



IMU03 and YAW03 Inertial Sensor User Guide



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Introduction

The YAW03 from Racelogic is a yaw rate (Z axis) sensor module combined with X and Y axis acceleration sensors.

The IMU03 from Racelogic is a full Inertial Measurement Unit that can measure Z, Y and X axis rotational rate (yaw, pitch and roll) as well as X, Y and Z axis acceleration.

The IMU03 and YAW03 are constructed with a splash-proof casing which is rated to a limited ingress IP rating of IP65, making it ideal for use on boats or in harsh environments.

Features

- Robust MEMS technology
- Internal temperature compensation
- Twin socket CAN Bus interface
- RS-232 serial interface for firmware upgrade and setup
- 24 bit internal resolution
- Can be used with VBOX or with any other CAN based logging system
- IP65 rating

Standard inventory

Description	Qty	Racelogic Part #
CAN based module	1	VBYAW03 / VBIMU03
VBOX IMU 5W Lemo Splashproof	1	RLCAB005-CS
VBOX YAW02 Splashproof Serial Cable	1	RLCAB030-S
VBOX IMU03/YAW03 Manual	1	VBIMU03MAN

Operation

The IMU03/YAW03 power supply range is 8V to 30V. When using with a VBOX logging system, power is obtained through the CAB005-CS CAN Bus connection cable. The maximum operating voltage input must not exceed 30V DC.

It is important to note that the lower voltage range of 8 Volts means that the IMU03/YAW03 should not be used on systems powered by the Racelogic battery packs.

LED Indicators

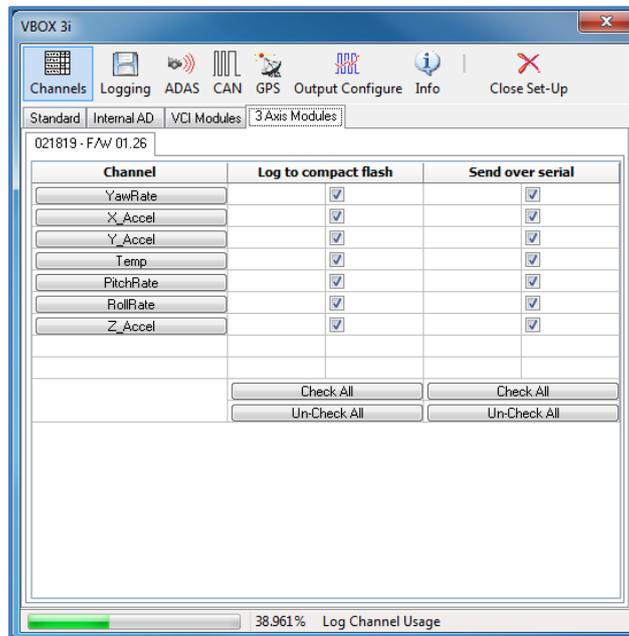
LED	Colour	Function
Power	Red	IMU03 / YAW 03 is connected to a live power source.
SC	Blue	Serial or CAN data communications are active.

Using the IMU03/YAW03 with a Racelogic VBOX

Required equipment:

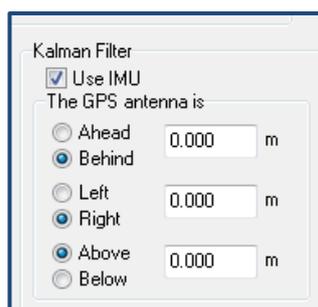
- IMU03/YAW03 (supplied)
- VBOX unit such as VB3i, VB2SX
- RLCAB005-CS connecting cable (supplied)
- RLCAB030/S (supplied)

1. Mount the VBOX and IMU03/YAW03 in the vehicle. The IMU03/YAW03 should be mounted rigidly to the vehicle mid-way along the wheelbase
2. Connect the IMU03/YAW03 to the Racelogic CAN port of the VB3i using the CAB005-CS cable.
3. Power on the VB3i and connect it to the PC being used via USB or Serial Cable. Open VBOX Tools software, ensure correct COM port is selected and open VBOX setup section.
4. In VBOX setup, IMU 03/ YAW 03 channels can be selected to log from the 3 Axis Modules tab. If these channels need to be viewed live in VBOX Tools then ensure that each channel is ticked to be sent over serial.



IMU Integration

To enable IMU integration with an IMU03 unit, navigate to the GPS tab in VBOX Setup and tick the use IMU option under Kalman Filter. For full details on setting up IMU integration, please see the VB3i user guide.

