VRS20 Radar Level Gauge
Operating Manual

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As part of our policy of continuous development, we reserve the right to alter, without prior notice, all specifications, designs, prices and conditions of supply for all our equipment.

Table of Contents

1. Introduction

This manual covers the basic specifications, deployment and maintenance procedures for the following products

- VRS20 Radar level gauge

1.1. Description

The VRS-20 is a pulsed k-band radar level sensor developed by Valeport to work seamlessly with Valeport's TideMaster and TideStations.

VRS-20 can be operated in a standalone mode, with optional telemetry systems or interfaced directly to a third party data logger or PC.

Versatile and simple to install, the VRS-20 addresses a number of the issues traditionally associated with level measurement. Non-contact technology removes the installation, corrosion & fouling issues of submerged sensors, while simplifying datum control. Accuracy and performance are unaffected by changes in water density and atmospheric conditions

1.2. Features

- Fully sealed, injection moulded housing rated to IP67 (NEMA 6) with PTFE window.
- Integral stainless steel mounting bracket with tool free, 2 axis adjustment.
- Integrated spirit bubbles for easy levelling.
- RS232/485 & SDI12 communications
- 9-28V DC power supply

1.3. Dimensions

Length:	255mm
Width:	130mm
Height:	130mm (75mm without mount)
Weight:	~2 kg

1.4. Specifications

Minimum Range:	0.8 m
Maximum Range:	20 m
Beam Angle:	±6°
Frequency:	25 GHz
Accuracy:	±10 mm
Precision:	1 mm

The VRS-20 operates in metres but can convert the output data to feet.

1.5. Approvals

The VRS20 radar sensor is fully compliant with:

ETSI EN 302 729-2 V1.1.2(2011-05) Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Level Probing Radar (LPR) equipment operating in the frequency ranges 6 GHz to 8,5 GHz, 24,05 GHz to 26,5 GHz, 57 GHz to 64 GHz, 75 GHz to 85 GHz;

For operation outside of closed vessels, the following conditions must be met:

- The installation must be carried out by trained qualified personnel
- The instrument must be stationary mounted and the antenna directed vertically downward
- The mounting location must be at least 4 km away from the radio astronomy stations listed in the supplement, unless special permission was granted by the responsible national approval authority
- When installed within 4 to 40 km of one of the radio astronomy stations listed in the table below the instrument must not be mounted higher than 15 m above the ground.

Table C.1: List of radio astronomy sites exclusion zones

Country	Name of the station	Geographic Latitude	Geographic Longitude	Frequency Band
Finland	Metsähovi	60°13'04" N	24°23'37" E	A, B and C
	Tuorla	60°24'56" N	22°26'31" E	A and B
France	Plateau de Bure	44°38'01" N	05°54'26" E	B and C
Germany	Effelsberg	50°31'32" N	06°53'00" E	A, B and C
Hungary	Penc	47°47'22" N	19°16'53" E	B
Italy	Medicina	44°31'14" N	11°38'49" E	B
	Noto	36°52'34" N	14°59'21" E	B
	Sardinia	39°29'50" N	09°14'40"E	A, B and C
Latvia	Ventspils	57°33'12" N	21°51'17" E	B
Poland	Kraków - Fort Skala	50°03'18" N	19°49'36" E	B
	Toruń - Piwnice	52°54'48" N	18°33'30" E	A
Russia	Badari	51°45'27"N	102°13'16"E	A
	Dmitrov	56°26'00" N	37°27'00" E	B
	Kalyazin	57°13'22" N	37°54'01" E	B
	Pushchino	54°49'00" N	37°40'00" E	B
	Zelenchukskaya	43°49'53" N	41°35'32" E	A and B
	Svetloe	61°05'00"N	29°46'54"E	A
Spain	Yebes	40°31'27" N	03°05'22" W	B and C
	Robledo	40°25'38" N	04°14'57" W	B
	Pico Veleta	37°03'58" N	03°23'34" W	C
Switzerland	Bleien	47°20'26" N	08°06'44" E	B
Sweden	Onsala	57°23'45" N	11°55'35" E	A, B and C
The Netherlands	Westerbork	52°55'01" N	06°36'15" E	A
Turkey	Kayseri	38°59'45" N	36°17'58" E	A
UK	Cambridge	52°09'59" N	00°02'20" E	B
	Darnhall	53°09'22" N	02°32'03" W	B
	Jodrell Bank	53°14'10" N	02°18'26" W	A and B
	Knockin	52°47'24" N	02°59'45" W	B
	Pickmere	53°17'18" N	02°26'38" W	B

Band A: 6 GHz to 8,5 GHz
Band B: 24,05 GHz to 26,5 GHz
Band C: 75 GHz to 85 GHz

2. Installation

The basic mounting requirements for the VRS-20 are a sturdy, stable surface or boom that does not experience any significant vertical movement. The surface does not necessarily need to be level as the VRS-20 mounting bracket features two axis adjustment.

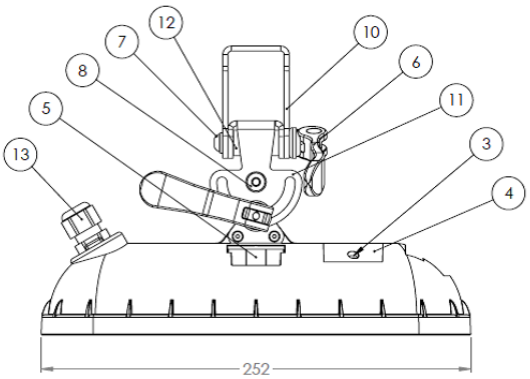
The VRS-20 must have a clear view of the water surface throughout the expected working range with no obstructions or fixed reflectors. The horizontal footprint of the radar is defined by the beam angle which is ±6 degrees. This approximates to a footprint radius of ~1/10th of the range.

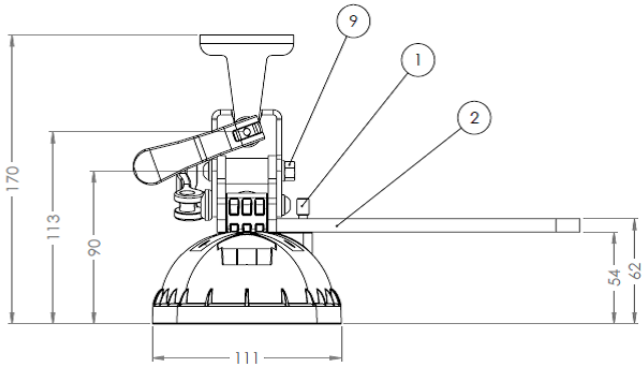
Range	Footprint Radius
1m	0.1m
5m	0.53m
10m	1.05m
15m	1.58m
20m	2.1m

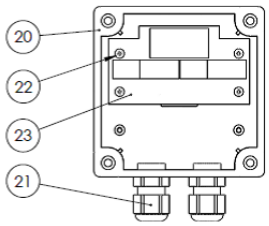
The vertical datum of the VRS-20 is the front face of the instrument and all ranges are measured from this point. With the input of a datum offset, the range values measured by the VRS-20 can be transformed to a height value.

