VBOX II User Manual

01 - VBOX II Front Panel

VBOX II units 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.

Note: Entering the configuration screen will cause the VBOX to stop logging to the SD card. When in continuous logging mode, please ensure that the '■' button is pushed prior to removing the SD card to avoid data loss.

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. Most Main menus contain sub-menus, for example the Settings and Setup Antennas menus contain separate menus for each parameter.

Note: The options highlighted in blue are only available on the SL series units.

Main menu

SETTINGS	Press '■' to enter the VBOX general settings menu.
COLDSTART	Press '■' to perform a GPS cold start
MODE	Press '■' to change the mode of operation between VBOX module mode and Stand Alone mode. Then press '■' to confirm.
SETUP ANTENNAS	Press '■' to enter the antenna configurations menu. This menu contains separate sub-menus for pitch antenna and roll antenna pairs
SMOOTHING	Press '■' to edit the smoothing levels of the Lat acc and Long acc channels, and also Slip, Pitch, Roll, channels on SL units only.
OUTPUTS	Press '■' ' configure the digital and analogue outputs.
EXIT	Press '■' to exit the setup menu and cause the settings to be saved in EEPROM

Settings menu

UNITS	Press '■' to change the displayed Velocity units. Then press '■' to confirm. KMH, MPH or Knots
APPLICATION	Press '■' and then use the '◄' and '►' buttons to select between AUTOMOTIVE or MARINE mode. Marine mode causes the box to display the Pitch, Roll and Slip angles as Trim, Heel and Leeway Angles on the built in screen and also as channel names inside the logged file.
USB MODE	Press '■' and then use the '◄' and '►' buttons to select whether the USB port is assigned to Serial data mode or Card reader mode.
CAN MODE	Press '■' and then the '◄' and '►' buttons to choose between the following modes: **VCI MODE*** To connect any external CAN modules to the input of the VBOX II **RACELOGIC MODULES MODE** To connect Racelogic CAN modules to the RLVBOX II (input or output)
LOG OPTIONS	Press '■' to enter the Log Options Menu. In this menu the Logging Mode and Log rate can be set.
SERIAL RATE	Press '■' and then use the '◄' and '►' buttons to select a serial data rate. The maximum serial rate is equal to the Log rate.
GPS	Press '■' to enter the GPS configuration Menu. The Kalman Filter, Dynamic Mode and DGPS mode is configured within this menu.
TIME OFFSET	Press' the '◄' and '►' buttons to set an Time offset in order to align the VBOX time to the users Local time.

BACK	Press '■' to go back to the Main menu.

Setup antennas (pitch antenna)

SEPARATION	Press '■' and then use the '◄' and '►' buttons to change the antenna separation. Then press '■' to confirm. Range is 0.5 – 5.0 m in 0.1 m increments
LEVEL	Press'■' and then use the '◄' and '►' buttons to enable or disable the LEVEL option. With the LEVEL set to YES the RTK lock is more resilient. But maximum ROLL or PITCH in this mode should be 10 degrees.
SWAP ANTENNAS	Set to 'ON' to allow the primary Antenna A to be mounted ahead of the Secondary Antenna B. Default is 'OFF'. Then press '■' to confirm.
SLIP OFFSET	Press '■' to enter the Slip offset sub menu. Within this sub menu the Slip offset can be calculated and applied or cleared.
PITCH OFFSET	Press '■' to enter the Pitch offset sub menu. Within this sub menu a Pitch offset can be calculated and applied or cleared.
BACK	Press '■' to go back to the Main menu.

Setup antennas (roll antenna)*

***VB20SL3 triple antenna units only**

SEPARATION	Press'■' and then use the '◄' and '►' buttons to change the antenna separation. Then press '■' to confirm. Range is 0.5 – 5.0 m in 0.1 m increments
LEVEL	Press '■' and then use the '◄' and '►' buttons to enable or disable the LEVEL option. With the LEVEL set to YES the RTK lock is more resilient. But maximum ROLL or PITCH in this mode should be 10 degrees.
ROLL OFFSET	Press '■' to enter the Roll offset sub menu. Within this sub menu a Roll offset can be calculated and applied or cleared.
BACK	Press '■' to go back to the Main menu.

Smoothing menu

LAT ACC	Press '■' and then use the '◄' and '►' buttons to change the amount of smoothing applied to the calculated Lateral Acceleration output. Then press '■' to confirm. 0.0 – 5.0 (0.1 steps)
LONG ACC	Press '■' and then use the '◄' and '►' buttons to change the amount of smoothing applied to the calculated Longitudinal Acceleration output. Then press '■' to confirm. 0.0 – 5.0 (0.1 steps)
SLIP	Press '■' and then use the '◄' and '►' buttons to change the amount of smoothing applied to the Slip angle channel. Then press '■' to confirm. 0.0 – 5.0 (0.1 steps)
PITCH	Press '■' and then use the '◄' and '►' buttons to change the amount of smoothing applied to the Pitch angle channel. Then press '■' to confirm. 0.0 – 5.0 (0.1 steps)
ROLL	Press '■' and then use the '◄' and '►' buttons to change the amount of smoothing applied to the Roll angle channel. Then press '■' to confirm. 0.0 – 5.0 (0.1 steps)
BACK	Press '■' to go back to the Main menu.

Outputs: digital setup menu (channel 1 and 2)

OUTPUT	Press '■' and then use the '◄' and '►' buttons to associate either of the following channels SPEED, SLIP, PITCH, ROLL, LAT ACC and LONG ACC to the Digital output. Then press '■' to confirm.
PULSES PER METER	Only available when output is set to SPEED. Press '■' and then use the '◄' and '►' buttons to set the number of pulses per revolution. Then press '■' to confirm. 0.1 – 120 (0.1 Steps)
MAX SPEED	Only available when output is set to SPEED. Press ■' and then use the '◄' and '►' buttons to set the maximum Speed. Then press '■' to confirm. 0 – 400 km/h (1 km/h steps)
MAX VALUE	Only available when output is set to LAT ACC, LONG ACC, PITCH, SLIP or ROLL Press '■' and then use the '◄' and '►' buttons to set the maximum value of that channel. Then press '■' to confirm. 0 – 180^{o} (1^{o} steps) for Slip 0 – 90^{o} (1^{o} steps) for Pitch 0 – 90^{o} (1^{o} steps) for Roll 0.5 – 2 g (0.1 g steps) for LAT ACC 0.5 – 2 g (0.1 g steps) for LONG ACC
MAX FREQUENCY	Only available when output is set to LAT ACC, LONG ACC, PITCH, SLIP or ROLL Press '■' and then use the '◄' and '►' buttons to set the maximum Frequency used on the digital output. Then press '■' to confirm.

	1 – 50 kHz (0.1 kHz steps)
TEST	Press '■' and then use the '◄' and '►' buttons to set a test value that the Digital output will simulate. Then press '■' to quit.
EXIT	Press '■' to exit the setup menu and cause the settings to be saved in EEPROM

Outputs: analogue setup menu (channel 1 and 2)

OUTPUT	Press '■' and then use the '◄' and '►' buttons to associate either of the following channels SPEED, SLIP or PITCH, ROLL, LAT ACC and LONG ACC to the Analogue output. Then press '■' to confirm.
VALUE @ +5V	Press '■' and then use the '◄' and '►' buttons to set the value to represent +5 V. Then press '■' to confirm. 1 – 400 km/h (1 km/h steps) -179^{o} to 180^{o} (0.1^{o} steps) for Slip -89^{o} to 90^{o} (1^{o} steps) for Pitch -89^{o} to 90^{o} (1^{o} steps) for Roll -1 to 2 g (0.1g steps) LAT ACC -1 to 2 g (0.1g steps) LONG ACC
VALUE @ 0V	Only available when output is set to SPEED. Press '■' and then use the '◄' and '►' buttons to set the velocity to represent 0 V. Then press '■' to confirm. 0-399 km/h (1 km/h steps)
VALUE @ -5V	Only available when output is set to LAT ACC, LONG ACC, PITCH, SLIP or ROLL. Press '■' and then use the '◄' and '►' buttons to set the value to represent -5 V. Then press '■' to confirm. -2 to 1 g (0.1g steps) LAT ACC -2 to 1 g (0.1g steps) LONG ACC -180^{o} to 179^{o} (0.1^{o} steps) for SLIP -90^{o} to 89^{o}(1^{o} steps) for PITCH -90^{o} to 89^{o}(1^{o} steps) for ROLL

TEST	Press '■' and then use the '◄' and '►' buttons to set a test value that the Analogue output will simulate. Then press '■' to quit.
EXIT	Press '■'to exit the setup menu and cause the settings to be saved in EEPROM.

GPS menu

DYNAMIC MODE	Press '■' and then the '◄' and '►' buttons to select the required dynamics. **HIGH DYNAMICS -** Essential for brake testing and lane changing manoeuvres. **NORMAL -** Select this for standard testing – speed, distance, etc. **LOW DYNAMICS -** Select this for route mapping and similar tests where the level of dynamic response is not important.
DGPS MODE	Press'■' and then the '◄' and '►' buttons to select the DGPS settings. **OFF** – No DGPS applied – standard position accuracy 3 m CEP **WAAS** – position accuracy 1.8 m CEP **40CM** – position accuracy 40CM* **20CM** – position accuracy 20CM*
KALMAN FILTER	Press '■' and then the '◄' and '►' buttons to set Kalman filter options. **POSITION LEVEL** – Smoothes the positional data **VELOCITY LEVEL** – Smoothes the velocity data
BACK	Press'■' to return to the GPS menu

*Note: These accuracies are only achievable in conjunction with a DGPS base station

02 - VBOX II SD Cards and Logging

The VB2 stores logged data onto SD cards. The supplied SD cards are already optimised for use on the VB2 and as such do not need formatting before use. Should the SD card subsequently need formatting due to card errors this can be done using windows - the SD card will need to be inserted into an SD card reader, before right clicking on the drive within the 'computer' section and selecting 'format'. To run a full format, make sure that 'quick format' is unmarked. VB2 units work with FAT or FAT32 card formats.

When logging data to an SD card, the OLED display will show a small disk icon next to the name of the current file at the bottom of the display. It is important not to remove the SD card while the VB20SL3 is logging. 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, wait a short time after the vehicle has stopped for logging to finish and the disk icon to disappear from the screen.

