

RLVBBS4

DGNSS Base Station User Guide



Contents

CONTENTS	3
INTRODUCTION	4
FEATURES	4
OPERATION	5
GPS ANTENNA	6
SATELLITE ELEVATION MASK	6
RADIO ANTENNA	7
<i>Telescopic Mast</i>	7
<i>Roof Location</i>	7
<i>Mast Mount Transmitter</i>	8
POWER AND ENVIRONMENT	8
FRONT PANEL INTERFACE	9
COMPATIBILITY MATRIX	10
SETTING UP THE BASESTATION	11
<i>Absolute and Relative Positioning</i>	11
USING THE BASE STATION AT A STORED LOCATION - SETUP PROCEDURE	13
USING USER SUPPLIED RADIO MODEMS	14
STATUS DISPLAY	15
BATTERY AND CHARGING STATUS	16
CONFIGURATION MENU OPTIONS	17
<i>SETUP</i>	17
<i>ENTER LOCATION</i>	19
<i>LIVE LOCATION</i>	19
<i>LOAD LOCATION</i>	20
<i>STORE LOCATION</i>	20
<i>SET TO CURRENT</i>	20
<i>SET TO AVERAGE</i>	20
SETTING UP THE VBOX TO RECEIVE LOCAL DGPS	21
CHECKING THAT YOU HAVE DGPS LOCK	22
<i>RTK (2cm) Mode</i>	22
<i>20 cm and 40cm Modes</i>	22
CONNECTION DATA	24
FIRMWARE UPDATES	25
CONTACT INFORMATION	25

Introduction

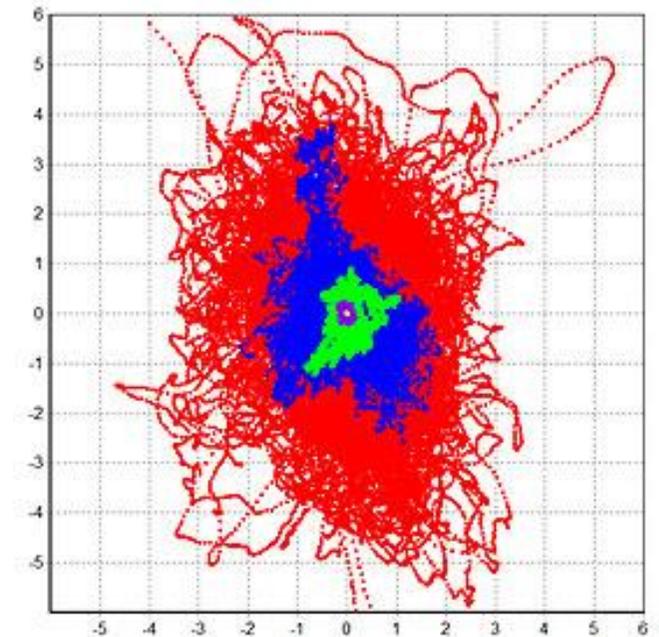
The Racelogic DGNSS base station is designed to improve positional accuracy of VBOXes and other compatible GPS/ GLONASS systems by calculating and transmitting differential correction data. The base station contains a highly accurate survey grade GPS receiver that is connected to a fixed antenna. When the exact position of the antenna is programmed into, or averaged by the base station, it is able to calculate errors between the real-time GPS position and the fixed point position. The error data is then used to broadcast a differential correction message in RTCM, CMR or proprietary RTK formats using an internal or mast mounted radio modem transmitter. Roving VBOXes and other compatible systems equipped with a receiving radio telemetry module can then use the local differential correction to provide greatly improved positional accuracies. Depending on the type of base station and roving unit used, position accuracies of up to 2cm 95%CEP are available. The 95% CEP value refers to the Circular Error Probable. For example, in the case of the RTK enabled base station in conjunction with an RTK enabled VBOX III or VBOX3i, the GPS position calculated will be within a 2cm radius of the true position 95% of the time.

Features

- Survey grade GPS or GPS/GLONASS receiver
- Integral 9Ah battery supply with fast charger
- LCD readout for status and configuration
- Optional integral or mast mount radio transmitters with range of up to 10km (approx 6.2miles line of sight) and 2km in a built up area.
- Supplied complete with all antennas, antenna tripod and radio receiver for use with a VBOX

The graph shown on the right shows the results of static positional data from VBOX systems with and without local DGPS corrections.

- The **red** plot shows position scatter from a **non-corrected** VBOX.
- The **blue** plot shows position scatter from an **SBAS corrected** VBOX.
- The **green** plot shows position scatter from an **RTCM (40cm) corrected** VBOX.
- The **purple** plot shows position scatter from a **20cm corrected** VBOX 2 series product.
- The **yellow** plot shows position scatter from an **RTK (2cm) corrected** VBOX 3 series product.

