VB2SX20SPS 20Hz GPS Speed Sensor

User Guide

Contents

EC Declaration of Conformity

We declare that this product has been tested to and meet the requirements of:

EC Directive 2004/104/EC

"Adapting to Technical Progress Council directive 72/245/EEC relating to the radio interference (Electromagnetic Compatibility) of vehicles and amending directive 70/156/EEC on the approximation of the laws of the member states relating to the type-approval of motor vehicles and their trailers."

And has also been assessed, via Technical Construction File, by an independent DTI Competent Body and found to be in conformance with the essential requirements of:

EC Directive 89/336/EEC (and amending directives)

"Council Directive of 03 May 1989 on the approximation of the laws of the member states relating to electromagnetic compatibility."

DTI Competent Body responsible for issuing certificate of compliance:

3C Test Ltd,
Silverstone Technology Park,
Silverstone,
Northants
NN12 8GX

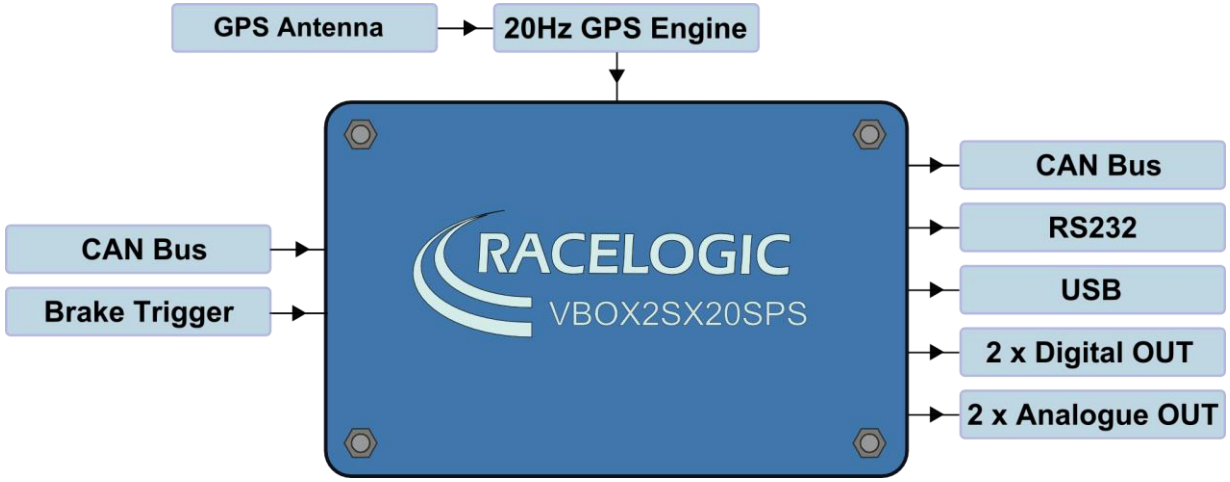
Introduction

The VB2SX20SPS represents the 2nd generation of GPS speed sensor system from Racelogic, updating the popular VBOXII speed sensor with USB communication and a built-in configuration panel with display. Using a powerful GPS engine, the VB2SX20SPS can sample GPS and other data at 20Hz. The data is transmitted via CAN bus, RS232 serial, analogue or digital outputs, for use with a variety of VBOX displays or third-party monitoring or logging equipment.

The VB2SX20SPS is compatible with the VBOX Multifunction Display (DSP03) and the VBOX LED Display (DSP02; older DSP02s may require a firmware upgrade). However, the VB2SX20SPS can not be used with VBOXTools for real-time monitoring of data; the VBOXTools software is supplied with this unit for configuration purposes only.

Features

- Non-contact 20Hz speed and distance measurement using GPS
- 1 x CAN Bus interface (on two sockets to allow daisy-chaining)
- USB interface for configuration and upgrading
- RS-232 serial interface for output to LED Display and for alternative configuration method
- 2 x 16bit user configurable analogue outputs
- 2 x digital outputs
- Brake trigger input with 210KHz scan rate
- Input voltage 6V to 30V operating range



Standard Inventory

Description	Qty	Racelogic Part #
VB2SX20SPS – 20Hz GPS Speed Sensor	1	VB2SX20SPS
USB Lead	1	RLCAB042
Analogue Output Cable	1	RLCAB008
Digital Output Cable	1	RLCAB009
2-Way LEMO to 3-Wire Un-terminated Power Cable	1	RLCAB014
5-Way LEMO to 9-Way “D” Connector CAN Cable	1	RLCAB019L
Padded Carrying Case	1	RLACS106
Magnetic GPS Aerial	1	RLVBACS018
CD ROM containing VBOXTools software	1	RLVBACS030
VBOXTools User Manual	1	VBTOOLSMANA5

Operation

Power

The VB2SX20SPS can be powered by connecting the LEMO end of the supplied RLVBCAB14 to the VBOX's POWER socket, and the un-terminated ends to any suitable power source. The maximum operating voltage input must not exceed 30V DC. Failure to observe this could result in damage to the VBOX.