Once the disk icon has gone, it is safe to remove the SD card. If '**Log continuously**' is selected, press the start/stop logging switch (if connected) to stop logging so that the card may be safely removed. If no start/stop logging switch is available, press '■' on the front panel to enter the on-board configuration screen. This will close the file so that the card can be removed.

It is recommended that files are removed from the disk regularly as writing continuously without fragments is easy. The more file fragments there are on an SD card, the harder it is to stream data to the card.

There are two Logging modes:

- **Log only when moving**: In this mode, the VBOX will start to log data only when a speed higher than 0.5 km/h is detected. This requires a satellite lock.
- **Log continuously**: Data is continuously logged to the SD card regardless of vehicle velocity or the number of satellites.

To set channels to be logged, they must be selected in the VBOX setup window of VBOXTools. Please see the VBOXTools manual for further information. The maximum number of CAN channels available for logging varies according to whether or not the Kalman Filter is enabled, as follows:

- Maximum logged channels without Kalman Filter enabled (both velocity and position set to zero): All standard channels plus **20** CAN channels.
- Maximum logged channels with Kalman Filter enabled (either velocity or position set to non-zero values): All standard channels plus **10** CAN channels.

03 - VBOX II Display screen overview

The screen will display data when the VB2 is operating. It also displays all the menus required to configure the VB2 via the front panel controls.

On start-up, the display screen shows the unit's firmware version and current offset value.

During normal operation, the display screen displays Speed (mph or km/h) and Slip Angle (dual antenna units only) Scroll left or right ('◄'and '►'), to display Pitch or Roll Angle instead.* As well as the number of satellites that the VB2 has locked on to, there are also three status indicators at the top of the display.

*Slip, pitch and roll angle only available on dual / triple antenna units.

GPS Status	Front Panel Light Status		
No Satellite Lock	-	SAT (flashing)	RTK (flashing)
Full Lock	OK	-	-
Antenna A only SAT Lock	-	RTK (flashing)	RTK (flashing)
Antenna A and B SAT Lock*	-	RTK	RTK (flashing)
Antenna A and C SAT Lock*	-	RTK (flashing)	RTK

* SL twin / triple antenna units only

If a DGPS mode is enabled, it is indicated by the middle indicator light with one of the following messages.

DGPS Mode	Light Status
WAAS, SBAS or EGNOS Differential correction	WAAS
40 cm Differential correction from Base station	40 cm

Logged File name:

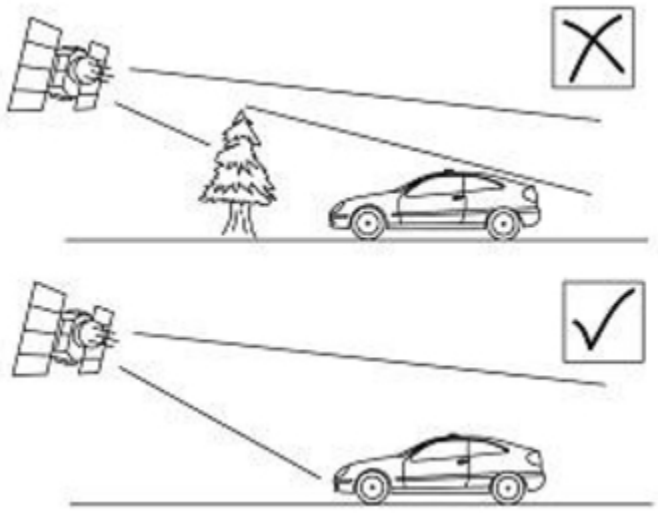
When an SD card is inserted the file name of the logged file appears on the screen whilst data is being logged.

04 - VBOX IISX Single antenna placement

The GPS Antennas supplied with the VB2SX are 3.5 V active antennas. For the best possible signal quality, it is important to maintain a clean connection between the antennas and the VBOX. Before fixing the antennas 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.

RLVBACS065 'mushroom' type Ground Plane Antenna

05 - VBOX 20SL Dual antenna placement

Whilst installation and use of the VB20SL is intended to be fast and simple, careful attention must be paid to placement of the two antennas.

Note: It is essential that the separation of the two antennas is exactly the same as the value set in the unit's configuration screen. If the separation is incorrect, data may not be given or may be inaccurate. The measured distance between the antennas should be the straight-line distance between the antennas regardless of the mounting angle. It is not the 2D distance between the antennas as viewed from above.

The picture above shows a typical antenna placement for the measurement of Body Slip Angle and Pitch angle.

Antenna A is the *primary antenna,* from which all calculations are based. If overall slip is to be measured (at the centre of the vehicle), the primary antenna should be placed rearward of the secondary. Alignment of the antennas is not completely essential as the Slip Angle Sensor has the ability to calculate any offset. See the Slip Angle Offset Section.

However if you wish to measure Pitch or Roll then the alignment of the antennas must be in line with the vehicle or at 90^{o} as accurately as possible.

The picture below shows a typical antenna placement for the measurement of Body Slip Angle and Roll angle.

When measuring slip at a specific point on a vehicle (for example over a given wheel), the primary antenna must be placed over this point on the vehicle, whilst the secondary antenna should be placed towards the centre of the vehicle.

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.

If only one antenna will be placed ‘off-vehicle’ then only one Ground Plane antenna need be purchased.

Antenna separations >2 m

When the antenna separation is >2 m it is advised where possible to mount the antennas as level as possible so that the 'LEVEL' option can be enabled, otherwise the RTK lock is not so reliable and the Slip and Roll/Pitch data can drop out or become intermittent.

The VB20SL must only be used with the supplied antenna, unless instructed otherwise by Racelogic.

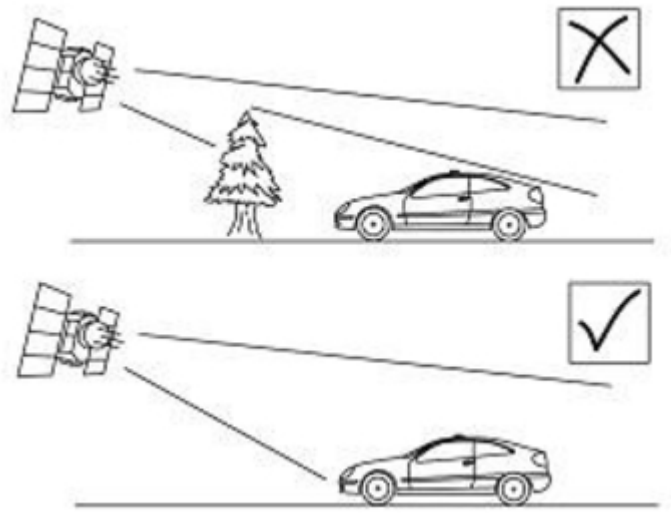
GPS antenna

The GPS Antennas supplied with the VB20SL are 3.5 V active antennas. For the best possible signal quality, it is important to maintain a clean connection between the antennas and the VBOX. Before fixing the antennas 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.

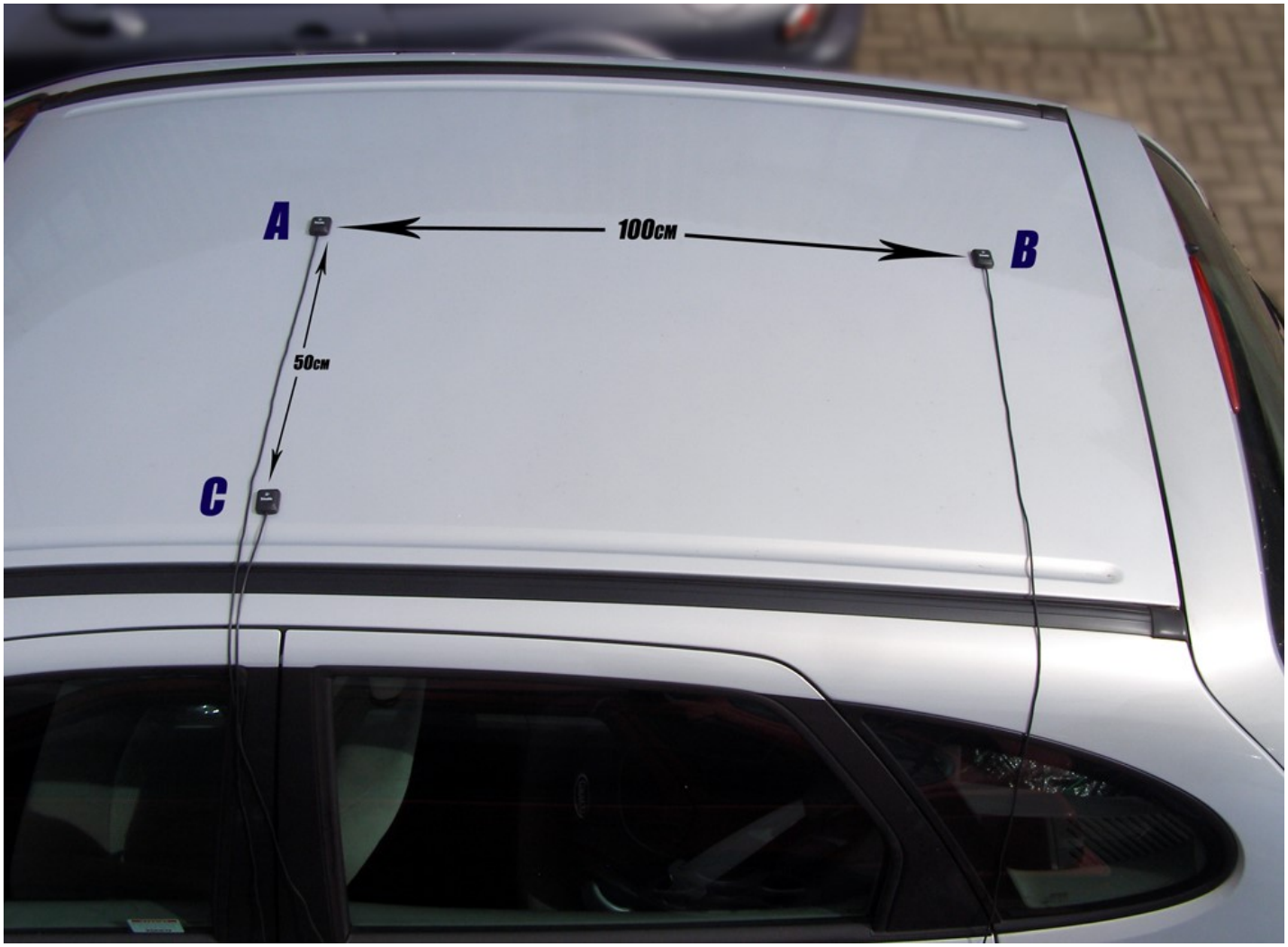
NOTE: VB20SL can struggle with maintaining an RTK lock required for Slip and Pitch measurement if the antennas are placed too close to Roof Bars. If a poor mounting position cannot be avoided then use Ground plane antennas, RLVBACS065.



