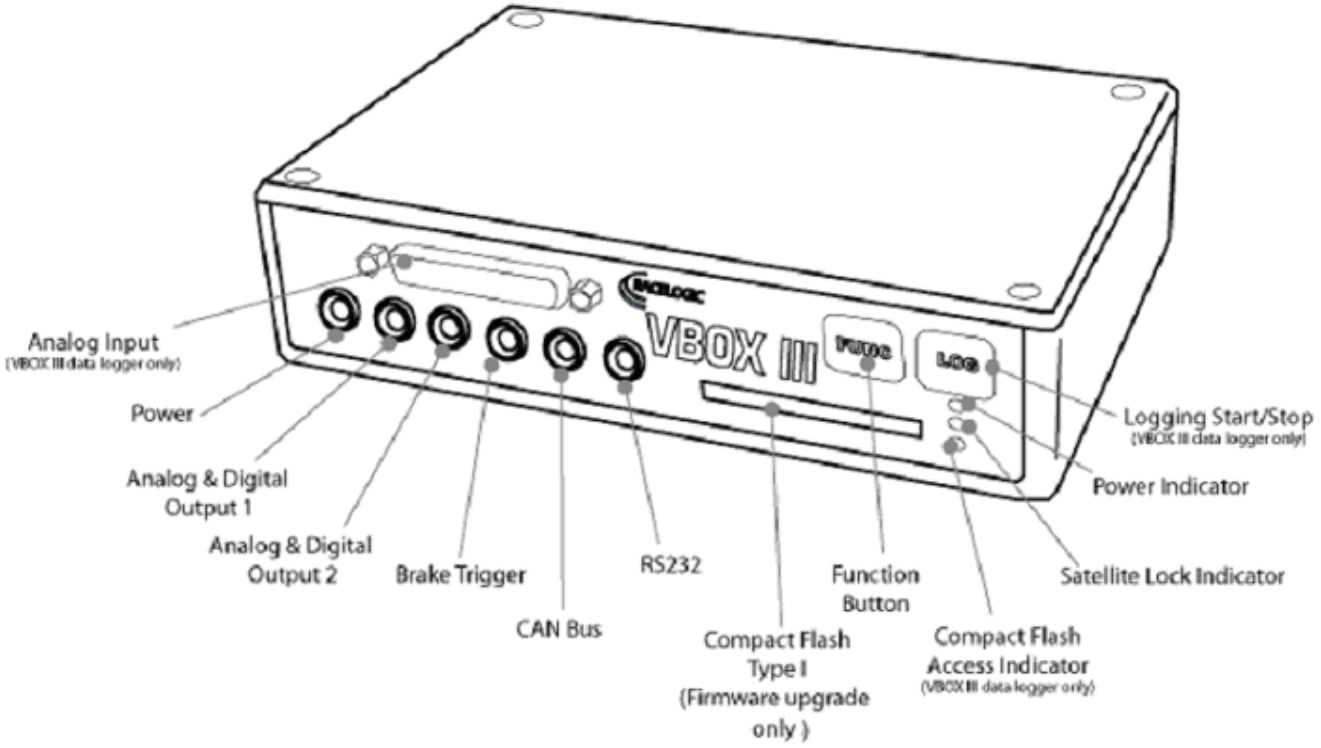
VBOX III 100Hz GPS Speed Sensor

User Guide

VBOX III SPS Overview



Introduction

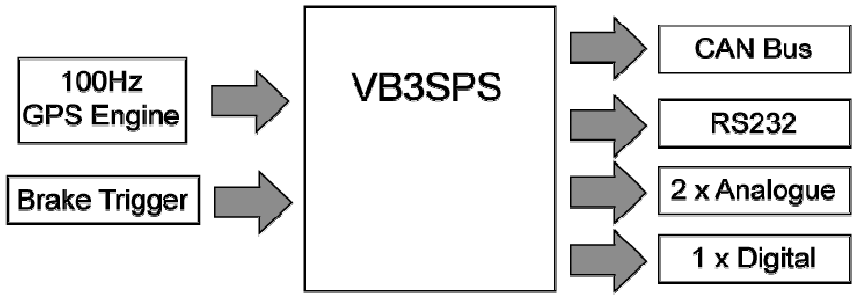
The VBOX III SPS is a 100Hz GPS speed sensor featuring a range of output formats to suit most applications. Outputs are available simultaneously as voltage, digital pulse, CAN Bus and RS232. With the exception of RS232, all outputs are updated at the full 100Hz rate. The RS232 update rate is restricted to 20Hz due to limitations in the PC COM port bandwidth.