2.1. Tool requirements

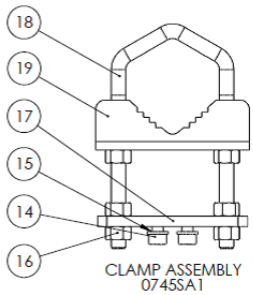
Sim Module Cover (Telemetry Units Only):	2mm hex key
Radar Mount	4mm hex key
Scaffold Clamp	13mm A/F Spanner
Junction Box	1 to 2.5mm flat bladed screwdriver – to release the terminal clamps 19mm A/F Spanner – to close the cable glands 5 to 6mm flat bladed screwdriver – for the fasteners in the junction box lid







JUNCTION BOX ASSEMBLY
0745EA1



CLAMP ASSEMBLY
0745SA1

ITEM NO.	PART NUMBER	DESCRIPTION	QTY.
1	0745114	M4 Thumb Screw	1
2	0745086	Siting Antenna Bracket	1
3	M3X6BNSKA4	M3 x 6 Socket Button Screw	2
4	0745087	Sim Module Cover	1
5	0745MS3	A32 Spirit Vial	2
6	0745MS4	M6 Cam Lever (Female)	2
7	M6X60BNSKA4	M6 x 60 Socket Button Screw	1
8	M6X50BNSKA4	M6 x 50 Socket Button Screw	1
9	NUM6DBA4	M6 Dome Nut	1
10	0745101	UJ Part 2	1
11	0745100	UJ Part 1	1
12	0745102	UJ Spacer	2
13	GLM16DB1	M16x1.5 Cable Gland	1
14	M6X10CPSKA4	M6 x 10 Socket Cap Screw	4
15	WAM6SPA4	M6 Spring Washer	4
16	NUM8FUA4	M8 Full Nut	12
17	0745104	Adaptor Plate	1
18	0745118	M8 x 55.5 U Bolt	2
19	0745117	Clamp Saddle	1
20	0745116	Junction Box	1
21	GLM16DB1	M16x1.5 Cable Gland	2
22	N046PH	6mm Self Tapping Screw	4
23	0745518	Junction Box Terminal Board	1

UNLESS OTHERWISE SPECIFIED:

SCALE	DIMENSIONS ARE IN MILLIMETERS	TOLERANCES				
1:2	SURFACE FINISH: N8 (Ra 3.2)	0<10	10<50	50<150	150<400	>400
	DEBUR AND BREAK SHARP EDGES	±0,05	±0,10	±0,20	±0,25	±0,5

DESCRIPTION: VRS-20 RADAR ASSEMBLY

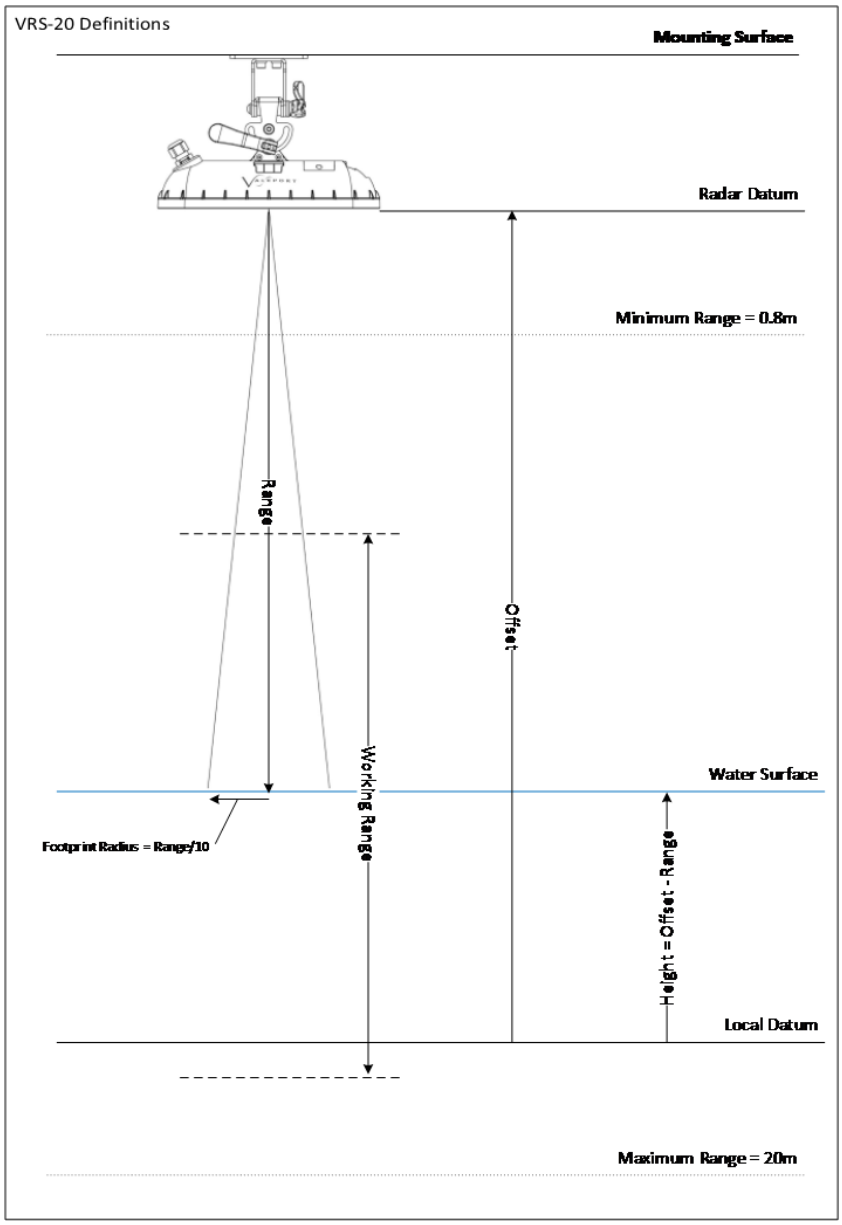
MATERIAL	FILE NAME	REVISION
VARIOUS	0745057	J

