VBOX PROLITE GPS Data Logger

User Guide

Introduction

The VBOX Pro Lite is a powerful instrument used for measuring the speed and position of a moving vehicle. It is based on a new generation of high performance satellite receivers, and provides accurate measurement of acceleration figures, lap times, cornering forces and much more. Due to the small size and simple installation procedure, the VBOX is ideally suited for use in cars, bikes, off road vehicles and boats.
Using a powerful GPS engine, the VBOX PROLITE can log interpolated 5Hz GPS information at 20Hz. The logged data is stored directly onto internal RAM which can then be downloaded to a PC.

The VBOX PROLITE is compatible with all of the existing peripherals including the Multifunction display, ADC03, TC8, FIM02 and Yaw rate sensor.

Features

- Non-contact 5Hz speed and distance measurement using GPS
- 1 x CAN Bus interface
- RS-232 serial interfacee
- 1 x 16bit User configurable analogue outputs
- 1 x Digital outputs
- 1 x Trigger/Event marker input
- Input Voltage 6V to 18V operating range
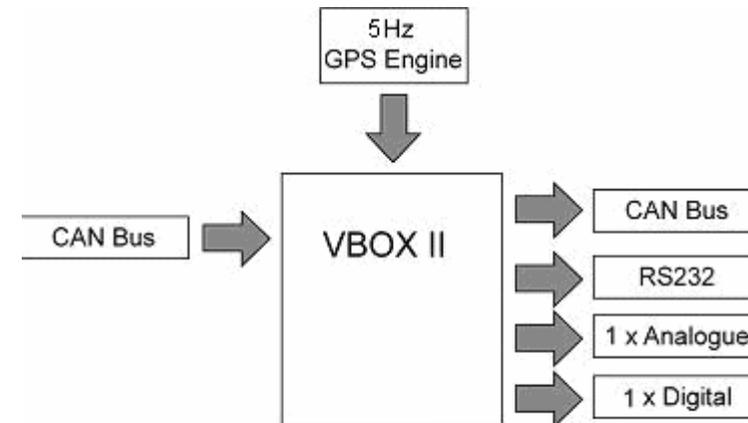
Standard Inventory

Description	Qty	Racelogic Part #
VBOX Pro Lite	1	VBPROL
Cigar Lighter adaptor	1	RLVBCAB10
GPS Magnetic Aerial	1	RLVBACS001
CD ROM containing VBOX software	1	RLVBACS030
Serial PC Cable	1	RLVBCAB01
User Manual	1	RLVBACS031
VBOX Lite carrying case	1	RLVBACS016

Optional Accessories

Description	Racelogic Part #
4.5Ah Battery Pack	RLVBACS012
Mains Charger/Supply	RLVBACS020
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	RLVBCAN01
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 Prolite 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

Red   Power ok

Yellow   Start of count

Green   Satellite count

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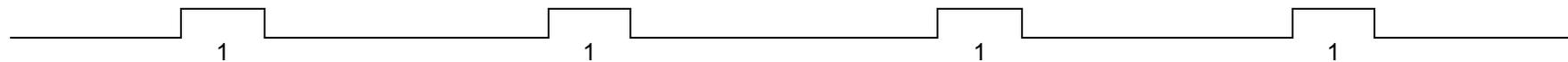
If this is the case then check that you have the GPS antenna connector correctly fitted to the VBOX. Also check that the antenna has a clear view of the sky.

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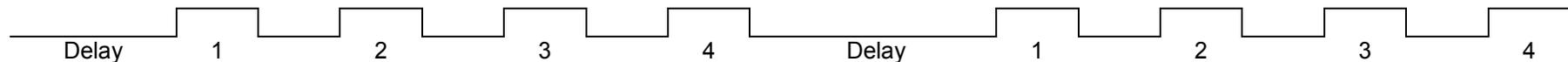
The yellow LED (**SC**) flashes to indicate start of count. When satellite lock occurs the number of green LED flashes between yellow flashes indicates the number of satellites in lock.

