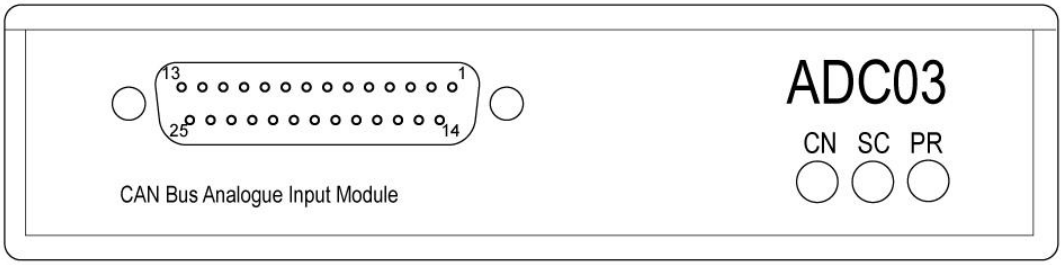
# 16bit Analogue Interface
# RLVBADC03

Instruction Manual

# Contents

## *EC Declaration of Conformity*

We declare that this product has been tested to and meet the requirements of:

**EC Directive 2004/104/EC**

"Adapting to Technical Progress Council directive 72/245/EEC relating to the radio interference (Electromagnetic Compatibility) of vehicles and amending directive 70/156/EEC on the approximation of the laws of the member states relating to the type-approval of motor vehicles and their trailers."

And has also been assessed, via Technical Construction File, by an independent DTI Competent Body and found to be in conformance with the essential requirements of:

**EC Directive 89/336/EEC** (and amending directives)

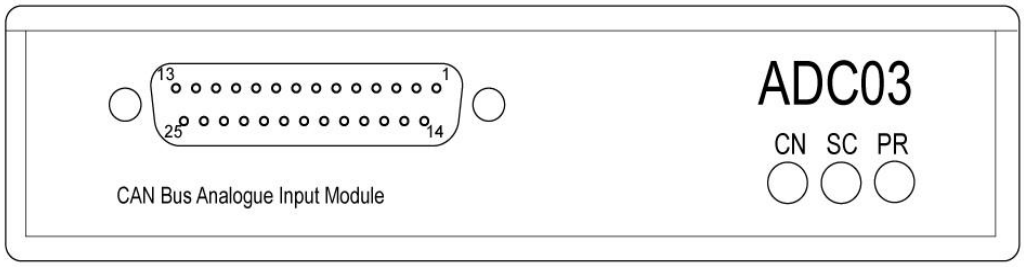
"Council Directive of 03 May 1989 on the approximation of the laws of the member states relating to electromagnetic compatibility."

DTI Competent Body responsible for issuing certificate of compliance:

3C Test Ltd,
Silverstone Technology Park,
Silverstone,
Northants
NN12 8GX

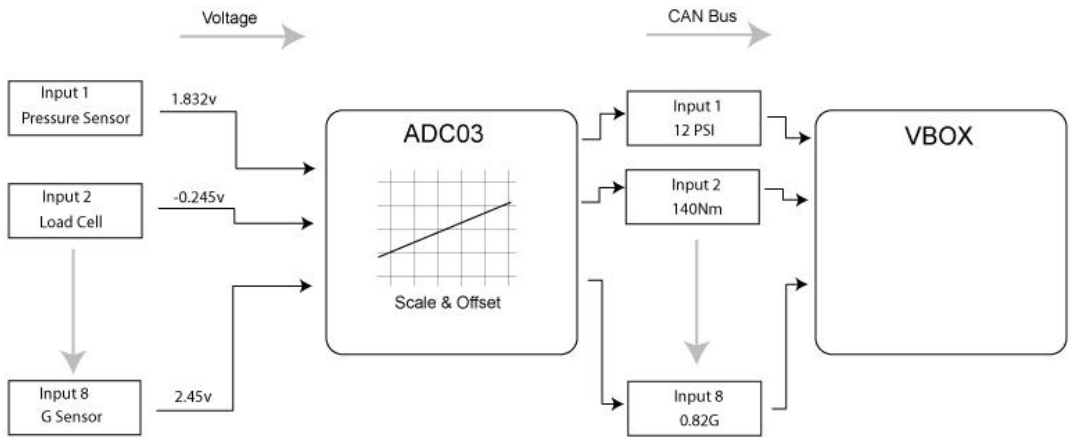
## Introduction

The RLVBADC03 is an 8-channel analogue voltage input module for use with the Racelogic VBOX. Each channel is electrically isolated and provides bipolar voltage measurement with a DC accuracy of 400µV. Isolated, regulated 5v and 12v supplies are available on the main 25-way sub-d connector in addition to a supply voltage connection. Configuration of the ADC03 is achieved through the VBOX and allows scale and offset of the voltage reading for conversion into real data.