06 - VBOX 20SL3 Triple antenna placement

Whilst installation and use of the VB20SL3 is intended to be fast and simple, careful attention must be paid to placement of the antennas.

Note: It is essential that the separation of Antenna B and Antenna C from Antenna A is exactly the same as the separation values set inside the VB20SL3 via the configuration screen. If the separation is incorrect, data may not be given or may be inaccurate. The measured distance between the antennas should be the straight-line distance between the antennas regardless of the mounting angle. It is not the 2D distance between the antennas as viewed from above.



The picture above shows a typical 3-antenna placement for the measurement of Body Slip Angle, Pitch and Roll angle. Antenna A the primary antenna is placed in the centre of the roof. Antenna B is placed behind Antenna A, allowing True heading, Slip angle and Pitch Angle to be measured. Antenna C is placed to the side of Antenna A allowing the measurement of Roll angle.

Antenna A is the *primary antenna,* from which all calculations are based. If overall slip is to be measured (at the centre of the vehicle), the primary antenna should be placed at the centre of the vehicle. Alignment of the antennas is not completely essential as the Slip Angle Sensor has the ability to calculate any offset. See the Slip Angle Offset Section.

However if you wish to measure Pitch or Roll then the alignment of the antennas must be in line with the vehicle or at 90^{o}as accurately as possible.

When measuring Slip angle Antenna B can be placed either in front or behind Antenna A. If it is placed behind Antenna A as in the picture above then the ‘Swap Antenna’ option needs to be enabled in the Antenna configuration options.

When measuring Slip angle at a specific point on a vehicle (for example over a given wheel), the primary Antenna A must be placed over this point on the vehicle.

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.

If a vehicle roof also has obstacles such as roof bars then Ground plane antennas should be used as they can be mounted higher than the obstacle.

The Ground Plane ‘mushroom’ style antennas RLVBACS065 are available from your VBOX distributor.

If only one antenna will be placed ‘off-vehicle’ then only one Ground Plane antenna need be purchased.

Antenna separations >2 m

When the antenna separation is >2M it is advised where possible to mount the antennas as level as possible so that the 'LEVEL' option can be enabled, otherwise the RTK lock is not so reliable and the Slip and Roll/Pitch data can drop out or become intermittent.

The VB20SL must only be used with the supplied antenna, unless instructed otherwise by Racelogic.

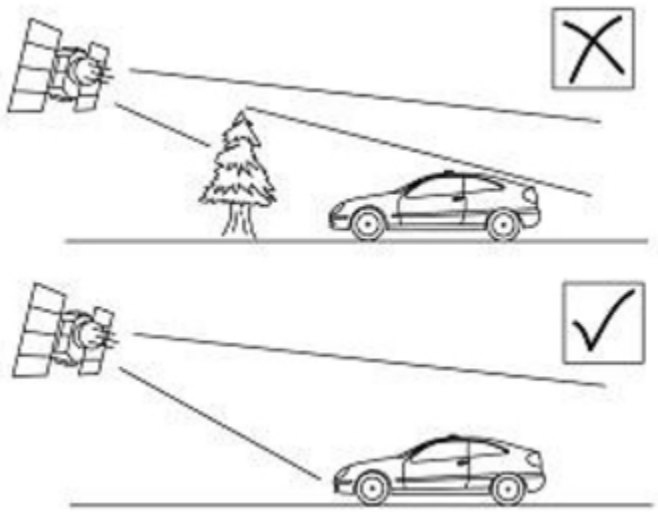
GPS antenna

The GPS Antennas supplied with the VB20SL3 are 3.5v active antennas. For the best possible signal quality, it is important to maintain a clean connection between the antennas and the VBOX. Before fixing the antennas 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.

NOTE: VB20SL3 can struggle with maintaining an RTK lock required for Slip, Pitch and Roll measurement if the antennas are placed too close to Roof Bars. If a poor mounting position cannot be avoided then use Ground plane antennas, RLVBACS065.



Using the VB20SL3 with one GPS antenna

The VB20SL3 can be used like a traditional VBOX. Only Antenna A is needed if the VB20SL3 is to be used like a traditional VBOX without the requirement to measure Slip, Pitch, Roll, YAW rate and Lateral Acceleration channels.

For single antenna use (for standard, non-slip GPS data), the antenna should be connected to the Ant A connector.

Velocity can be output on either the Analogue or Digital outputs.

See the table below for the GPS data available with each antenna configuration.

Antenna combinations	Sats	Time	Latitude	Longitude	Velocity	Heading	Height
A	✓	✓	✓	✓	✓	✓	✓
A+B	✓	✓	✓	✓	✓	✓	✓
A+C	✓	✓	✓	✓	✓	✓	✓
A+B+C	✓	✓	✓	✓	✓	✓	✓

Antenna combinations	Vertical Velocity	True Heading	Slip Angle	Pitch Angle	Yaw rate	Lateral Velocity	Roll Angle
A	✓	✗	✗	✗	✗	✗	✗
A+B	✓	✓	✓	✓	✓	✓	✗
A+C	✓	✗	✗	✗	✗	✗	✓
A+B+C	✓	✓	✓	✓	✓	✓	✓

The VB20SL3 has a brake trigger input so not only can the VB20SL3 measure and output Velocity it can measure and output Trigger Velocity, Trigger to zero Time and Trigger to zero Distance. This data is logged to SD card and available on the CAN bus or USB/serial connection bus along with all the other GPS data.

NOTE: When measuring a braking distance the GPS optimisation must be set to High and the Kalman filter Velocity parameter set to 0 (zero), via the front panel controls or the VBOXTools software.

07 - VBOX 20SL Slip / roll angle offsets

Slip angle offset

When using the VB20SL3 for measurement of Slip Angle, Pitch and/ or Roll Angle, True Heading, Lateral Velocity or Yaw Rate, it is essential that the Slip Angle offset is determined before conducting tests. This then compensates for any misalignment in the placement of Antennas A and B.

There are also many occasions when the antennas cannot be placed directly in line with the car, such as when an ‘off-vehicle’ antenna is used to measure the Slip angle over a particular wheel.

Measuring Pitch Angle and Slip Angle

To measure Pitch angle accurately at the same time as Slip angle with Antennas A and B will require the antennas to be aligned as close as possible to a line parallel to the longitudinal line of the car.

Setting the slip offset

The VB20SL3 includes a built-in facility for calculating and setting the offset. With the antennas placed suitably and the antenna separation set correctly in the unit, enter the Setup Antenna configuration menu and select Slip offset ‘Calc. Offset’. The unit will give instructions on its display screen to allow it to determine the offset.

First, the unit will instruct you to drive at a speed greater than 25 km/h. Once this is achieved, the unit will tell you to drive straight, and will begin calculating the Slip Angle offset automatically. During the 5 second process, it is very important that you keep the vehicle in a straight line and above 25 km/h. The Slip angle sensor beeps during this calculation and then stops beeping when it has finished calculating the offset.

If required, the Slip Angle offset can be re-calculated at any time by repeating this procedure. Selecting the ‘Clear Offset’ option in the Configuration Screen will clear the current offset value.

Please note that the unit will need to have a full RTK lock to perform this procedure – if the orange ‘RTK’ light is flashing, the procedure cannot be initiated.

Pitch / roll angle offset

It is not always possible to mount the antennas on a vehicle so that they are perfectly level. In order to compensate for non-level antenna placements you should use the Pitch and/or Roll offset facility, which will automatically compute and then use an offset compensation.

Measuring Roll angle:

To measure Roll angle accurately with Antennas A and C will require the antennas to be aligned as close as possible to a line perpendicular 90^{o} to the longitudinal line of the car.

Setting pitch / roll offset

Press the ’■’ button to enter the Main menu then select the Setup Antenna Menu, and then select either the Pitch or Roll antenna setup menu.

From within either the Pitch or Roll antenna setup menu select either Pitch or Roll offset menu, when the screen shows ‘CALC OFFSET’ press the ’■’ to calculate a PITCH or ROLL offset.

If required, the Pitch or Roll angle offset can be re-calculated at any time by repeating this procedure. Selecting the ‘Clear Offset’ option will also clear the current offset value.

Setting slip angle offset remotely via CAN

It is possible to request that the VB20SL3 calculates a Slip Angle Offset by sending it requests via CAN.

The CAN Baud rate is 500Kbit/s, Motorola 11 bit – Standard Frame, The DLC = 8

The VB20SL3 will respond on CAN to indicate stages of the Slip offset process and also indicate completion or failure.

Please see the table below:

Message Type		CAN ID	Data Bytes							
			0	1	2	3	4	5	6	7
Request	Start Slip offset calculation	0x7FE	46	49	4C	45	4D	41	4E	40
Request	Cancel Slip offset calculation	0x7FE	46	49	4C	45	4D	41	4E	41
Response	Increase speed to >25 km/h	0x7FB	05	02	00	00	00	00	00	00
Response	Drive Straight	0x7FB	05	03	00	00	00	00	00	00
Response	Offset done – value shown in Data bytes 2-5	0x7FB	05	01	3F	9D	70	A4	00	00
Response	Offset failed	0x7FB	05	00	00	00	00	00	00	00

The Response message to indicate completion also contains the Offset value as a 32 bit IEEE float on Data bytes 2-5.

In the example above Data bytes 2 - 5 = 3F 9D 70 A4 which equals a decimal value of 1.23^{o}

Level

The ‘LEVEL’ option should be enabled (set to YES) when the antennas are mounted within 10^{o} of each other (from the horizontal), and not expected to exceed 10^{o} during testing. With the LEVEL option enabled the GPS engines maintains its RTK lock more efficiently and the Slip and Pitch channels are less likely to drop out.

If the expected angle between the antennas will be greater than 10^{o} then the ‘LEVEL’ option should be disabled (set to ‘NO’).

Note: When the antenna separation is <2 m the RTK lock is very resilient in most conditions and scenarios when the ‘Level’ option is not enabled.