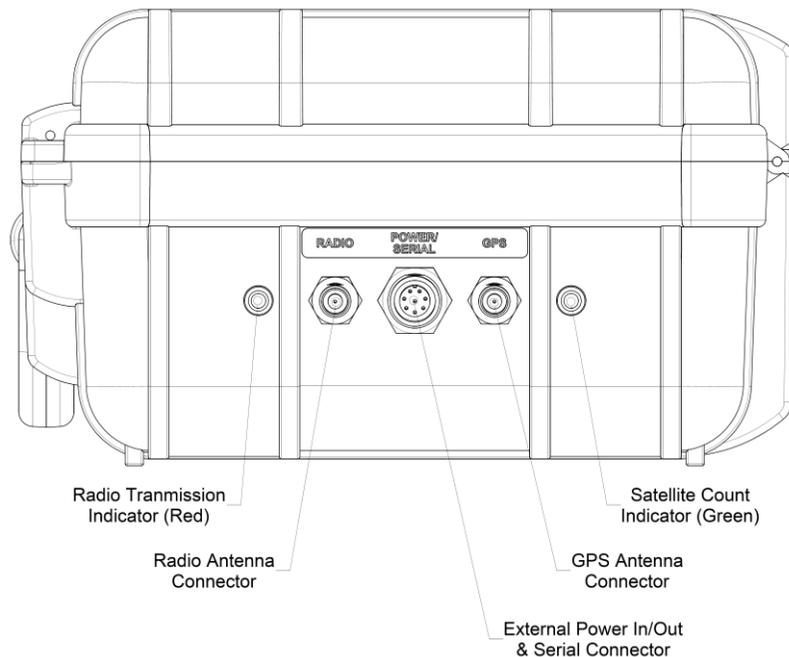
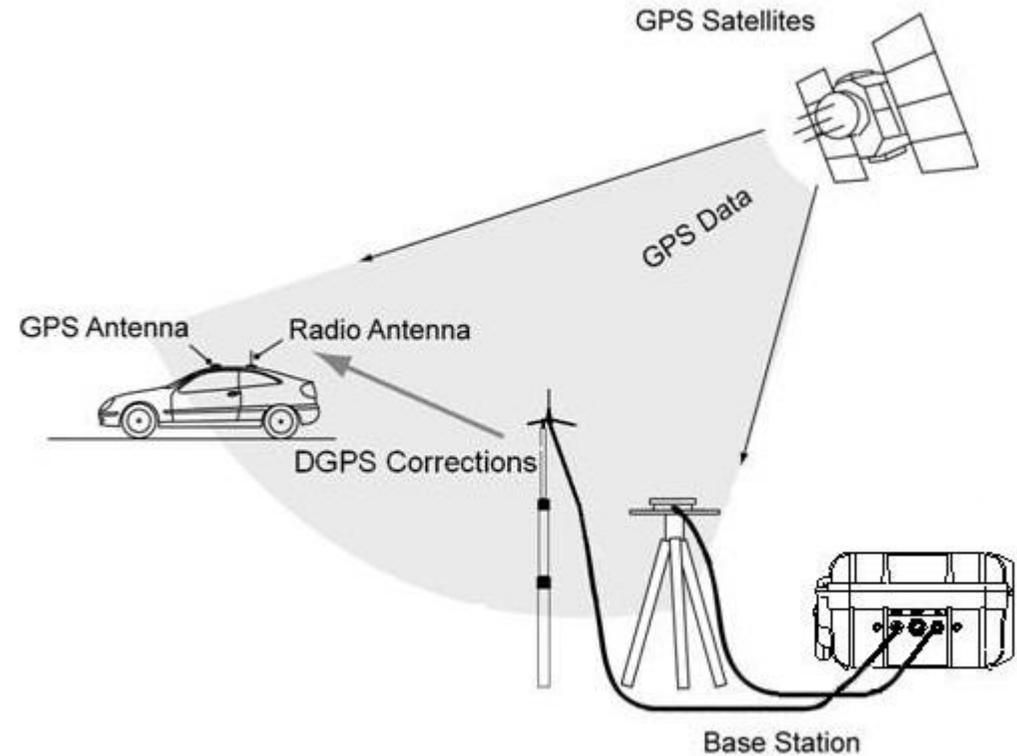


Operation

The base station is designed to operate outdoors and is housed in a rugged splash proof case. It is important to note however that the front panel is not waterproof so the lid must be shut if it is raining. Power can be obtained either from the internal battery supply or from an external source via a front panel (using the supplied mains power supply, or via an external waterproofed connector from a suitable 8-30v DC supply). If powering from an external source, make sure that rainwater cannot run down the supply cable into the unit.

Both the radio cable and the GPS cable connect to the base station via screw-on TNC connectors and the antennas should be connected before the base station is switched on.

i It is important to make sure that the GPS and RADIO antennas are connected to the correct connectors on the base station.



GPS Antenna

The GPS antenna must be placed in a position away from any buildings, trees, walls, high wire fences or any other obstacles that could cause satellite signals to be blocked or reflected.

i Even solid objects below the height of the GPS antenna should be avoided as they can also cause reflections of the satellite signals.

Wherever possible, place the GPS antenna and tripod at the highest available spot to ensure the best un-affected satellite reception.

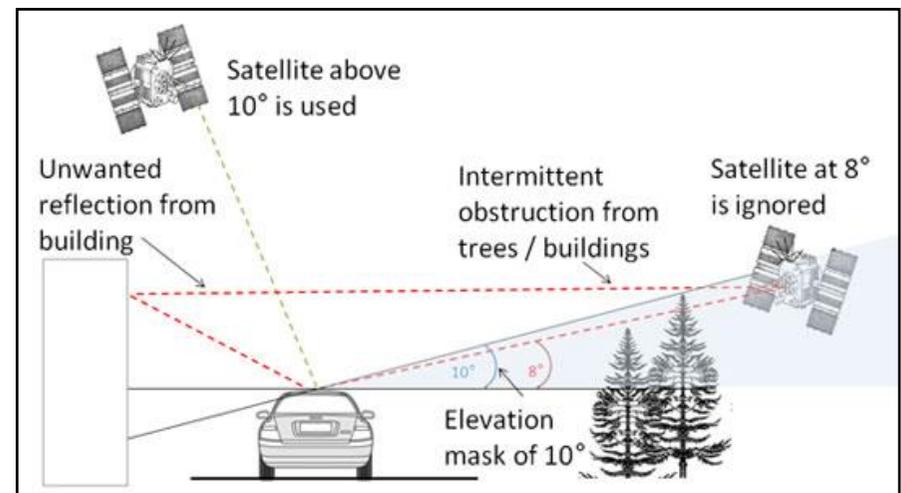
Make sure the legs of the tripod are fully extended to give maximum height.

If the base station is to be fitted on a permanent roof top location, then also ensure that the GPS antenna is not shadowed by any other parts of the building or nearby objects.



Satellite Elevation Mask

This feature can be used to improve GPS signal quality when nearby obstacles like trees and building are reflecting or temporarily obscuring the signal from satellites at low elevation. Raising the mask will cause the Base Station to ignore satellites below the mask angle, so must be used carefully as it also reduces the total number of received satellites.



Radio Antenna

The base station radio antenna must be placed in the highest available position in order to realise the maximum possible transmission range. Where possible the position should be close to the centre of the area over which the system is to be used.

For example, if used at a test or race circuit, mount the tripod in the centre of the circuit to give equal radio coverage to all points of the circuit.

If your base station is used in temporary locations, then it is recommended that you use a telescopic mast to raise the radio antenna as high as possible.

Telescopic Mast

A suitable telescopic mast including guy ropes can be purchased through Racelogic, please contact your local VBOX distributor for details. The telescopic mast can be easily erected by two people. One person should hold and extend the mast to the correct height whilst the other person pegs out the three supplied guy lines.

 **The guy rings on the mast should be at 2/3rds height of the antenna for stability.**

Once the three guy lines have been pegged out the antenna can be raised further to increase guy line tension.



Roof Location

The base station radio antenna can also be mounted on a roof top when the base station is required in a permanent location. The radio antenna is supplied with a “U” bolt fixing to enable a fixing to a suitable upright pole.