## Key features

- Voltage input ±50V
- 16 Bit Resolution
- 400µV DC accuracy
- Synchronous sampling of all channels
- Bi-polar voltage input
- Internal scale + offset for conversion to real data



## Parts supplied with RLVBADC03

| | |
|---|---|
| 1 x **VBADC03** | 16bit 8 channel analogue interface |
| 1 x **RLCAB006** | 5 Way Lemo to 5 Way Lemo 300mm |
| 1 x **ADC25IPCON** | 25 Way D Connector |

## Optional accessories

| | |
|---|---|
| **RLCAB001** | Serial connection cable for stand-alone configuration. |

## Specification

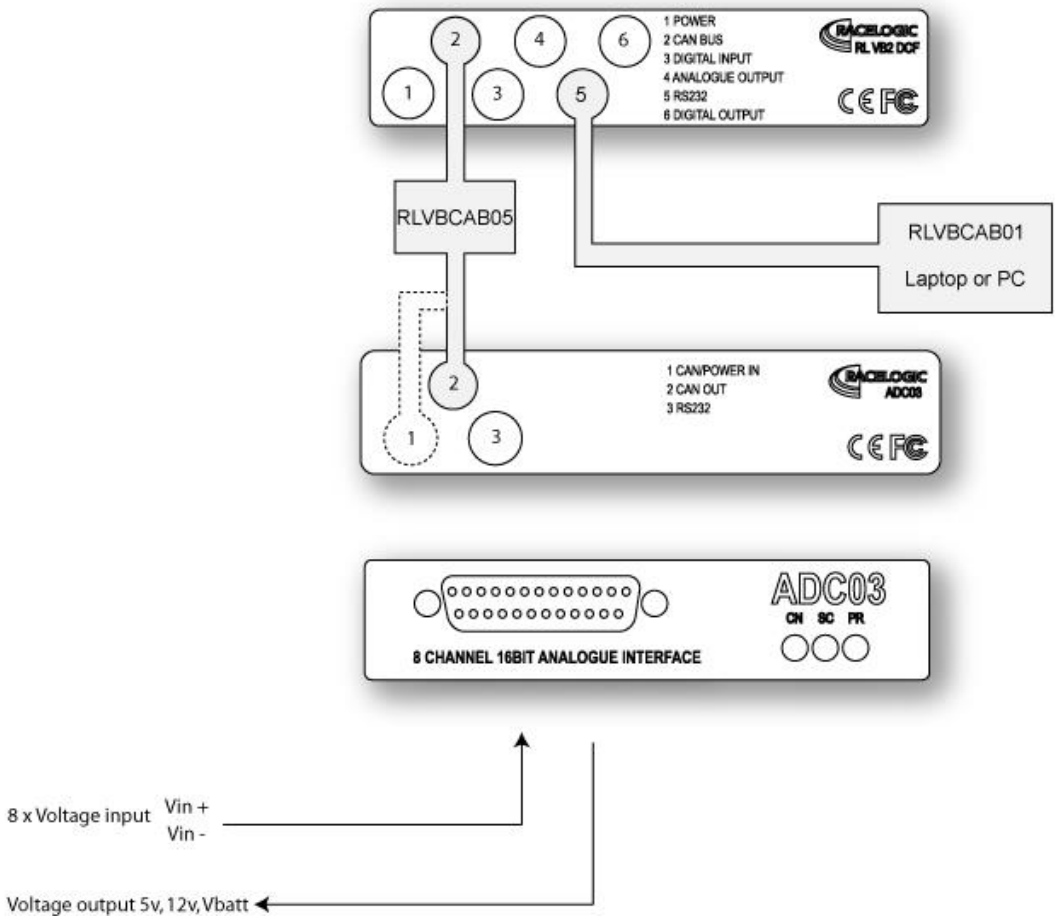
| | |
|---|---|
| Number of Channels | 8 |
| Voltage Resolution | 3µV |
| DC Accuracy | 400µV |
| Input range | ±50V |
| Input impedance | >100KΩ |
| Output voltage supply on SUB-D Connector | 12V Isolated 80mA max current draw<br>5V Isolated 100mA max current draw<br>+Vbatt ** |
| Supply Voltage | 12V DC |
| Current | 530mA |