08 - VBOX II CAN / RS232 / USB

VBOX II units are equipped with a CAN bus interface, an RS232 serial socket and an USB socket. Either of the SERIAL or USB sockets can be used for all communication between the VBOX and a PC, including configuration of the VBOX and to transmit live data from the VBOX to the PC for viewing and performing real-time tests.

Note, however, that only the USB socket can be used for upgrading the VBOX's firmware.

CAN

The CAN Bus port is available in either the socket labelled CAN or the socket labelled Serial. This CAN port has three functions, CAN Input in VCI mode, CAN Input in Racelogic Modules Mode (Internal Mode) and CAN output in Racelogic Modules Mode (External Mode).

VCI Mode:

This mode should be selected if you wish to log incoming CAN data from external modules from other manufacturers, or a Racelogic Micro Input Module. Note in VCI mode no CAN output or connection to any other Racelogic modules is possible.

Racelogic Modules mode

This mode should be selected when Racelogic modules are connected to the VBOX or VBOX CAN output is required. Depending upon configuration, VBOX Tools software should be set as follows:

- **Internal Mode:** This mode should be selected when Racelogic input modules are connected to the VBOX. In this mode the CAN id's and Baud rate are non configurable.
- **External Mode:** This CAN mode should be used when a VBOX CAN data output is to be used by an external CAN device such as a Data acquisition system. In this mode the attributes of the CAN output stream are configurable by the user in VBOX Tools

The Socket labelled CAN also contains a secondary RS232 port for direct connections to the GPS engine. These can be used to provide the GPS engine with Local DGPS correction messages, or occasionally for fault-finding under the instruction of a Racelogic employee.

09 - VBOX II Smoothing and filtering

Velocity

VBOX II units 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, such as brake stop and acceleration tests.

Slip, pitch, roll angle and acceleration channels

The smoothing routine is set by selecting a value from 0 – 5.0 in 0.1 steps. This value corresponds the size in time (S) of a moving window smoothing routine.

e.g. if 0.3 is selected then a smoothing window of 0.3 seconds (6 samples @20 Hz) will be applied to the data.

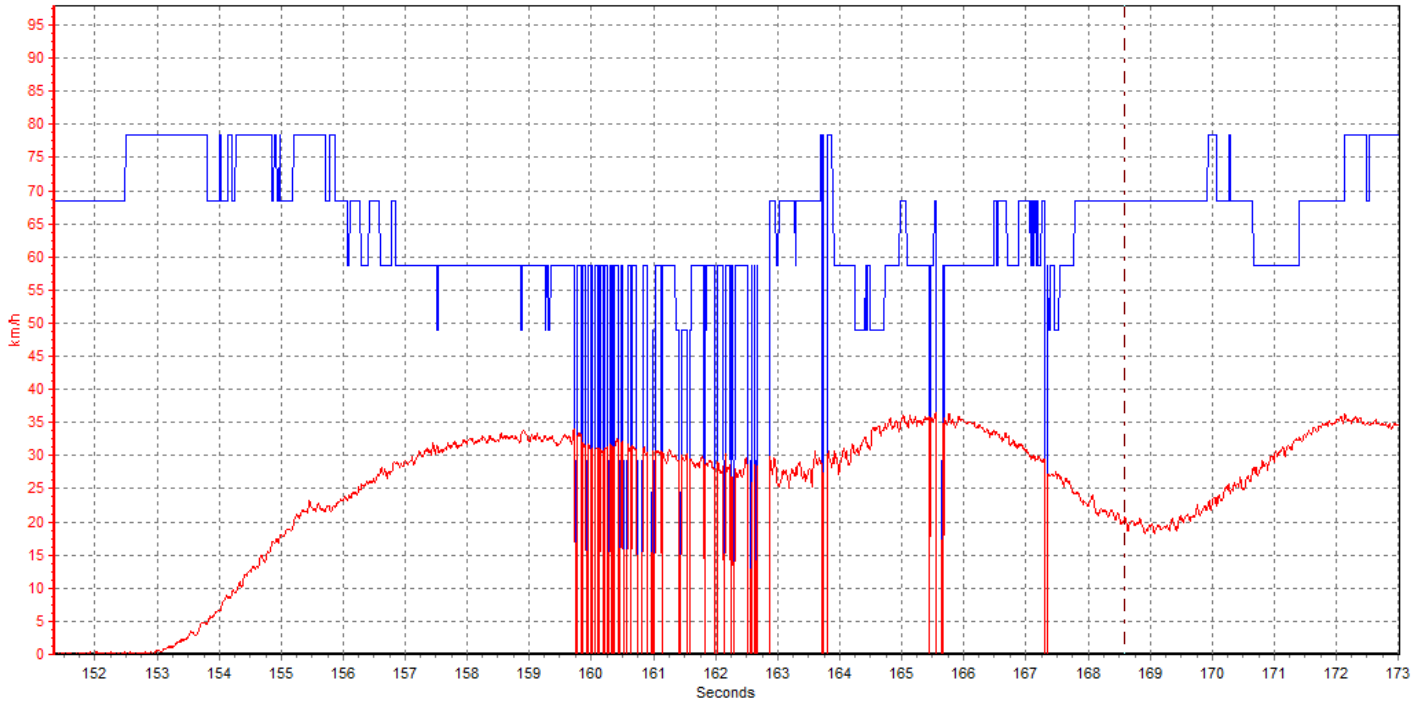
Kalman filter

This facility provides filtering separately to the Velocity and Position channels (long, lat and height). Note that 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.

It is often better to record unfiltered data then use the software filter routines available within the VBOX Tools software (if necessary) as these will have much less impact on latency.

The levels of filtering cannot be adjusted; the Kalman filter can only be enabled or disabled.

Note: Once the filter is turned on in the VBII, it remains on until it is manually turned off or a GPS Cold Start is performed, even if the VBOX is disconnected from its power supply.


km/h
Seconds

10 - VBOX II Digital and analogue outputs

The outputs on connectors OUT1 and OUT2 can be used either as frequency/pulse digital outputs or as analogue outputs that can be configured to represent any of the following parameters:

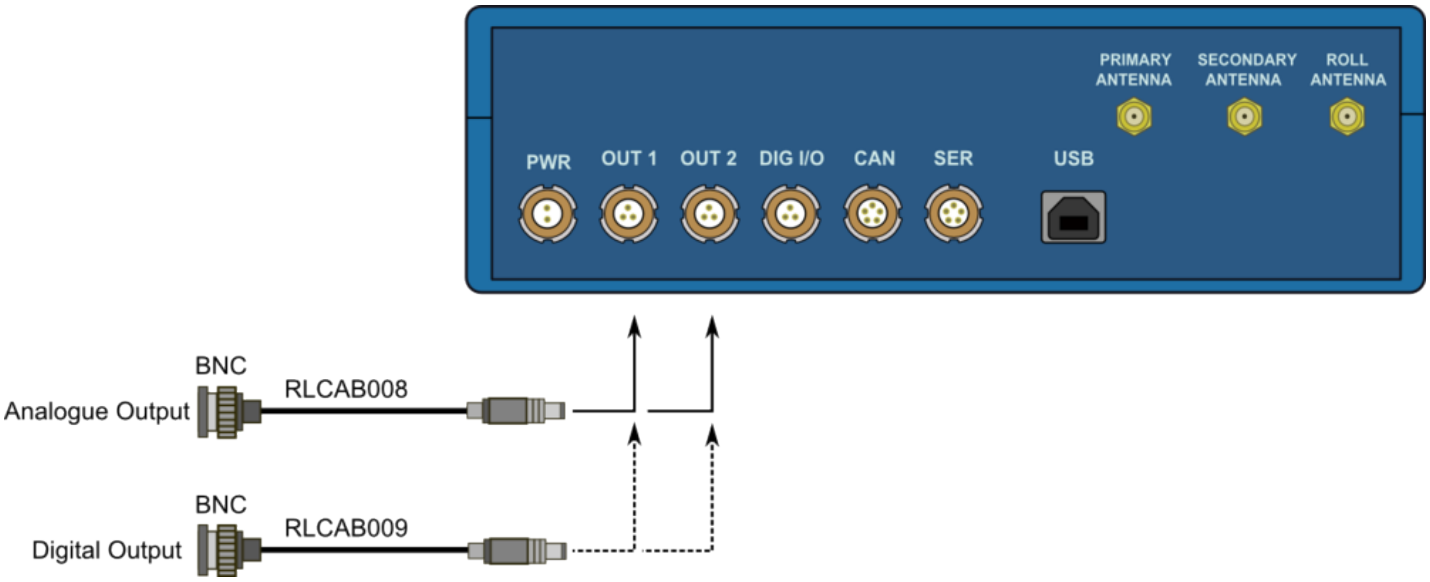
- Velocity
- Longitudinal Acceleration
- Lateral Acceleration
- Slip Angle*
- Pitch Angle*
- Roll Angle*

* SL units only

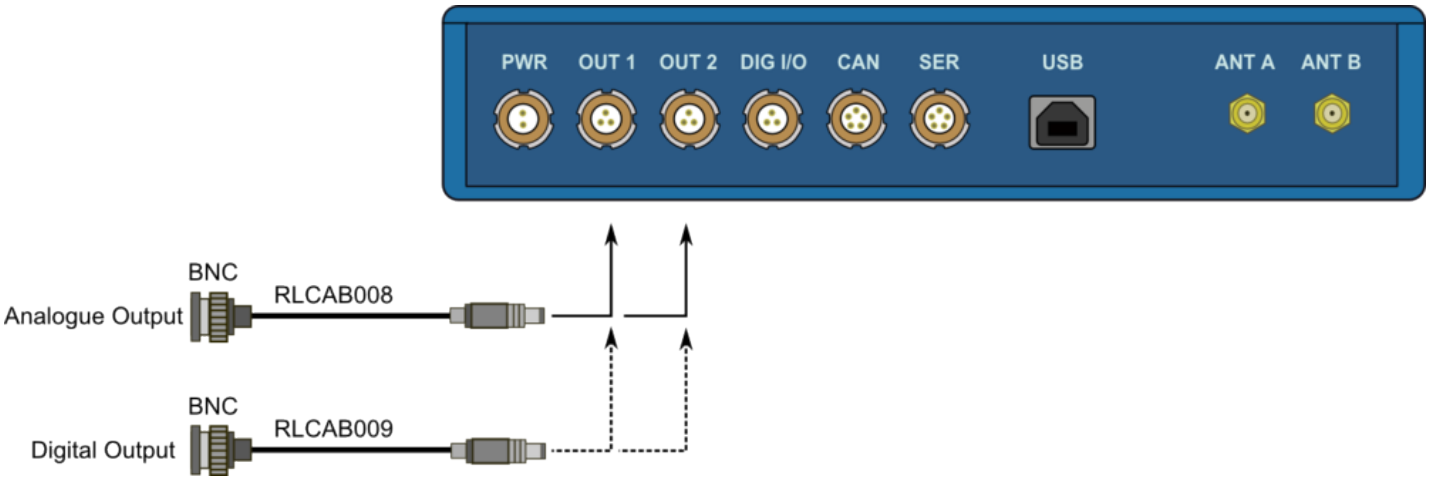
For digital outputs, the scale and maximum output values can be adjusted using the VBOXTools software or via the front panel controls. For velocity, these are controlled by setting the maximum velocity and the pulses per metre. For the other parameters, the scale and maximum are controlled by setting the maximum frequency and the angle or acceleration value to which this relates. Please note that the digital outputs do not show the direction of angles and accelerations, only their magnitudes. Therefore “negative” angles or accelerations will be shown in the same way as their positive equivalents.