Display Screen

The display screen will display velocity and satellite data when operating. It also displays all the menus required to configure the VB2SX20SPS via the front panel controls. The display screen also shows the unit's firmware version on start-up.

During normal operation, the display screen displays Speed (mph or km/h), as well as the number of satellites that the VB2SX20SPS has locked on to. There are also two satellite status displays and a DGPS status display.

OK (Green):
Indicates that the VB2SX20SPS has sufficient satellites locked to allow normal operation.

SATS (Yellow):
This flashes to indicate that the VB2SX20SPS has insufficient satellites and will not be able to operate at all.

WAAS/40cm (Orange):
This indicates that the corresponding DGPS corrections are available and being used by the unit. DGPS increases the absolute positional accuracy of the VB2SX20SPS, but has no affect on velocity or distance measurements unless the Kalman Filter is in use. 40cm positional accuracy is only available when used in conjunction with a DGPS basestation.

Front Panel Controls

The VB2SX20SPS can be configured using the front panel buttons, which enables configuration without the need for a computer.
From the main screen, press the'■' button to enter the configuration screen.
Once in the configuration screen, press the '◄'and '►' buttons to highlight the next or previous choice in any menu, and press '■' to select the highlighted option. Some menus contain sub-menus, for example the Analogue and Digital Output menus contain separate menus for each parameter.

MAIN MENU

UNITS	KALMAN FILTER	COLDSTART	DGPS MODE
Press'■' and then the '◄' and '►' buttons to change the displayed Velocity units. Then press '■' to confirm. KMH or MPH	Press'■' to enter the Kalman Filter Menu. In this menu the amount of filtering applied to the Velocity and Positional channels can be set between 0-4. Velocity must t be set to 0 for Brake stop tests	Press'■' to perform a GPS cold start	Press'■' to enter the DGPS Menu, then '◄' and '►' to move to the desired option. Then press '■' to confirm. Note that 20cm and 40cm options require access to a DGPS basestation, and 20cm also requires a paid upgrade to the VB2SX20SPS.

MAIN MENU cont'd

GPS OPTIMISATION	DIGITAL1 SETUP	DIGITAL1 SETUP	ANALOGUE1 SETUP	ANALOGUE2 SETUP	EXIT
Press'■' and then use the '◄' and '►' buttons to change the amount of smoothing applied to the Velocity Channel at source by the GPS engine. Then press '■' to confirm. This must be set to High Dynamics for brake stop tests. This option has previously been called "Velocity Smooth".	Press'■' to enter the setup menu for the Digital output Channel 1	Press'■' to enter the setup menu for the Digital output Channel 2	Press'■' to enter the setup menu for the Analogue output Channel 1	Press'■' to enter the setup menu for the Analogue output Channel 1	Press'■' to exit the setup menu and cause the settings to be saved in EEPROM

DIGITAL SETUP MENU (Digital 1 and Digital 2)

OUTPUT	VELOCITY PULSES PER METRE	VELOCITY MAX VELOCITY	LONG ACC / LAT ACC MAX VALUE	LONG ACC / LAT ACC MAX FREQUENCY
Press'■' and then use the '◀' and '▶' buttons to select from: Velocity Long ACC Lat ACC	Press'■' and then use the '◀' and '▶' buttons to set the number of pulses per metre. Then press '■' to confirm. 0.1-120 pulses per metre in 0.1 steps	Press'■' and then use the '◀' and '▶' buttons to set the level of the maximum Velocity. Then press '■' to confirm. 0-400km/h in 0.1km/h steps	Press'■' and then use the '◀' and '▶' buttons to set the level of the maximum Long ACC or Lat ACC level. Then press '■' to confirm. 0.5g to 2g in 0.1 g steps	Press'■' and then use the '◀' and '▶' buttons to set the frequency of the maximum Long ACC or Lat ACC level. Then press '■' to confirm. 1-50kHz in 0.1kHz steps

TEST	BACK
Press'■' and then use the '◀' and '▶' buttons to set a test value that the Digital output will simulate. Then press '■' to quit.	Press'■' to exit the digital setup menu and cause the settings to be saved in EEPROM

ANALOGUE SETUP MENU (Analogue 1 and Analogue 2)

OUTPUT	VALUE @ +5V	VALUE @ -5V (0V for Velocity)	TEST	BACK
Press'■' and then use the '◀' and '▶' buttons to select from: Velocity Long ACC Lat ACC	Press'■' and then use the '◀' and '▶' buttons to set the Velocity, Long ACC or Lat ACC level to represent +5V. Then press '■' to confirm. 1-400km/h in 1km/h steps, or -1g to 2g in 0.1 g steps	Press'■' and then use the '◀' and '▶' buttons to set the Velocity, Long ACC or Lat ACC to represent 0V (velocity) or -5V (Lat ACC & Long ACC). Then press '■' to confirm. 0-399km/h in 1km/h steps, or -2g to 1g in 0.1g steps	Press'■' and then use the '◀' and '▶' buttons to set a test value that the analogue output will simulate. Then press '■' to quit.	Press'■' to exit the analogue setup menu and cause the settings to be saved in EEPROM