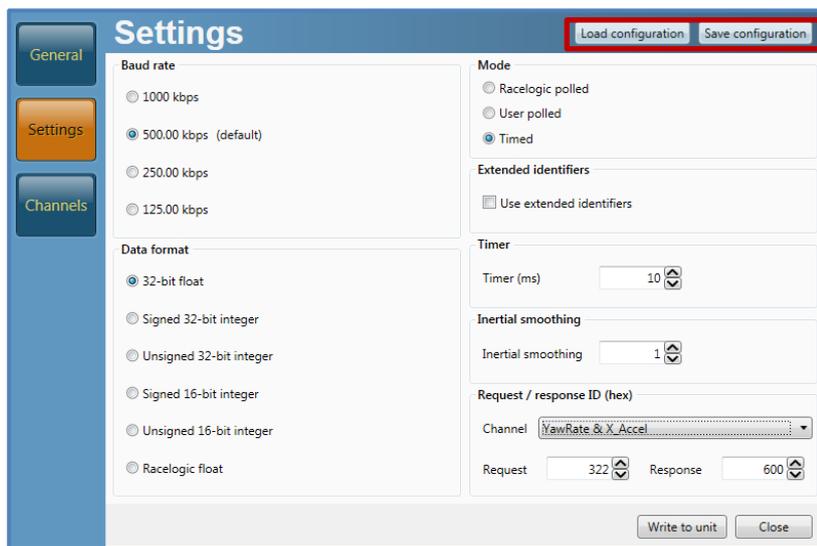


Using the IMU03/YAW03 with another data logger

The IMU03/YAW03 can be configured to run in standalone Timed or Polled CAN operating modes using the supplied RLVBCAB30-S cable and Racelogic Config software.

Configuring a IMU03/YAW03 with Racelogic Module Setup Software

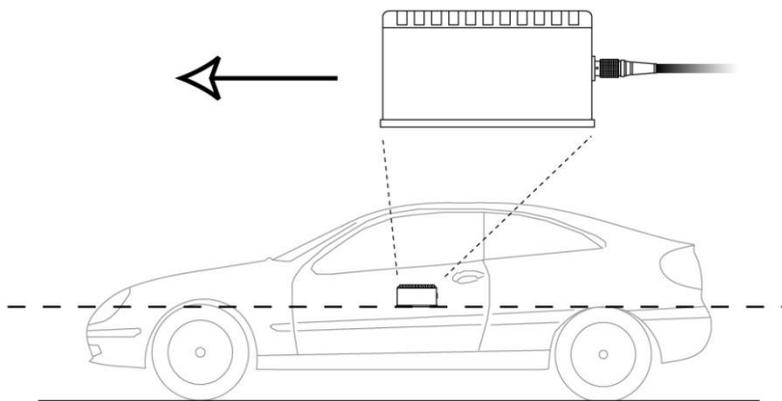
1. Connect the IMU03/YAW03 to a PC using the supplied RLVBCAB30-S cable.
2. Power up the IMU03/YAW03 using a suitable 12v power source.
3. Run the Racelogic Config software.
4. Select the COM port assigned to IMU03/YAW03 (check device manger if unsure) and the software will display the current settings for the attached IMU03/YAW03. The screenshot below shows the settings for an IMU03.
5. Make the changes required and then select write to unit.



To save a particular configuration for use at a later date, use the save and load configuration buttons at the top right hand corner of the settings page.

Note: When any setup changes are made then the IMU03/YAW03 must be powered cycled for this to take effect.

Mounting



The IMU03 should be mounted rigidly to the vehicle mid-way along the wheelbase. Try to position the unit as close as possible to the centre of the vehicle, making sure it is mounted in the direction of travel - as shown in the image above. It is also important to mount the sensor so that it is level with the ground.

CAN operating modes

The IMU03/YAW03 can operate in one of three different modes:

- Racelogic polled CAN mode
- User polled CAN mode
- Timed CAN mode

Racelogic polled CAN mode – default mode

This mode should be set if the IMU03/YAW03 is to be used with a Racelogic VBOX. All the CAN parameters are set to work with the Racelogic VBOX CAN protocol. In this mode no other parameters can be set.

User polled CAN mode

This mode allows a user's own data logging system to poll the IMU03/YAW03 for data using the CAN bus. The IMU03 module can be polled at up to 100 Hz. The following parameters are used in this mode:

- Baud rate (selectable from 125kbit/s, 250kbit/s, 500kbit/s or 1Mbit/s)
- Extended identifiers (OFF or ON)
- Request identifiers (identifiers used to request data from the sensor)
- Response identifiers (identifiers used to transmit data from the sensor)

The timer parameter has no effect in this mode.