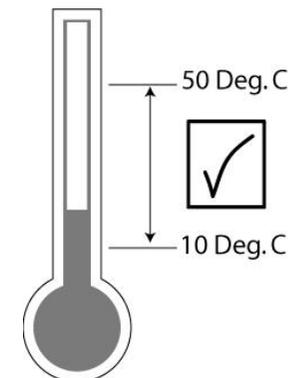
Mast Mount Transmitter

The option of a mast mounted enclosure (RLVBACS153 for 868 MHz and 915MHz radios, RLVBACS153-24 for 2.4GHz radios, and RLAS153-VAR for SATEL Radios) is available. This option greatly reduces the RF cable length between the transmitter and the antenna. This results in greatly reduced transmission line losses which in turn increases transmission power, giving better range. The Mast mount enclosure is IP67 rated to protect the radio from harsh weather and is supplied with a 6m serial/power connection cable (RLCAB106 for the SATEL radio and RLCAB105 for all other radios) allowing full extension of the mast. The serial/power cable connects to an external IP68 rated connector on the basestation, ensuring that the basestation remains weatherproof.



Power and Environment

The base station will accept an input voltage range of 8V to 30V for operation. 19V is required to charge the internal battery cells. Charging is achieved by using the supplied mains power adapter. Before the base station is used for the first time it is advisable to charge the internal battery completely. When power is connected, battery fast charging will begin. Fast charging is indicated on the LCD display panel when the unit is switched on. However, the unit will still charge when switched off at the front panel. Charging of the internal battery pack will normally take approximately 4 hours from empty. The fast charge temperature range of the internal battery pack is above 10°C and below 50°C. Outside this range, the internal charger will only charge in trickle mode to prevent damage to the battery cells. It is possible to charge the battery while the base station is operating.



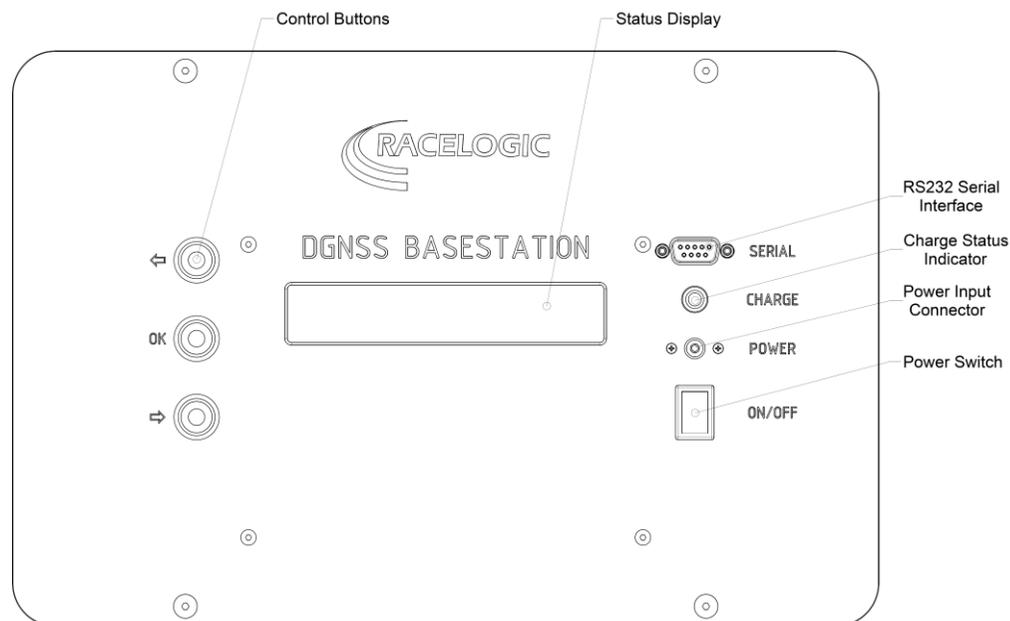
Front Panel Interface

The front panel of the base station contains a display for indicating the operating status of the base station. User input for configuring the base station is via the three control buttons. The control buttons consist of left and right menu selection buttons and an 'OK' selection button.

An RS232 connector on the front panel is used for updating the operating firmware of the base station using a PC or porting to the GPS engine or radio modem for update of firmware or manual configuration changes.

There is also a power input connector for charging the basestation internal battery using the supplied mains adaptor. This can be used to permanently power the unit; however this should only be done if the basestation is located indoors with the GPS and radio antennas located outside as the basestation is not weatherproof with the lid open.

A power 'ON/OFF' switch is located on the front panel which powers the unit for operation. However the unit can be charged even if the power switch is in the OFF position. The charge LED gives a status of the battery charger circuit at all times when an external supply is connected. Details of what this LED indicates can be found in the section entitled 'Battery and Charging Status'.



For convenience, the base station contains a 25-location memory. This enables the user to store different reference locations and recall them at a later date. When storing a new location, the basestation should be set to average the current antenna position over a period of time to obtain the best of location data accuracy.

Depending on the specification of the base station and the type of VBOX used, The DGPS accuracy ranges from 40cm CEP to 2cm CEP. There are two options available for the base station. Both options have a 40cm DGPS mode which can be used with all VBOX data loggers and third party GPS equipment that can accept RTCM format corrections. Each option then has a second DGPS mode which will be either 20cm or 2cm RTK.

Basestation mode compatibility with VBOX data loggers and speed sensors can be seen in the following 'Compatibility Matrix'.

Compatibility Matrix

	SBAS (WAAS / EGNOS) DGPS	RTCM 40cm 95% CEP DGPS VBBS4 and VBBS4RG	20cm 95% CEP DGPS VBBS4 only	RL 2cm 95% CEP RTK VBBS4RG only	2cm 95% CEP RTCMv3 or CMR VBBS4RG only
VBOX Data Loggers					
VBOX Lite	✓	✓	✗	✗	✗
VBOX II DCF	✓	✓	✗	✗	✗
VBOX IIS	✓	✓	✓	✗	✗
VBOX IISX (5Hz, 10Hz & 20Hz)	✓	✓	✓	✗	✗
VBOX IISL	✓	✓	✗	✗	✗
VBOX IISL3 (3 Axis)	✓	✓	✗	✗	✗
VBOX 3 and 3i	✓	✓	✗	✗	✗
VBOX 3 and 3i R2G2	✓	✓	✗	✓	✓
VBOX 3i R10G10	✓	✓	✗	✓	✓
VBOX 3i SL RTK	✓	✓	✗	✗	✓
VBOX Speed Sensors					
VBOX 5Hz Speed Sensor	✓	✓	✗	✗	✗
VBOX 10Hz & 20Hz Speed Sensor	✓	✓	✓	✗	✗
VBOX 100Hz Speed Sensor	✓	✓	✗	✗	✗
VBOX 100Hz Speed Sensor R10G10	✓	✓	✗	✓	✓
VBOX IISX 20Hz Speed Sensor	✓	✓	✓	✗	✗

Key: ✓ = Compatible ✓ = Compatible with upgrade ✗ = Not compatible

To check compatibility of unlisted Racelogic products please check www.racelogic.co.uk or contact support@racelogic.co.uk for details.