Because the VBOX III SPS is based on the VBOX III data logging system, it is possible to upgrade the VBOX III SPS to a full VBOX III to take advantage of the analogue inputs, CAN Bus recording and Compact Flash logging. For further information and pricing on upgrades please contact your supplier.

In line with previous VBOX models, the VBOX III SPS is compatible with the Multifunction display to view parameters such as speed and braking distance. ***See Note***

Features

- Non-contact 100Hz speed and distance measurement using GPS
- 12.5ms Latency
- CAN Bus interface
- RS-232 serial interface
- 2 x 16bit User configurable analogue outputs
- Digital output
- Brake trigger Input with 100KHz scan rate
- Wide 5.3V to 30V operating range ***See Note***



* RACELOGIC external modules such as Multifunction display only operate from a 12v vehicle supply. Therefore, when using external can modules, VBOX III supply must not exceed 15vDC.

Standard Inventory

Description	Qty	Racelogic Part #
VBOX III SPS	1	VB3SPS
GPS Magnetic Aerial	1	RLVBACS050
CD ROM containing VBOX software	1	RLVBACS030
Serial PC Cable	1	RLVBCAB01
User Manual	1	RLVBACS031
Carrying Case	1	RLVBACS017
DC Power cable	1	RLVBCAB14

The standard inventory also includes 2 out of the three follow cables analogue output (CAB08), digital output (CAB09) or CAN (CAB19), as specified by user.

Optional Accessories

Description	Racelogic Part #
Brake Pedal Trigger	RLVBACS004
Hand-held brake trigger	RLVBACS009
Multifunction Display	RLVBDSP03
Analogue output to BNC	RLVBCAB08
Digital output to BNC	RLVBCAB09
CAN to D-sub connector	RLVBCAB19

Operation

Power

The VBOX III SPS is supplied with a DC power cable to allow connection to a power source provided by the user. Minimum operating voltage is approximately 5.3VDC. The maximum operating voltage input must not exceed 30V DC. Failure to observe this could result in damage to the VBOX.

Warning

The VBOX III SPS can be connected to the Multifunction display. Please note that the voltage supply to Racelogic modules connected to the VBOX will be at the same level as the VBOX power input. Therefore when using the Racelogic multifunction display with VBOX III SPS, the input voltage must not exceed 15 volts. Failure to observe this could result in damage to the display and possibly the VBOX III

Please also note that during extended use, the VBOX III SPS case may become hot. This is normal, however it is good practice to mount the VBOX III SPS in a position where it has sufficient airflow around the case.

Buttons

The VBOX III SPS has two membrane buttons on the front panel, LOG and FUNC. LOG is used primarily for the VBOX III data logger to start and stop logging to the compact flash card and does therefore not apply to the VBOX III SPS. FUNC is used to switch between two sample rates, 100Hz and 20Hz.

Sample rate

Pressing the FUNC button briefly flashes the LED's to indicate the current sample rate. A slow flash (once per second) on all the LED's indicates 20Hz, and rapid flashing (5 times a second) indicates a 100Hz sample rate. A running sequence of lights indicates a sample rate other than 100Hz or 20Hz. Pressing and holding the FUNC button for 5 seconds toggles the current sample rate. The sample rate can also be set in the VBOX software.