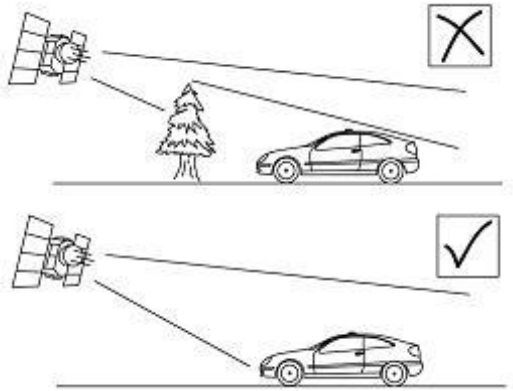
Smoothing and Filtering

Velocity: The VBSSX20SPS has three smoothing settings (Dynamic Modes) for velocity: High Dynamics, Normal and Low Dynamics. High dynamics has the least amount of smoothing and must be used for high dynamic tests where Time or Distance measurements are critical to the test, such as Brake stop and acceleration tests.

Kalman Filter: This filter provides filtering separately to the Velocity and Position channels (latitude, longitude and height). Note with any live filter routine more latency will occur if higher levels of filtering are used. Hence the Kalman Filter velocity settings should be set to zero for Brake stops and acceleration runs

GPS Antenna

The GPS Antenna supplied with the VB2SX20SPS is a 3.5v active antenna. For the best possible signal quality, it is important to maintain a clean connection between the antenna and the VBOX. Before fixing the antenna to the VBOX, ensure that there are no dust particles in either connector. Replacement antennas are available by contacting your VBOX distributor.



The antenna is a magnetic mounting type for quick and simple mounting to the vehicle roof. For optimum GPS signal reception, make sure that the antenna is fitted to the highest point of the vehicle away from any obstructions that may block satellite reception. The GPS antenna works best with a metal ground plane underneath (eg. Vehicle roof).

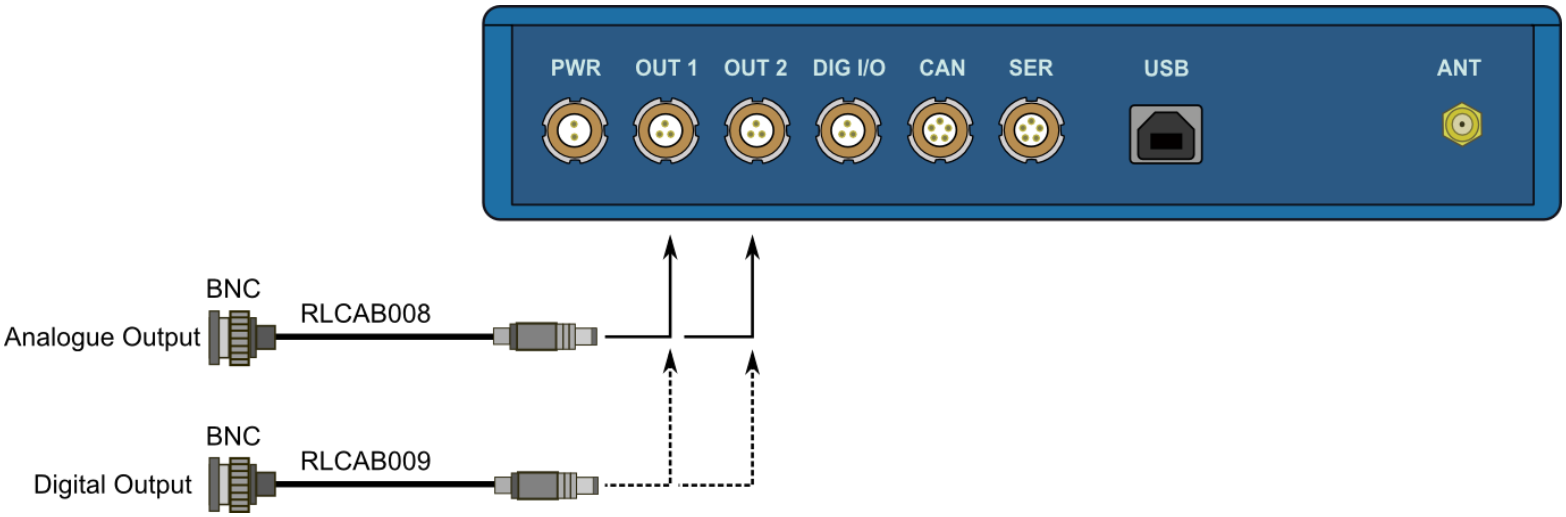
Please also note that when using any GPS equipment, a clear sky view is important. Objects in the surrounding area such as tall buildings or trees can block the GPS signal causing a reduction in the number of satellites being tracked, or introducing reflected signals that can decrease the accuracy of the system.