**

# Warning!

**Fit in line 100mA fuse when using +vbatt pin on 25 way connector to power sensors. Failure to do this could result in damage to the ADC03 and VBOX**

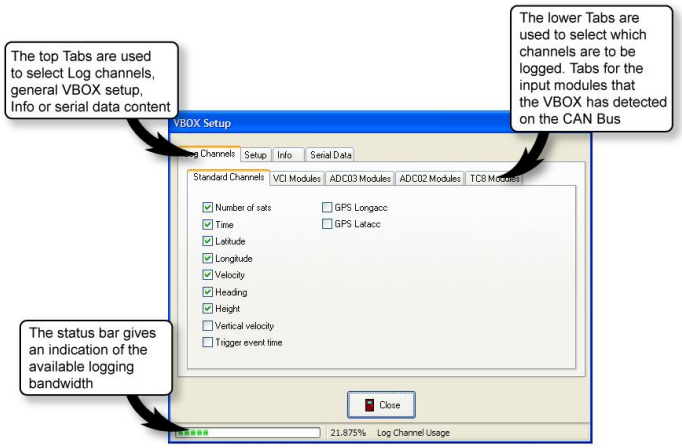
## Connection of ADC03 to VBOX




Using the 5 way LEMO to 5 way LEMO cable (RLVBCAB06) connect socket 2 (CAN BUS) of the VBOX to socket 1 (CAN/POWER IN) or socket 2 on the ADC03 module. Power the VBOX using either the 12V cigar adapter or a fully charged battery pack. Connect socket 5 (RS232) of the VBOX to COM1 or COM2 on a PC.

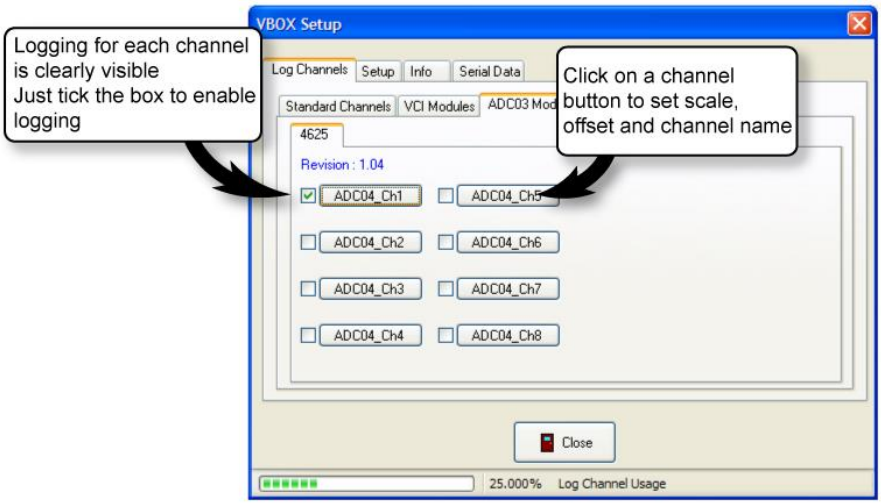
## Configuring the ADC03

The configuration of the ADC03 module and its individual channels is done through the connected VBOX using VBOX software.
When a module is connected to a VBOX, it will be automatically recognised and a Tab for the module will appear in VBOX setup section of the VBOX software.



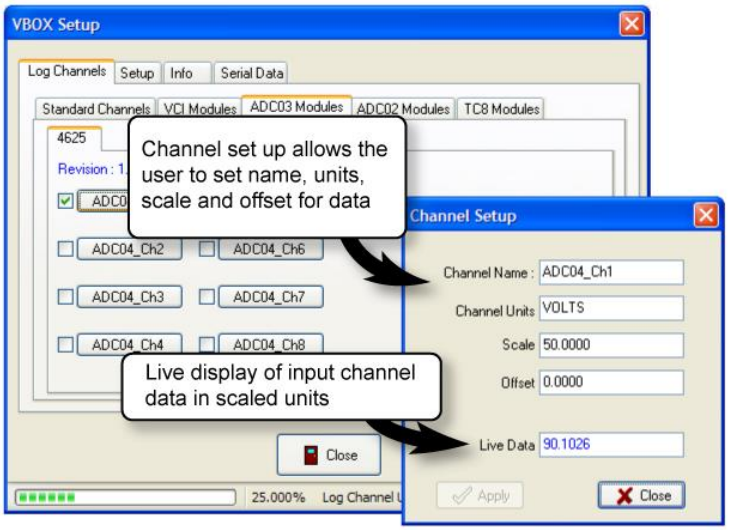

The bandwidth status bar gives an indication of available logging bandwidth. When the status bar is full, all of the bandwidth is used. If more logging channels are added beyond this, there is a risk that data will be lost. The bandwidth status bar is calculated for a speed optimised compact flash card. If a windows formatted card is used (see applications note Compact Flash Formatting on Racelogic web site), the status bar may be inaccurate with the risk that data will be lost.