Default setup

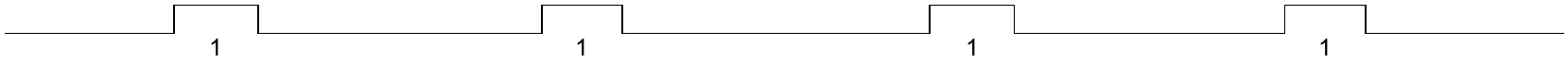
The default factory settings are restored to the VBOX by pressing and holding the FUNC button, and then at the same time pressing and holding the LOG button for 5 seconds. This will put the VBOX III into the default factory settings. (DGPS will be off by default.).

LED indicators

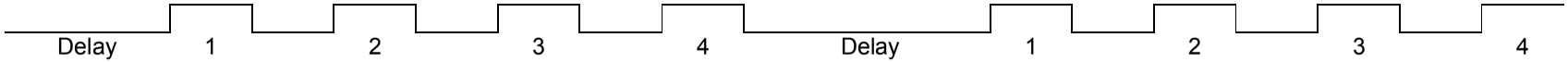
There are 3 LED indicators on the front panel of the VBOX. The first LED, **PWR,** indicates that the VBOX is powered correctly. The **SAT** LED is used to indicate the number of GPS satellites that the VBOX has in lock. When no satellites are in lock, the SAT LED flashes slowly to indicate that the VBOX is searching for satellites. When one or more satellites are in lock, the LED will pulse the satellite count repeatedly with a short delay.

The following diagram shows an example of SAT LED pulse sequence.

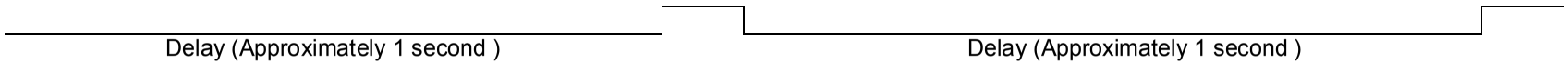
Sequence showing 1 Satellite



Sequence showing 4 Satellites



Sequence showing 0 Satellites

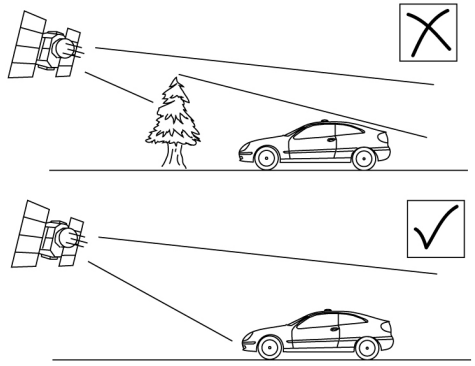


GPS Antenna

The GPS Antenna supplied with the VBOX III is a 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).

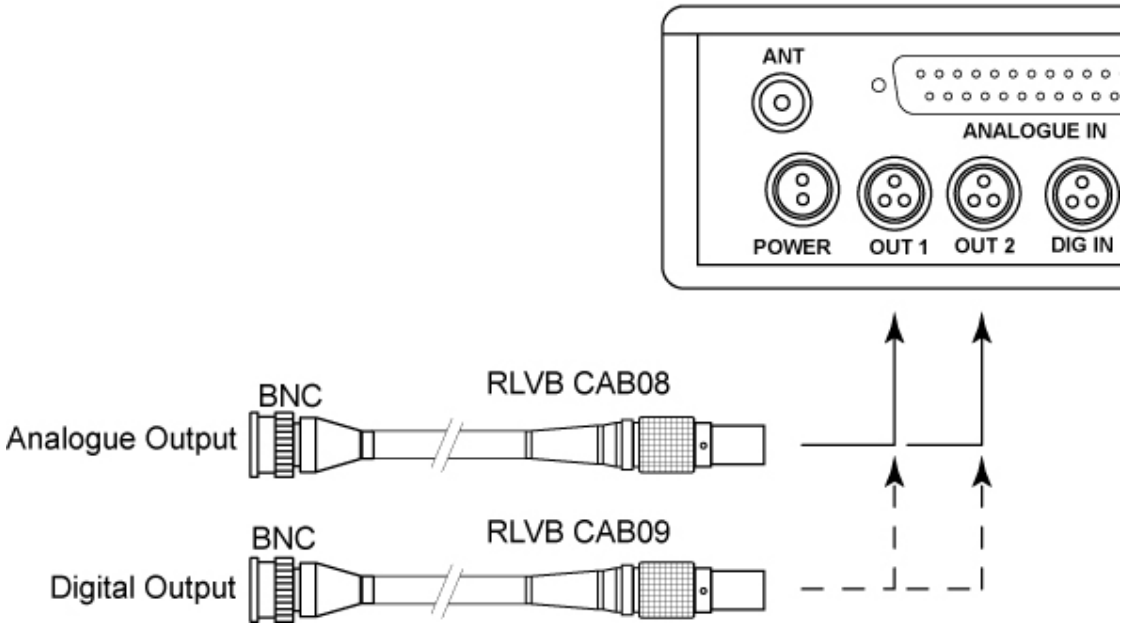
Please also note that when using any GPS equipment, a clear sky view is important. Objects in the surrounding area such and tall buildings or trees can block the GPS signal causing a reduction or loss in the number of satellites being tracked.