Timed CAN mode

In this mode the IMU03/YAW03 will send CAN data at intervals determined by the timer value. The following parameters are used in this mode:

- Timer (time interval in milliseconds between output data)
- Baud rate (selectable from 125kbit/s, 250kbit/s, 500kbit/s or 1Mbit/s)
- Extended identifiers (OFF or ON)
- Response identifiers (identifiers used to transmit data from the sensor)

The request identifiers have no effect in this mode.

Data format in user polled and timed CAN mode

The IMU03 has 7 channels:

- Channel 1 Yaw_Rate (deg/sec)
- Channel 2 X_Accel (g)
- Channel 3 Y_Accel (g)
- Channel 4 Temp (deg C)
- Channel 5 Pitch_Rate (deg/sec)
- Channel 6 Roll_Rate (deg/sec)
- Channel 7 Z_Accel (g)

The YAW03 has 4 channels:

- Channel 1 Yaw_Rate (deg/sec)
- Channel 2 X_Accel (g)
- Channel 3 Y_Accel (g)
- Channel 4 Temp (deg C)

Channels are sent as pairs, so channels 1 and 2 will be sent together, 3 and 4 together and so on. The pairing of channels cannot be changed. The channel data is in an IEEE 32 bit float format so each channel occupies 4 bytes. The first 4 data bytes contained within a CAN frame are the lower channel; the second 4 bytes are for the higher data channel. A CAN DBC file containing default settings for each sensor is available on request from Racelogic.

Setup parameters

Timer

The timer value is in milliseconds (ms). A smaller value means data will be sent more frequently, a larger value means data will be sent less frequently. The range of values that can be entered is 0 to 65535, however the minimum value that should be entered is 10. Below this level data values may be repeated on successive cycles. If a value of 0 is entered, the IMU03/YAW03 will change it to 1000 on the next power cycle.

Frequency output can be calculated as follows:

$$\text{Freq} = (1/\text{Timer}) * 1000$$

The timer value for a required frequency can be calculated as follows:

$$\text{Timer} = (1/\text{Freq}) * 1000$$

Timer value [ms]	Frequency [Hz]
10	100
50	20
100	10
400	2.5
1000	1

In the table to the right are some example timer values shown against the frequency output.

Baud rate

Baud rate sets the bit rate of the CAN messages (not the frequency at which the messages are sent). There are four options that baud rate can be set to – 1000 Kbit/s, 500 Kbit/s, 250 Kbit/s and 125 Kbit/s.

Extended identifiers

The extended identifiers box can be marked or unmarked. If it is unmarked, the CAN identifier type will be standard (11 bit). If it is marked, the CAN identifier type will be extended (29 bit). The standard identifier type allows 2048 different CAN message identifiers or message “names”. The extended identifier type allows 436207616 different CAN message identifiers. The identifier type should be set to match the CAN data logging equipment that the IMU03/YAW03 is connected to.

Request and response identifiers

The request identifiers only have an effect in user polled CAN mode. They set the identifier values that the IMU03/YAW03 will filter for. If a CAN message is received that matches a request identifier then the module will respond by sending the corresponding channel data on the corresponding response identifier. *Note: All channels can have the same request identifier – this means that on receipt of a single CAN message the IMU04 will respond with all channels of data. The response identifiers MUST all be different.*

In timed mode the channel data will be sent at intervals with the corresponding response identifier – the request identifiers have no effect.

When using standard identifiers the maximum value for the identifiers is 0x7FF. Entering a value higher than this may cause unexpected results, for instance a response identifier of 0x00FFAA23 will result in a message being sent with identifier 0x223. To avoid anything unexpected, the request and response identifiers should be set appropriately for use with standard identifiers.

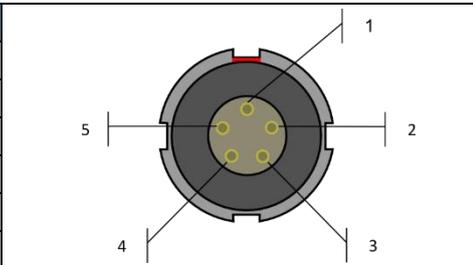
Specification

Specification	
Rate sensors	T _A =25°C
Dynamic Range	Full-Scale: ±150 /s
Nonlinearity	% of full scale: 0.1%
Resolution	0.01 /s
Bandwidth	40 Hz
Bias Stability	±0.5 /s
Acceleration	
Range	±1.7G
Nonlinearity	% of full scale: (Min) ±0.5% - (Max) ±2.5
Resolution	1mg
Accuracy	0G-input: ±0.03G
Accuracy	1G-input: ±0.01G
Bandwidth	50 Hz
Max Ratings (Shock)	Powered (0.5ms): 2000g
Temperature Sensor	
Temperature calibration range	-10°C to 50°C
Temperature resolution	0.1°C
Current	~150mA
Voltage	8 – 30V DC.
Operating temperature	-30 to +70 °C