Setting up the Basestation

The base station is designed to be as simple to use as possible, but to get consistent results from the equipment requires some initial setup and future planning by the user. The ideal setup for the basestation would be to permanently locate the GPS and radio antennas in a position with a clear view of the sky and a clear view of the test area respectively. A good example of this would be on top of a building like a control tower. However, this is not always possible and it may be necessary to use the base station in several different locations. A good compromise is to have marked locations that have been surveyed that the basestation antennas can be returned to when required in a particular test area.

Absolute and Relative Positioning

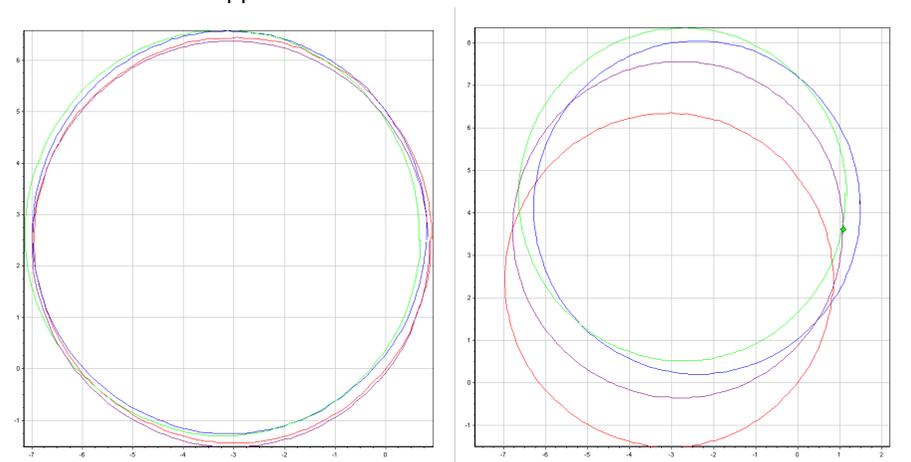
There are several modes that allow the location of the base station to be set or surveyed, and how these are used depends upon what type of positional accuracy and stability that is achieved. The amount of drift that is seen in the position of a roving receiver using the base station corrections is relative to the DGPS mode that is being used. For example, if RTCM 40cm 95% CEP is being used then the rover position will drift no more than 40cm from its relative position 95% of the time. Likewise for RTK 2cm 95% CEP, this will not drift more than 2cm from its relative position 95% of the time. The important word to note in this statement is relative. The base station provides drift corrections to the rover based on the positional information that has been set; so if the position that has been set in the base station is offset from the actual absolute position on earth then this offset will also be present in the rover position.

There are two positional plots below to illustrate this point. The graph on the left shows a drive around a marked circle at different times of the day using 20cm 95% CEP DGPS corrections from a base station with a 24hour averaged position that has been stored. You can see that the position of each circuit is in close proximity and that the positional error is due only to the 20cm drift in relative accuracy. The plot on the right shows the same drive logged immediately after each of the first plots, but with the base station position set using 'SET TO CURRENT' **before each circuit**. While the relative positional data for each individual circuit is stable to a 20cm radius, a positional shift of nearly 2m can be seen between the green and red plots. So in this case where a geographical feature is being referenced and data is being collected during different test sessions (even without the base station antenna being moved), this 'SET TO CURRENT' method is not suitable.

However, it should be noted that if the 'SET TO CURRENT' location had been stored and reused for each measurement; the results would have looked almost identical to those of the averaged position. This makes 'SET TO CURRENT' a perfectly valid method for comparing data with relative positioning from different test sessions. The difference would have shown when comparing the absolute geographical positions of the two sets of data. The 'SET TO CURRENT' data would have had a positional offset as compared to the 'SET TO AVERAGE' data, and this is the important thing to keep in mind as it can cause problems if forgotten. For example, If the extents of a circuit were mapped not using the same location corrections as those being used during testing, the lines taken by the vehicle and the extents of the circuit could be misaligned by several metres.

The same effect of offsetting would be seen if an averaged position was used but the base station GPS antenna was not placed in the same position as the original average was taken. Any error in locating the antenna would be translated into the correction at the rover. It should also be noted that any error in a manually set location as compared to the actual position would result in the same type of error in the correction.

A similar affect to the right hand plot would be produced if stored location was used but without correctly locating the GPS antenna in the same position for each use. This is why it is important to mark the physical location carefully if you intend to reuse it.



Using the base station at a new location - setup procedure

- 1 Set up the GPS antenna on the tripod and radio antenna and mast in a suitable position. This should ideally be central to the test area. The GPS antenna should be high enough to ensure a clear, unobstructed view of the sky away from buildings and trees. The radio antenna should be as high as possible to provide best coverage of the test area.
- 2 Connect the radio and GPS antennas to the base station. Take care to connect the antenna plugs to the correct ports on the base station.
Warning! Connecting the GPS antenna to the radio port can cause permanent damage to the GPS antenna and/or radio. Also ensure that the Radio antenna is connected to the Radio connector on the base station before power is switched to avoid damaging the internal radio modem.
- 3 If powering the unit from the internal battery supply ensure that the battery has been fully charged. This will normally take around 4 hours. If powering from an external source make sure that the source voltage is between 8v and 30v DC. Switch the base station on using the on/off switch on the front panel.
- 4 After switch-on, the base station will begin searching for satellites. On start-up the status display will initially show the unit serial number, firmware revision, and current DGPS MODE and radio configuration. If the displayed DGPS mode and radio config are not as desired then these options should be changed in the setup menu.
▶ After a short time the status display will change to show satellite status. The usual number of satellites seen in an open area is 8-12 for a BS4 and 13-21 for a BS4RG. A minimum of 4 satellites are required for the base station to calculate the differential. The message 'POSITION MISMATCH
- 5 Press 'OK' then scroll through the menu to the 'Set to Average' option and press 'OK'. Choose the period of time over which to average the location: 5 minutes, 12 hours or 24 hours. A countdown will be displayed for the duration of the averaging procedure. When this reaches zero and displays 'LOCATION SET OK' press 'OK'. The averaged position is now set into the base station and it will transmit DGPS correction information.
- 6 To store this new averaged location for future use at the same location, press 'OK' and scroll through the menu to display the 'STORE LOCATION' option. Press 'OK' to enter this option then use the arrow keys and the 'OK' button to select the letters to make the name of the location. Pressing 'OK' at the end of this procedure then saves this averaged location with the name you have chosen.

 To ensure accuracy the VBOX must receive Local DGPS corrections for at least 20 minutes before being used in 40cm or 20cm modes.