OUT 1 & OUT 2

The OUT1 and OUT2 connectors each have 1 analogue voltage and 1 digital output. The digital output on connector OUT1 is a frequency/pulse output corresponding to velocity. The pulse per meter range is adjustable in software. The digital output on connector OUT2 is a simple on/off state output. The default function of this digital output is to indicate the current logging state, where logic 1(5v) indicates that logging is happening and logic 0 (0v) indicates that the VBOX is not logging.

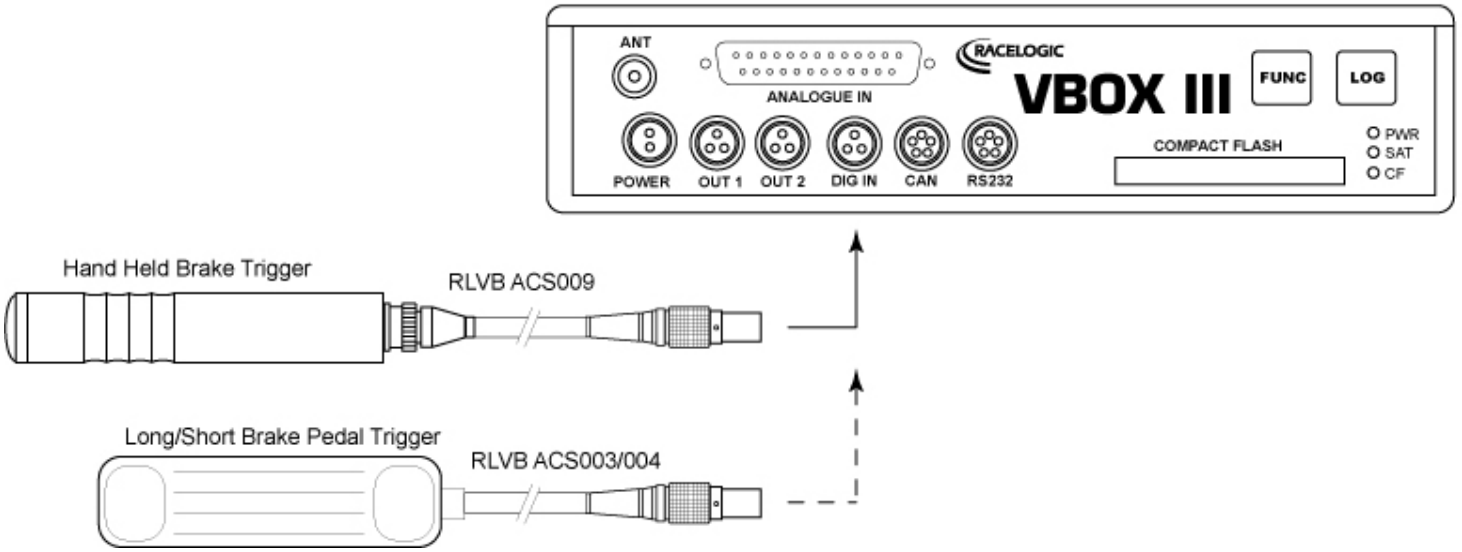
The analogue outputs on connectors OUT1 and OUT2 are both user configurable. For example, analogue output 1 could be configured to output velocity while analogue output 2 might be configured to output lateral acceleration. The voltage range of both analogue outputs is 0 to 5v DC.