For analogue outputs, the values relating to the maximum voltage (+5V) and minimum voltage (0 for Velocity, –5V for all other channels) can be set, either via the front panel or using the VBOXTools software. The negative voltage capability of the analogue outputs allows the direction of angles and accelerations to be output.

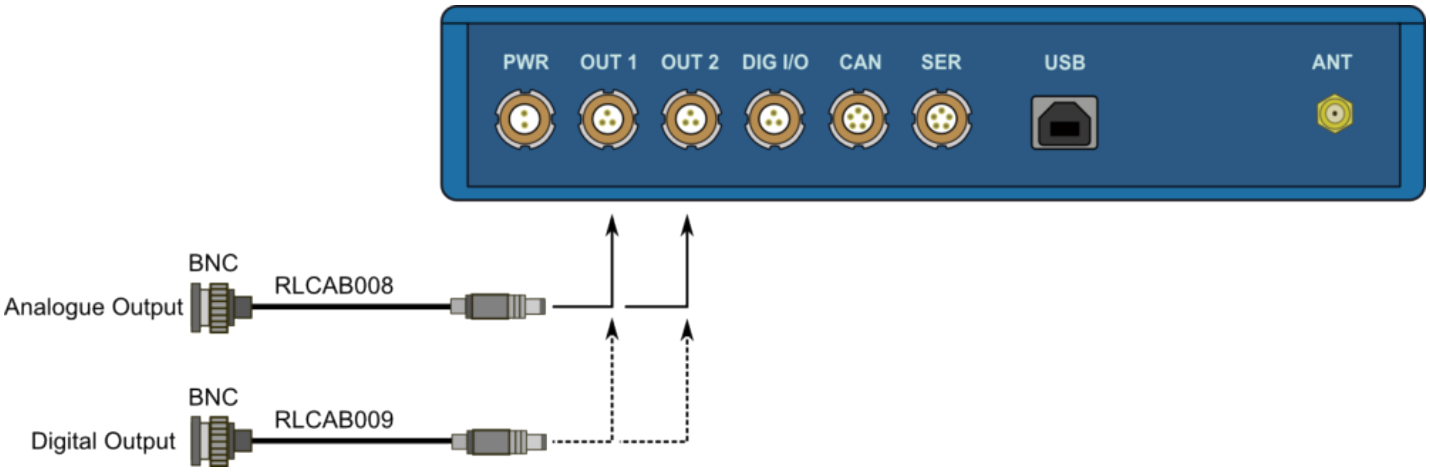
VB20SL3



VB20SL



VB2SX


PWR
OUT 1
OUT 2
DIG I/O
CAN
SER
USB
ANT
BNC
Analogue Output
RLCAB008
BNC
Digital Output
RLCAB009

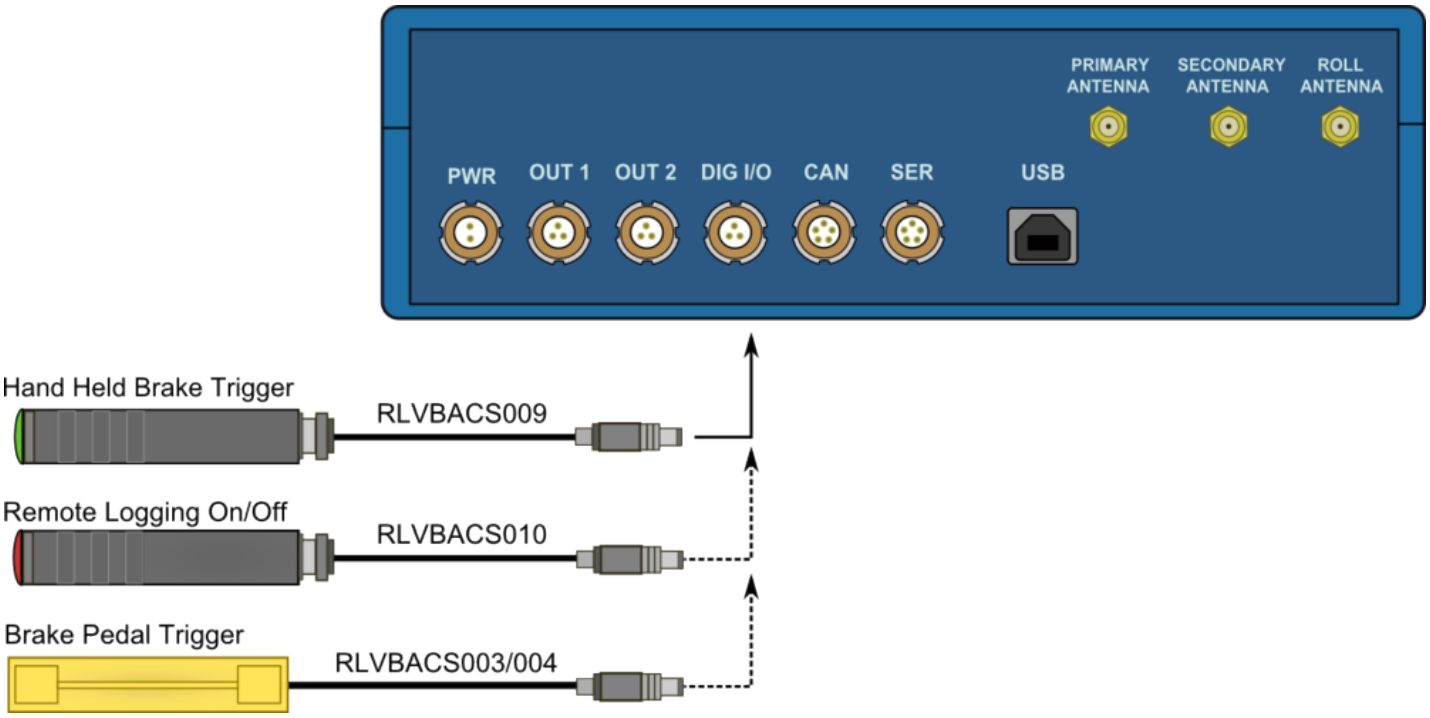
11 - VBOX II Digital inputs

The DIGITAL I/O socket contains the two digital inputs for the VBOX II, accessed by connecting to different combinations of the three pins.

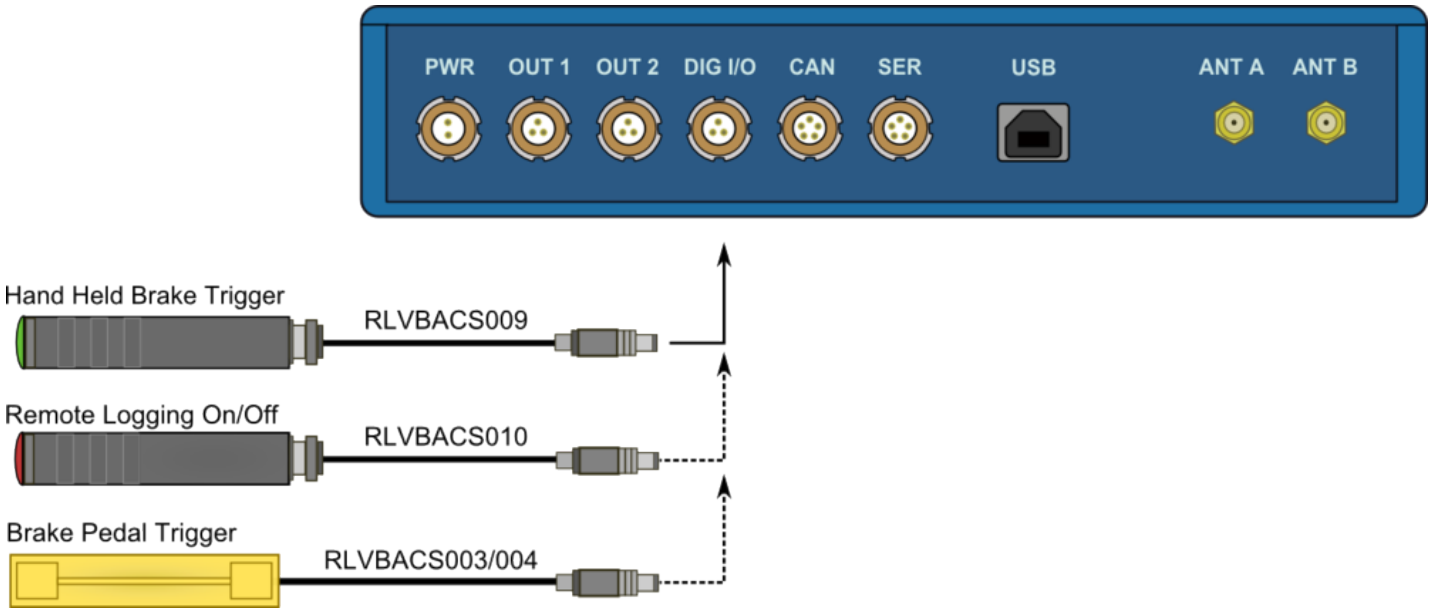
The first digital input is most commonly referred to as the brake trigger input. This input is connected to an internal timer capture module that is able to record precisely an event time for use in brake distance calculation. This period of time is called the trigger event time, and is logged as the value in milliseconds between the last GPS sample and the trigger event. Typically, this will be connected to a pressure switch placed on the brake pedal, however a hand-held brake trigger is also available to allow the user to record marker events for other purposes.

