position (6 bytes), centre position (6 bytes), right position (6 bytes) followed by a new-line (<LF>) character. Can be sent during continuous output mode.	20 bytes	A[LLLLLLCCCCCCRRRRRR]<LF>
B	Returns a continuous response of the bubble position with pixels x 100. The ASCII readable response includes the original Command ('B') the bubble left position (6 bytes), centre position (6 bytes), right position (6 bytes) followed by a new-line (<LF>) character.	20 bytes	B[LLLLLLCCCCCCRRRRRR]<LF>
C	Returns a one-time response of the bubbles centre point. The ASCII readable response includes the original Command ('C') the bubble centre position (6 bytes), followed by a new-line (<LF>) character.	8 bytes	C[CCCCCC]<LF>
D	Returns a one-time response of the bubble position with pixels x 100. The ASCII readable response includes the original Command ('D') the bubble left position (6 bytes), centre position (6 bytes), right position (6 bytes) followed by a new-line (<LF>) character. Will not respond to this command during continuous output mode.	20 bytes	D[LLLLLLCCCCCCRRRRRR]<LF>
E	Returns a continuous response of the bubble centre position at the sample rate set using the commands below. The ASCII readable response includes the original Command ('E'), the bubble centre position (6 bytes), followed by a new-line (<LF>) character.	8 bytes	E[CCCCCC]<LF>
F	Stop Continuous Transmission. The ASCII readable response includes the original Command ('F'), followed by a new-line (<LF>) character.	2 bytes	F<LF>
H	Returns a one time response of the firmware version number currently installed on the VSM unit. The ASCII readable response includes the original Command ('H'), VSM and the Firmware Version number, followed by a new line <LF> character.	12 bytes	H[VSM VX-XX]<LF>
J	Returns the 8 digit serial number registered to the device. The ASCII readable response includes the original Command ('J'), The 8 digit serial number, followed by a new line <LF> character.	10 bytes	J[XXXXXXXX]<LF>
2	Sets the internal sample rate to 20 samples per second. The ASCII readable response includes the original Command ('2') (1 byte), followed by a new-line (<LF>) character.	2 bytes	2<LF>
3	Sets the internal sample rate to 10 samples per second. The ASCII readable response includes the original Command ('2') (1 byte), followed by a new-line (<LF>) character.	2 bytes	3<LF>
4	Sets the internal sample rate to 5 samples per second. The ASCII readable response includes the original Command ('2') (1 byte), followed by a new-line (<LF>) character.	2 bytes	4<LF>
5	Sets the internal sample rate to 2 samples per second. The ASCII readable response includes the original Command ('2') (1 byte), followed by a new-line (<LF>) character.	2 bytes	5<LF>