The VBOX creates a tabbed page in the set up window for each input module that it finds. If it finds two modules of the same type (e.g.; 2 x ADC03) then it lists each one by its serial number.

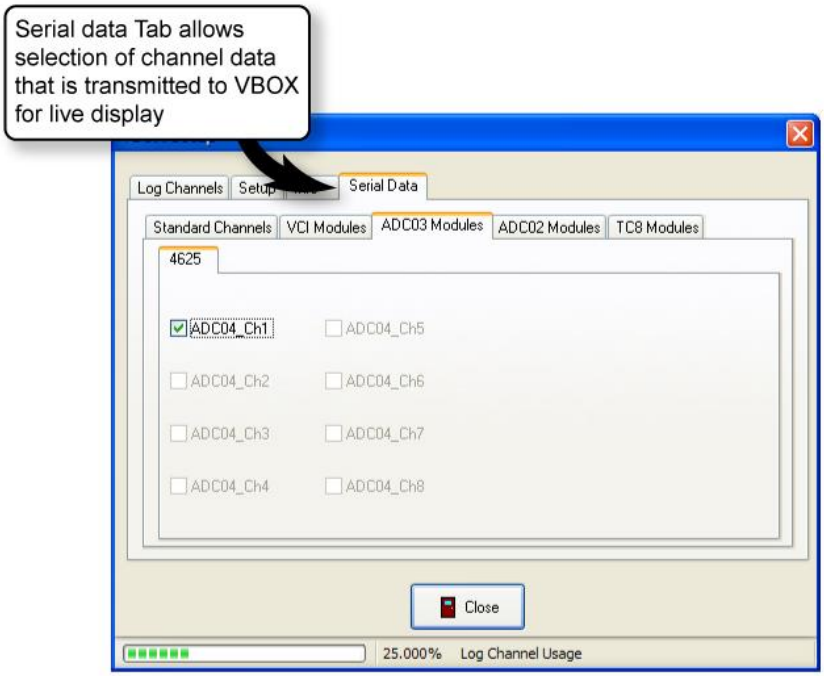



Clicking on a channel button opens up a channel set up allowing the user to set the channel name, the units of measurement, the scale and the offset. Once a channel is configured, the settings are stored within the associated module. Also displayed in the channel set up is a real-time view of the data on that channel. The data shown is the scaled and offset value so if

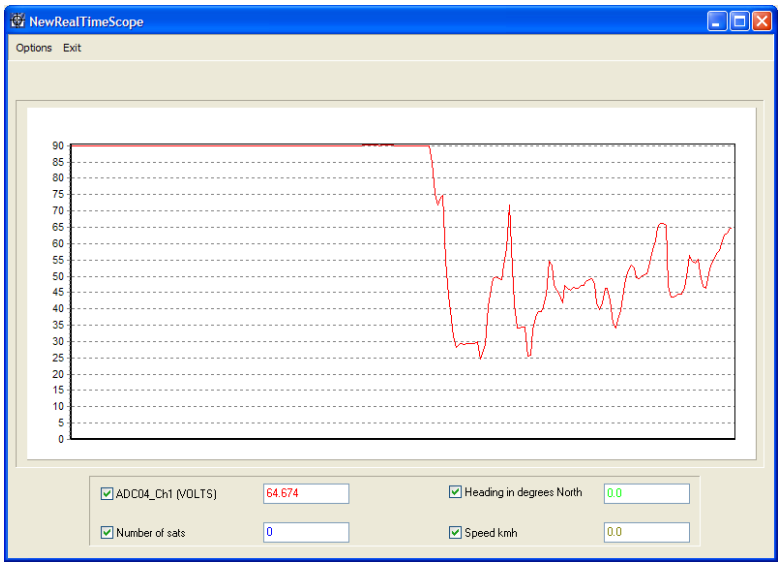
for example an ADC03 input channel is connected to a pressure sensor and scale and offset are calibrated for PSI then the live data value will show a reading in PSI.