ASSOCIATED ASSEMBLY DRAWING

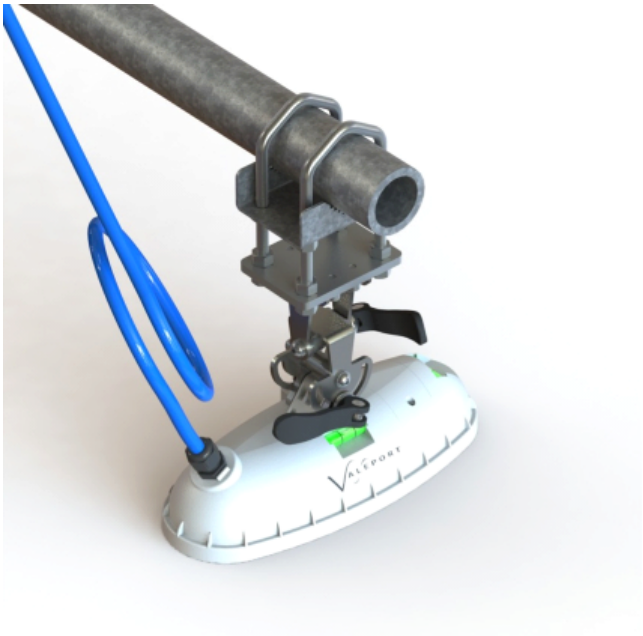
OR	BU	
DRAWN	SH	29/06/2012
CHECKED		
APPROVED		
MANUFACTURED		
INSPECTED		

DO NOT SCALE DRAWING — BS 8888

ISO VIEW



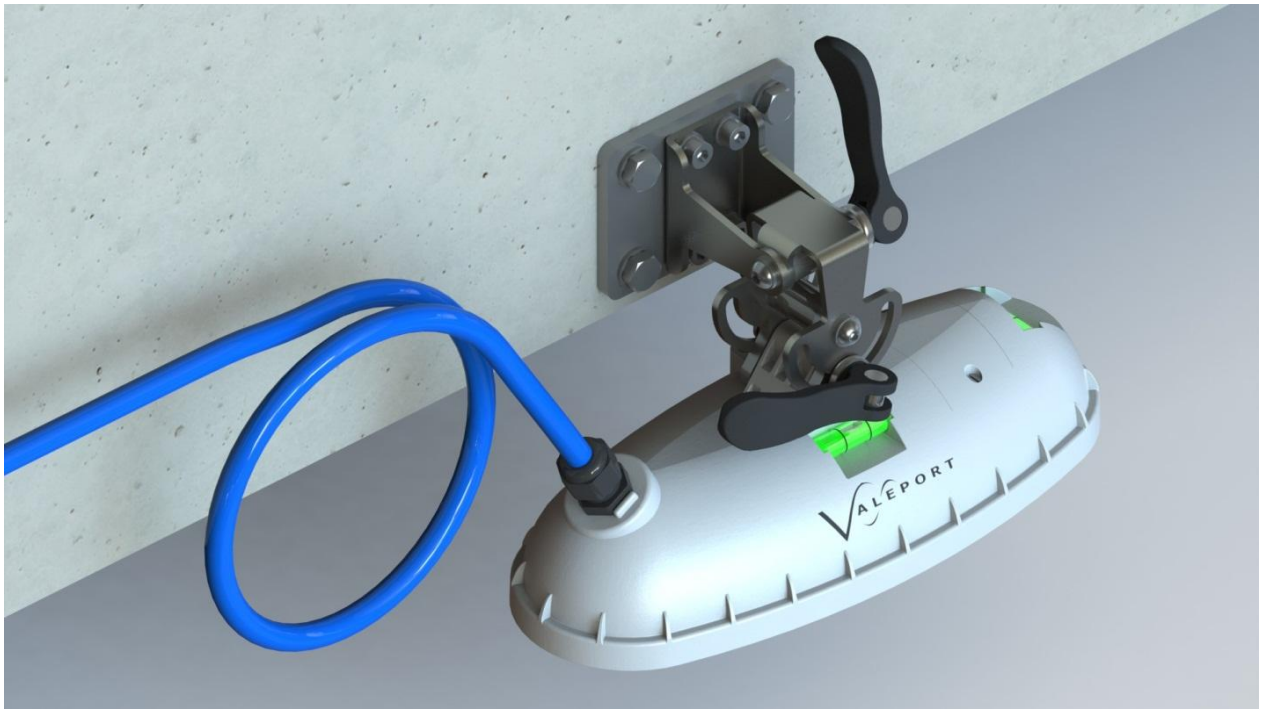
2.2. Mounting on a Boom



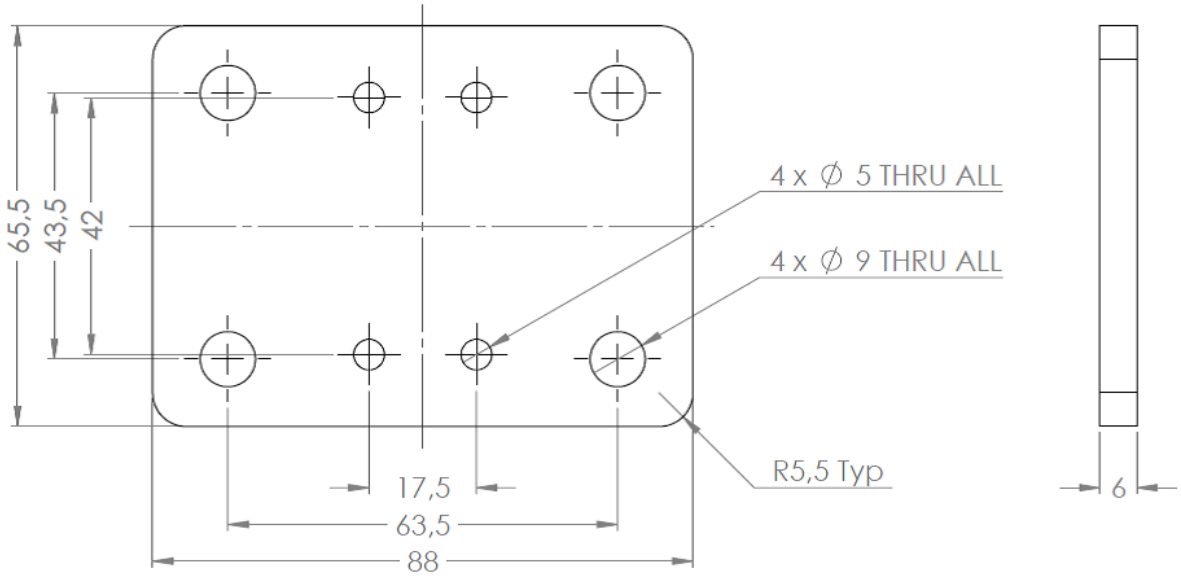
The radar is supplied with a stainless steel clamp (as pictured) for attaching to railings/scaffold poles.

Constructed from standard scaffolding parts and attached to existing railing structure:

2.3. Direct Mounting



The clamp can be removed and the stainless steel adaptor plate fitted directly to a mounting surface if required. The diagram below gives the dimensions of the adaptor plate in millimetres.



