

# VBOX II Lite 5Hz GPS Data Logger

## User Guide



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## 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:

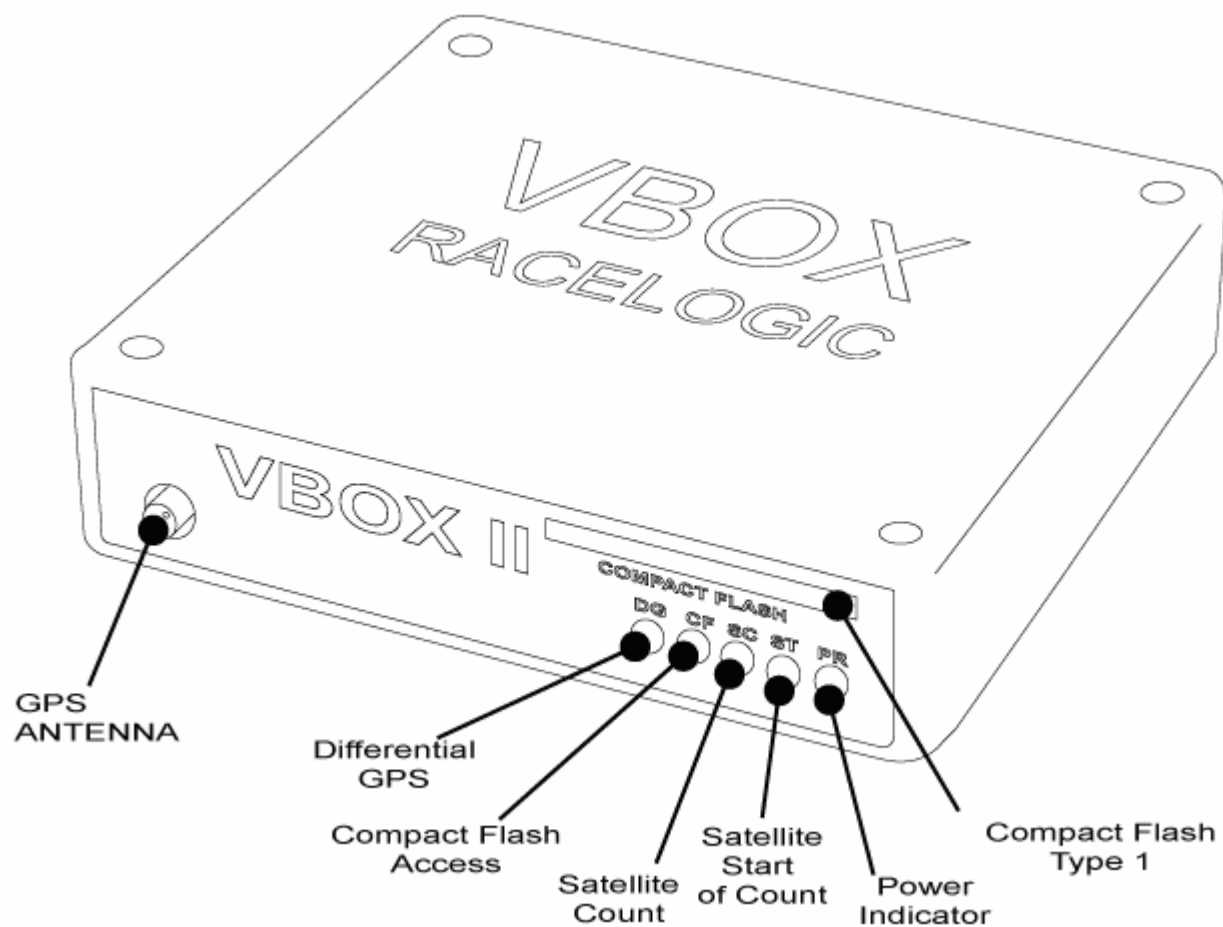
### **EC Directive 89/336/EEC** (and amending directives)