Digital Inputs

The DIG IN connector contains the two digital inputs for the VBOX III. 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 output via CAN Bus 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 VBOX III data file.



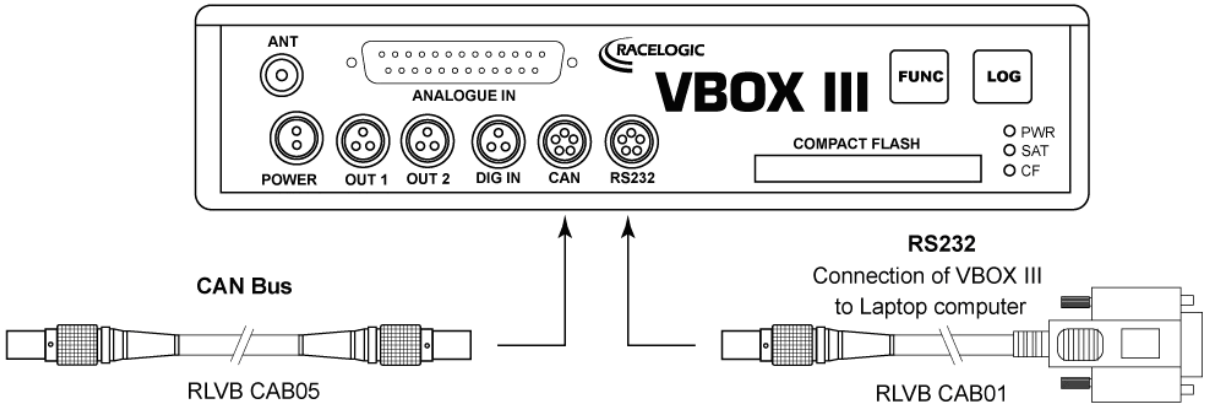
CAN / RS232 Ports

The VBOX III is equipped with one CAN Bus interface and one RS232 serial port. The RS232 port is used for all communication between the VBOX and laptop PC. The RS232 port is marked **RS232** on the VBOX III front panel. The RS232 port is able to transmit live data from the VBOX to an LED display for viewing and performing real-time data. It is important to note however that due to limitations of the PC serial port, live data transfer is limited to 20Hz.

There is also a secondary RS232 port, used for reception of Differential GPS (DGPS) data for local correction (using a suitable radio system and base station). The secondary RS232 port is located in the connector marked CAN on the VBOX III front panel.

The CAN Bus port is located on the VBOX III connector "CAN". The CAN Bus connection carries VBOX III SPS data. See section ***CAN BUS data output*** for more information.

Power supplied to external Racelogic modules through the "CAN" or "RS232" cables is at the same voltage as the input power supply. Therefore when using Racelogic external modules (eg; MFD or ADC03), the VBOX III supply voltage must not exceed 15vDC.



Getting Started

Required equipment (All supplied as standard unless specified)

- VBOX III SPS
- Power cable
- GPS Antenna
- RS232 Cable
- VBOX Software CD
- Laptop PC(not supplied)
- Suitable power source (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 serial cable (CAB01) to laptop

6. Connect other end of serial cable to VBOX

7. Connect the power cable to the VBOX and apply power.

8. If using 12V power cable, connect to vehicle

9. With the power applied, the red PWR led should illuminate. After a short delay the VBOX III SPS will start searching for satellites. The number of satellites currently in lock will be indicated by the SAT led. For best results ensure the VBOX III SPS 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 III SPS after a long period of time, allow the VBOX III SPS to sit for between 5 and 10 minutes to re-collect data needed to track satellites.

VBOXTools Software

The VBOXTools software is used for configuration of the VBOX III SPS. Please refer to the VBOXTools software manual for further instructions.