2.4. Levelling

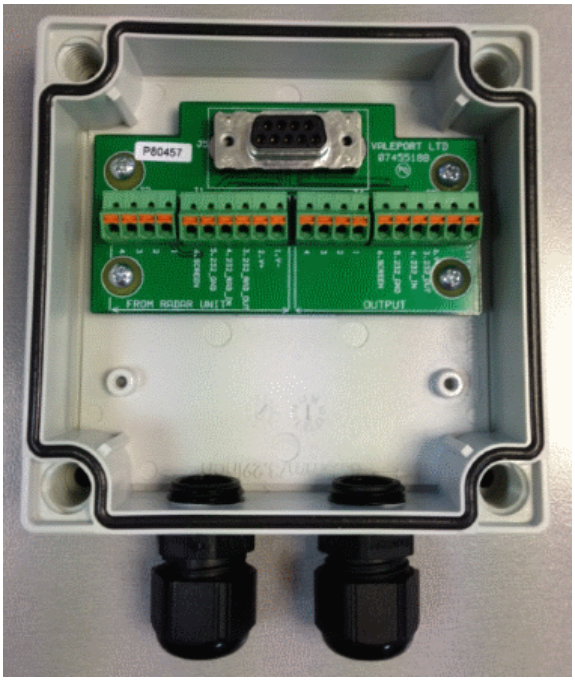
The VRS-20 needs to be parallel to the water surface for reliable and consistent operation. To aid this, the sensor has been fitted with two bubble levels. Once the clamp or mounting bracket is firmly fixed to the mounting surface the two axis adjustment on the bracket can be adjusted until the VRS-20 is level.

2.5. Wiring

The VRS-20 is supplied as standard with a 5m cable (Other lengths are available on request). The cable is glanded into the VRS-20 at the sensor end, and issued as unterminated cable at the other end. This is to allow easy routing of the cable through walls/bulkheads etc.

2.5.1. Junction box

The cable from the VRS-20 sensor terminates into a small junction box.



The bare cable from the VRS-20 should be passed through the cable gland and terminated in the push fit connectors with reference to the wiring schedule.

To insert the bare wires into the terminals, push in the orange tab in with a fine screwdriver and release to clamp the wire. Check the wire is securely clamped by pulling gently on the wire.

The output from the junction box will depend on the configuration of the VRS-20.

3. Communications

For use with the TideMaster, the VRS-20 will be set up via the TideMaster and TideMaster Express software. Please refer to the TideMaster manual

There should be no requirement to communicate directly with the VRS-20. If this is required then refer to the standalone VRS-20 instructions.

3.1. RS232 Communications

Direct communication with a standalone VRS-20 is via a terminal program such as Valeport Terminal or HyperTerminal. Details of the commands that can be manually sent and received are provided in the # Codes section.

A USB-Serial adapter is supplied with the unit for computers not fitted with a serial port.

Communication parameters are factory set to 115200 Baud, 8 data bits, 1 stop bit, no parity. The baud rate can be changed if required by # code.

Function	**Command**	**Options:**
Set Baud Rate	#051;Baud	300,600,1200,1200,4800,9600,14400,19200, 38400,57600,115200,128000,256000
Read Baud Rate	#053	

3.2. RS485 Communications

RS485 communication is enabled by grounding the comms select pin and then wiring the junction box accordingly (See Wiring Information section) for use with a suitable RS485 adaptor.

3.2.1. RS485 Address Mode

RS485 address mode is intended for use with multiple sensors active on a bus. Each sensor is given a unique ID and will only respond to commands prefaced with this address followed by a colon.

In Address Mode the unit will only work in Single Measurement Mode as detailed in section Single Mode

Function	**Command**	**Options:**
Set RS485 address	#162;xx	Where xx = RS485 address
Report R485 address	#163	
Set RS485 address mode	#100;12	
Exit RS485 address mode	NN:#100;9	NN is RS485 address Reverts to standard mode

For example a sensor on address 01 will only respond to commands prefaced with 01:

01:#003 will report the unit serial number
01:S030 will instruct the sensor to gather a 30s average
01:L will report the last recorded measurement

3.3. SDI12 Communications

All SDI-12 standard command (SDI-12 version 1.3) are implemented in the Valeport VRS20.

Please refer to http://www.sdi-12.org/specification.php for further detail. The SDI-12 conformance has been verified with the SDI-12 verifier from NR Systems, Inc.

There is no functionality via the SDI-12 interface to change VRS20 configuration so any configuration changes such as output units, sampling period or datum offsets must be made via the serial interface.

RS232/485 communications are possible while wired for SDI-12 but will interrupt any SDI-12 communications.

The VRS20 will output the following parameters in SDI12 mode:

D	Parameter	Default Units
0	Station ID	
1	Range (outlier removed	m
2	Level (outlier removed)	m
3	SD	m
4	Error Code	

The VRS20 supports the following SDI12 commands:

Code	Response	Description
a!	a<CR><LF>	Acknowledge Active Command a = sensor address default address = 0
aI!	allccccccccmmmmmmvvvxxx . . . xxx<CR><LF>	Send Identification Command a - the sensor address ll - the SDI-12 version number, indicating SDI-12 version compatibility; for example, version 1.3 is encoded as 13cccccccc - an 8 character vendor identification, usually a company name or its abbreviation mmmmmm - 6 characters specifying the sensor model number vvv - 3 characters specifying the sensor version xxx . . . xx - an optional field, up to 13 characters, used for a serial number or other specific sensor information that is not relevant for operation of the data recorder <CR><LF> - terminates the response
?!	a<CR><LF>	Address Query Command a = sensor address NB if more than one sensor is connected to the bus, all will respond to this command causing a bus contention.
aAb!	b<CR><LF>	Change Address Command

Code	Response	Description
		b - the address of the sensor (will equal the new address or the original address if the sensor is unable to change the address)
aM!	atttn<CR><LF> followed by a<CR><LF> after a delay of ttt seconds	Start Measurement Command a - the sensor address ttt - the specified time, in seconds, until the sensor will have the measurement(s) ready n - the number of measurement values the sensor will make and return in one or more subsequent D commands; n is a single digit integer with a valid range of 1 to 9
aMC!	atttn<CR><LF> followed by a<CR><LF> after a delay of ttt seconds	Start Measurement Command with CRC (Cyclic Redundancy Check) a - the sensor address ttt - the specified time, in seconds, until the sensor will have the measurement(s) ready n - the number of measurement values the sensor will make and return in one or more subsequent D commands; For the VRS20 n= 5 and value will return in positions D0 to D4 If using this command the response to aD0! command is extended by a CRC value
aD0! aD1! AD2! AD3! AD4!	a<ID value><CR><LF> a<Range Value><CR><LF> a<Level Value><CR><LF a<Range Standard Deviation><CR><LF> a<Status Code><CR><LF>	Send Data Command (after aM! Or aMC!) a - the sensor address <value> - data value in requested position <CRC> - if measurement was requested by aMC! command

4. Data

For operation with the TideMaster, data logging and formatting are controlled by the TideMaster. Please refer to the TideMaster manual.