“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

## VBOX II Lite Overview



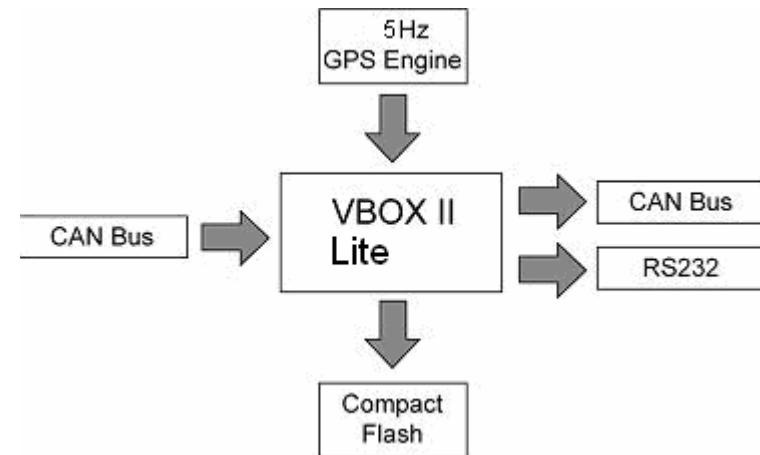
## Introduction

The VBOX II Lite represents the 2<sup>nd</sup> generation of GPS data logging system from Racelogic. Using a powerful GPS engine, the VBOX II Lite can log GPS and other data at 5Hz. The logged data is stored directly onto a compact flash card for easy transfer to a PC.

The VBOX II Lite is compatible with all of the existing peripherals including the Multifunction display, ADC03, TC8, FIM03 and Yaw rate sensor.

## Features

- Non-contact 5Hz speed and distance measurement using GPS
- 1 x CAN Bus interface
- RS-232 serial interface
- Compact Flash Interface
- Trigger / Event marker input
- Input Voltage 6V to 18V operating range
- Logging rate selectable from 5Hz, 2Hz, 1Hz, 0.5Hz, or 20Hz / 10Hz interpolated



## Standard Inventory

Description	Qty	Racelogic Part #
VBOX II Lite	1	VB2L
Cigar Lighter adaptor	1	RLVBACAB10
GPS Magnetic Aerial	1	RLVBACS015
32Mb Compact Flash Card	1	RLVBACS005
PCMCIA Compact Flash Adaptor	1	RLVBACS028
CD ROM containing VBOX software	1	RLVBACS030
Serial PC Cable	1	RLVBACAB01
User Manual	1	RLVBACS031
Padded Carrying Case	1	RLVBACS016

## Optional Accessories

Description	Racelogic Part #
4.5Ah battery pack	RLVBACS012
Mains Charger	RLVBACS020
Brake Pedal Trigger	RLVBACS004
Hand-held brake trigger	RLVBACS009
Logging Start/Stop Switch	RLVBACS010
Multifunction Display	RLVBDSP03
8 Channel (16bit) Analogue Interface	RLVBADC03
8 Channel (10bit) Analogue Interface	RLVBADC02
4 Channel Frequency Input Module	RLVBFIM03
8 Channel Vehicle CAN Interface	RLVBACAN01
8 Channel Thermocouple Interface	RLVBTC8
Can to Analogue Output Module	RLVBDAC01
Single Yaw Rate Sensor + 2 axis G Sensor	RLVBYAW02
Inertial Measurement Unit. 3 Yaw Rate Sensors & 3 accelerometers	RLVBIMU01

## Operation

### Power

The VBOX Lite can be powered from a wide range of voltage sources including the supplied Vehicle Cigar adapter, or other source provided by the user. The maximum operating voltage input must not exceed 18V DC. Failure to observe this could result in damage to the VBOX.



As an optional extra a battery pack is available from Racelogic RLVBACS012.