Firmware Upgrades

Firmware refers to the operating software inside the VBOX III SPS. The firmware is responsible for all of the functions within the VBOX and from time to time, firmware updates will be released by Racelogic to improve or enhance the way that the VBOX works. The latest firmware will always be available on the Racelogic web site in the downloads directory:-

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

It is recommended to check the web site periodically for updates. The VBOX III upgrade files have a ".UPG" file extension. To upgrade the VBOX III firmware, download the latest firmware file from the Racelogic web site and copy this file onto a compact flash card. Then insert the compact flash card into the VBOX III. Apply power to the VBOX. All three LEDs on the front panel should illuminate. After a short period of time, the green and blue LEDs on the front panel will flash. When the LEDs stop flashing the VBOX will re-initialise and begin normal operation. This will be indicated by the green SAT LED flashing slowly as the VBOX searches for satellites.

After upgrade, the UPG file will be deleted from the flash card and an upgrade log file will have been created. This log file can be emailed to the support address below should any problems arise.

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	100 Hz	Update rate	100Hz
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	100 Hz		
Resolution	1 cm		
Heading		**Power**	
Resolution	0.01°	Input Voltage range	5.3v-30v DC
Accuracy	0.1°	Power	Max 10.6 watts
Acceleration		**Environmental and physical**	
Accuracy	0.5%	Weight	Approx 900 grammes
Maximum	20 G	Size	170mm x 121mm x 41mm
Resolution	0.01 G	Operating temperature	-20°C to +70°C
Update rate	100Hz	Storage temperature	-30°C to +80°C
Memory		**Definitions**	
Not applicable to VBIII Speed Sensor		** 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	Format: Motorola
Bit rate	125Kbits, 250Kbits ,500Kbits & 1Mbit selectable baud rate
Identifier type	Standard 11bit 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

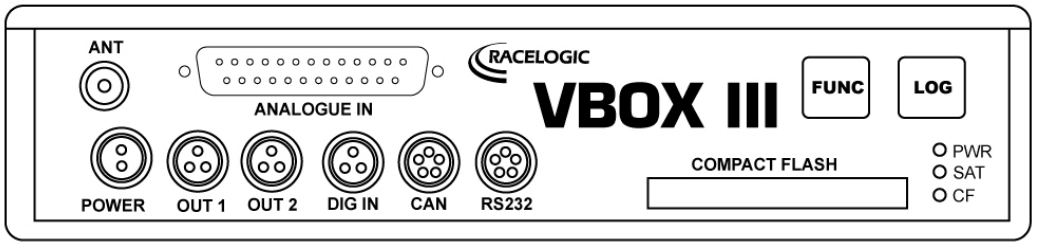
Analogue		**Digital**	
Voltage range	0 to 5Volts DC	Frequency range	DC to 44.4Khz
Default setting *	Velocity 0.0125Volts per Km/h (0 to 400Km/h)	Default setting *	25Hz per Km/h (0 to 400Km/h)
Accuracy	0.1 Km/h		90 pulses per metre
Update rate	100Hz	Accuracy	0.1Km/h
		Update rate	100Hz

** The range settings can be adjusted by the user in software*

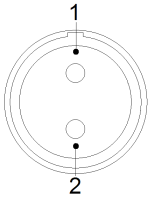
Inputs

Digital	
Brake/Event Trigger	Selectable signal polarity. 16bit timer capture with12µs resolution

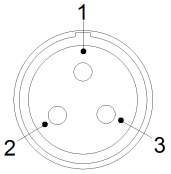
Connection Data



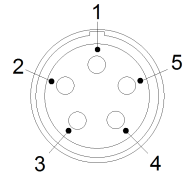
Front View of VBOX III



2 pin LEMO socket



3 pin LEMO socket



5 pin LEMO socket

Connector	**1 POWER**	**Type**	**Lemo 2 pin**
PIN	In/Out	Description	Range
1	I	Power +	5.4V to 30V
2	I	Ground	0V