4.1. Standalone Data Format

The Standard output format is a NMEA style output

$PVRS,ii,RR.RRR , LL.LLL,DD.DDD,U*xx

Where:

$PVRS0	=	Message Identifier
ii	=	Station ID (1-10)
RR.RRR	=	Range
LL.LLL	=	Level
DD.DDD	=	Standard Deviation
SSS	=	Status
U	=	Units (m for meters and f for feet)
*xx		the checksum data, always begins with *

Example:
$PVRS0,07,4.225,2.206,0.009,000,m*75
$PVRS0,07,4.219,2.212,0.013,000,m*75
$PVRS0,07,4.211,2.220,0.010,000,m*70
$PVRS0,07,4.197,2.234,0.009,000,m*71
$PVRS0,07,4.191,2.240,0.007,000,m*79

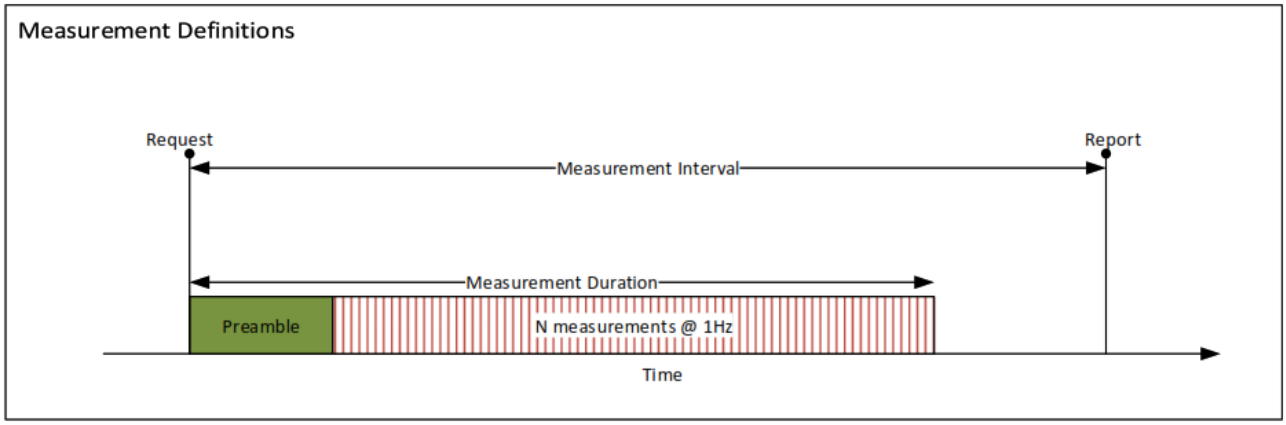
4.2. Data Status

An error code status of 000 is no reported errors.

Any error code outside of this list should be reported to Valeport Support support@valeport.co.uk

5. Sampling modes

5.1. Sampling Principles



The VRS-20 measurement follows this general pattern:

- Carry out pre-measurement checks (Preamble)
- Gather N samples at 1 Hz
- De-trend samples
- Calculate mean and standard deviation of samples
- Reject any samples >3 SD from mean value
- Recalculate mean and standard deviation.
- Report data

5.2. Operation with a TideMaster

When paired with a TideMaster the radar sampling pattern is chosen from a series of predefined modes. The measurement and timing is controlled by the TideMaster logger
The VRS20 is turned off between measurements to conserve power.

B1 Burst sampling pattern of 30 seconds / 1 minute
B2 Burst sampling pattern of 40 seconds / 6 minutes
B3 Burst sampling pattern of 40 seconds / 10 minutes
B4 Burst sampling pattern of 40 seconds / 15 minutes
B5 Burst sampling pattern of 60 seconds / 30 minutes

5.3. Stand Alone Operation

To operate the VRS20 as standalone sensor, i.e. connected to a non-Valeport logger or PC, the duration of data sampling, interval between measurement cycles and the sequence in which operations are carried out can be fully defined. The factory default setup is:

Measurement Cycle:

- Measurement interval = 60 seconds (use #204 to change)
- Measurement duration = 30 seconds + preamble time (use #128 to change)

Operational Sequence: (use #200 to change)

- Initial Operation at power on (or after the #028 command): Measure
- Operation after measure : Report
- Operation after report : Wait for Interval to end
- Operation after interval ends (and new interval starts): Measure

Before making any changes to the operational setup, it is important to read and fully understand the settings and how they affect the instrument and the data gathered. To return to factory default settings, interrupt the instrument and enter the following commands:

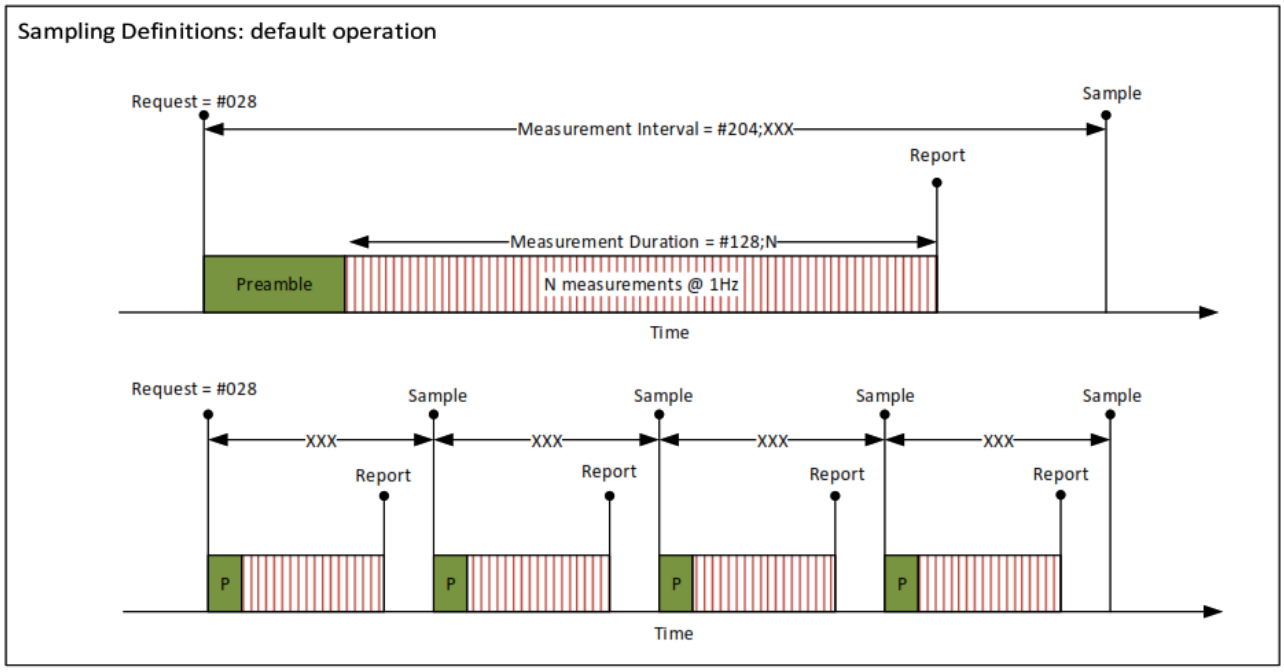
```
#204;60
#128;30
#200;1;3;1;2
```

When operating in standalone mode, the maximum interval between measurement cycles is one hour (3600s) and the maximum measurement duration is 6 minutes (360s).