The battery pack is a 6v 3.8amp hour Nickel Metal Hydride unit, with a built in charging and monitoring circuit. The battery is plugged into the two pin power socket on the front of the VBOX to provide power for up to 6 hours (4 hours with the display attached).

The battery pack can be charged via two methods, either by plugging the VBOX cigar lighter adapter into the pack, or by using the mains charger. The battery pack can be either discharged fully and then re-charged, or partially discharged and then re-charged, there is no memory effect on NiMH batteries.

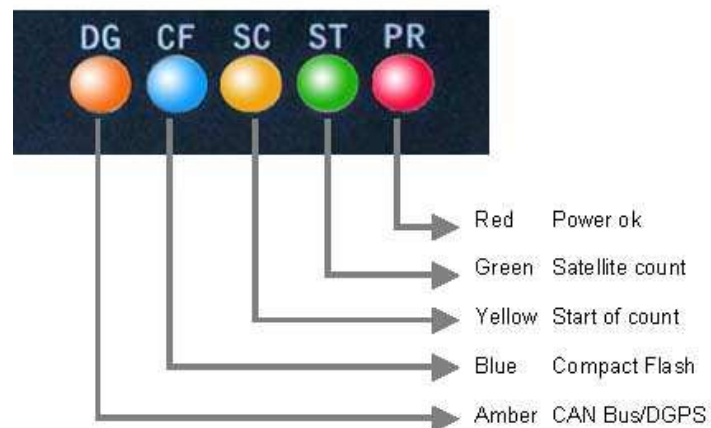
To protect the battery cells from damage, the battery will only charge when the temperature range is between 0 & 46°C. If whilst charging the internal temperature of the battery reaches 46°C, the charge will be turned off until the internal temperature reduces to 43°C and the charge status led (25% 50% , 75% or 100% ) will flash. The charge will then automatically restart.

Whilst charging, the 25%, 50%, 75% and 100% will illuminate in succession to give an indication of the total charge time. When the battery is fully charged, the 100% led will remain illuminated, and the charging led will turn off. Occasionally the battery will turn the charging back on to keep the battery at full capacity. To check the state of the battery charge; press and hold in the white button on the side of the box. There are four LED's which will light up indicating how much charge is left in the battery. 100% LED indicating 100% charge, 75% led indicating up to 99% charge, 50% led indicating up to 74% and 25% led indicating up to 49% charge. When the battery is at a level not suitable for powering the VBOX, the 25% led will flash.

The battery can be connected to a charger, and also the VBOX at the same time. This allows the battery to be charged whilst the external source is powering the VBOX. In such a situation, you can power the VBOX from the cigar lighter, with the battery acting as a back up if the ignition is turned off which sometimes stops the power to the cigar lighter.

When the battery is close to fully discharged, the VBOX will give an audible warning by a slow series of beeps from the internal buzzer. You should have around 5 minutes of time left when these beeps begin.

## LED Indicators



The green LED (**ST**) is used to indicate the number of satellites currently in lock. If the yellow LED (**SC**) is flashing whilst the green (ST) LED is off, then the VBOX has no satellite lock.

If this is the case then check that you have the GPS antenna connector correctly fitted to the VBOX. Also check that the antenna has a clear view of the sky.

The VBOX will normally lock onto satellites within 30 seconds of power up. However on its first use it can take up to 20 minutes to acquire satellite lock.

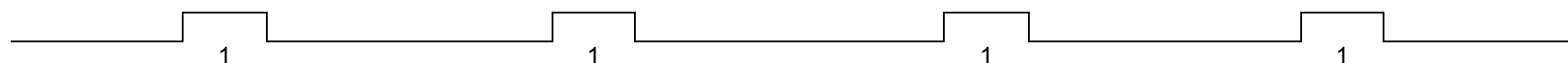
The yellow LED (**SC**) flashes to indicate start of count. When satellite lock occurs the number of green LED flashes between yellow flashes indicates the number of satellites in lock.

When a Compact Flash memory device is inserted into VBOX II Lite the blue LED (**CF**) will flash to indicate that the VBOX is writing to the device.

