10Hz Speed Sensor
RLVB10SPS

Instruction Manual

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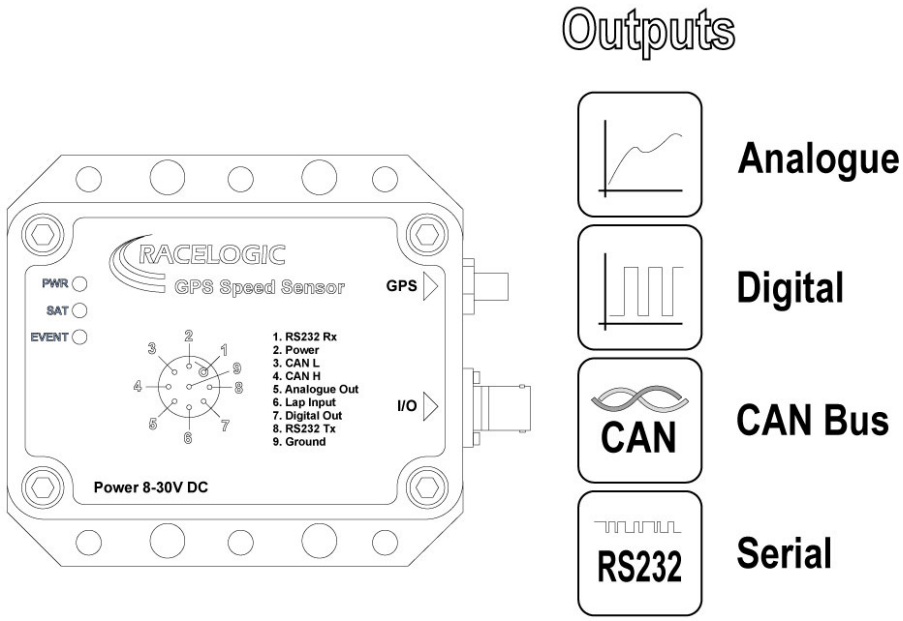
Introduction

The VB10SPS is a GPS based, non-contact speed and position sensor. Outputs available are CAN, analogue, digital and serial, which allow easy integration into most motor sport and testing applications.

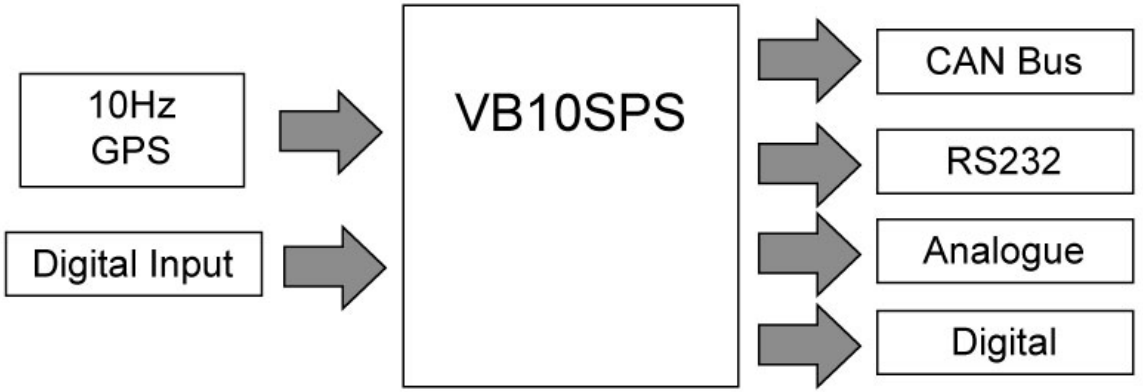
The analogue output can either output vehicle speed, lateral or longitudinal acceleration (g) or alternatively, it can be used as a lap beacon marker. The digital output can be configured as either a digital speed pulse output or as a lap beacon marker.

NMEA 0183 data containing the GPVTG and GPGGA GPS messages are available at 115200b/s on the RS232 serial output.



Key features

- High performance 10 Hz GPS receiver
- Configurable CAN Bus output of Velocity, Position, Long and Lat G, Heading, Radius of turn, Height and Time.
- Configurable Analogue Output
- Configurable Digital Output
- Virtual Lap Beacon Output
- RS232 NMEA serial output (115200b/s)
- Wide 8V to 30V operating range
- Rated to IP66



Parts Supplied with RLVB10SPS

1 x **VB10SPS**	10Hz Speed Sensor
1 x **RLVBACS018**	GPS Antenna

Optional Accessories

1 x **RLCAB49**	VB10SPS Interface cable
1 x ASDD606-09pn	Deutsch Connector plug and crimp pins, (pins require correct Deutsch crimp Tool)

Getting Started

Interfacing with the VB10SPS

If you have purchased a RLCAB49 interface cable, then connect this to the VB10SPS. The RLCAB49 features connections for power, input and all outputs of the VB10SPS.

Because the VB10SPS can be used in a number of ways, it is common for the end user to integrate the VB10SPS connector into their own wiring harness. A mating connector, Deutsch ASDD606-09PN, may be purchased from Racelogic for this purpose. Please see the section of this manual 'Building an interface cable for the VB10PS'.