Using the base station at a stored location - setup procedure

- 1 Set up the tripod in exactly the same position as is used each time you return to the test area (ideally within 1cm). It is recommended that the tripod leg positions are marked using survey nails for quick relocation, or that a plumb line be used and the centre point under the antenna be marked. ▶
- 2 Connect the radio and GPS antennas to the base station. Take care to connect the antenna plugs to the correct ports on the base station.
Warning! Connecting the GPS antenna to the radio port can cause permanent damage to the GPS antenna and/or radio. Also ensure that the Radio antenna is connected to the Radio connector on the base station before power is switched to avoid damaging the internal radio modem. ▶
- 3 If powering the unit from the internal battery supply ensure that the battery has been fully charged. This will normally take around 4 hours. If powering from an external source make sure that the source voltage is between 8v and 30v DC. Switch the base station on using the on/off switch on the front panel.
- 4 After switch-on, the base station will begin searching for satellites. On start-up the status display will initially show the unit serial number, firmware revision, and current DGPS MODE and radio configuration. After a short time it will change to show satellite status. The usual number of satellites seen in an open area is 8-12 for a BS4 and 13-21 for a BS4RG. A minimum of 4 satellites are required for the base station to calculate the differential. ▶
- 5 If the base station was last used at this position it will have remembered this location and be working immediately once satellites are in view. If the base station was last used somewhere else then you will need to load the stored location. Press 'OK' and scroll to the 'Load Location' option and press 'OK'. Then select the previously stored location from the list of locations and press 'OK' to confirm. The base station will immediately start sending out DGPS correction data.

ⓘ It is important when recalling a stored position, that the GPS antenna is in the same geographic position that it was when the location was originally stored. For example, if the GPS antenna is placed 50cm from the position where the stored location was originally created, the DGPS output and hence the VBOX data logged will carry a 50cm offset.

ⓘ To ensure accuracy the VBOX must receive Local DGPS corrections for at least 20 Minutes before being used in 40cm or 20cm modes

Using user supplied radio modems

Any radio modem can be connected to a basestation to send out DGPS correction messages. You can connect these radios to the base station via:

1. The internal RS232 D-sub connector beneath the front panel
2. The internal Molex connector beneath the front panel
3. The external waterproof Bulgin connector

The connections in each of these positions are the same, and so only one radio should be connected at any one time to any of these connectors.

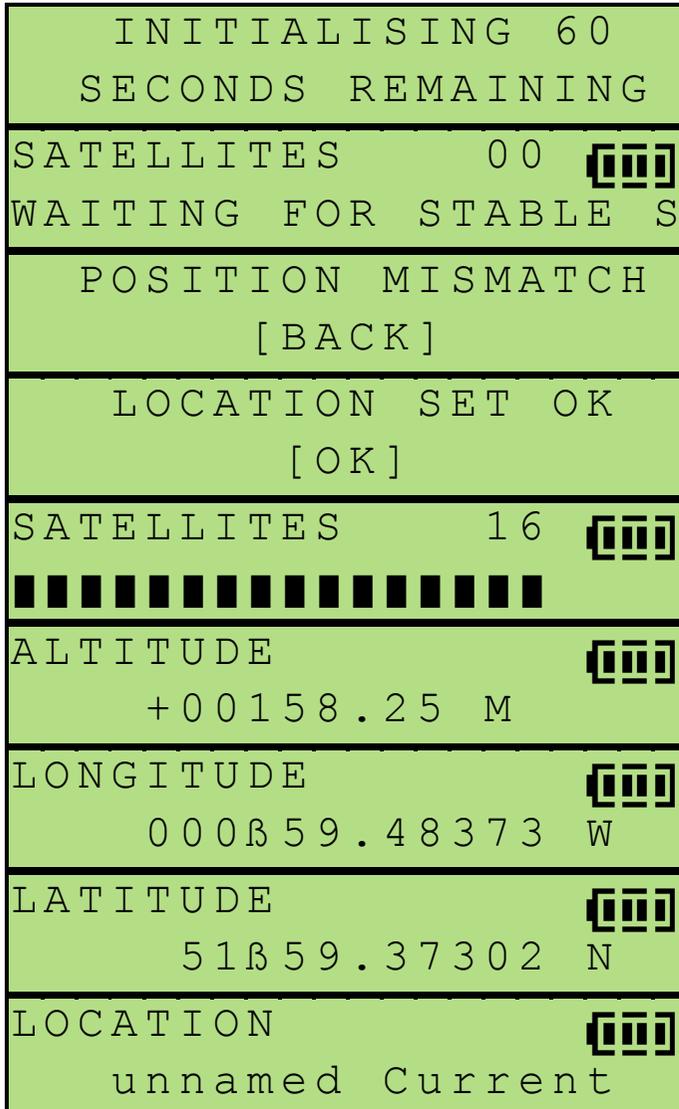
For all radios, configure the radio type and baud rate:

1. Press the 'OK' button on the front panel
2. Choose 'Setup' and press 'OK'
3. Choose 'Radio Mode' and press 'OK'
4. Choose 'User' and press 'OK'
5. Having chosen a user supplied radio modem mode, there is now an additional option to select: DGPS Baud and Hardware Handshaking
6. Select 'DGPS Baud' and press 'OK'
7. Choose the baud rate at which your radio modem is configured to communicate and press 'OK'
8. Select 'Handshaking' and press 'OK'
9. Choose whether hardware handshaking should be 'On' or 'Off' and press 'OK'
10. Exit from the menus and follow the instructions on previous pages for normal operation

 **The power supply to the base station is conditioned, but not regulated before being passed to the radio. The radio must therefore be able to operate from the same voltage as the base station's power supply.**

Status Display

The status display is used to show the operating status of the base station including satellite lock, internal battery condition and location information.



After powering up the base station, the display will initially show the unit serial number and firmware version, then an initialisation screen with a 60 second countdown.

If the base station has no satellite reception fix within the initialisation period then a flashing zeros satellite count will be displayed and the message 'WAITING FOR STABLE SAT LOCK' will scroll across the bottom of the display. If the basestation is tracking satellites but does not yet have a fix then it will flash the number of satellites being tracked instead of zeros.

When the base station attains a positional fix, if it is located in a different position than it was last used it will display a 'LOCATION MISMATCH' message. This indicates that the position of the basestation must be set using a current, average, stored, or user entered location

If the GPS antenna is located in the same location as the last time the basestation was used then 'LOCATION SET OK' will be displayed to show that there is a set position and is ready to use. This should be used with caution as the previous position may have been set using 'SET TO CURRENT' which would give an offset in absolute position as compared to a 'SET TO AVERAGE'. Also, if the antenna has been positioned near to, but not in the same place as it was previously sited it will give a positional offset equal to the location offset.

The 'LOCATION SET OK' message can be cleared by pressing the 'OK' button. The live satellite count is then displayed. This count will be for all constellations that the basestation is able to track. So for a VBBS4RG unit it will be the total number of GPS and GLONASS satellites combined.