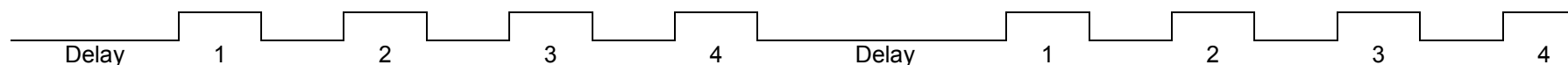
The amber LED is used to indicate either CAN activity (**CN**) or if the unit is a DGPS version (**DG**), then this LED will come on when DGPS lock has been successful.

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

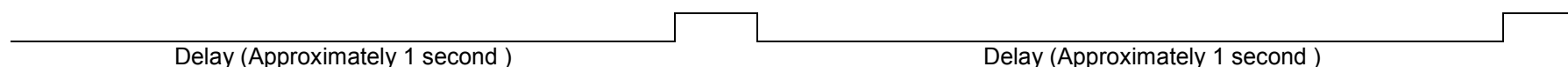
Sequence showing 1 Satellite



Sequence showing 4 Satellites



Sequence showing 0 Satellites





## Memory Cards

The VBOX II Lite can accept Type-I compact flash memory cards. The memory cards must be formatted using FAT or FAT16 but not FAT32. This option is normally selectable when formatting the memory card in a card reader connected to a PC.

When logging data to compact flash the blue CF LED will flash or be constantly illuminated. It is important not to remove the flash card while the blue LED is illuminated. If the card is removed while the VBOX is writing data to it, there is a risk that the data file may be corrupted resulting in loss of data. If '**Log only when moving**' is the logging mode selected then wait a short time after the vehicle has stopped for the Blue CF LED to go out. If '**Log only when moving**' is not selected i.e. the VBOX is continuously logging then press the Start/stop logging switch if connected or enter VBOX setup in the VBOX software to stop the VBOX logging data to the compact flash card.

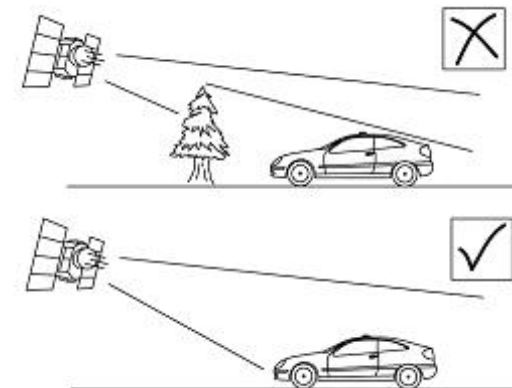
**NOTE** If you cannot do either of the above then just remove the card. If however the file is reported as corrupt by the VBOX software then load the file into Notepad and go to the end of the file. It is usual in this case that the last entry is corrupt, so delete it and re-save the file.

## GPS Antenna

The GPS Antenna supplied with the VBOX II Lite 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 as tall buildings or trees can block the GPS signal causing a reduction or loss in the number of satellites being tracked.