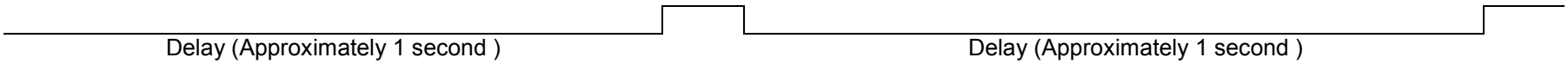
Before connecting power to the VB10SPS you should connect the GPS antenna, this is because the VB10SPS will look for a connected GPS antenna and automatically adjust its gain for optimum performance from the connected antenna. For more information about the GPS antenna and antenna placement see the section 'GPS Antenna'.

LED indicators

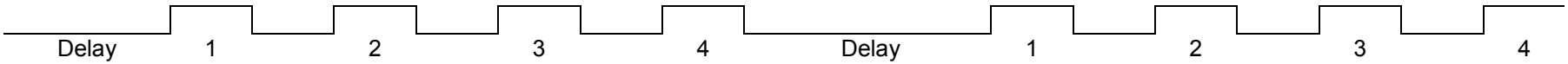
There are 3 LED indicators on the front panel of the VBOX. The red LED, **PWR,** indicates that the VBOX is powered correctly. The green LED, **SAT,** is used to indicate the number of GPS satellites that the VBOX has in lock. When no satellites are in lock, the **SAT** LED flashes slowly to indicate that the VBOX is searching for satellites. When one or more satellites are in lock, the LED will pulse the satellite count repeatedly with a short delay.
The blue LED, **EVENT,** will flash in time with the digital pulse output, if the digital output is set to velocity then this will flash in time with speed at a rate of 1 flash per meter. If the output is set to Lap beacon then the LED will flash when either a Start/Finish or Finish line is crossed.

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

Sequence showing 0 Satellites



Sequence showing 4 Satellites



Locking onto Satellites

If the VB10SPS is having trouble locking onto satellites then please follow the checklist below for typical solutions.

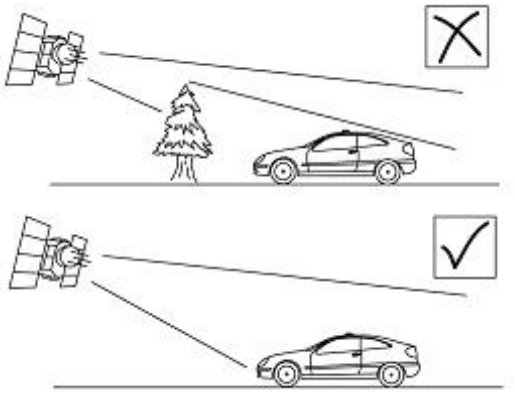
1) Confirm that the antenna is placed in a position were it has an unobstructed view of the sky.
2) Check the antenna connection with the VB10SPS; only small amounts of dirt in the socket can cause a significant reduction in signal strength. Also check the cable at the plug and along its length for any damage.
3) Check that the power supply is OK.
4) If possible try another known working antenna, to confirm antenna functionality.
5) Perform a GPS coldstart and then leave the unit powered up in an open static position for at least 15minutes. See 'GPS Coldstart'.

Once the VB10SPS has locked onto 5 or more satellites then it will be ready for use and will output data on CAN, RS232 and the analogue and digital outputs in accordance with the default settings.
The default settings of the CAN bus is shown in the CAN format table at the end of this manual. A CAN '.dbc' data file of this default CAN format is present on the CD, this file can be loaded directly into many CAN based data acquisition systems.
The default setting of the Analogue output is Velocity configured to 5V output representing 400Kph.
The default setting for the Digital output is Velocity configured to 90 pulses per metre.

GPS Antenna

The GPS Antenna supplied with the VB10SPS is a 3.5v active antenna. For the best possible signal quality, it is important to maintain a clean connection between the antenna and the speed sensor. Before fixing the antenna to the sensor ensure that there are no dust particles in either connector. Replacement antennas are available by contacting your 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 and increase the measurement noise.



GPS Coldstart

This forces the GPS engine to reset its downloaded almanac of current satellite position. This can be used if the Speed sensor is having trouble locking onto satellites. This can be caused by the Speed sensor not having been used for a period of time or if it was last used a long distance away from your current point.

A GPS satellite Almanac is relevant for about 3- 4weeks, so if it has not been used or updated within that time it can cause the GPS engine to struggle. After performing a GPS Cold start leave the Speed sensor powered up in a static situation where the antenna has an unobstructed view of the skies, for 15 minutes.

Once the Speed sensor has downloaded the new almanac it is much quicker to re-acquire satellites in noisy situations such as near trees buildings and bridges. Also it is much quicker to acquire satellites on power-up.

There are two ways to perform a GPS coldstart on the VB10SPS, with or without the use of a computer.

Without a computer:
Connect the Lap Beacon input to ground for 15 seconds, the SAT and EVENT lights will then come on to indicate that the GPS coldstart is being performed. This is a very useful facility so it should be noted that if you are making your own loom it would be worth fitting a cable into the Lap Beacon pin position even if you have no need for the Lap Beacon facility on this product.