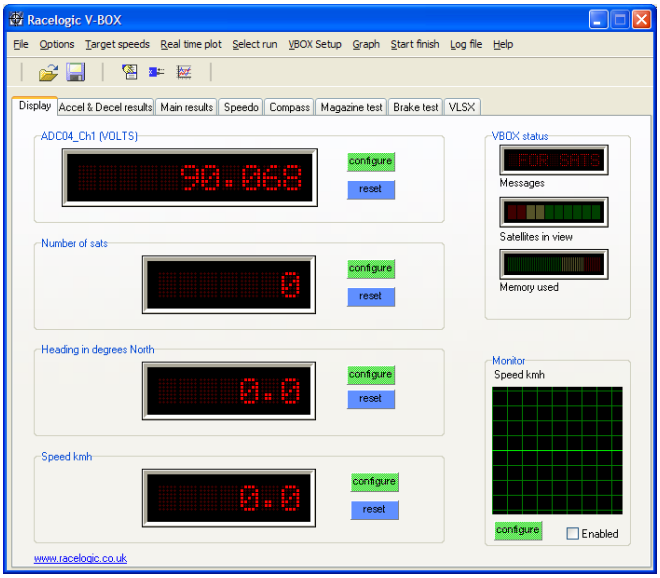

In addition to the data that is logged by the VBOX, there is a serial data stream that is transmitted periodically to the PC. This serial data stream can now be freely configured to include data from input modules. This then allows the data to be displayed in the real-time scope display.




Channels in the serial data can be displayed through the real-time scope view. This can show up to 4 separate data values at once.

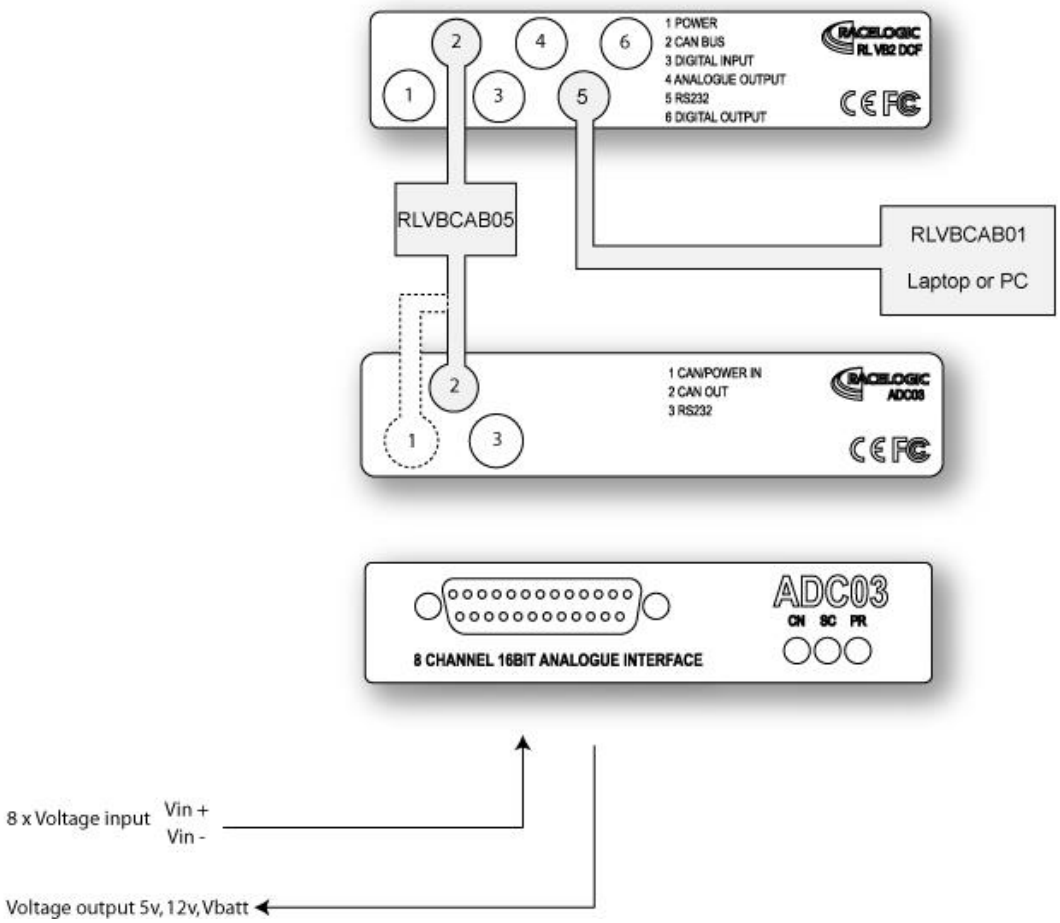



Serial data channels can also be displayed in the 4 user configurable displays on the main VBOX screen.