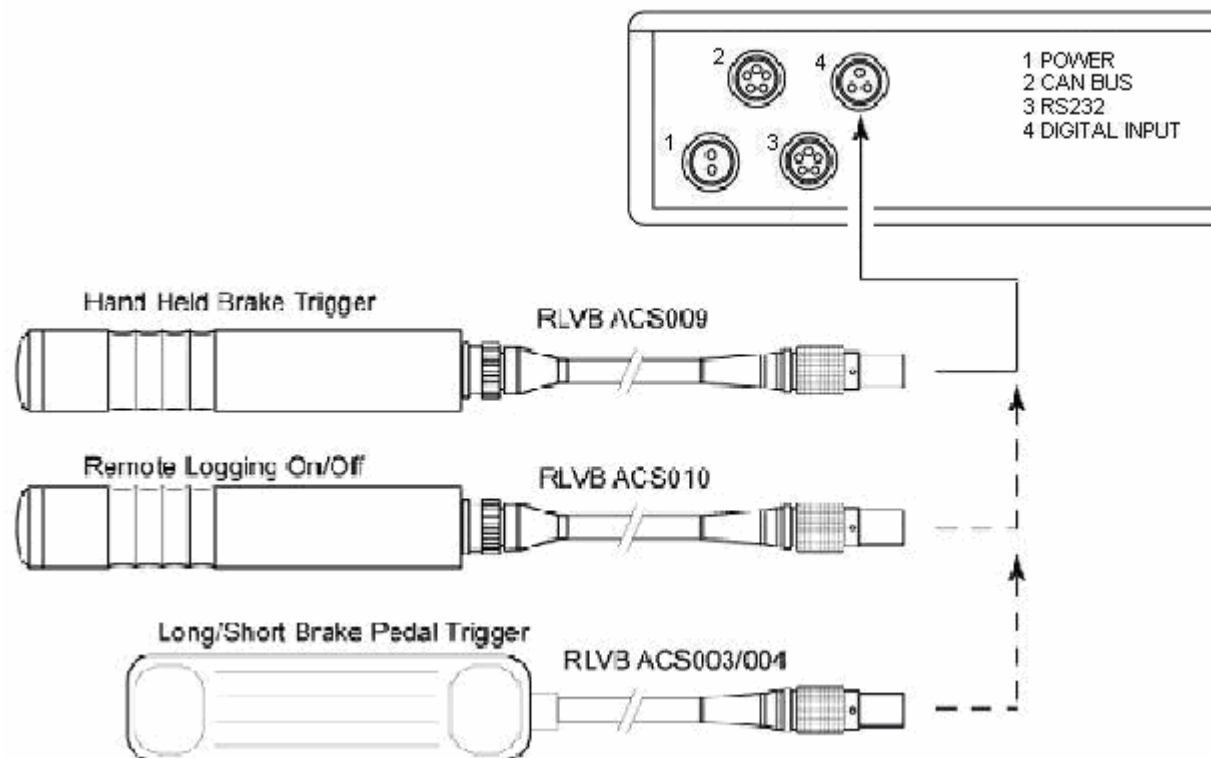
## Digital Inputs

The DIGITAL INPUT (Socket 4) contains the two digital inputs for the VBOX II Lite. Digital input 1 is also referred to as the trigger / event marker input.

A hand-held trigger is available to allow the user to record marker events in the VBOX II Lite data file.

A remote logging on/off switch is also available.

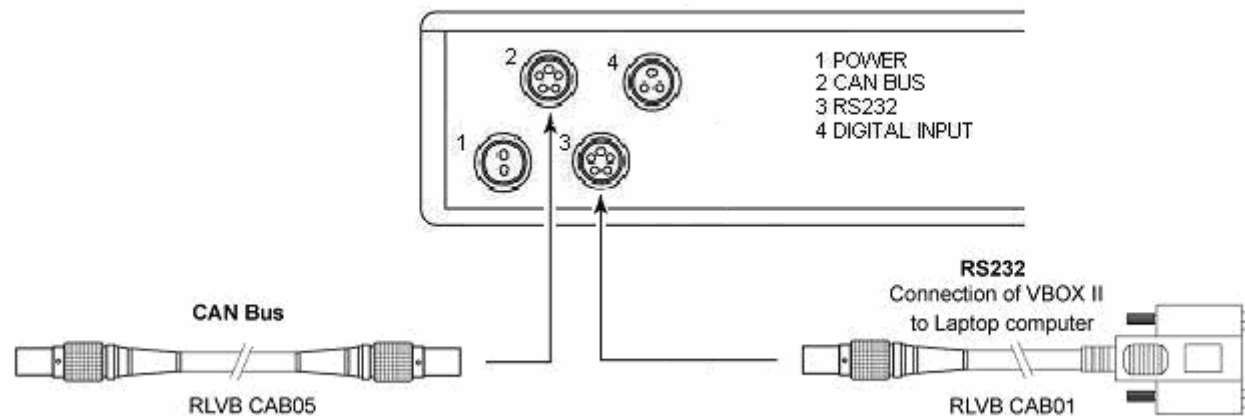
If you wish to use both digital inputs at the same time, you will require a 3way digital splitter (RLVBACS027).