GPS antennas require a ground plane to operate correctly. Usually, the metal roof of a vehicle performs this function. However, if a test requires an antenna to be placed off of the vehicle, then a special Ground Plane ‘mushroom-style’ antenna must replace the off-vehicle antenna, as these antennas are capable of operating without a ground plane. The Ground Plane ‘mushroom’ style antennas RLVBACS065 are available from your VBOX distributor.

Digital and Analogue Outputs

The digital outputs on connectors OUT1 and OUT2 are a frequency/pulse output corresponding to velocity, long ACC or Lat ACC. The frequency range is adjustable in software or via the front panel controls.

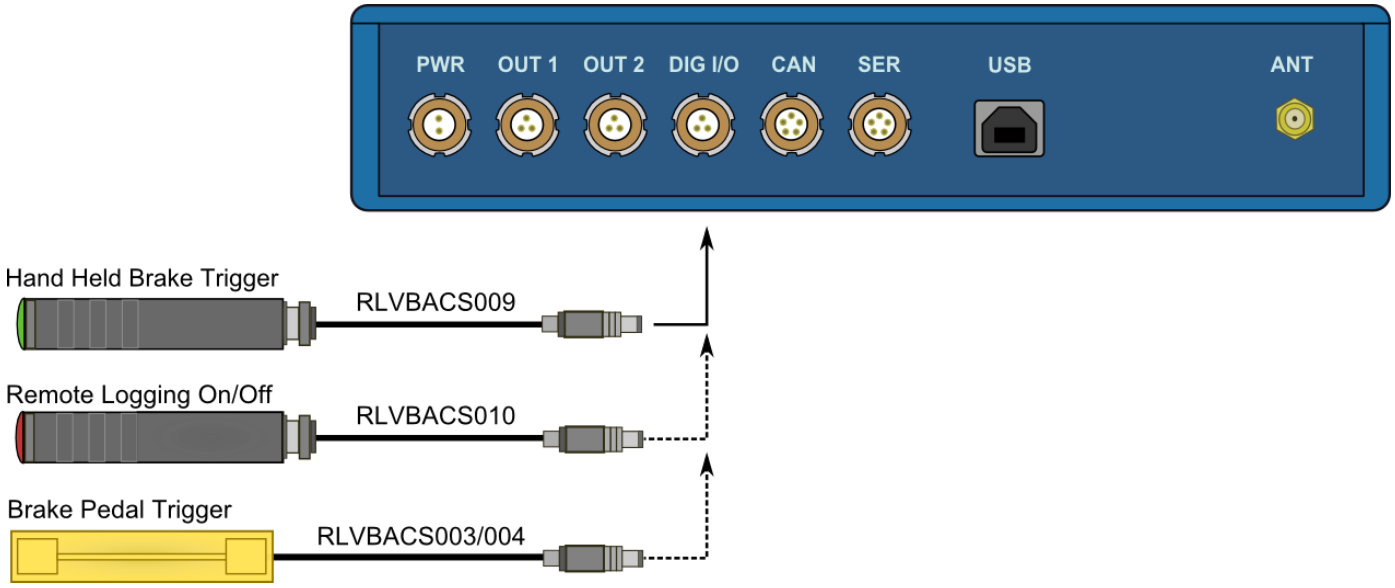
The analogue outputs on connectors OUT1 and OUT2 output are a 0V to +5V DC signal corresponding to velocity or a -5V to +5V signal corresponding to Long ACC or Lat ACC. The volts range is adjustable in software or via the front panel controls.



Digital Inputs

The DIGITAL I/O socket contains the two digital inputs for the VB2SX20SPS. Digital input 1 is also referred to as the Brake trigger input. This input is connected to an internal timer capture module that is able to record precisely an event time for use in brake distance calculation. This period of time is called the trigger event time, and is given as the value in milliseconds between the trigger event and the last GPS sample.

A hand-held brake trigger is also available to allow the user to record marker events in the VB2SX20SPS data file.
A remote logging on/off switch is also available for ease of use and when the front panel switch is not accessible.



CAN / RS232 / USB Ports

The VB2SX20SPS is equipped with a CAN Bus interface, an RS232 serial port and a USB port. The RS232 port or USB is used for all communication between the VBOX and laptop PC. The USB or RS232 ports allow the unit to be configured from a PC using the VBOXTools software. They are also able to transmit live data from the VBOX to third-party equipment using Racelogic's proprietary serial data format.

Note that only the USB port is used for firmware upgrading, whilst only the RS232 socket may be used to transmit data to a VBOX LED Display (RLVBDSP02).