With a Computer:
To cold start the GPS engine in the Speed sensor using a computer, connect the RS232 port to a computer and run the VB10SPS set up software which is supplied with the unit. Press ‘Connect’ to start the communications, then select the ‘Cold start’ option, the SAT and EVENT lights will then come on to indicate that the GPS coldstart is being performed.

Configuring the VB10SPS

Configuration of the VB10SPS is performed using the setup software supplied with the unit. You will need to power up the VB10SPS and make a connection from its RS232 to a serial com port or USB socket (via a serial to USB adapter) on your computer.
This is most easily achieved using an RLCAB49 cable, which provides a power connection and 9way D type RS232 connection from the VB10SPS.

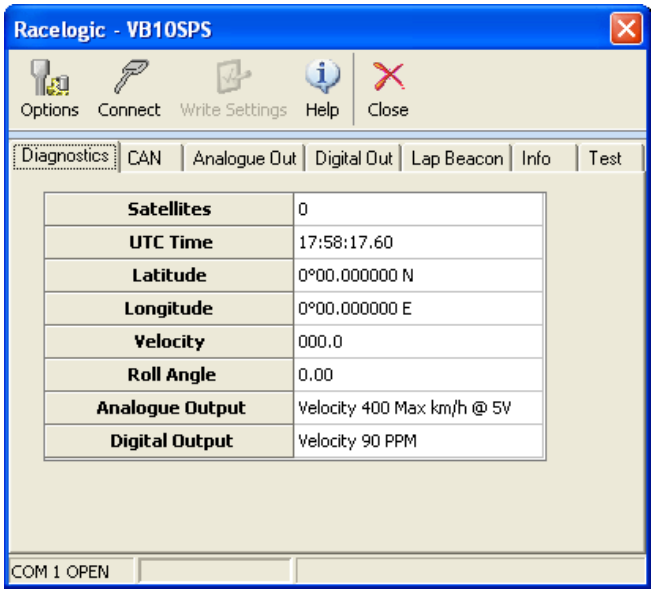
Installing the software

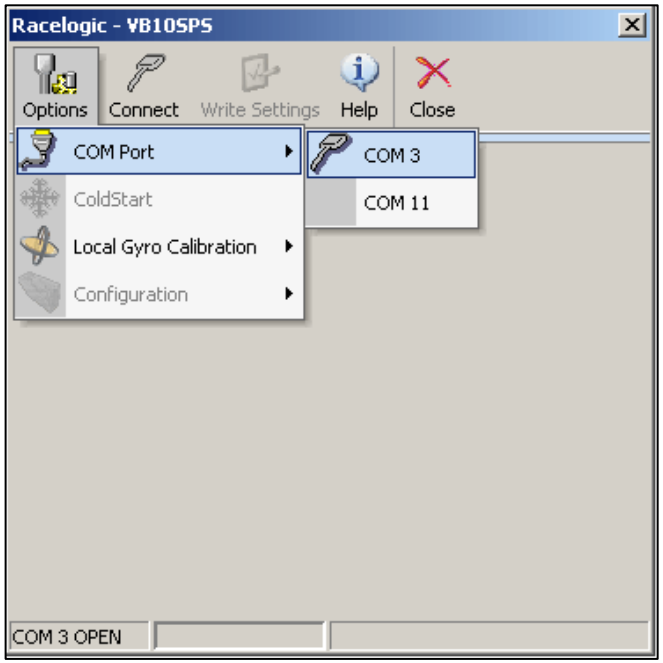
Insert the supplied CD into the CD drive of your computer. An installation box will automatically appear, follow the on screen instructions to complete the installation of the setup software.
After installation the CD can be removed and an Icon should have appeared on your desktop that will allow you to start the VB10SPS software.

Running the software

First, click on the Options button to select the correct Com port on your computer.

Now click the Connect button to enter the VB10SPS setup screen.
Note: After changing any settings in the setup software you will need to press the write button to confirm the changes in the speed sensor.





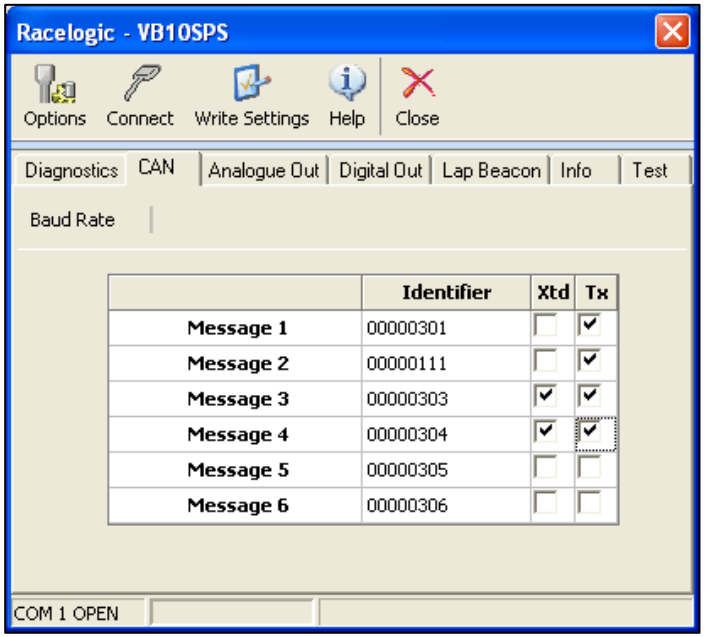
Configuring the CAN output

The CAN output consists of 6 CAN messages that contain the following data channels: Satellites, Time, Latitude, Longitude, Velocity, Heading, Height, Vertical Velocity, Lap Beacon Output, Longitudinal Acceleration, Lateral Acceleration, Distance, Lean Angle (relevant to motorcycles only) and Radius of turn.