## CAN / RS232 Ports

The VBOX II Lite is equipped with a CAN Bus interface and a RS232 serial port. The RS232 port is used for all communication between the VBOX and laptop PC. The RS232 port is in Socket 5 on the VBOX II Lite. The RS232 port is able to transmit live data from the VBOX to the PC for viewing and performing real-time tests.

The CAN Bus port is in Socket 2 of the VBOX II Lite. The function of this port is configurable by the user for use by either Racelogic modules (Internal mode) or the users own CAN Bus equipment (External mode). See the section 'Setup' in the VBOX software manual. The CAN Bus port also contains a secondary RS232 port for direct connections to the GPS engine for Local DGPS correction connection.



## Getting Started

Required equipment (All supplied as standard unless specified)

- ☐ VBOX II Lite
- ☐ Fully charged battery pack or Cigar lighter 12v adapter lead
- ☐ GPS Antenna
- ☐ Blank Compact Flash Card
- ☐ RS232 Cable
- ☐ VBOX Software CD
- ☐ Laptop PC(not supplied)

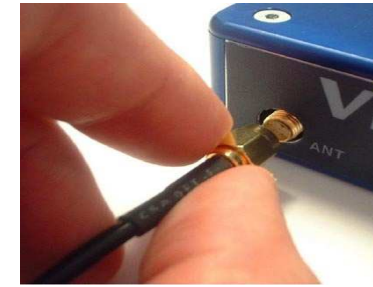
### 1.Install Software



### 2.Place VBOX in vehicle



### 3.Fit antenna connector to VBOX



### 4. Mount GPS antenna on vehicle roof



### 5.Connect serial cable (CAB01) to laptop



### 6. Connect other end of serial cable to VBOX



7. Connect the power cable/ battery pack to the VBOX



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



9. With the power applied, the red PWR led should illuminate. The VBOX II Lite will start searching for satellites. The ST led 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 blue CF led should begin to flash as data is recorded to compact flash, if inserted. When the vehicle comes to a stop, the blue CF led should extinguish. The card can now be removed and the data transferred onto the PC for analysis. If no compact flash card is fitted then data will be recorded to the internal RAM. NOTE before using the Internal RAM, the RAM should be cleared. See section 'Setup' of the VBOX Software manual.



## VBOX II Lite '.VBO' File Format

The VBOX II Lite data files are saved in standard space de-limited text format. This allows the data to easily be imported into third party applications such as word processors or spreadsheets. The files each contain a header section before the main data that describes the channel content and information about the VBOXII such as serial number and firmware version.

The [Column names] parameter specifies the data in each column of the data section.

An example of a VBOX VBO file is shown on the right.

File created on 15/04/2004 @ 08:21

[header]  
satellites  
time  
latitude  
longitude  
velocity knots  
heading  
height  
Vertical velocity m/s

[channel units]

[comments]  
(c)2003 Racelogic  
VBoxII Version4.2d  
Serial Number: 004866  
Log Rate (Hz) : 20.00  
Software Version :-8.1.4 (build45)