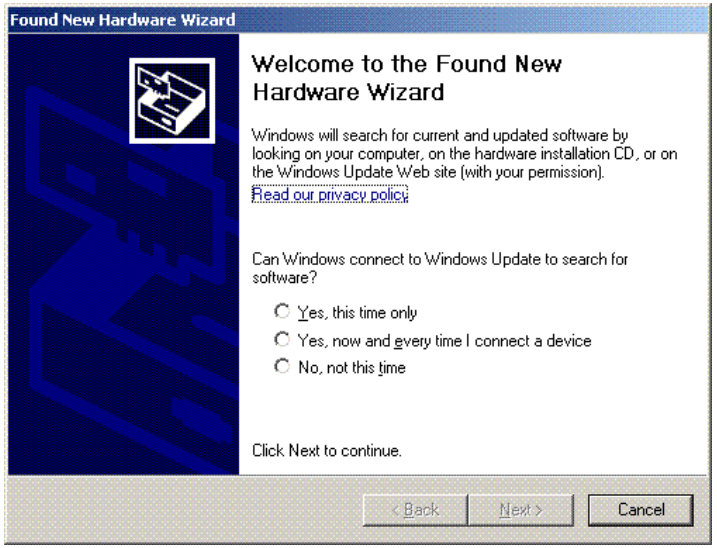
The CAN Bus port is available in either the socket labelled CAN or the socket labelled Serial. See the section 'Setup' in the VBOXTools software manual for information on configuring the CAN baud rate and CAN identifiers.

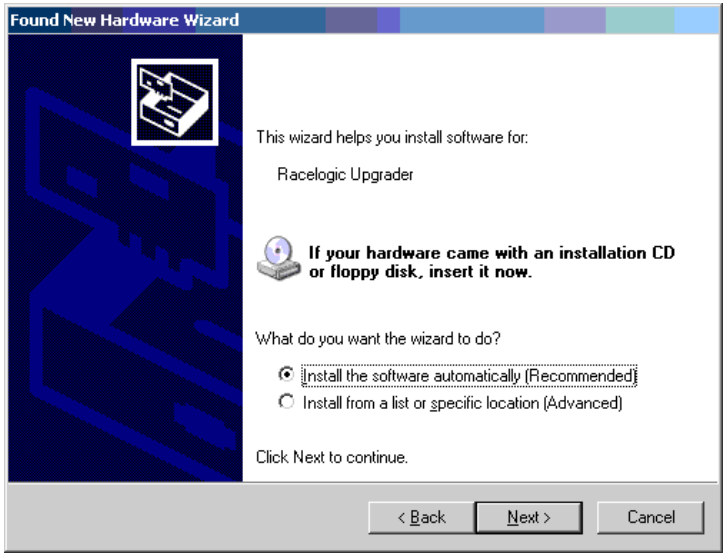
The socket labelled CAN also contains a secondary RS232 port for direct connection to the GPS engine. This is used for providing local DGPS corrections to the GPS engine (requires telemetry connection to a DGPS basestation).

Using the USB cable

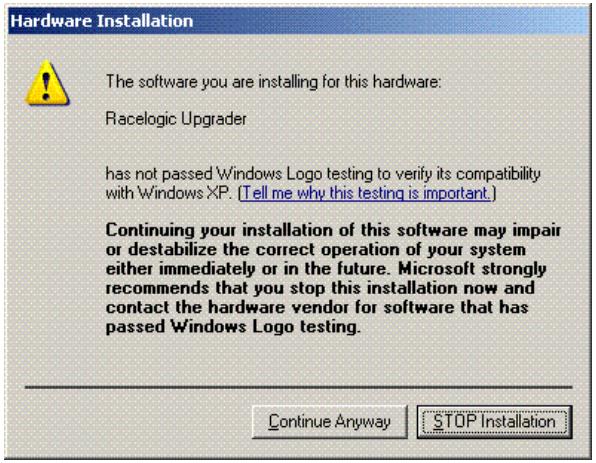
The first time you use the USB cable, you will need to follow the instructions below.

- Connect the USB cable between the VB2SX20SPS and your computer.
- Your computer will now recognise the presence of a new device, after a period of time a 'Found New Hardware Wizard' window will appear. See below.
- Click the option 'No, not this time' and click 'Next' (see image, right)
- A new window will appear at this window click 'Next' (see image, below)





- A new 'Hardware Installation' window will appear. Click the button labelled 'Continue Anyway'.
- At the last window click 'Finish' to complete the installation.
- After a short period of time a window will ask you if you wish to reboot your computer, select 'NO'



Now disconnect the power from the VB2SX20SPS and then reconnect the power, your computer will now recognise the Slip angle sensor. When you run the VBOXTools software it will recognise the USB connections.