The following diagram shows an example of SAT LED pulse sequence.
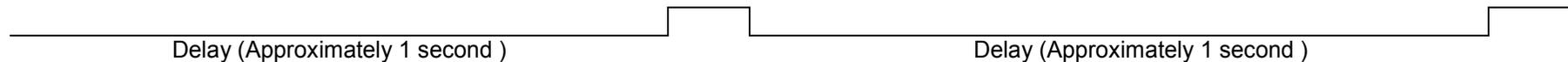
Sequence showing 1 Satellite

1   1   1   1

Sequence showing 4 Satellites

Delay   1   2   3   4   Delay   1   2   3   4

Sequence showing 0 Satellites

Delay (Approximately 1 second)   Delay (Approximately 1 second)

GPS Antenna

The GPS Antenna supplied with the VBOX II 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.
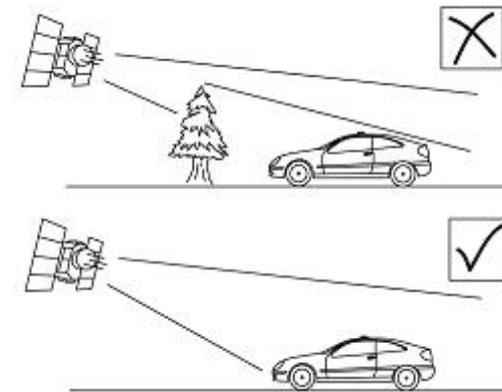
DIGITAL and ANALOGUE OUTPUTS

The digital output on connector 3 pin 2 has a frequency/pulse output corresponding to velocity. The pulse per meter range is adjustable in software.

The analogue output on connector 3 pin2 outputs 0-5volt DC signal corresponding to velocity.

The Trigger/Event marker input is on pin3 of connector 3. This enables a hand held brake trigger to be connected for trigger event marking. Not for brake trigger use.
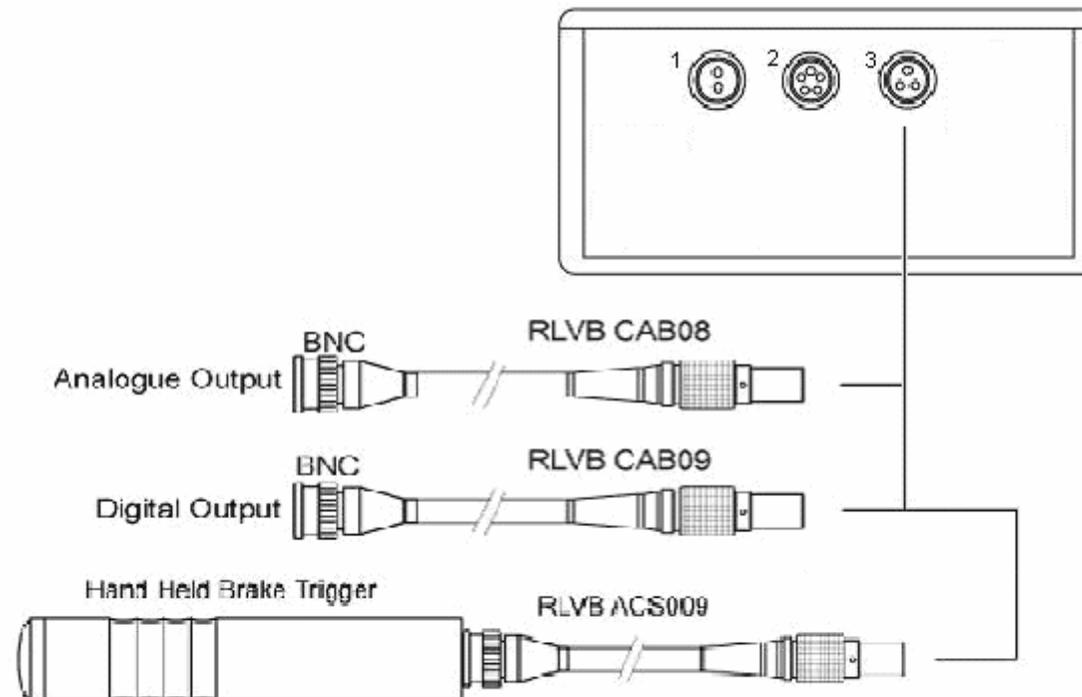
CAN / RS232 Ports

The VBOX Prolite is equipped with a CAN Bus interface and a RS232 serial port, both of these interfaces share the same socket. The RS232 port is used for all communication between the VBOX and laptop PC. The RS232 port is able to transmit live data from the VBOX to the PC for viewing and performing real-time tests.