[column names]  
sats time lat long velocity heading height vert-vel

[data]  
004 072148.26 +3119.408424 +00062.635139 015.13 356.06 +00155.27 -00000.22  
004 072148.27 +3119.408592 +00062.635104 015.17 356.02 +00147.93 -00000.37  
004 072148.28 +3119.408629 +00062.635108 015.09 355.92 +00147.92 -00000.40  
004 072148.29 +3119.408669 +00062.635115 014.98 355.64 +00147.92 -00000.35  
004 072148.30 +3119.408711 +00062.635119 015.00 355.87 +00147.91 -00000.47  
004 072148.31 +3119.408753 +00062.635122 015.03 356.11 +00147.90 -00000.61  
004 072148.32 +3119.408797 +00062.635125 015.16 356.48 +00147.88 -00000.84  
004 072148.33 +3119.408837 +00062.635130 015.06 356.32 +00147.88 -00000.67  
004 072148.34 +3119.408874 +00062.635138 014.84 355.81 +00147.91 -00000.14  
004 072148.35 +3119.408919 +00062.635144 015.03 355.84 +00147.90 -00000.28  
004 072148.36 +3119.408968 +00062.635147 015.42 356.17 +00147.87 -00000.66  
004 072148.37 +3119.409013 +00062.635148 015.56 356.72 +00147.87 -00000.69

## VBOX.EXE Software

The VBOX.EXE software is used for configuration of the VBOX II Lite and also for analysis of the VBO data files.

For further information on the VBOX.EXE software refer to the VBOX Software manual supplied with VBOX II Lite.



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## Firmware Upgrades

Firmware refers to the operating software inside the VBOX II Lite. 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 II Lite upgrade files have a ".ruf" file extension. To upgrade the VBOX II Lite firmware, download the latest firmware file from the Racelogic web site and copy this file onto your PC. If you have done a full VBOX CD installation then you will have the upgrade programme automatically installed in the Utilities folder of VBOX folder. If not then this can also be downloaded from the website.

Connect your PC to the VBOX via the VBOX serial lead and apply power to the VBOX.

Either 'double click' on the .ruf upgrade file, which auto runs the upgrader software, or run the upgrader software and load in the .ruf firmware upgrade file. Then follow the onscreen instructions and the VBOX firmware will be upgraded. At the end of the process power down the VBOX when prompted, before further use.

During the upgrade process 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](mailto:support@racelogic.co.uk)

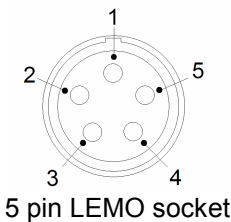
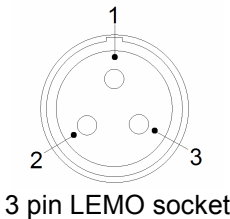
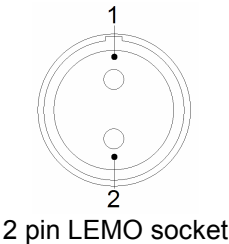
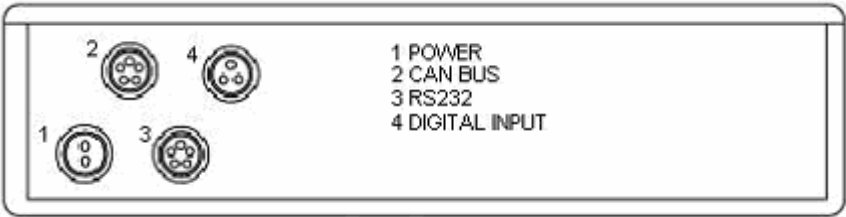