The default CAN output of the VB10SPS is shown in the CAN format section at the end of this manual, the default baud rate for this output is 500Kbaud.

The following attributes of the CAN data can be configured in the VB10SPS.

1) Baud Rate
2) CAN id
3) Extended/standard identifier (11/29bit)
4) Enabling/disabling individual CAN messages



Baud Rate:
To change the Baud Rate click on the Baud Rate button and select a Baud Rate from the drop down list.

CAN Identifier:
To change the identifier of a CAN message click the cursor in the Identifier box and type in a new CAN id.

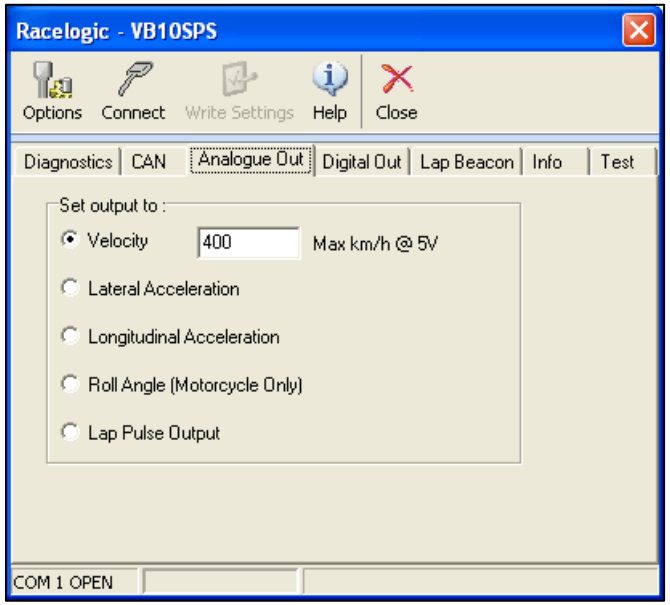
Standard/Extended Identifier:
To change the identifier format from standard 11bit to extended 29bit tick the **Xtd** box in the corresponding column.

Enabling a CAN message:
To switch off or on a CAN message tick or un-tick the box for the corresponding message.

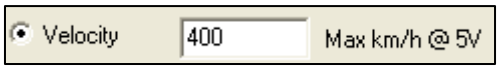
After making any changes you must click 'Write Settings' for the changes to be programmed into the VB10SPS.

Configuring the Analogue output

The Analogue output of the VB10SPS can be set to any one of 5 options, Velocity, Latacc, Longacc, Roll Angle and Lap Pulse.

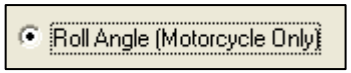


Velocity:
Enter the maximum for the speed range you wish to measure.



Latacc & Longacc:
Select the range you wish to use from the pull down list.

Roll Angle (Motorcycle Only):
When this option is selected a calculated Lean angle relevant for a motorcycle is transmitted on the Analogue output. The VB10SPS produces a Roll Angle calculated from Lateral Acceleration that uses the assumption that a motorcycle has virtually no resultant lateral force perpendicular to the motorbike when it is cornering. This does not hold true for any other vehicles.



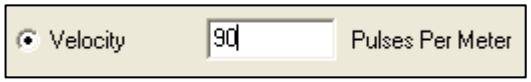
Lap Pulse Output:
When this option is selected the analogue output will transmit a 300mS 5V pulse when a Start/finish or Finish line is crossed.

After making any changes you must click 'Write Settings' for the changes to be programmed into the VB10SPS.

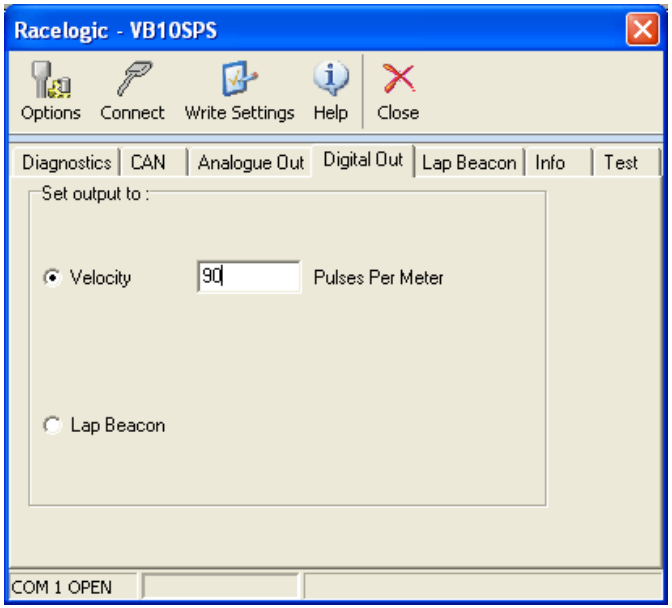
Configuring the Digital output

The Digital output of the VB10SPS can be set to one of 2 options, Velocity or Lap Beacon.