By using the < and > buttons various status screens can be viewed. These show the averaged or set position of the GPS antenna and NOT the live positional parameters. The first of these screens displays Altitude in metres to 1cm resolution.

The next screen shows the longitudinal coordinate in the format DDD°MM.mmmmm to a resolution of 0.00001 minutes. The coordinate is suffixed with an E or W to indicate if the coordinate is East or West of the prime meridian.

The next screen shows the latitudinal coordinate in the format DD°MM.mmmmm to a resolution of 0.00001 minutes. The coordinate is suffixed with an N or S to indicate North or South of the equator.

The last screen shows the location name if the location being used is a stored and named location.

Battery and Charging Status

The following table describes the states of the charge status LED located on the front panel.

COLOUR	DESCRIPTION
	No external power is connected and the unit is either switched off or running off the internal battery.
	Unit is connected to a power supply and fast charging is complete or the battery does not need fast charging.
	Unit is connected to a power supply and the battery is fast charging.
	There is a fault with the charging circuit. Please contact Racelogic for support.

The following table describes the symbols showing battery and charging status in the top right corner of the display when the basestation is switched on.

SYMBOL	DESCRIPTION
	Unit is connected to a power supply and the battery is fast charging.
	Unit is connected to a power supply and fast charging is complete.
	Unit is running from internal battery power and has between 75% and 100% charge remaining.
	Unit is running from internal battery power and has between 50% and 75% charge remaining.
	Unit is running from internal battery power and has between 25% and 50% charge remaining.
	Unit is running from internal battery power and has between 0% and 25% charge remaining.
	Flashing symbol. Unit is running from internal battery power and the battery charge is almost depleted. A power supply should be connected immediately to charge the battery.
	There is a fault with the battery or battery charging circuitry. You should contact Racelogic support department if this symbol appears.

Configuration Menu Options

By pressing the 'OK' button from any of the status display screens the configuration menus can be accessed. These can be navigated using the < and > buttons for find an option and then the 'OK' button to select it. The first screen to be displayed is the 'EXIT' option to return to the status display. To exit out from any area of the configuration menu select the 'BACK' and 'EXIT' options.

SETUP

This menu contains general setup options to configure the basestation.

- **LANGUAGE**

This setting changes the interface language. The options available are:

- English
- Deutsch
- Français

- **BRIGHTNESS**

This setting allows the brightness of the display to be increased and decreased.

- **CONTRAST**

This setting allows the contrast of the display to be increased and decreased.

- **SET DGPS MODE**

Allows the user to choose what type of differential correction should be transmitted. The options available are:

- RTCM 40cm
- Racelogic 20cm (only available on VBBS4)
- Racelogic 2cm (only available on VBBS4RG)
- CMR 2cm (only available on VBBS4RG)
- RTCM v3 2cm (only available on VBBS4RG)

The Racelogic options are proprietary modes that only work with 20cm enabled VBOX 2 series products and RTK (2cm) enabled VBOX 3 series products. The RTCM and CMR modes are industry standard modes that will work with any GNSS receiver that is capable of using these differential modes.

- **COLDSTART**

Coldstart will clear the GNSS receiver of its almanac and ensure it is configured correctly. The GPS almanac is information about the 'health' of each satellite in the constellation and navigational data regarding its orbit. This allows the receiver to quickly obtain a positional fix when it has been switched off. However, if the almanac is old because the receiver has been switched off for several days or weeks; or if the receiver has been moved a long distance between being powered down and re powered, then the almanac no longer serves its purpose as the information is no longer relevant to the situation. In this case the data in the almanac can actually extend the time it takes to get a fix on the current position. It is recommended that a Coldstart be performed in the above instances.

- **FP RS232 MODE**

This allows the RS232 serial connector on the front panel to be configured for various tasks. The options are:

- Radio Config Ports to the radio modem to allow direct configuration or firmware update
- F/W Update Allows the basestation firmware to be upgraded using Racelogic Upgrader software and an appropriate .ruf firmware release
- GPS Update Ports to the GNSS receiver to allow direct configuration or firmware update

- **RADIO MODE**

This allows the user to select what type of radio modem is connected to or fitted inside the basestation. The options are:

- SATEL Refers to SATEL SATELLINE-3ASd and SATEL M3-T1 which can be used in most countries but may require a licence
- 868 MHz Refers to Racelogic 868MHz medium range radio modems that are legal for licence free use in Europe
- 915 MHz Refers to Racelogic 915MHz medium range radio modems that are legal for licence free use in North America
- User Allows user configuration of the radio communications baud rate and hardware handshaking for a custom radio solution
- 2.4GHz Refers to Racelogic 2.4GHz short range radio modems that are legal for licence free use worldwide

 You should always check the local laws and regulations regarding radio transmissions in your country to ensure you are not broadcasting illegally. Racelogic and its representatives can offer guidance in this area, but it is the responsibility of the user to ensure that they are not breaking local transmission regulations.

- **ELEVATION MASK**

This allows a user configurable elevation mask to be set within the Base Station. Values of 5, 10, 15 or 20° can be set. The default setting is 5°.

- **DGPS BAUD**

This setting is only available when the 'RADIO MODE' is set to 'USER'. It allows for a compatible serial baud rate to be set to communicate with a custom radio modem configuration. The available bps rates are below.

-1200 -4800 -9600 -19200 -38400 -57600 -115200

- **HANDSHAKING**

This setting is only available when the 'RADIO MODE' is set to 'USER'. It allows for hardware handshaking to be turned 'ON' or 'OFF' when communicating with a custom radio modem configuration. It is recommended that hardware handshaking be used where possible to prevent buffer overflows on the radio modem. If data is lost in this way then the transmission of partial correction messages may affect the performance of the rover unit and result in differential dropouts.

- **BATT/VOLT MON**

This allows the user to view two displays (using the < and > buttons) which provide status and fault indication for the power supply and battery charging circuits. If the operation of the basestation battery charge and discharge functions are not operating as expected then you may be asked to provide information from these screens by Racelogic Support in order to help diagnose any possible fault.

ENTER LOCATION

The ENTER LOCATION option allows the user to manually enter the latitude and longitude in degrees and minutes and the altitude in metres. This option is useful when the basestation antenna is being sited in a position that is known or has been surveyed.

- **UPDATE POSITION**

By selecting this option the values that have been entered for latitude, longitude and altitude in the other 'Enter Location' options are set as the reference location for the GNSS receiver antenna.

- **LATITUDE**

This allows the user to define a latitude in the format DD°MM.mmmmm and suffixed by N for north or S for south. For example: 51°59.37252 N

- **LONGITUDE**

This allows the user to define a longitude in the format DDD°MM.mmmmm and suffixed by E for east or W for west. For example: 000°59.48398 W

- **ALTITUDE**

This allows the user to define an altitude in the format MMMMM.mm and is prefixed by a sign (+ or -) and suffixed by M for the unit metres. For Example: +00155.61 M

LIVE LOCATION

The VIEW LOCATION option allows the user to view the current latitude and longitude in degrees and minutes and the altitude in meters.