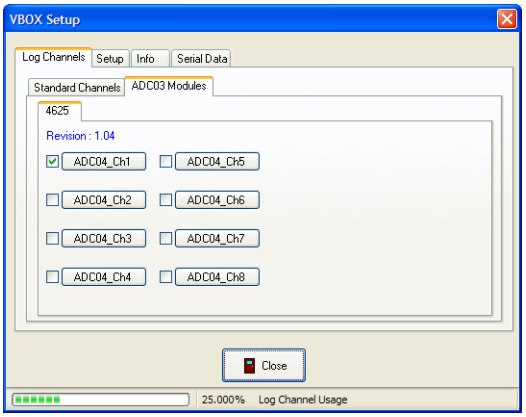
## Example set up for ADC03

**1**. Connect the VBOX and ADC03 in the normal way as shown below and apply power to the VBOX.

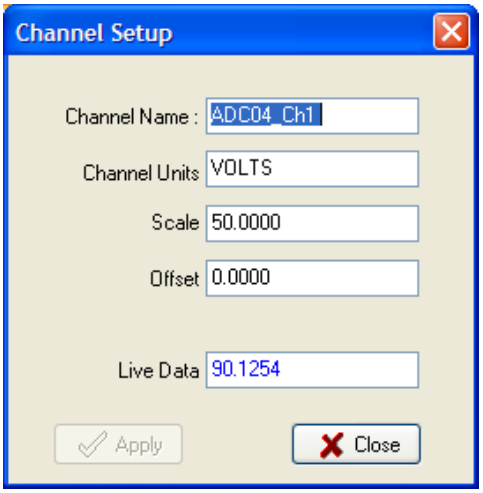



**2**. Run the VBOX.EXE program and click on the "VBOX Setup"

**3**. Click on the "Log Channels" tab. Under this, the ADC03 should be listed along with its serial number. The tick boxes show which channels are enabled for logging. In the example picture on the right, only the first channel is selected to be logged



**4**. Clicking on the button for a channel will bring up the channel set up window. Options in this window are:-




*Channel Name* allows the user to enter a meaningful channel name that corresponds to the input. For example 'Pressure_1' if the channel is connected to a pressure sensor.

*Channel Units* is a description of the measurement units. Type the name of the measurement units (eg;PSI) in this box.

The *Scale* box contains the value by which the input data is multiplied.

*Offset* defines the offset of the multiplied data. Because the offset is applied after scaling (y=mx+c) the offset value must be entered corresponding to the SI units.

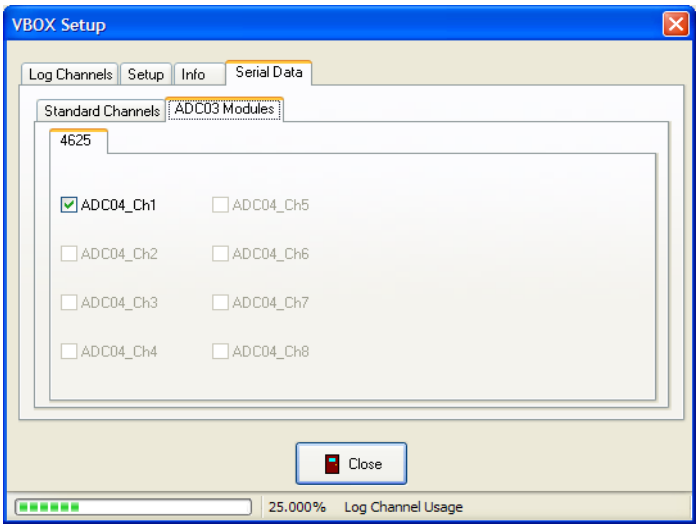
Using scale and offset it is possible to calibrate an SI unit output for most linear output sensors. This follows the rule *y=mx+c* where y=the output value, x is the input value, m is the multiplier (Scale) and c is the constant (offset).

As the ADC03 is a voltage input module, a scale of 1.00 and offset of 0.00 will return a value in ***volts***.