The second digital input is used to control the VBOX's logging; a remote logging on/off switch is available for ease of use and when the front panel switch is not accessible.

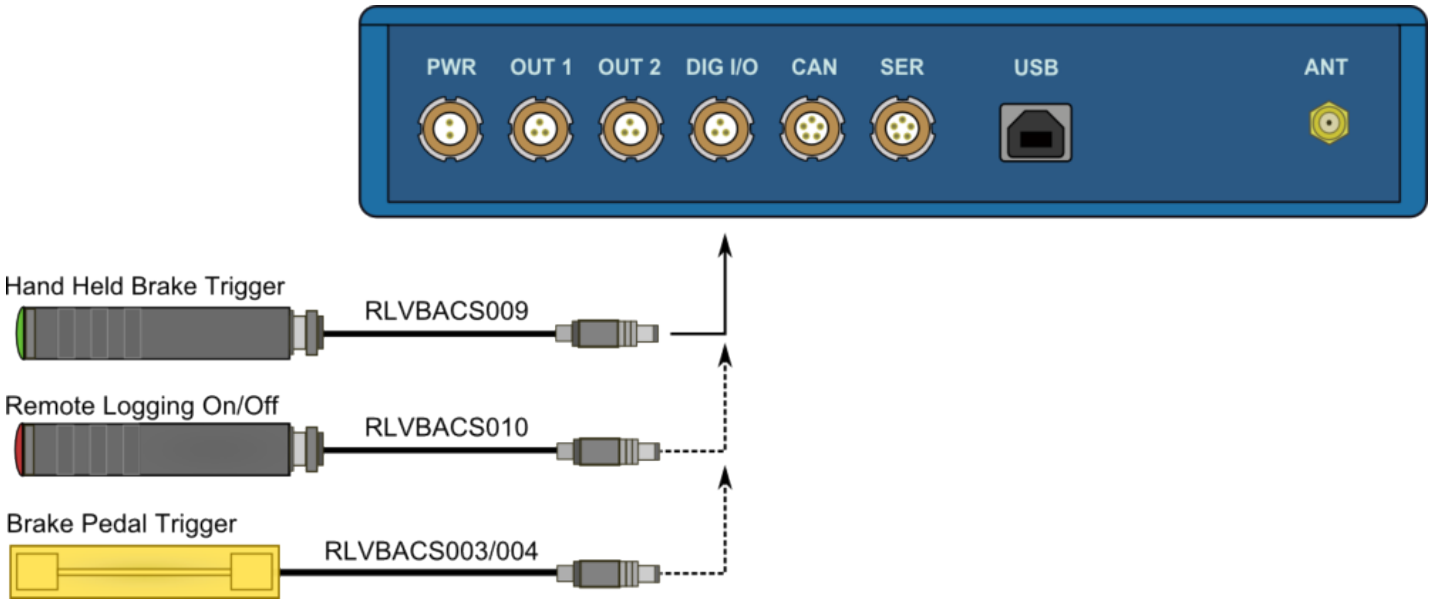
VB20SL3



VB20SL



VB2SX



12 - VBOX II firmware upgrade procedure

Occasionally Racelogic release new versions of firmware code for VBOX products, which may be required to fix bugs or to add new features.

New firmware for VBOX II units can be loaded into the unit using a computer and the supplied USB cable.

The latest firmware upgrade (.RUF) file for the VBOXII is available from the VBOX website in the **Support section**.

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

If you are connecting your VBOX 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 VBOX II.
- The front panel 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.

13 - VBOX II CAN output

Note: Channels highlighted in Blue are only present on outputs from SL type units.

Data format: Motorola

ID*	Data Bytes							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
0x301	(1) Sats	(2) Time since midnight UTC			(3) Position – Latitude DDMM.MMMMM			
0x302	(4) Position – Longitude DDMM.MMMMM				(5) Velocity (kts)		(6) Heading (°)	
0x303	(7) Altitude. WGS 84 (m)			(8) Vertical velocity (m/s)		Unused	(9) Status	(10) Status
0x304	(11) Distance (m)				(12) Longitudinal Accel. (g)		(13) Lateral Accel. (g)	
0x305	(14) Distance travelled since VBOX reset (m)				(15) Trigger time		(16) Trigger Velocity (kts)	
0x306	Unused		(17) True Heading (°)		(18) Slip Angle (°)		(19) Pitch Angle (°)	
0x307	(20) Lateral Velocity (kts)		(21) Yaw Rate (°/s)		(22) Roll Angle (°) **		Unused	

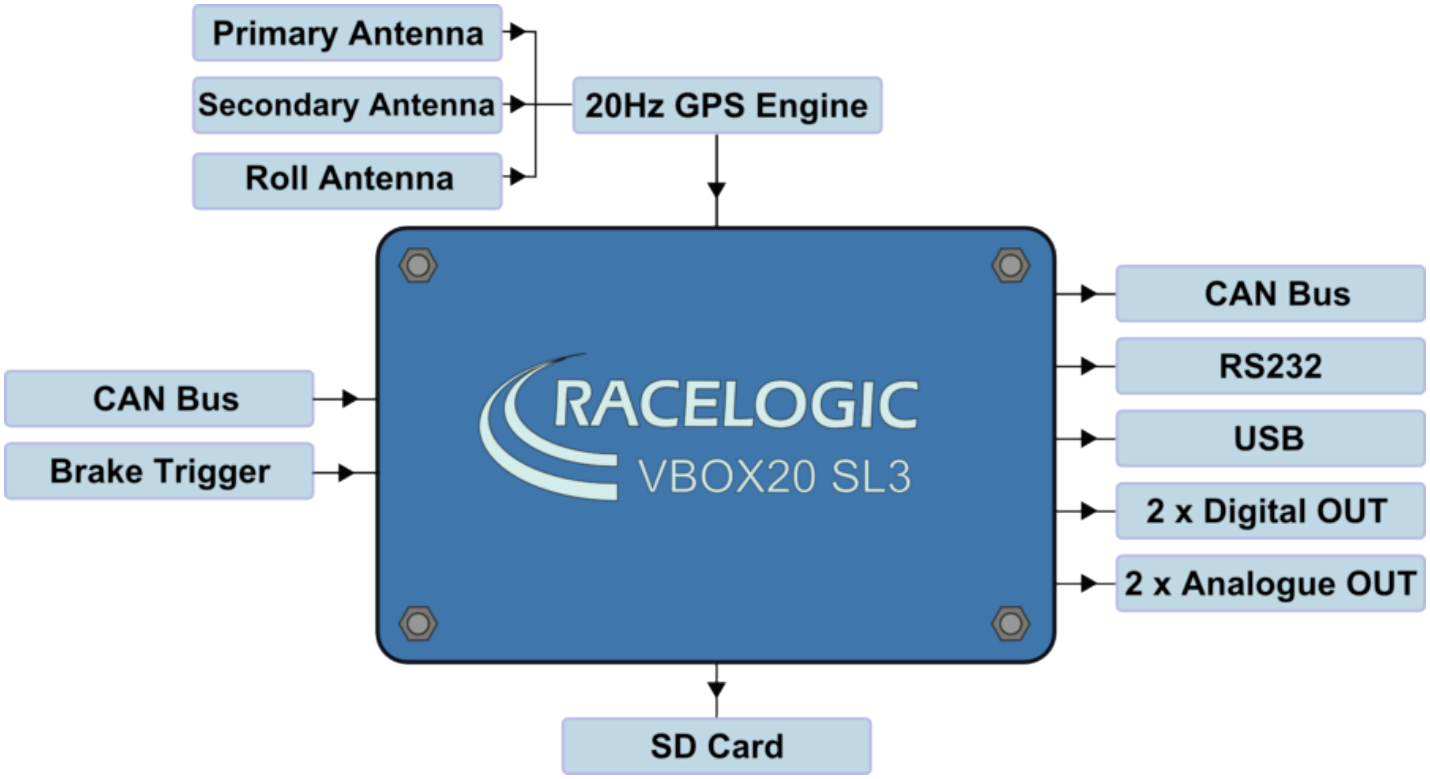
* Default Identifiers. The identifier values can be changed using the configuration software.

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 10 ms 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 kts per bit.