- **SATELLITES**

This give a bar graph representation of the number of satellites that are being tracked with one block representing each satellite.

- **LATITUDE**

This displays the current latitude in the format DD°MM.mmmmm and is suffixed by N for north or S for south.

- **LONGITUDE**

This displays the current longitude in the format DDD°MM.mmmmm and is suffixed by E for east or W for west.

- **ALTITUDE**

This displays the current altitude in the format MMMMM.mm and is prefixed by a sign (+ or -) and suffixed by M for the unit metres.

LOAD LOCATION

The LOAD LOCATION option is used to load a previously stored reference position from memory. A location is stored using the STORE LOCATION function described below.

STORE LOCATION

STORE LOCATION allows the user to store the position that has been obtained via SET TO CURRENT or SET TO AVERAGE, or set using ENTER LOCATION for use at a later date. This is useful if the base station is used in a number of different locations on a regular basis. It is also possible to give the location a meaningful name before it is stored. To do this, select STORE LOCATION and then press OK. Use the arrow buttons to select an unused memory location and then press OK again. The display should now show the location name with a flashing cursor at the beginning of the name. Use the arrow keys to select a letter and then press OK to move on to the next character position. Repeat this until the new name is complete. The basestation can store a total of 25 unique locations.

SET TO CURRENT

The SET TO CURRENT option can be used when the base station is required to be setup and operational as quickly as possible. It allows a DGPS reference point to be marked almost immediately after satisfactory satellite lock is achieved. Using STC will give relative positional stability during the period that equipment is being used, but will have an offset of the absolute positional accuracy on earth. SET TO CURRENT should only be used where absolute positional accuracy is not important and all that is required is positional stability.

SET TO AVERAGE

The 'SET TO AVERAGE' option should normally be used to set a DGPS reference position. You can choose to average the location over 5 minutes, 12 hours or 24 hours. The display will state the number of seconds remaining in the averaging process. Using this option ensures that a good average of current position has been obtained. Press OK to abort at any time.

ⓘ If a 24 hour average is being used then it is recommended that the basestation be powered from an external source as if the battery power is depleted before the average is complete then the average data will be lost.

ⓘ To obtain the best absolute positional accuracy a 24 hour average is recommended, however this only needs to be done once for a test site and can then be stored and recalled, so long as the GPS antenna is returned to exactly the same position for all subsequent uses.

EXIT

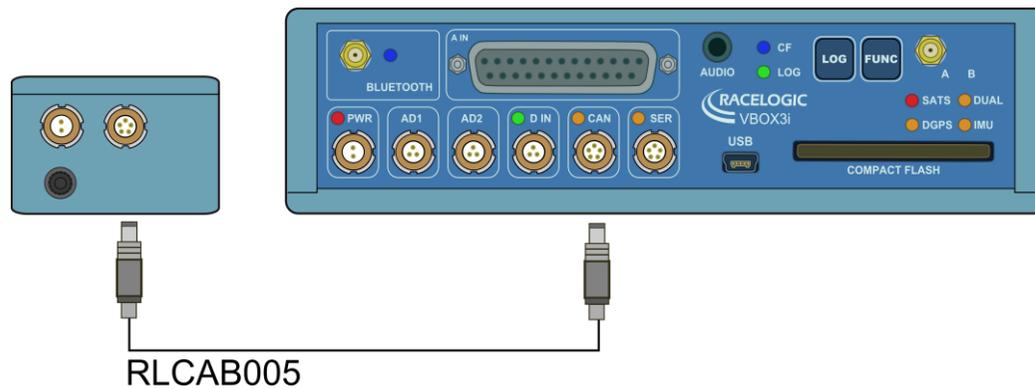
Selecting this option exits from the configuration menus back to the status display.

Setting up the VBOX to receive local DGPS

In order to receive DGPS corrections from the base station, the VBOX will need to be connected to a Racelogic telemetry modem that matches the type used in the basestation setup. Example connections for VBOX 3i and VBOX II are as follows.

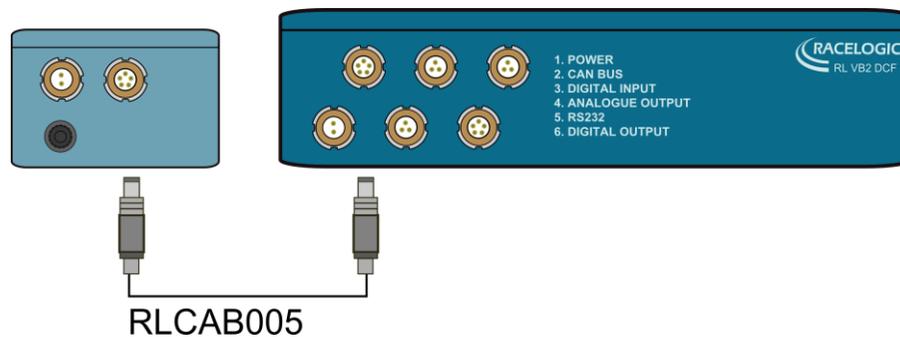
Example of Local DGPS operation with VBOX 3i

VBOX receives RTCM correction data from radio module. Radio module acts as receiver for information transmitted by Racelogic DGPS base station.



Example of Local DGPS operation with VBOX II

VBOX receives RTCM correction data from radio module. Radio module acts as receiver for information transmitted by Racelogic DGPS base station.

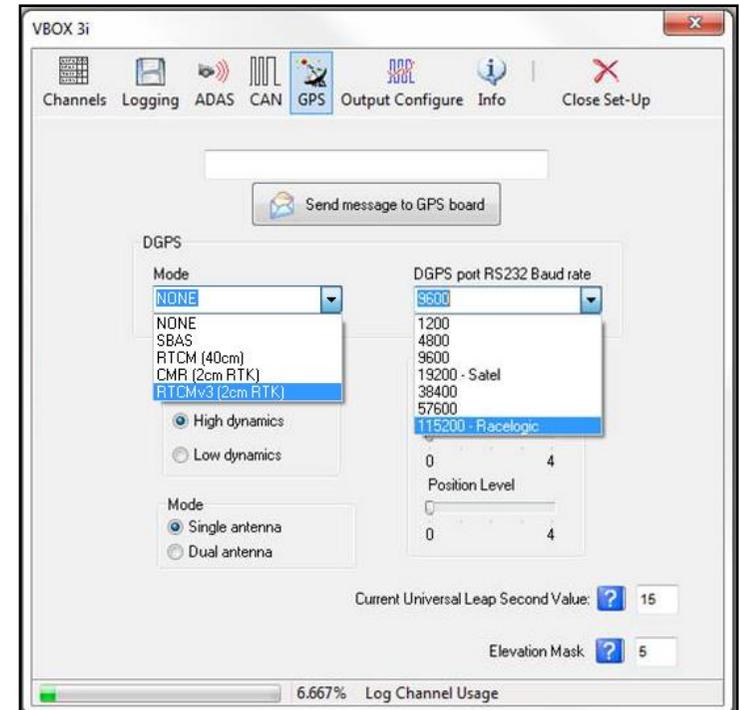


Racelogic also provide solutions to use SATEL radio modems for long range applications on large test sites. The connection to the VBOX will be the same in this instance, but an RLCAB096L would be used which has a 15wat D-Sub connector for connection to the SATEL radio modem.