Connector	**2 OUT 1**	**Type**	**Lemo 3 pin**
PIN	In/Out	Description	Range
1	O	Analogue 1 Output	0V to 5V
2	O	Digital 2 Output	0V to 5V
3	I	Ground	

Connector	3 OUT 2	Type	Lemo 3 pin
PIN	In/Out	Description	Range
1	O	Analogue 2 Output	0V to 5V
2	O	Digital 1 Output	0V to 5V
3	I		

Connector	4 DIG IN	Type	Lemo 3 pin
PIN	In/Out	Description	Range
1	I	Ground	
2			
3	I	Digital Input 1. Brake Trigger	0V to 5V (14v tolerant)

Connector	5 CAN Bus	Type	Lemo 5 pin
PIN	In/Out	Description	Range
1	O	RS232 Tx (to GPS engine)	±12v
2	I	RS232 Rx (to GPS engine)	±12v
3	I/O	CAN Bus High	
4	I/O	CAN Bus Low	
5	O	+V Power	Same as Power +

Connector	6 RS232	Type	Lemo 5 pin
PIN	In/Out	Description	Range
1	O	RS232 Tx (to VBOXIII processor)	±12v
2	I	RS232 Rx (to VBOXIII processor)	±12v
3			
4			
5	O	+V Power	Same as Power +

Antenna connector

Connector	ANT	Type	SMA
PIN	In/Out	Description	Range
Center	-	RF Signal / Power for active antenna	
Chassis	-	Ground	

Analogue Input Connector

The analogue input connector is not applicable to VBOX III SPS. If the VBOX III SPS is upgraded to the full VBOX III data logger, the 4 x 24 bit analogue inputs can be logged directly to compact flash.

CAN Bus data format

Format		Motorola							
ID**	Update rate *	Data Bytes							
		1	2	3	4	5	6	7	8
0x301	10ms	(1) Sats in view	(2) Time since midnight UTC			(3) Position – Latitude MMMM.MMMMM			
0x302	10ms	(4) Position – Longitude MMMMM.MMMMM				(5) Velocity. (Knots)		(6) Heading. (Degrees)	
0x303	10ms	(7) Altitude. WGS 84. (Metres)			(8) Vertical velocity. (M/S)		Unused	(9) Status	(10) Status
0x304	10ms	(11) Distance. (Meters)				(12) Longitudinal Accel. (G)		(13) Lateral Accel. (G)	
0x305	10ms	(14) Distance travelled since VBOX reset				(15) Trigger time (ms)		(16) Trigger Velocity	
0x306	10ms	Velocity Quality		Unused		Unused		Unused	

5 Update rate depends on GPS update rate. 10ms Update rate shown corresponds to 100Hz GPS setting.
**Default Identifiers. The identifier values can be changed using the configuration software.

5 If Satellites in view < 3 then only Identifier 0x301 transmitted and bytes 2 to 8 are set to 0x00.
5 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)
5 Position, Latitude * 100,000 (515924579 = 51 Degrees, 59.24579 Minutes North). This is a true 32bit signed integer, North being positive.
5 Position, Longitude * 100,000 (5882246 = 0 Degrees, 58.82246 Minutes West). This is a true 32bit signed integer, West being positive.
(5) Velocity, 0.01 knots per bit.
(6) Heading, 0.01° per bit.
5 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
5 Distance, 0.000078125 meters per bit, unsigned. Corrected to brake trigger time.
5 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 last brake trigger event. 0.01 Seconds per bit.
(16) Velocity at brake trigger point in Knots.

The VBOX CAN database is available in Vector Database (DBC File) format on request from Racelogic

Contact Information

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Revision	Date	Description	Author
1	21/7/2004	First Draft	CS
2	6/1/2005	CAN bus data correction	KB
3	7/2/2005	CAN bus data correction	CS
4	8/2/2006	Correction to long Lat CAN Description	KB
5	15/5/2006	Correction to CAN capabilities	JH
6	03/12/2007	Inclusion of Format: Motorola to CAN Bus Data Format table	NT
7	11/2/08	Correction of volt range to Brake trigger input	KB
8	30/04/2008	Update of Address	AM