Velocity:
The velocity output is configured by changing the number of pulses per metre. Default = 90 pulse per metre => 25 Hz per km/h.



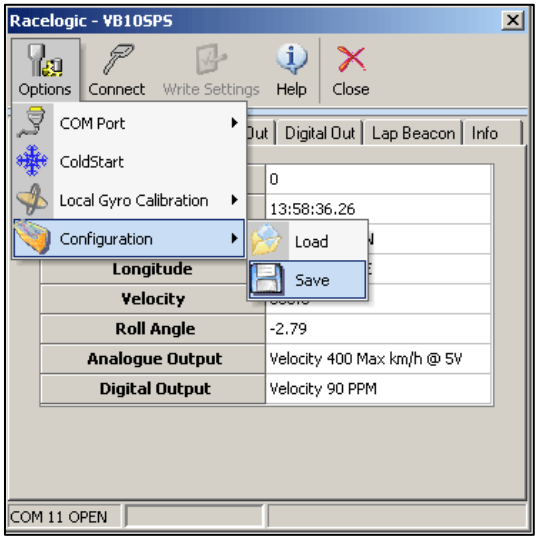
Lap Beacon:
When this option is selected the digital output will pulse from 5v to 0v for 300mS when a Start/finish or Finish line is crossed.



After making any changes you must click 'Write Settings' for the changes to be programmed into the VB10SPS.

Loading And Saving Configuration files

The configurable settings of a VB10SPS can be saved to a file. The software also allows a configuration file to be loaded enabling quick and easy configuration of the VB10SPS.

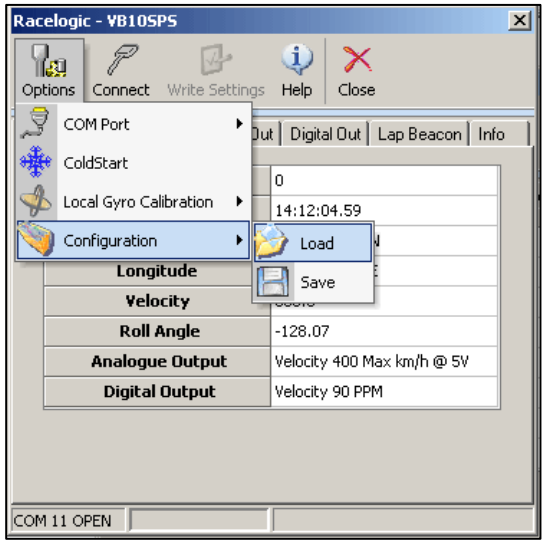


Saving a Configuration file.

- Run the VB10SPS software
- Connect a powered VB10SPS to the PC via a RS232 connection
- Click the ‘Connect‘ button in the VB10SPS software to start communications with the VB10SPS.
- Configure the VB10SPS as required.
- Go to the ‘Options’ menu
- Highlight the ‘Configuration’ option
- Then click ‘Save’
- The standard Windows save window will appear where you can select a file name and file destination.

The file will automatically be given the extension .rlcfg.

Loading a Configuration file.



- Run the VB10SPS software
- Connect a powered VB10SPS to the PC via a RS232 connection
- Click the ‘Connect‘ button in the VB10SPS software to start communications with the VB10SPS.
- Go to the ‘Options’ menu
- Highlight the ‘Configuration’ option
- Then click ‘Load’
- The standard Windows Browse window will appear where you can select and load an ‘.rlcfg’ file in to the software.
- Now click ‘Write Settings’ to apply the configurations from this loaded file into the VB10SPS

Configuring and using the using the lap beacon output

The VB10SPS has the ability to simulate a Lap Beacon signal when a virtual GPS Start/finish or finish line has been crossed.
The Lap Beacon output signal can be configured to come out of either the Digital or Analogue output and it is also present as a bit inversion of a bit in a message on the CAN bus output. The Beacon pulse on the analogue and digital channel are opposite polarity, this is to provide two options for a lap beacon pulse.

For a Lap beacon pulse to be output by the VB10SPS it must first be programmed with the position of a Start/finish or Finish line.