Getting Started

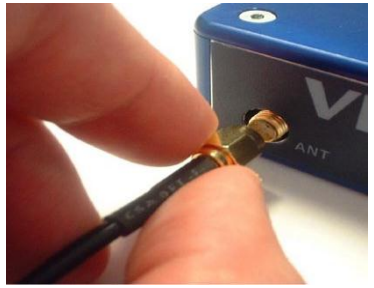
Required equipment (All supplied as standard unless specified)

- VB2SX20SPS
- Power supply cable (CAB14)
- GPS Antenna
- USB/RS232 Cable
- VBOXTools Software CD
- Laptop PC (not supplied)

1.Install Software

2.Place VBOX in vehicle

3.Fit antenna connector to VBOX



4. Mount GPS antenna on vehicle roof

5.Connect USB or serial cable (CAB01) to laptop

6. Connect other end of USB or serial cable to VBOX

7. Connect the power cable to the VBOX

8. Connect other end of power cable to power supply

9. See below

9. With the power applied, the display screen will illuminate. The VB2SX20SPS will start searching for satellites. The ST count will indicate the number of satellites currently in lock. For best results ensure the VBOX has acquired a lock on 5 or more satellites, essential for quality signal reception. When using the VBOX for the first time or when using the VBOX after a long period of time, allow the VBOX to sit for between 5 and 10 minutes to re-collect data needed to track satellites.

As the vehicle begins moving, the display will show the speed of the vehicle, along with a regularly updated satellite count and DGPS status.

VBOXTools Software

The VBOXTools software is used for configuration of the VB2SX20SPS.

For further information on the VBOXTools software refer to the VBOXTools Software manual supplied with VB2SX20SPS.

Upgrading the Firmware

Occasionally Racelogic releases new versions of firmware code for VBOX products, this maybe to fix bugs or to add new features.
New firmware for the VB2SX20SPS is loaded into the unit using a computer and the supplied USB cable.

The latest firmware upgrade (.ruf) file for the Speed Sensor is available from the Racelogic website in the VBOX downloads section.

http://www.racelogic.co.uk/2003/vbox/downloads.htm

If you need the latest file, download it from the website and copy it to your computer.

If you are connecting your slip angle sensor to your computer with the USB cable for the first time then follow the instructions in the Section 'Using the USB cable' earlier in this manual before following the instructions below.

How to upgrade the firmware

- Press and hold the '◀' button whilst the power is connected to the VB2SX20SPS.
- The screen will now display the UPGRADER screen, showing that it is ready for upgrading
- Connect the USB cable to your computer.
- Double click on the .ruf firmware upgrade file that you have downloaded from the website
- This will automatically run the upgrade program where you will see the progress of the upgrade.
- At the end of the process disconnect the USB and then disconnect and reconnect the power.

If you have any questions regarding upgrade of VBOX, please do not hesitate to contact support@racelogic.co.uk

Specification

GPS

Velocity		**Distance**	
Accuracy	0.1 Km/h (averaged over 4 samples)	Accuracy	0.05% (<50cm per Km)
Units	Km/h or Mph	Units	Metres / Feet
Update rate	20 Hz	Update rate	20Hz
Maximum velocity	1000 Mph	Resolution	1cm
Minimum velocity	0.1 Km/h	Height accuracy	6 Metres 95% CEP**
Resolution	0.01 Km/h	Height accuracy with DGPS	2 Metres 95% CEP**
Absolute Positioning		**Time**	
Accuracy	3m 95% CEP**	Resolution	0.01 s
Accuracy with DGPS	1.8m 95% CEP**	Accuracy	0.01 s
Update rate	20 Hz		
Resolution	1 cm		
Heading		**Power**	
Resolution	0.01°	Input Voltage range	6v-30v DC
Accuracy	0.1°	Current	Typically 560mA
Acceleration		**Environmental and physical**	
Accuracy	0.5%	Weight	Approx500 grammes
Maximum	20 G	Size	119mm x 128mm x 30mm
Resolution	0.01 G	Operating temperature	-30°C to +60°C
Update rate	20Hz	Storage temperature	-40°C to +80°C

Definitions

** CEP = Circle of Error Probable
95% CEP (Circle Error Probable) means 95% of the time the position readings will fall within a circle of the stated diameter

Outputs

CAN Bus

Bit rate	125Kbits, 250Kbits, 500Kbits & 1Mbit selectable baud rate
Identifier type	Standard 11bit or extended 2.0A
Data available	Satellites in View, Latitude, Longitude, Velocity, Heading, Altitude, Vertical velocity, Distance, Longitudinal acceleration & lateral acceleration, Distance from trigger, Trigger time, trigger Velocity

Analogue		**Digital**	
Voltage range	0 to 5Volts DC	Frequency range	DC to 44.4Khz
Default setting *	Velocity 0.0125Volts per Km/h (0 to 400Km/h)	Default setting *	25Hz per Km/h (0 to 400Km/h)
Accuracy	0.1 Km/h		90 pulses per metre
Update rate	20Hz	Accuracy	0.1Km/h
		Update rate	20Hz