The VRS20 does not have a low power sleep mode in the idle time between measurements. If power conservation is critical then the VRS20 will need to be turned off between measurement cycles by the controlling system. In this instance it is best to use the instrument in single mode (see Single Mode Section)

5.3.1. Measurement Interval and Duration

Measurement interval is defined as the elapsed period between the start and finish of measurement cycles. The measurement duration is defined as length of time data is gathered for within that cycle. The measurement interval must be set a value greater than the combined time taken for the pre-amble and measurement duration or the measurement duration will be truncated.



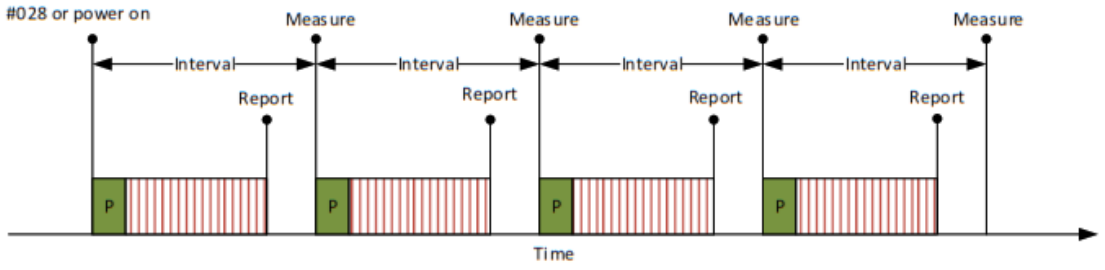
Function	Command	Options:
Set Measurement Duration	#128;nnn	nnn = duration of 1Hz measurements. Maximum Value = 360
Report Measurement Duration	#129	
Set measurement interval in seconds.	#204;xxx	xxx = Interval between measurement reports
Reports measurement interval in seconds.	#205	

5.3.2. Operational Sequence

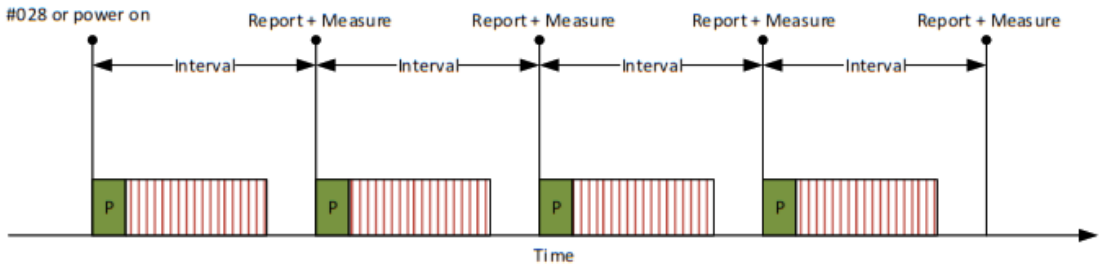
The operational sequence of the instrument can be configured to suit the requirement of the application. Examples are given below of common operating sequences and the commands required to set them up:

Operational Sequence examples:

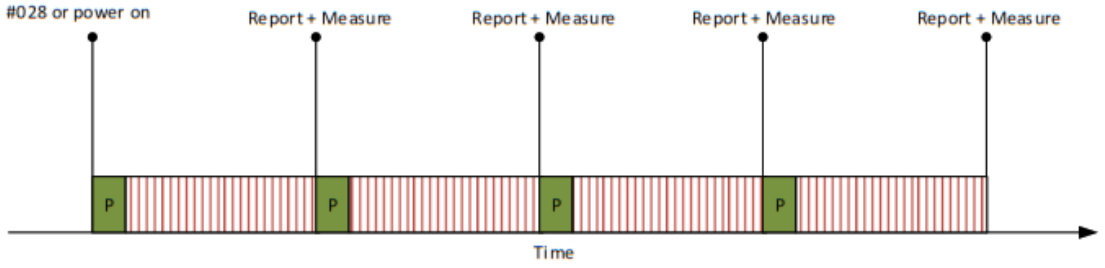
#200;1;2;3;1 gives: measurement -> report ->wait for interval ->.....-> measurement -> report ->wait for interval .....



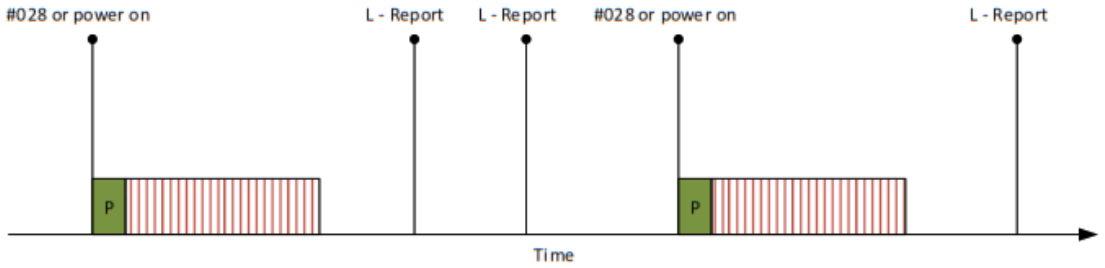
#200;1;3;1;2 gives: measurement ->wait for interval -> report -> .....-> measurement ->wait for interval -> report .....



#200;1;2;1;1 gives: measurement -> report -> measurement -> report .....



#200;0;0;0;0 gives single measurement, no automatic report, last data requested by L command.



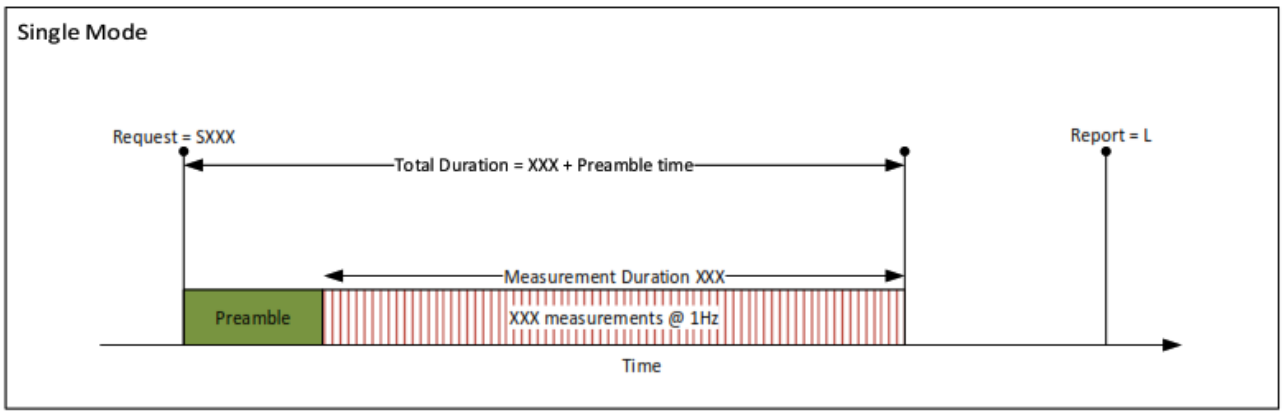
Function	Command	Options:
Set operational sequence	#200;a;b;c;d	Where: a: Initial Operation at power on (or after the M or #028 command) b: Operation after measure c: Operation after report d: Operation after interval ends Key operations or states: Operation type 0: Wait for command Operation type 1: Measure Operation type 2: Report (output data) Operation type 3: Wait for Time Interval to end (set by #204)
Report operational sequence	#201	