Connection data

Lemo Socket Connections

Pin	I/O	Function
1	O	TxD, Serial Data Transmit - Configuration
2	I	RxD, Serial Data Receive - Configuration
3	I/O	CAN High
4	I/O	CAN Low
5	O	+ V Power 8V to 30V DC
Chassis		Ground



CAN data format

Each data channel is in an IEEE 32 bit float Motorola form

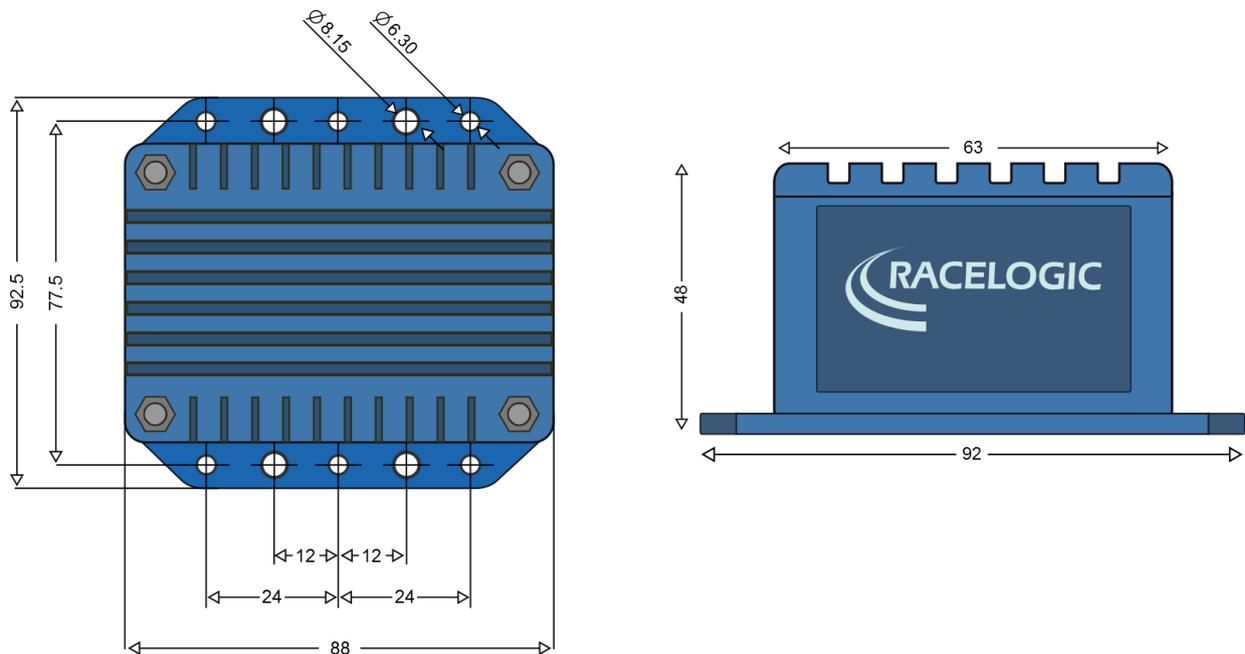
ID**	Data Bytes							
	0	1	2	3	4	5	6	7
0x600	Yaw Rate				X Acceleration			
0x601	Y Acceleration				Temperature			
0x602	Pitch Rate				Roll Rate			
0x603	Z Acceleration							

* In timed mode the update rate can be changed using the configuration software

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

The IMU/YAW CAN database is available in vector database (DBC File) format on the Racelogic website

Unit dimensions



Firmware upgrades

It is recommended to check the web site periodically for updates. To upgrade the IMU03 firmware, download the following from the RL website.

1. [The latest IMU03 firmware file](#) (.RUF extension file)
2. [Racelogic Upgrader software](#)

Connect the IMU03 to the PC via the supplied RLCAB030-S serial cable, and apply power to the IMU03.

Double click on the .RUF upgrade file, which auto runs the Upgrader software. Ensure the correct COM port is selected in Racelogic Update software, then hit 'upgrade' to start the procedure.

When this is complete, powering the IMU03 off and back on will complete the process.

Note: To confirm which COM port is assigned to the IMU03, check device manager.

Ensure that other software which may try and use the COM port communications, such as VBOX Tools, is closed.

Contact Information

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