In addition to connecting the radio modem to the VBOX, it is also necessary to inform the GPS engine that it must use the correction data in its calculations. The VBOXTools software has options to enable the DGPS corrections in any VBOXII, VBOXIII or VBOX3i connected to it, in the VBOX Setup screen.

To enable DGPS in a VBOXII, VBOXIII or VBOX3i, simply run the VBOXTools software with the VBOX connected to the required COM port as usual, and then click on 'VBOX Setup'.

The software will take a few seconds to communicate with the VBOX and open the VBOX Setup screen shown on the right. Once the VBOX Setup screen appears, click on 'GPS', and then set the DGPS 'Mode' and 'DGPS port RS232 Baud rate' as shown in the drop down menus. The mode selection will should be chosen to reflect the basestation mode that is being used, and the baud rate to reflect the type of radio modems and data baud rate being used. If your VBOX is not enabled for RTK (2cm) or 20cm then this will not work and an error message will confirm this. Once configured, you can then close the VBOX Setup screen before disconnecting the VBOX.



i From approximately July 2004, all VBOX units have been shipped with DGPS reception enabled. However, VBOX units supplied before this date will require a small hardware modification to be carried out by Racelogic to accept the DGPS information via the radio modem. Please contact Racelogic for more information.

Checking that you have DGPS Lock

RTK (2cm) Mode



→ No data



→ 2cm RTK fix



→ Receiving data but not yet fixed

20 cm and 40cm Modes



→ No data



→ Differential fix

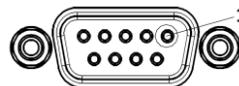
Specifications

Parameter	Conditions	Max	Min	Typ	Unit
Temperature	Storage	+50	-40	-	°C
	Operating	+45	0	-	°C
	Limits for battery fast charge	+50	10	-	°C
Battery Life				24	Hours
Input voltage range		30	8	-	Volts
Input Current	Operating and charging @ 19V	2.25	-	-	Amps
	Operating and not charging @ 19V	< 0.5	-	-	Amps
95% Circle Error Probable (CEP)	RTCM 40cm Mode			<0.40	Metres
	Racelogic 20cm Mode			<0.20	Metres
	Racelogic 2cm Mode			<0.02	metres
	CMR 2cm Mode			<0.02	metres
RTCM Messages Rate	Type 1 – Differential GPS Corrections			1	Second
	Type 3 – GPS Reference Station Parameters			10	Second
	Type 31 – Differential GLONASS Corrections (VBBS4RG only)			1	Second
	Type 32 – GLONASS Reference Station Parameters (VBBS4RG only)			10	Second
CMR Message Rate (VBBS4RG only)	Type 0 – GPS Measurements			1	Second
	Type 1 – Reference Station Coordinates			10	Second
	Type 3 – GLONASS Measurements			1	Second
Radio Modem	Frequency – Europe			868	MHz
	Frequency – All other countries			915	MHz
	Frequency – Satel			430	MHz
	Power			500	mW
	Max Range – Open area			3.5	Km
	* Obstacles such as trees and buildings will greatly reduce radio range			2.2	Miles

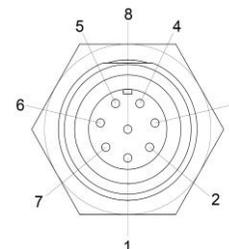
Connection Data



Coaxial DC power socket



9 pin Sub-D



8 pin Bulgin

Connector	1 POWER	Type	Lemo 2 pin
PIN	In/Out	Description	Range
1	I	Power +	7V to 18V
2	I	Ground	0V

Connector	2 RS232	Type	9 pin Sub-D
PIN	In/Out	Description	Range
2	O	RS232 Transmit	+/- 12V
3	I	RS232 Receive	+/- 12V
5	I	Ground	0V

Connector	3 Power/RS232	Type	8 pin Bulgin
PIN	In/Out	Description	Range
1	O	RS232 RTS	+/- 12V
2	O	RS232 Transmit	+/- 12V
3	I	RS232 Receive	+/- 12V
4	O	External Radio Power +	Vin
5		RS232 Ground	0V
6	I	Power +	19V Typ, 30V Max
7	I	RS232 CTS	+/- 12V
8		Power in/out Ground	0V

Firmware updates

From time to time, Racelogic may release new versions of firmware to improve the operation of the base station. It is advisable to check the Racelogic web site for updates periodically to be sure that you have the latest firmware version.

To upgrade the base station, download the latest upgrade file from the Racelogic web site. The file will have a '.RUF' file extension. Link the RS232 connector on the base station to the serial port of the PC using the RS232 link cable provided. If you use an external radio, select F/W Update from the FP RS232 Conn Setup menu option. Double click the upgrade file and follow the on-screen instructions. If you have any questions about the upgrade procedure, please do not hesitate to contact Racelogic.

Contact Information

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

Tel: +44 (0) 1280 823803

Fax: +44 (0) 1280 823595

Email: support@racelogic.co.uk

Web: www.racelogic.co.uk

Revision	Date	Description	Author
1	01/02/2005	First draft	CS
2	25/04/2005	Additions to menu options and improved setup explanation	KB
3	13/05/2005	Correction of order of VBOX DGPS commands for VBOX II	DD
4	29/03/2006	Updates to include instructions for use with VBOXTools	JH
5	01/06/2006	Update to cover new 20cm and 2cm modes. New Tripod mounting	KB
6	21/06/2006	Wording changes and pictures changes re new tripod and RTK system	CS
7	19/12/2006	Advice for waiting 20minutes before use with 40cm and 20cm mode.	KB
8	30/04/2008	Update of Address	AM
9	18/11/2009	Update to Radio and GPS antenna setup and Absolute positioning	KB
10	15/06/2010	Updates to basestation 4	DS
11	24/12/2010	Further updates to basestation 4	ST
12	8/8/2012	Correction to Bulgin connector description	KB