5.3.3. Single Mode

Single mode is only available in RS485 addressed mode

A single sample period can be requested using the SXXX command. This will gather the data but not report until requested.

The last measurement recorded can be requested using the L command. This can be done multiple times.



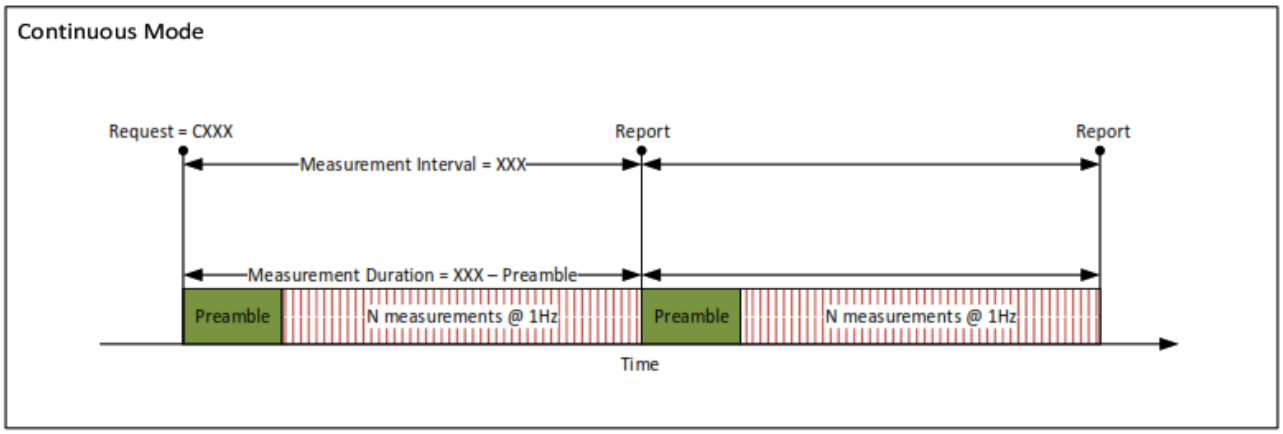
Function	Command	Options:
Run single sampling measure	NN:Sxxx	NN = RS485 address xxx = measurement duration NB. This does not include pre-amble time
Reports last recorded reading	NN:L	Only works in conjunction with Single mode

5.3.4. Continuous Mode

Continuous mode is not available in RS485 addressed mode

Continuous mode is designed for testing and evaluation use where a regular and ongoing level measurement is required. Only the interval between readings is defined and the radar calculates how much data can be gathered in this period taking the preamble into account. The radar will continue in this mode until interrupted or powered off.

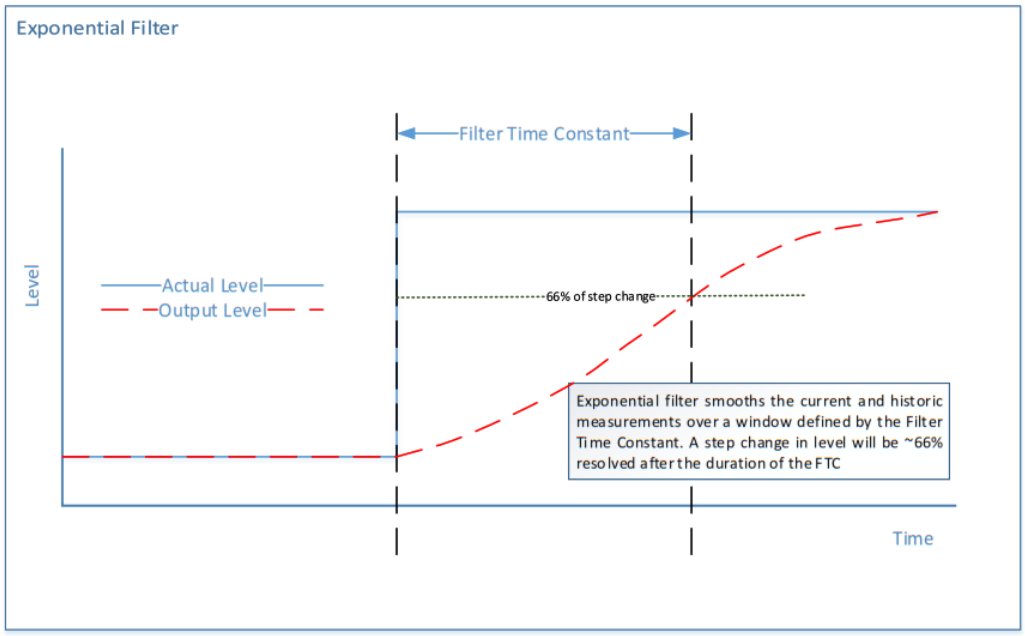
On power cycle it will revert to the default sampling pattern as defined by #204 & #128 (see section Single Mode)