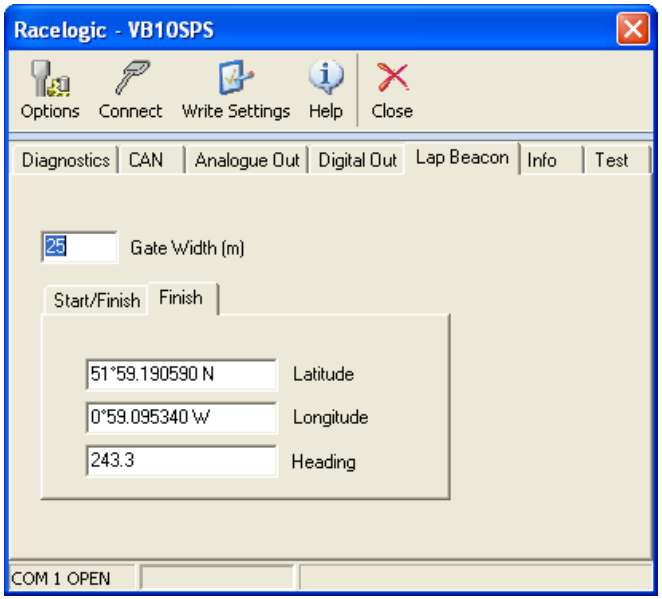
Setting Start/Finish and Finish Lines

To program the position of a virtual line in the 10SPS you must first ensure that you have a connection to the Lap Input (pin 6). This pin should be connected to one side of a momentary switch and the other side of the switch connected to the Ground pin of the VB10SPS, so that when the switch is pressed the Lap Input pin will shorted to Ground.

To set a Start/finish line: press and immediately release the Lap input switch as you cross the start finish line. You must be moving >5km/h to do this and following the normal line along the track.
The VB10SPS notes the point and your direction of travel at which you press the switch and then creates a virtual line perpendicular to your line of travel 25m wide.
To set a new Start/finish line simple repeat the process above.

To set a separate Finish line: press the switch as you cross the Finish line and hold the switch for >1.5 seconds before releasing.

After you have set a Start/Finish or Finish line you can view the Latitude and longitude of this line position in the Lap beacon page of the setup software. If the software was already connected then press 'Connect' again to refresh the settings.



Changing the Width of a Virtual line

The Gate width of the Start/finish or Finish line is set in the Lap Beacon page. Change this by entering a new number in the edit box. Then click 'Write Settings' to program the new setting into the VB10SPS.

This is a useful feature when two parts of a track may run very close to each other and you do not want the virtual line to be triggered by the wrong part of circuit.

RS232 / NMEA output

The RS232 output is present to provide a connection to a computer for configuring the settings of the VB10SPS through the VB10SPS setup software. It also Outputs an NMEA format message at 115200 baud. The NMEA messages transmitted are GPVTG and GPGGA:

`$GPGGA,hhmmss.ss,Latitude,N,Longitude,E,FS,NoSV,HDOP,msl,m,Altref,m,DiffAge,DiffStation*cs<CR><LF>`

Name	ASCII String Format	ASCII String Example	Units	Description	
$GPGGA	string	$GPGGA		Message ID	GGA protocol header
hhmmss.ss	hhmmss.sss	092725.00161229.487		UTC Time	Current time
Latitude	dddmm.mmmm	4717.113993723.2475		Latitude	Degrees + minutes
N	character	N		N/S Indicator	N=north or S=south
Longitude	dddmm.mmmm	00833.9159012158.3416		Longitude	Degrees + minutes
E	character	WE		E/W indicator	E=east or W=west
FS	1 digit	1		Position Fix Indicator	See Table 41
NoSV	numeric	078		Satellites Used	Range 0 to 12
HDOP	numeric	1.001		HDOP	Horizontal Dilution of Precision
Msl	numeric	499.69.0	m	MSL Altitude	
M	character	M		Units	Meters
Altref	blank	48.0	m	Geoid Separation	
M	blank	M		Units	Meters
DiffAge	numeric		second	Age of Differential Corrections	Blank (Null) fields when DGPS is not used
DiffStation	numeric	0		Diff. Reference Station ID	
Cs	hexadecimal	*5B *18		Checksum	
<CR> <LF>					End of message

$GPVTG,cogt,T,cogm,M,sog,N,kph,K*cs<CR><LF>

Name	ASCII String		Units	Description	
	Format	Example			
$GPVTG	string	$GPVTG		Message ID	VTG protocol header
cogt	numeric	77.52	degrees		Course over ground (true)
T	character	T		fixed field	True
cogm	Blank			Course over ground (magnetic).	Not output (empty)
M	character	M		fixed field	Magnetic
sog	numeric	0.004	knots		Speed over ground
N	character	N			
kph	numeric	0.008	km/h	Speed	
K	character	K		K	Kilometers per hour - fixed field
cs	hexadecimal	*0B		Checksum	
<CR> <LF>					End of message

Building an interface cable for the VB10PS

If you are building your own interface cable for the VB10SPS it is worthwhile adding the RS232 connection and the Lap input connection. Particularly as the Lap input provides a method of performing a GPS coldstart.

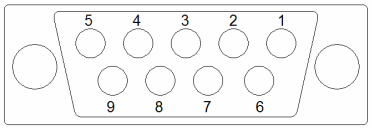
Digital an Analogue outputs

It is advisable to use a screened cable on the Analogue and Digital output for the best noise immunity, making sure that the ground is connected to the shielding of the screened cable.

RS232 Connection

Connect the pins shown in the table to a Female 9 way D-type connector.