** The settings can be adjusted by the user in software or via the front panel buttons*

Inputs

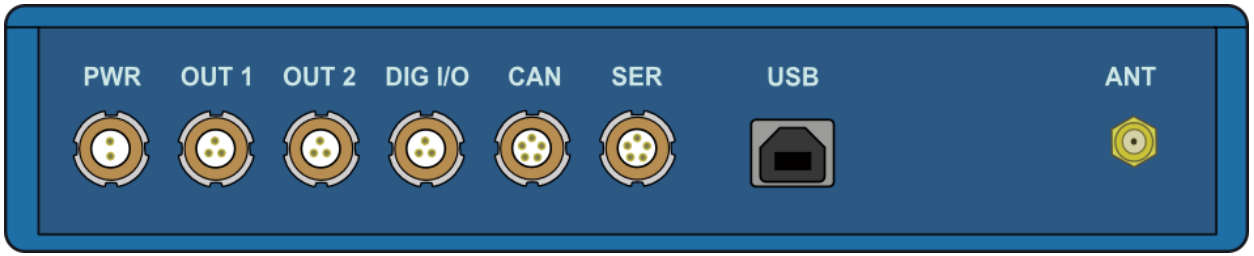
CAN Bus

Racelogic modules	Up to 32 channels from any combination of ADC02, ADC03, FIM02, TC8, Yaw sensor or CAN01

Digital

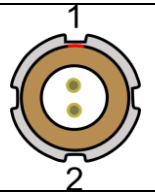
Brake/Event Trigger	Selectable signal polarity. 16bit timer capture with 5µs resolution
On/Off Logging control	Remote log control from hand-held switch

Connector Assignments



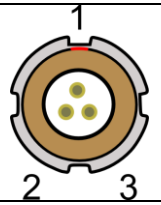
Connector 1 POWER (Dedicated 4.5V to 36V DC Power Connector)

Pin	I/O	Function
1	I	Power +
2	I	Ground
Chassis	I	Ground



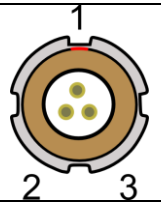
Connector 2 / 3 – OUT 1 / OUT 2 (One Analogue and One Digital Output Each)

Pin	I/O	Function
1	O	Analogue Out 1 / 2
2	O	Digital Out 1 / 2
3	I	Ground
Chassis	I	Ground



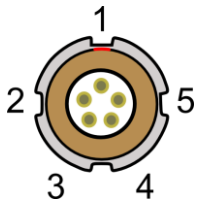
Connector 4 – DIG I/O (Wheel Speed and Brake Trigger Inputs)

Pin	I/O	Function
1	I	Wheel Speed (not available yet)
2	I	NC
3	I	Brake Trigger
Chassis	I	Ground



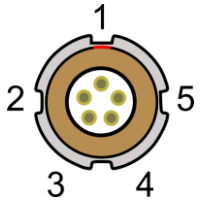
Connector 5 – CAN (First CAN Bus Connector, Serial Connection to GPS Engine)

Pin	I/O	Function
1	O	RS232 Tx GPS (Tx Data from GPS engine)
2	I	RS232 Rx GPS (Rx Data to GPS engine)
3	I/O	CAN High (Also direct connection to Connector 6 CAN High)
4	I/O	CAN Low (Also direct connection to Connector 6 CAN Low)
5	I/O	Power +
Chassis	I	Ground



Connector 6 – SERIAL (Setup / Upgrade, Second CAN Bus Connector)

Pin	I/O	Function
1	O	RS232 Tx Serial Data transmit
2	I	RS232 Rx Serial Data receive
3	I/O	CAN High (Also direct connection to Connector 5 CAN High)
4	I/O	CAN Low (Also direct connection to Connector 5 CAN Low)
5	I/O	Power +
Chassis	I	Ground



Connector 7 – USB (Setup / Upgrade)

Pin	I/O	Function
1		
2	I/O	USB–
3	I/O	USB+
4	I/O	Ground
Chassis	I	Ground

Connector 8 – ANT (GPS Antenna)