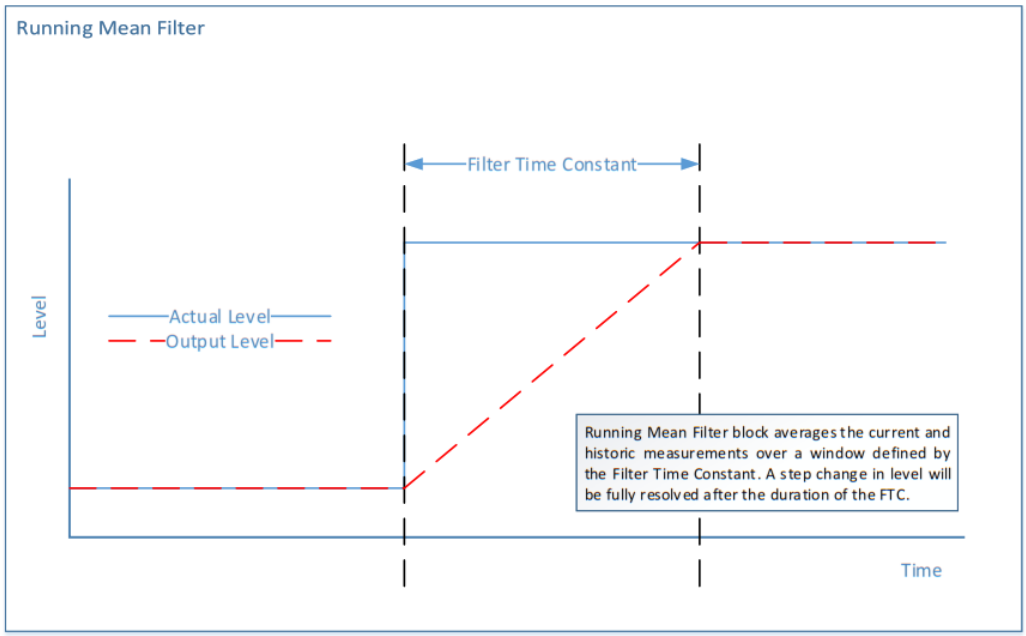


Function	Command	Options:
Runs continuous sampling measures	Cxxx	xxx = interval between start of each measurement.

5.3.5. Filtering and Smoothing

In addition to the simple averaging and outlier rejection carried out over a sampling period, exponential and running mean filters can be enabled to smooth the output of the VRS20. A filter time constant controls the amount of smoothing applied and how long the radar takes to recognise a step change. If the filter time constant is set to less than measurement interval the filters will have no effect.





Function	Command	Options:
Sets Filtering algorithm	#224;x	Where 0 = no filtering (default) 1 = Exponential 2 = Running Mean
Reports Filtering algorithm	#225	
Sets Filtering Time constant	#222;xxx	Where xxx = filter time constant in seconds.
Reports Filtering Time Constant	#223	

6. # codes

- All commands must be confirmed using “Carriage Return” or “Enter” on the keyboard, with the exception of the “Stop” command (#).
- All commands are echoed back by the instrument as they are typed

6.1. Stop Command

The instrument can be stopped when it is awake by sending the ‘#’ character (ASCII value 13). Once interrupted the instrument returns a ‘>’, and waits for a further command. If an incorrect command or syntax is entered the instrument will return an ERROR status.

If no command is received for 2 minutes then the unit will resume operation and return to its sampling pattern.

6.2. General Commands

Function	**Command**	**Notes:**
Report Serial Number	#003	N/A
Report Firmware Version	#031	N/A
Report Pre-amble time	#203	Pre-amble time is reported in seconds.
Report Default use protocol	#101	9 = standalone mode 10 = TideMaster mode 12 = RS485 Address mode
Set RS485 address	#162;xx	Where xx = RS485 address
Report R485 address	#163	

6.3. Setup Commands

Function	**Command**	**Notes:**
Set Valid Working Range	#106;min;max	Sets working range, Signals from a target outside working range will be ignored.
Report Valid Working Range	#107	
Set Station Identifier	#142;XXX	Sets numerical station identifier where XXX can be 0 to 256
Report Station Identifier	#143	
Set Output Units	#090;X;Y	X Set output units for range +height.

Function	Command	Notes:
		0 = Units in Metres 1 = Units in Feet Y Set time/date placeholder. 0 = No time/date 1 = Add time/date
Report Output Units	#091	
Set Datum Offset Value	#092;x.xxx	Sets offset value in currently configured units for transformation from Range to Height above Datum. NB datum value is reset to 20m or 65ft when units are changed with #090
Report Datum Offset Value	#093	

6.4. Sampling Commands

Function:	Command:	Notes:
Run instrument in last defined sampling scheme	#028	N/A
Run single sampling measure	Sxxx	xxx = total measurement time. NB. This does not include pre-amble time
Reports last recorded reading	L	Only works in conjunction with Single mode
Runs continuous sampling measures	Cxxx	xxx = interval between start of each measurement cycle.
Set Measurement Duration	#128;xxx	xxx = number of 1Hz measurements.
Report Measurement Duration	#129	
Set measurement interval in seconds.	#204;xxx	xxx = Interval between measurement reports
Reports measurement interval in seconds.	#205	
Sets Filtering algorithm	#224;x	Where 0 = no filtering (default) 1 = Exponential 2 = Running Mean

Function:	Command:	Notes:
		See section 5 for a description of the filtering options
Reports Filtering algorithm	#225	
Sets Filtering Time constant	#222;xxx	Where xxx = filter time constant in seconds.
Reports Filtering Time Constant	#223	

7. Wiring Information

7.1. Tidemaster

END 1: 0745518 PCB Into Radar Junction Box		END 2: 0745518 PCB Out of Radar Junction Box		END 3: UTS6JC10E7S TideMaster		END 4: D-TYPE For Setup		
CONNECTOR	**PIN**	**BOARD**	**PIN**	**CONNECTOR**	**PIN**	**CONNECTOR**	**PIN**	**FUNCTION**
J1 6Way Terminal block	1							POWER_GND
	2							POWER_IN
	3							RS232_OUT OF RADAR
	4							RS232_IN TO RADAR
	5							RS232_GND
	6							SCREEN
		J3 6Way Terminal block (Stripped & twisted end)	1	6Way UTS plug UTS6JC10E6P	B			POWER_GND
			2		A			POWER_IN
			3		D			RS232_OUT OF RADAR
			4		C			RS232_IN TO RADAR
			5		E			RS232_GND
			6		E			SCREEN
						9Way D-Type Plug	2	RS232_OUT OF RADAR
							3	RS232_IN TO RADAR
							1,5,6,8,9	RS232_GND
							SHELL	SCREEN

7.2. Stand Alone

END 1: FROM RADAR INTO JUNCTION BOX		END 2: OUT OF JUNCTION BOX			END 3: D-TYPE		
CONNECTOR	PIN	BOARD	CONNECTOR	PIN	CONNECTOR	PIN	FUNCTION
J1 6Way Terminal block Plug	1						POWER_GND
	2						POWER_IN
	3						RS232_OUT OF RADAR
	4						RS232_IN TO RADAR
	5						RS232_GND
	6						SCREEN
J2 4Way Terminal block Plug	1						COMMS_SEL
	2						SDI12
	3						RS485- (A)
	4						RS485+ (B)
		0745518 Junction Box PCB	J3 6Way Terminal block Plug	1			POWER_GND
				2			POWER_IN
				3			RS232_OUT OF RADAR
				4			RS232_IN TO RADAR
				5			RS232_GND
				6			SCREEN
			J4 4Way Terminal block Plug	1			COMMS_SEL
				2			SDI12
				3			RS485- (A)
				4			RS485+ (B)
					9Way D-Type Plug	2	RS232_OUT OF RADAR
						3	RS232_IN TO RADAR
						1,5,6,8,9	RS232_GND
						SHELL	SCREEN

The D-Type plug at End 3 is to be used only for the initial setup of the Radar unit. Ensure that Pin 3 & 4 are disconnected from J3 during this process to prevent any damage to the 232 port