VB10SPS		9 Way D-Type
Pin		Pin
8 Tx	———	2 Rx
1 Rx	———	3 Tx
9	———	5



PIN D Female
VIEW FACING SOCKETS

Lap Input/ GPS Coldstart

Connect a momentary switch to the pins shown in the table.

VB10SPS		Momentary push to make switch
Pin		Pin
6	———	1 signal
9	———	2 Ground

Upgrading the Firmware

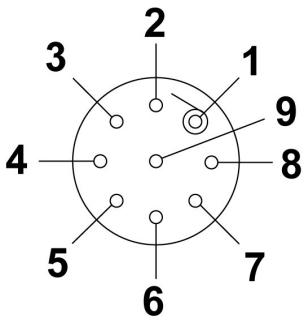
The latest firmware upgrade ('.ruf') file for the Speed Sensor is available from the Racelogic website in the VBOX downloads section.

New firmware for the VB10SPS is loaded into the unit using a computer and a cable to connect the Speed Sensor RS232 port to the computer.

How to upgrade the firmware

- Install the software CD supplied with the unit, or download the Racelogic Upgrader software from our website.
- Connect the Speed Sensor to your computer via a suitable RS232 connection. If you do not have a serial port on your computer, then you can use a Serial to USB converter (available places such as Amazon)
- Double click on the '.ruf' firmware upgrade file that you have downloaded from the website.
- The upgrade process should now be carried out automatically. If not, then run the Upgrader, and manually select the upgrade file.

Connector Assignments



1	RS232 Rx (Receive Data)
2	Power In (8v to 30v DC)
3	CAN Bus Low
4	CAN Bus High
5	Analog Output
6	Lap Marker Input
7	Digital Output
8	RS232 Tx (Data Output)
9	Ground

Specification

GPS

Velocity		Distance	
Accuracy	0.2 Km/h	Accuracy	0.05% (<50 cm per Km)
Units	Km/h or Mph	Units	Metres / Feet
Update rate	10 Hz	Update rate	10 Hz
Maximum velocity	1000 Mph	Resolution	1 cm
Minimum velocity	0.1 Km/h	Height accuracy	10 Metres 95% CEP**
Resolution	0.01 Km/h		
Latency	160ms		

Absolute Positioning		Time	
Accuracy	2.5m 95% CEP**	Resolution	0.1 s
Update rate	10 Hz	Accuracy	0.1 s
Resolution	1 cm		

Heading		Acceleration	
Resolution	0.01°	Accuracy	1%
Accuracy	0.2°	Maximum	4 G
		Resolution	0.01 G
		Update rate	10Hz

Definitions

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

Outputs	
CAN Bus	
Output Data Rate	125Kbit, 250KBit, 500KBit, 1MBit selectable. Un-terminated CAN node.
Data Available	Position, vehicle speed, Heading, Lateral Acceleration, Longitudinal Acceleration, Satellite Count, Time, Radius of Turn, Roll Angle Estimate, Altitude
RS232	
Output Data Rate	10Hz
Data Available	NMEA $GPGGA and $GPVTG messages at 115200Baud
Analogue Output	
Output Data Rate	0v to 5v DC
Data Available	Any one of Speed, Lateral Acceleration, Longitudinal Acceleration, Roll angle (Motorcycle only), or Lap Beacon
Digital Output	
Output Data Rate	Low = 0v, High = 5v, 10 -1000 pulses per revolution, Max frequency 4.4Khz
Data Available	Speed or Lap Beacon

Inputs	
Power	8v to 30vDC 1.5W Max
GPS Antenna	3V Active Antenna (inc)
Digital Input	Cold Start Activate / Set Lap Beacon Position
LED	Power, Satellite Count, Event Out

Environmental and Physical	
Size	Approx 90mm x 92mm x 28mm, not including connectors
Weight	Approx 200g
Connectors	Deutsch Autosport
IP Rating	IP66
Operating Temperature	-10^{o} to $+70^{o}$C