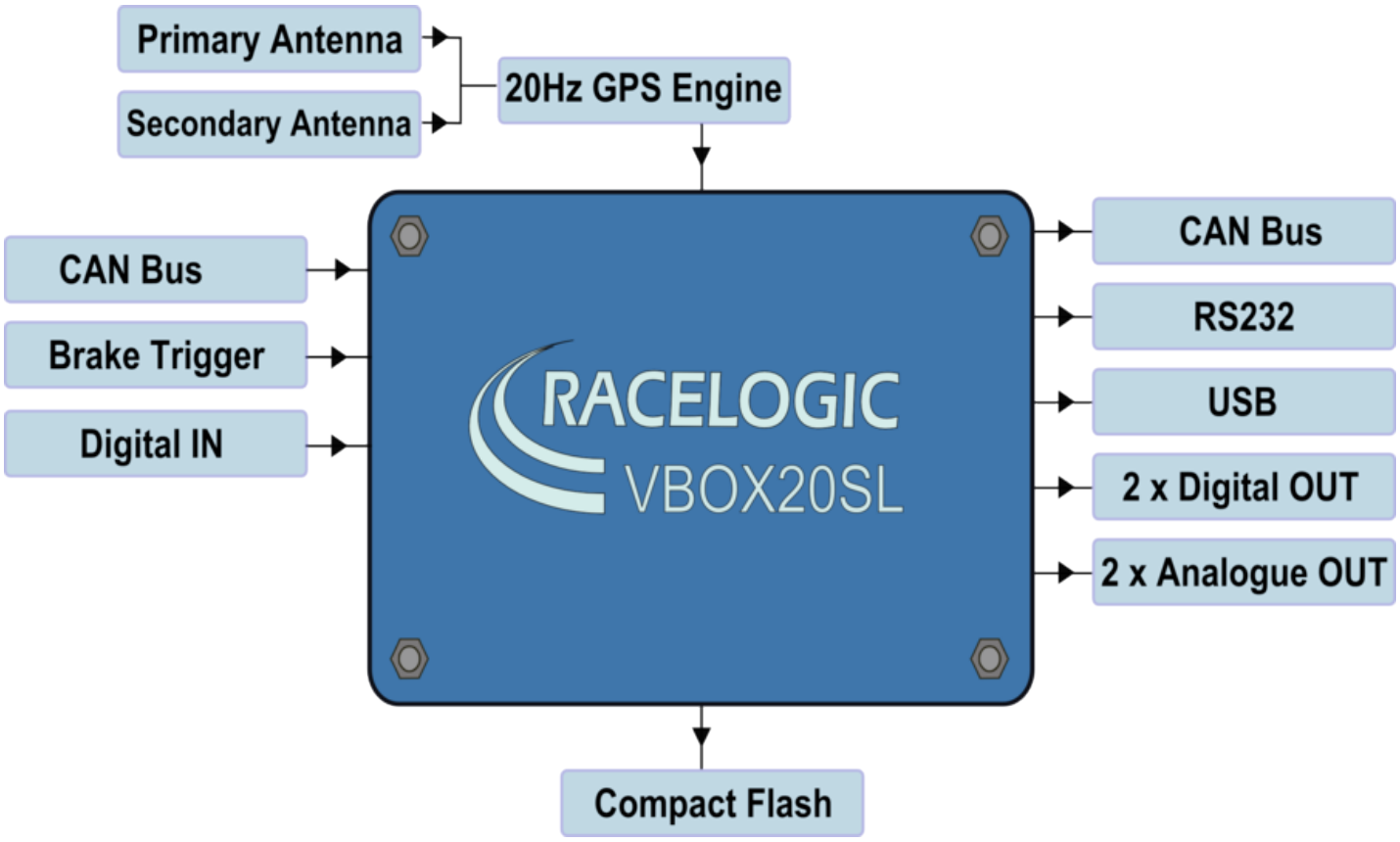
6. Heading, 0.01° per bit.
7. Altitude, 0.01 m per bit, signed.
8. Vertical Velocity, 0.01 m/s per bit, signed.
9. Status. 8 bit unsigned char. Bit 0=VBOX Lite, Bit 1=Open or Closed CAN Bus (1=open), 2=VBOX3.
10. Status is an 8 bit unsigned char. Bit 0 is always set, Bit 3=brake test started, Bit 4 = Brake trigger active, Bit 5 = DGPS active.
11. Distance, 0.000078125 m per bit, unsigned.
12. Longitudinal Acceleration, 0.01 g per bit, signed.
13. Lateral Acceleration, 0.01 g 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.
17. True Heading of vehicle, 16-bit signed integer * 100.
18. Slip Angle, 16-bit signed integer * 100.
19. Pitch Angle, 16-bit signed integer * 100.
20. Lateral Velocity, 16-bit signed integer * 100.
21. Yaw Rate, 16-bit signed integer * 100.
22. Roll Angle, 16-bit signed integer * 100 ****VB20SL3 units only**

14 - VBOX II Inputs / outputs

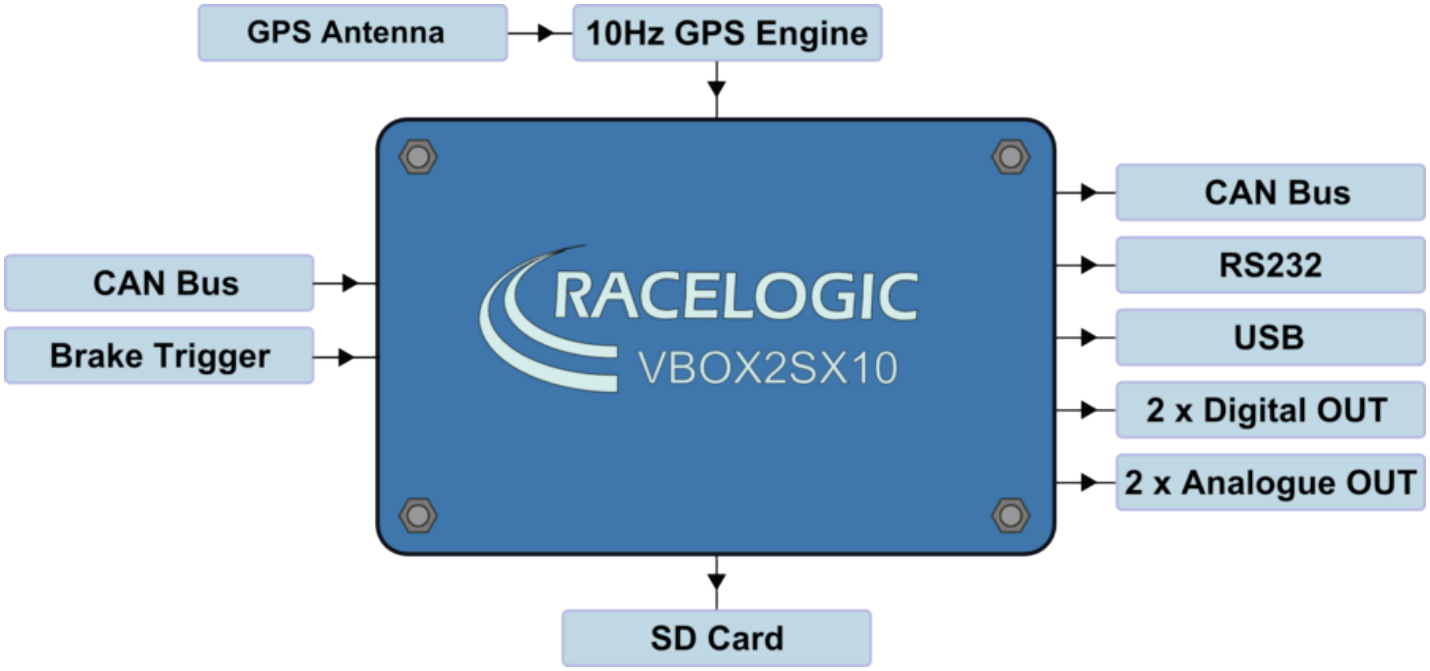
VB20SL3



VB20SL



VBSX10



15 - VBOX II Fuse reset button

VBOX II units contain 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.

16 - VBOX II PIN OUTS

Connector 1 - POWER (Lemo 2 PIN)

(Dedicated 4.5 – 36 V DC Power Connector)

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

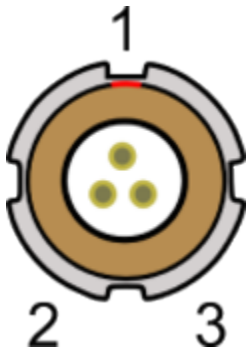
Connector 2 / 3 - OUT 1 / OUT 2 (Lemo 3 PIN)

(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 (Lemo 3 PIN)

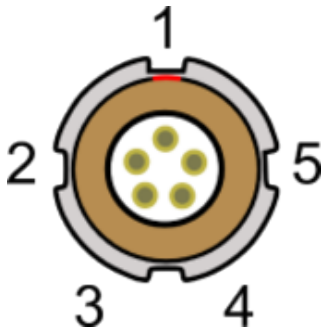
(Wheel Speed and Brake Trigger Inputs)



PIN	I/O	Function
1	I	NC
2	I	NC
3	I	Brake Trigger
Chassis	I	Ground

Connector 5 - CAN (Lemo 5 PIN)

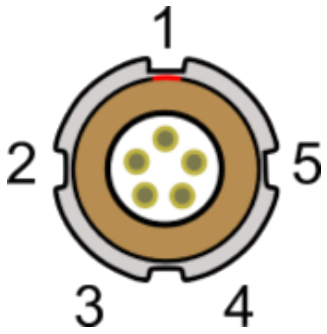
(First CAN Bus Connector, Serial Connection to GPS Engine)



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 (direct connection between ports 5 and 6)
4	I/O	CAN Low (direct connection between ports 5 and 6)
5	I/O	Power +
Chassis	I	Ground

Connector 6 - SERIAL (Lemo 5 PIN)

(Setup / Upgrade, Second CAN Bus Connector)



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 (direct connection between ports 5 and 6)
4	I/O	CAN Low (direct connection between ports 5 and 6)
5	I/O	Power +
Chassis	I	Ground

Connector 7 - USB

(Setup / Upgrade)

PIN	I/O	Function
1	I/O	Power
2	I/O	USB-
3	I/O	USB+
4	I/O	Ground
Chassis	I/O	Ground

Connector 8 - GPS Antenna

PIN	I/O	Function
1	I	Signal
Chassis	I	Ground

17 - VBOX II Technical specification

Velocity	
Accuracy	0.1 km/h (averaged over 4 samples)
Units	km/h or mph
Update Rate	**20 Hz -** VB2SX, VB20SL, VB20SL3 **10 Hz** - VB2SX10 **5 Hz** - VB2SX5
Maximum Velocity	1000 mph
Minimum Velocity	0.1 km/h
Resolution	0.01 km/h

Distance	
Accuracy	0.05 % (>50 cm per km)
Units	m / ft
Update rate	**20 Hz -** VB2SX, VB20SL, VB20SL3 **10 Hz** - VB2SX10

Distance	
	5 Hz - VB2SX5
Resolution	1 cm
Height Accuracy	6 m (95 % CEP**)
Height Accuracy with DGPS	2 m (95 % CEP**)

Latency	
VBOX IISX	41.5 ms
VBOX IISL (single antenna mode)	30.5 ms
VBOX IISL (dual antenna mode)	31.5 ms

Brake stop accuracy	
Accuracy	20 Hz units +/- 10 cm 10 Hz units +/- 20 cm 5 Hz units +/- 50 cm

Memory	
SD Card Recording time	Approx 4.3 MB/Hour @ 20 Hz

Time	
Accuracy	0.01 s
Resolution	0.01 s

Power	
Input Voltage range	6 – 30 V DC
Current	Typically 560 mA

Absolute positioning	
Accuracy	3 m (95% CEP*)
Accuracy with DGPS	To 40 cm (95 % CEP*)
Resolution	1 cm
Update Rate	**20 Hz -** VB2SX, VB20SL, VB20SL3 **10 Hz** - VB2SX10 **5 Hz** - VB2SX5

Acceleration	
Accuracy	0.5 %

Acceleration	
Maximum	20 g
Resolution	0.01 g
Update Rate	**20 Hz -** VB2SX, VB20SL, VB20SL3 **10 Hz** - VB2SX10 **5 Hz** - VB2SX5

Note: Channels highlighted in **Blue** are for SL series units only.