## Specification

GPS			
<b>Velocity</b>		<b>Distance</b>	
Accuracy	0.2 Km/h (averaged over 4 samples)	Accuracy	0.05% (<50cm per Km)
Units	Km/h or Mph	Units	Metres / Feet
Update rate	5 Hz	Update rate	5 Hz
Maximum velocity	1000 Mph	Resolution	1cm
Minimum velocity	0.1 Km/h	Height accuracy	10 Metres    95% CEP**
Resolution	0.01 Km/h		
<b>Absolute Positioning</b>		<b>Time</b>	
Accuracy	3m    95% CEP**	Resolution	0.01 s
Accuracy with DGPS	< 1.8m    95% CEP**	Accuracy	0.05 s
Update rate	5 Hz		
Resolution	1 cm		
<b>Heading</b>		<b>Power</b>	
Resolution	0.01°	Input Voltage range	6v-18v DC
Accuracy	0.2°	Current	Typically 560mA
<b>Acceleration</b>		<b>Environmental and Physical</b>	
Accuracy	1%	Weight	Approx 0.5Kg
Maximum	20 G	Size	119mm x 128mm x 30mm
Resolution	0.01 G	Operating temperature	-30°C to +60°C
Update rate	5 Hz	Storage temperature	-40°C to +80°C
<b>Memory</b>		<b>Definitions</b>	
<b>Compact Flash</b>	Type I	** CEP = Circle of Error Probable	
Recording time	Dependent on flash card capacity*	95% CEP (Circle Error Probable) means 95% of the time the position readings will fall within a circle of the stated diameter	
* Approximately 4.3Mb per hour used when logging GPS data at 20Hz			

Inputs	
<b>CAN Bus</b>	
Racelogic modules	Up to 32 channels from any combination of ADC02, ADC03, FIM03, TC8, Yaw sensor or CAN01
<b>Digital</b>	
Trigger/Event	Digital input can be used as test start, end and line conditions or to externally mark events in the logged data.
On/Off Logging control	Remote log control from hand-held switch

# Connection Data



Connector	1 POWER		Type	Lemo 2 pin
PIN	In/Out	Description		Range
1	I	Power +		6V to 18V
2	I	Ground		0V
Chassis		Ground		

Connector	2 CAN BUS	Type	Lemo 5 pin
PIN	In/Out	Description	Range
1	O	RS232 Tx (PORT B Local DGPS)	$\pm 12\text{v}$
2	I	RS232 Rx (PORT B Local DGPS)	$\pm 12\text{v}$
3	I/O	CAN Bus	
4	I/O	CAN Bus	
5	O	+V Power	
Chassis		Ground	

Connector	3 RS232	Type	Lemo 5 pin
PIN	In/Out	Description	Range
1	O	RS232 Tx Serial Data Transmit	$\pm 12\text{v}$
2	I	RS232 Rx Serial Data Receive	$\pm 12\text{v}$
3	-	-	
4	-	-	
5	O	+V Power	
Chassis		Ground	

Connector	4 DIGITAL INPUT	Type	Lemo 3 pin
PIN	In/Out	Description	Range
1	O	Ground	
2	I	Digital Input 2. Start/Stop Logging	0V to 5V
3	I	Digital Input 1. Brake Trigger	0V to 5V
Chassis		Ground	

#### Antenna connector

Connector	ANT	Type	SMA
PIN	In/Out	Description	Range
Center	-	RF Signal / Power for active antenna	
Chassis	-	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	Unused				(11) Longitudinal Accel. (G)		(12) Lateral Accel. (G)	
0x305	50ms	(13) Distance. (Meters)							

\*\*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) Longitudinal Acceleration, 0.01G per bit, signed.
- (11) Lateral Acceleration, 0.01G per bit, signed.
- (13) Distance, 0.000078125 meters per bit, unsigned.

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

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## Contact Information

Racelogic Ltd  
Unit 10 Swan Business Centre  
Osier Way  
Buckingham  
MK18 1TB  
UK

Tel: +44 (0) 1280 823803

Fax: +44 (0) 1280 823595

Email: [support@racelogic.co.uk](mailto:support@racelogic.co.uk)

Web: [www.racelogic.co.uk](http://www.racelogic.co.uk)

Revision	Date	Description	Author
1	21/10/2005	First Draft	JDH
2	18/09/2006	Addition of text describing Digital inputs	KB
3	05/06/2007	Inclusion of Declaration of Conformity Statement	CAS
4	07/11/2007	Correction to CAN format table	KB
5	03/12/2007	Addition of Format: Motorola to CAN Bus Data Format table	NT
6	30/04/2008	Updated Racelogic contact information	JH