CAN Bus Data Format

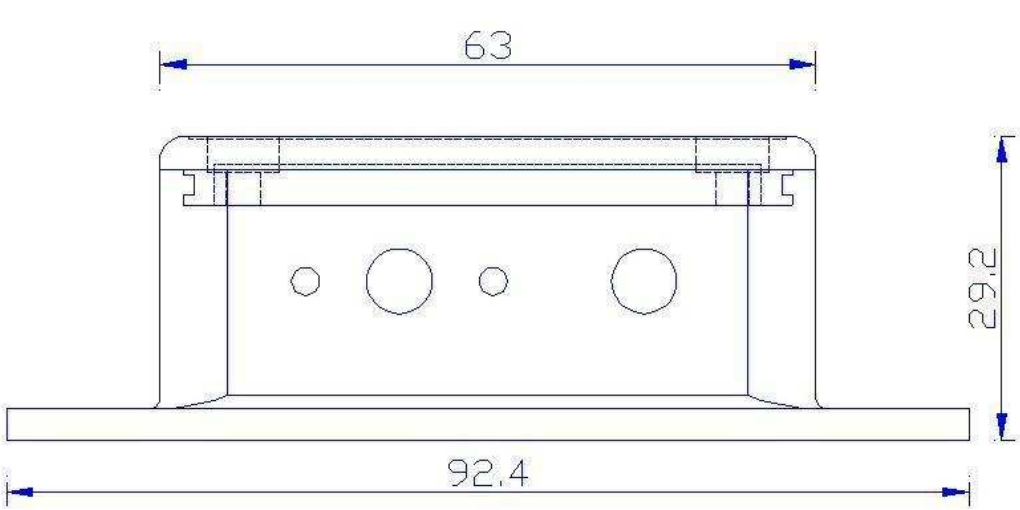
Format		Motorola							
ID*	Update Rate	Data Bytes							
		1	2	3	4	5	6	7	8
0x301	50ms	(1) Sats in view	(2) Time since midnight UTC			(3) Position – Latitude MMMM.MMMMM			
0x302	50ms	(4) Position – Longitude MMMM.MMMMM				(5) Velocity. (Knots)		(6) Heading (Degrees)	
0x303	50ms	(7) Altitude. WGS 84. (Metres)			(8) Vertical velocity. (M/S)		Unused	(9) Status	(10) Status
0x304	50ms	Unused				(11) Longitudinal Accel. (G)		(12) Lateral Accel. (G)	
0x305	50ms	(13) Distance travelled since VBOX reset (Metres)				Unused		Unused	
0x306	50ms	Unused		(14) Lean Angle (degrees)		(15) Radius of Turn (meters)			
0x307	100ms	(16) Position – Latitude DD.DDDDDDD				(17) Position – Longitude DD.DDDDDDD			

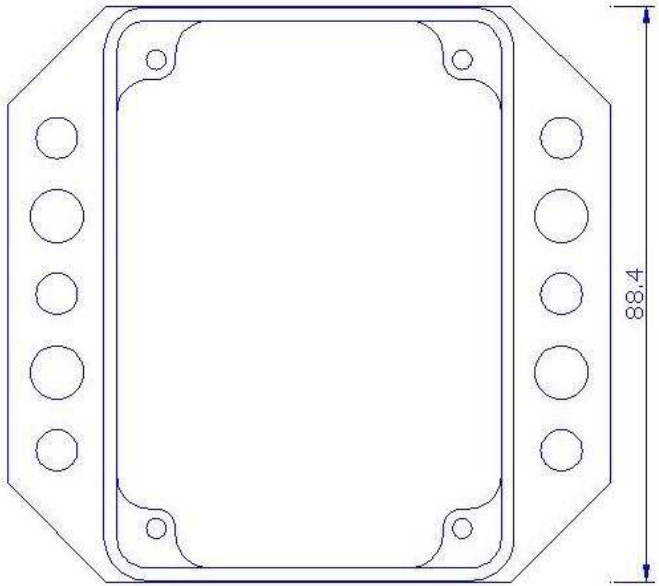
* Default Identifiers. The identifier values can be changed using the configuration software.

(1) If Satellites in view < 3 then only Identifier 0x301 transmitted and bytes 2 to 8 are set to 0x00.
(2) Time since midnight. This is a count of 10ms intervals since midnight UTC. (5383690 = 53836.90 seconds since midnight or 14 hours, 57 minutes and 16.90 seconds).
(3) Position, Latitude * 100,000 (311924579 = 51 Degrees, 59.24579 Minutes North). This is a true 32bit signed integer, North being positive.
(4) Position, Longitude * 100,000 (11882246 = 0 Degrees, 58.82246 Minutes West). This is a true 32bit signed integer, West being positive.
(5) Velocity, 0.01 knots per bit.
(6) Heading, 0.01° per bit.
(7) Altitude, 0.01 meters per bit, signed.
(8) Vertical Velocity, 0.01 m/s per bit, signed.
(9) Status. unused.
(10) Status is an 8 bit unsigned char. Bit 0 is always set, Bit 4 = Lap Beacon active.
(11) Longitudinal Acceleration, 0.01G per bit, signed.
(12) Lateral Acceleration, 0.01G per bit, signed.
(13) Distance travelled in meters since VBOX reset.
(14) Lean Angle, 16-bit signed integer * 100. (Motorcycles only)
(15) Radius of Turn 32-bit signed * 100.
(16) Position, Latitude (DD.DDDDDDD) * 10,000,000 (519874298 = 51.9874298 Degrees, North). This is a true 32bit signed integer, North being positive.
(17) Position, Longitude (DD.DDDDDDD) * 10,000,000 (11882246 = 1.9803743 Degrees, West). This is a true 32bit signed integer, West being positive.

The VB10SPS CAN database is available in Vector Database (DBC File) format from the Racelogic VBOX website and on the supplied CD

Module Dimensions (mm)





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Document updates

Revision	Description	Date
1	First Release. KB	26/01/07
2	Amendments and Additions. JT	31/01/07
3	Addition of specification table KB	13/03/07
4	Addition of Operating temperature KB	24/03/07
5	Addition of Load/Save configurations	24/03/07
6	Addition of Format: Motorola to CAN Bus Data Format table	03/12/07
7	Addition of new CAN message, with long/lat in degrees	11/04/08
8	Updated Racelogic contact details	30/04/08