Slip angle	
Accuracy	<0.5° rms at 0.5 m antenna separation
	<0.1° rms at 2 m antenna separation

Pitch and roll angle	
Accuracy	<1.0° rms at 0.5 m antenna separation
	<0.25° rms at 2 m antenna separation

YAW rate	
YAW rate RMS Noise	0.75 degrees per second**

Definitions

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

Note that for comparison, the VBOX YAW02 or IMU rate sensor has an RMS noise of 0.05 degrees per second, so it should be noted that the Slip Angle sensor calculated YAW rate is significantly noisier than a solid state sensor for yaw rate measurement.

Outputs	
CAN Bus	Format; Motorola
Bit rate	125 kbit/s, 250 kbit/s, 500 kbit/s and 1 Mbit/s selectable baud rate
Identifier type	Standard 11 bit or extended 2.0 A
Data available	Satellites in View, Latitude, Longitude, Velocity, Heading, Altitude, Vertical velocity, Distance, Longitudinal acceleration & lateral acceleration, Distance from trigger, Trigger time, trigger Velocity, True heading, Slip angle, Pitch Angle, Yaw Rate, Lateral Velocity, Roll Angle

Analogue	
Voltage range	–5 V to +5 V DC
Default setting *	Velocity 0.0125 Volts per km/h (0 to 400 km/h)
Accuracy	0.1 km/h
Update rate	**20 Hz -** VB2SX, VB20SL, VB20SL3 **10 Hz** - VB2SX10 **5 Hz** - VB2SX5

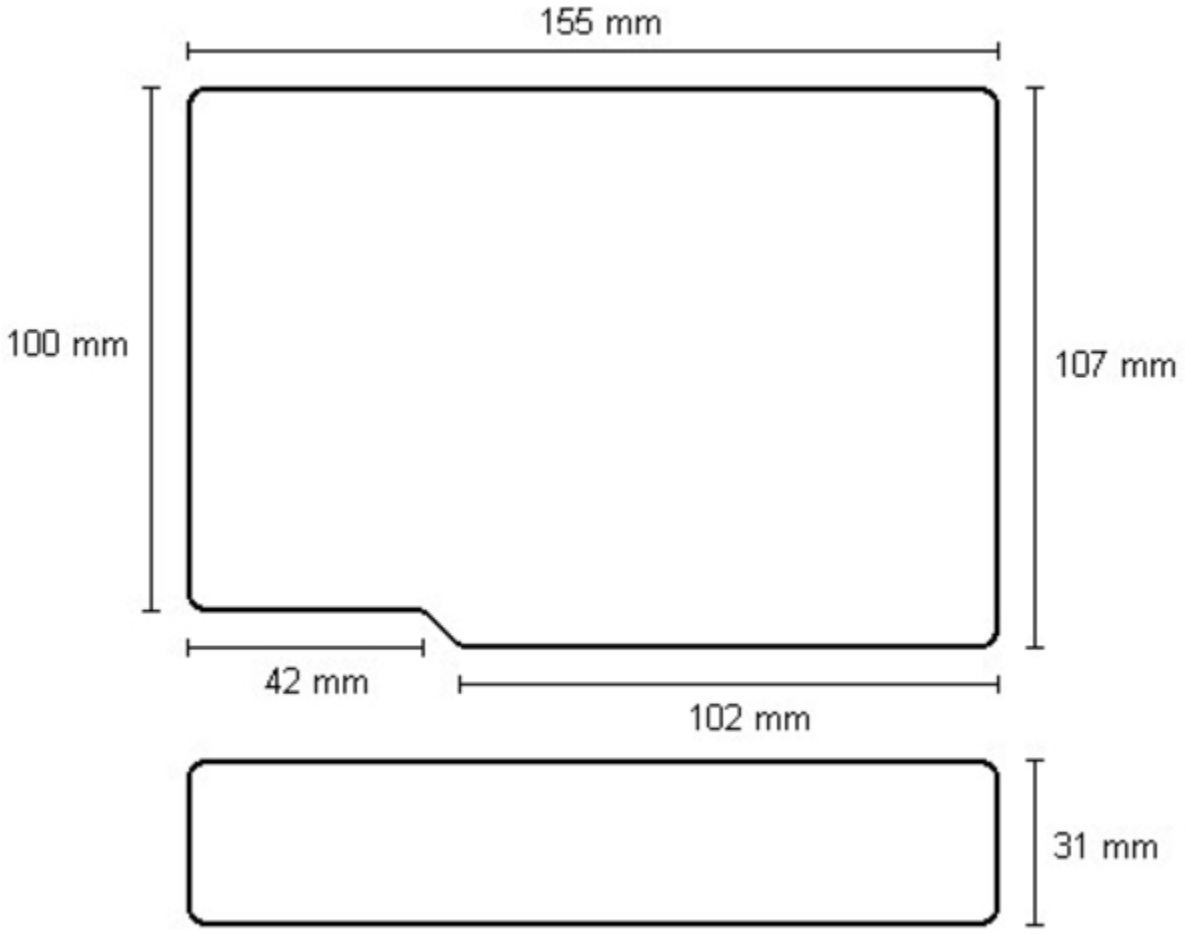
Inputs	
CAN Bus	Format; Motorola
VCI CAN mode	Up to 16 channels from any external CAN module
Racelogic modules mode	Up to 20 channels from any combination of ADC02, ADC03, FIM02, TC8, Yaw sensor or CAN01

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

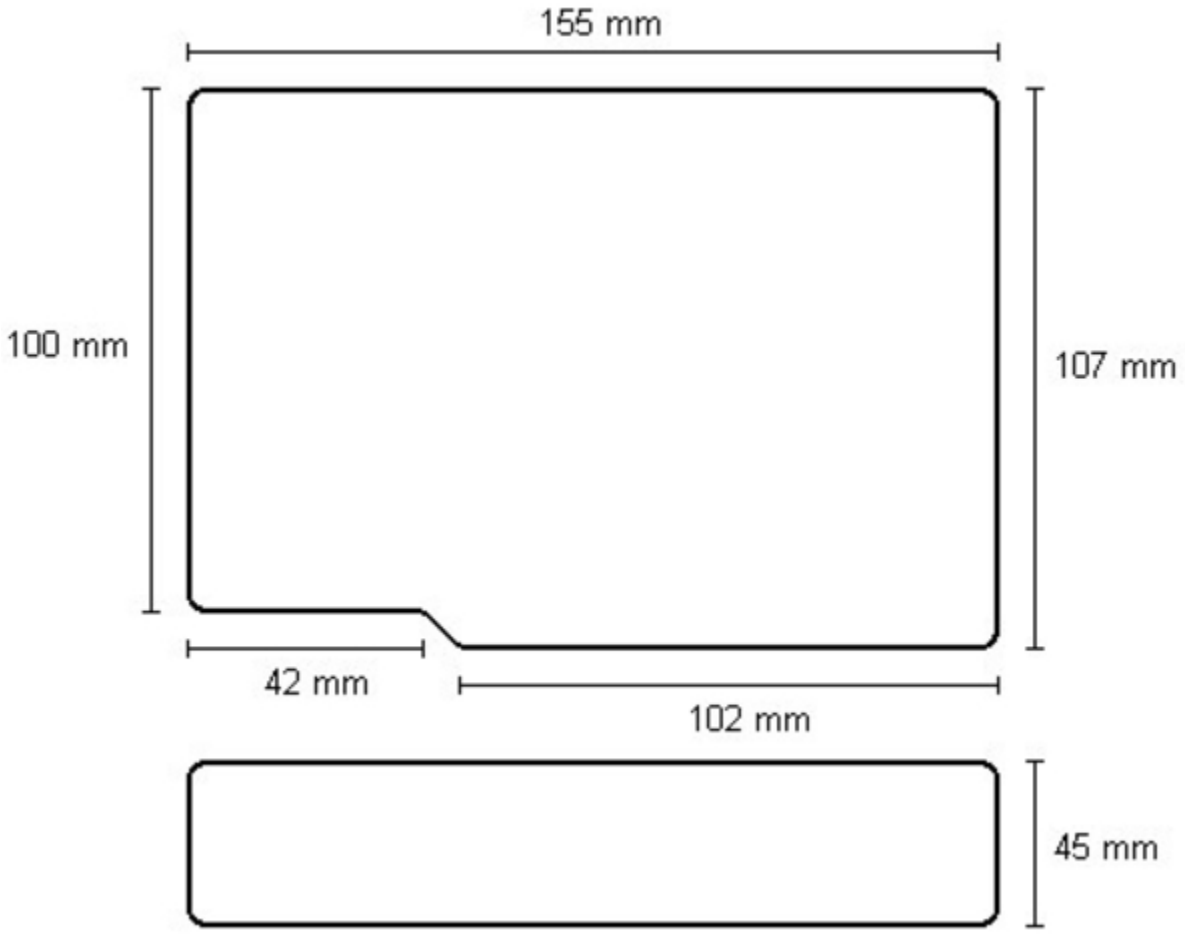
Environmental and physical	
Weight	Approx 500 g
Size	119 mm x 128 mm x 30 mm
Operating Temperature	-30°C to +60°C
Storage Temperature	-40°C to +80°C
Industrial Protective Class (with case closed)	IP 64

18 - VBOX II Dimensions

VB2SX (all varients) and VB20SL



VB20SL3



19 - VBOX II Standard inventory

Some items on the inventory differ between different VBOXII unit types.

Items highlighted in BLUE are only delivered with SL type units, and items highlighted in YELLOW are only delivered with SX type units.

Description	Qty	Product Code
VBOX II unit	1	RLVB20SL3 RLVB20SL RLVB2SX RLVB2SX10 RLVB2SX5
Mains Charger	1	RLVBACS020
Cigar Lighter Power Cable	1	RLCAB010L
USB Lead	1	RLCAB042
4 GB SD Card	1	RLACS137
GPS Ground Plane Antenna	2 (3 when supplied with RLVB20SL3)	RLACS103
GPS Magnetic Antenna	2	RLACS018
VBOX PC Serial Cable	1	RLCAB001
CD ROM containing VBOX software	1	RLVBACS030
VBOX Carry Case	1	RLVBACS013

Description	Qty	Product Code
VBOX Carry Case	1	RLACS106