The function of the CAN 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.

CAN Bus

RLVB CAB05

RS232
Connection of VBOX II
to Laptop computer

RLVB CAB01
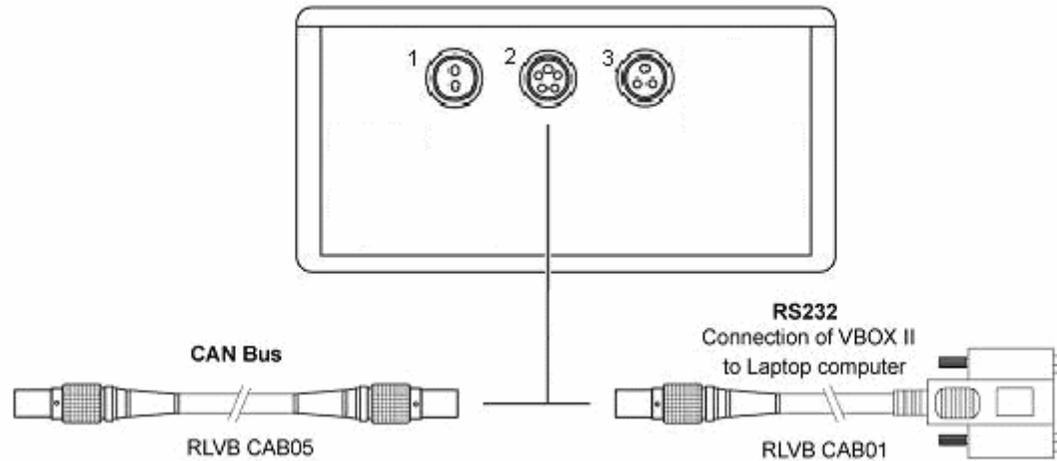
Getting Started

Required equipment (All supplied as standard unless specified)

- ❑ VBOX Pro Lite
- ❑ Fully charged battery pack or Cigar lighter 12v adapter lead
- ❑ GPS Antenna
- ❑ 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 Pro Lite will start
searching for satellites. The Green 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.
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.