*Live Data* is a real-time representation of the input signal for the current channel. This value is constantly updated while the channel set up window is displayed and can be used as a reference to ensure correct channel operation. The value displayed is the value after scale and offset is applied. Again, in the case of ADC03, scale=1 offset=0 will show a live data value in volts corresponding to the relevant input pins on the ADC03. When a change is made to either the scale or offset values, click "Apply" to update the module settings. This will cause the Live Data to be show with the new scale and offset taken into account.

**5**. When the channel settings have been configured, close the channel set up window. Repeat the channel set up for any other channels that are to be logged. Make sure that the tick box is ticked ☑ for every channel of the ADC03 that is to be logged.

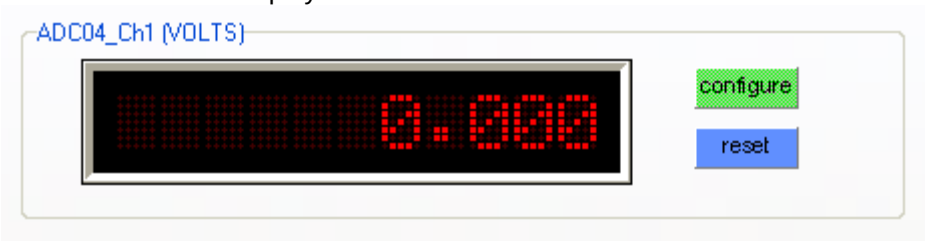
**6**. If the user wishes to view the ADC03 channel data while the VBOX is logging, is it necessary to enable the channels in the serial data stream that is transmitted from the VBOX to the PC via the RS232 cable. To do this, click on the "Serial Data" tab and then the ADC03 tab. Tick the ☑ box corresponding to the channels that are to be viewed. When finished, click on the close button to close the window. A progress bar will appear to show settings being written to the VBOX and ADC03.



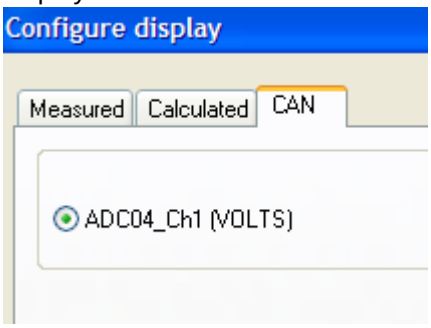

The channels are now set up for logging. If the ADC03 is disconnected, the VBOX will still try to log the data to memory but the values corresponding to the ADC03 will show zero. Also note that because the channel settings are stored in the input modules themselves, the VBOX identifies each module by its serial number. Therefore if an ADC03, for example, is configured and then replaced with another ADC03, the logged data will change.

## Viewing Serial Data

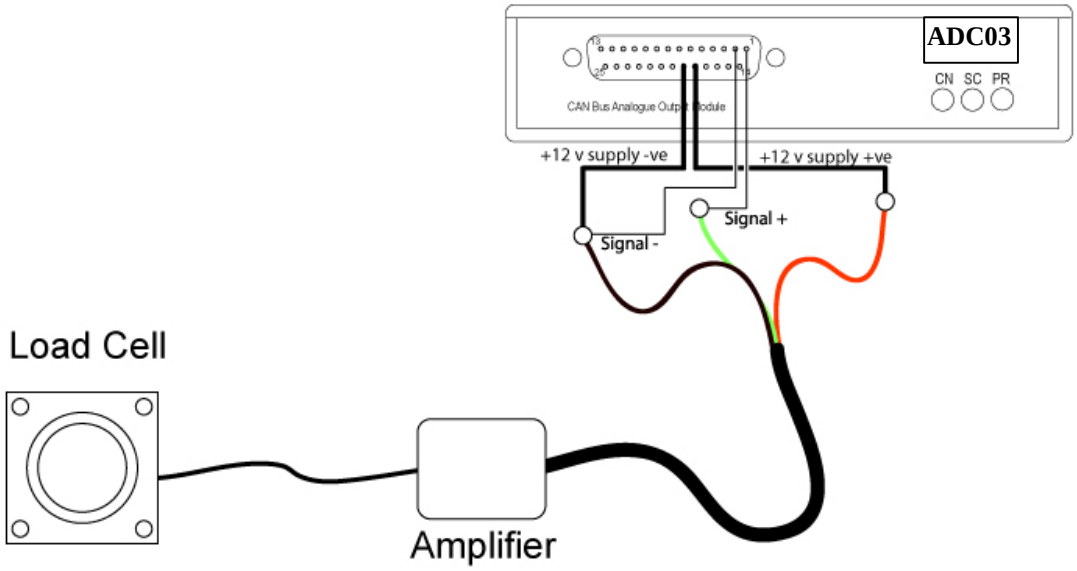
To view data from a channel that is included in the data stream, click the green configure button on one of the VBOX displays.