Pin	I/O	Function
1	I	Signal
Chassis	I	Ground

CAN Bus Data Format

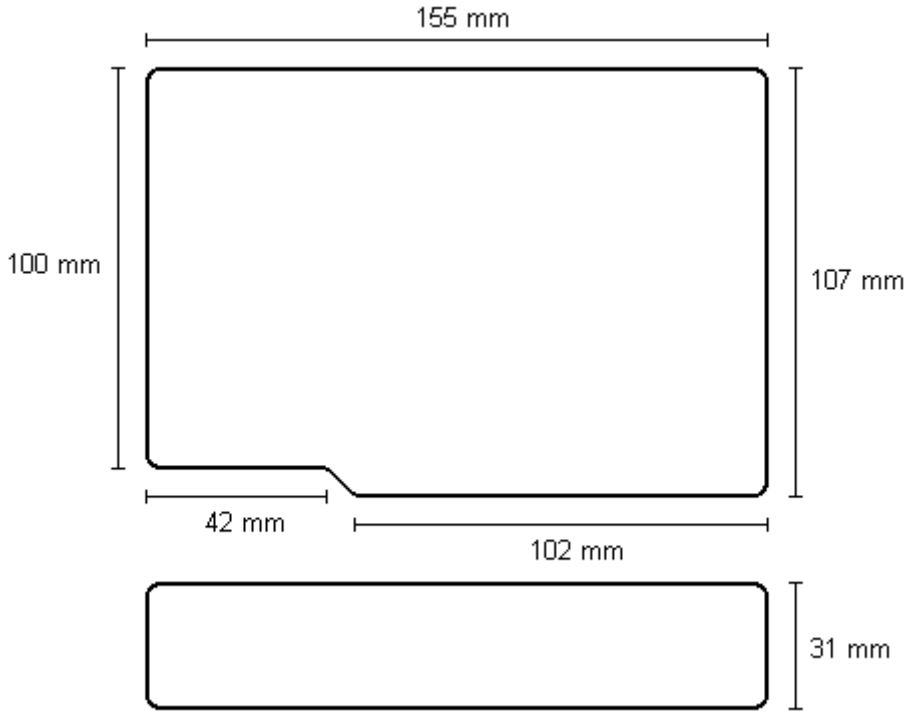
Format		Motorola							
ID*	Update Rate	Data Bytes							
		1	2	3	4	5	6	7	8
0x301	50ms	(1) Sats in view	(2) Time since midnight UTC			(3) Position – Latitude DDMM.MMMMM			
0x302	50ms	(4) Position – Longitude DDMMM.MMMMM				(5) Velocity. (Knots)		(6) Heading (Degrees)	
0x303	50ms	(7) Altitude. WGS 84. (Metres)			(8) Vertical velocity. (M/S)		Unused	(9) Status	(10) Status
0x304	50ms	(11) Distance. (Metres)				(12) Longitudinal Accel. (G)		(13) Lateral Accel. (G)	
0x305	50ms	(14) Distance travelled since VBOX reset (Metres)				(15) Trigger time		(16) Trigger Velocity (Knots)	

* Default Identifiers. The identifier values can be changed using the configuration software.

(1) If Satellites in view < 3 then only Identifier 0x301 transmitted and bytes 2 to 8 are set to 0x00.
(2) Time since midnight. This is a count of 10ms intervals since midnight UTC. (5383690 = 53836.90 seconds since midnight or 14 hours, 57 minutes and 16.90 seconds).
(3) Position, Latitude * 100,000 (515924579 = 51 Degrees, 59.24579 Minutes North). Latitude highest bit indicates north/south hemisphere. 0=north, 1=south, Bit 7 in Status is also set.
(4)Position, Longitude * 100,000 (5882246 = 0 Degrees, 58.82246 Minutes West). Longitude highest bit indicates east/west of Greenwich meridian. 0=west,1=east. Bit 6 in Status is also set.
(5) Velocity, 0.01 knots per bit.
(6) Heading, 0.01° per bit.
(7) Altitude, 0.01 meters per bit, signed.
(8) Vertical Velocity, 0.01 m/s per bit, signed.
(9) Status. 8 bit unsigned char. Bit 0=VBOX Lite, Bit 1=Open or Closed CAN Bus (1=open), 2=VBOX3.
(10) Status is an 8 bit unsigned char. Bit 0 is always set, Bit 3=brake test started, Bit 4 = Brake trigger active, Bit 5 = DGPS active.
(11) Distance, 0.000078125 meters per bit, unsigned.
(12) Longitudinal Acceleration, 0.01G per bit, signed.
(13) Lateral Acceleration, 0.01G per bit, signed.
(14) Distance travelled in meters since VBOX reset.
(15) Time from Trigger event to Zero Km/h.
(16) Velocity at brake trigger point in Knots.

The VBOX CAN database is available in Vector Database (DBC File) format from the Racelogic VBOX website.

Module Dimensions



Fuse Reset Button

The VB2SX20SPS contains a fuse to protect it from excessive currents. If the unit is accidentally subjected to large currents and the fuse has become tripped, it can be reset by pressing the button marked ‘Fuse Reset’ all the way into the unit with a long, thin implement.

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Revision	Date	Description	Author
1	13/07/2007	First release	JH
2	03/12/2007	Addition of Format: Motorola to CAN Bus Data Format table	NT
3	30/04/2008	Update of address	AM
4	06/01/2011	Addition of lat acc and long acc output options. Removal of ANT B connector data	SF
5	19/01/2012	Updated Inventory, images and general content.	LN