Red   Power ok

Yellow Start of count

Green   Satellite count

VBOX Pro Lite '.VBO' file format

After downloading a file from the VBOX the software will save the data file as a 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 VBOX ProLite 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 -00000.47
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
```
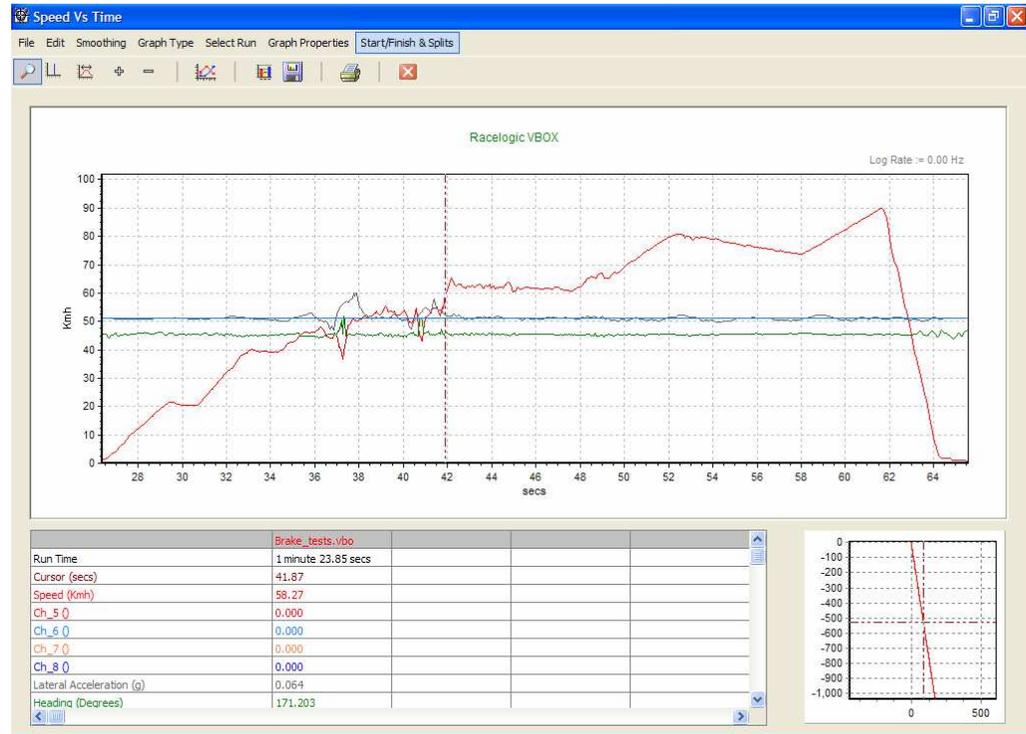
VBOX.EXE Software

The VBOX.EXE software is used for configuration of the VBOX Pro 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 Pro Lite

Firmware Upgrades

Firmware refers to the operating software inside the VBOX Pro 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 Pro Lite upgrade files have a ".ruf" file extension. To upgrade the VBOX Pro 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 downloaded from the website.
Connect you 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

Specification

GPS

Velocity		Distance	
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	5Hz
Maximum velocity	1000 Mph	Resolution	1cm
Minimum velocity	0.1 Km/h	Height accuracy	10 Metres 95% CEP**
Resolution	0.01 Km/h	Height accuracy with DGPS	5 Metres 95% CEP**

Absolute Positioning		Time	
Accuracy	3m 95% CEP**	Resolution	0.01 s
Accuracy with DGPS	1.8m 95% CEP**	Accuracy	0.05 s
Update rate	20 Hz		
Resolution	1 cm		

Heading		Power	
Resolution	0.01°	Input Voltage range	6v-18v DC
Accuracy	0.2°	Current	Typically 560mA

Acceleration		Environmental and physical	
Accuracy	1%	Weight	Approx500 grammes
Maximum	20 G	Size	84mm x 128mm x 40mm
Resolution	0.01 G	Operating temperature	-30°C to +60°C
Update rate	5Hz	Storage temperature	-40°C to +80°C

| Memory		Definitions	
Internal memory	1 Mbyte battery backed	** CEP = Circle of Error Probable	
Recording time	SRAM. Approx 45 minutes logging all GPS channels	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	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,

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 @ 100Km/h		90 pulses per metre
Update rate	5Hz	Accuracy	0.01Km/h @ 100Km/h
		Update rate	5Hz

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

Inputs

CAN Bus

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

Digital

Tiigger/Event	
On/Off Logging control	Remote log control from hand-held switch

Connection Data
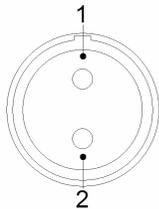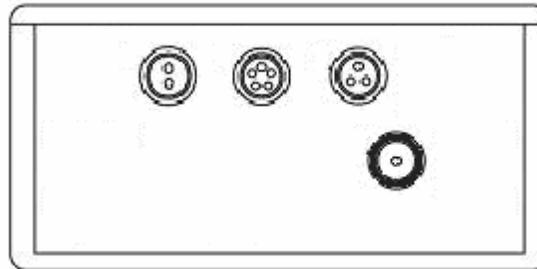
2 pin LEMO socket
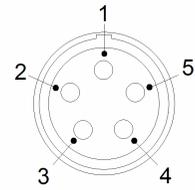
5 pin LEMO socket
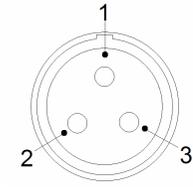
3 pin LEMO socket

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	3 Analogue/Dig OUT+ Event input		Type	Lemo 3 pin
PIN	In/Out	Description		Range
1	O	Analogue Voltage Output		0V to 5V
2	O	Digital Pulse Output		0V to 5V
3	I	Trigger/Event i/p		
Chassis		Ground		

Connector   2 CAN Bus/RS232   Type   Lemo 5 pin

PIN	In/Out	Description	Range
1	O	RS232 Tx Serial Data Transmit	±12v
2	I	RS232 Rx Serial Data Receive	±12v
3	I/O	CAN Bus	
4	I/O	CAN Bus	
5	O	+V Power	
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

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. (Meters)				(12) Longitudinal Accel. (G)		(13) Lateral Accel. (G)	

**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.

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	21/10/2005	First Draft	KB
2	30/04/2008	Updated Racelogic contact details	JH