Click the CAN tab. This will show any CAN module channels which are being transmitted in the serial data. Click the button ◉ on the left of the name to select the channel to be displayed. Click OK and the bottom of the window to close it. The data display should now be indicating the value of the selected input channel.



## Example sensor connection




PIC 6

In the example shown in PIC6, a load cell is fitted to the ADC03. The load cell is supplied complete with an amplifier module that is calibrated to give an output of approximately 5volts for a full load of 50 Kg. The amplifier has 3 wires ( ground, 12v supply and output signal) and these are connected to the ADC03 as shown. The Isolated 12v supply from the ADC03 is used to power the load cell amplifier while channel 1 +ve is used to read the output signal. The channel 1 -ve pin (pin 2) must be connected to the –ve 12v supply pin (pin 19) as a reference for the signal voltage.

The sensor calibration data in this case is shown in table 1.

| Load Applied (Kg) | Output Voltage |
|---|---|
| 0 | 0.530 |
| 10 | 1.311 |
| 20 | 2.185 |
| 30 | 3.070 |
| 40 | 4.014 |
| 50 | 4.956 |

Table 1.

Using the ADC03 channel setup, the scale and offset can be entered so that the output for ADC03 channel 1, and hence the data logged by the VBOX, represents Kg load rather than volts. From the calibration data it can be seen that there is a zero load offset of 0.53v. The scale is therefore calculated as:-

$$\frac{50Kg}{4.956v - 0.530v} = 11.2969 \text{ Kg / Volt}$$

The offset value is added after the scale function is performed and so is represented in Kg. Offset in this case is calculated as:-

Offset = 11.2969 Kg / Volt x 0.53v = 5.987Kg

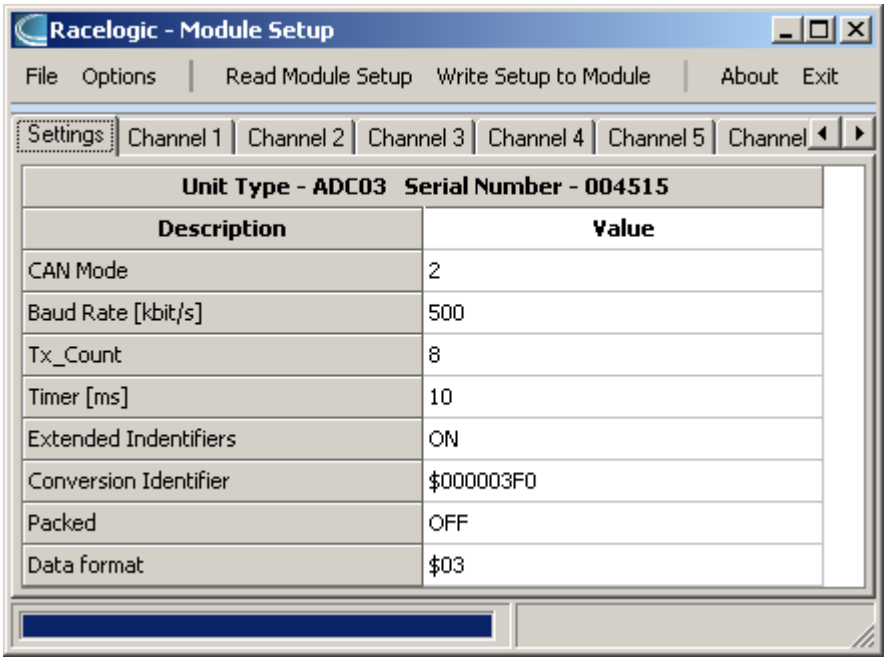
Because the voltage offset is +0.53v, the offset amount must be negative. Therefore a value of –5.987 is entered as the offset for the ADC03 channel.

# Stand Alone mode (Using the ADC03 with a Datalogger other than VBOX)

The ADC03 can be easily configured to run in different CAN Bus operating modes using the supplied RLVBCAB30 cable and Racelogic “Module Setup” software.

### Configuring the ADC03 with Racelogic Module Setup Software

1. Connect the ADC03 to a PC using the supplied RLVBCAB30 cable.
2. Power up the ADC03 using a suitable 12v power source. Please observe correct polarity (Red=12v, Black = Ground).
3. Run the Module Setup software.
4. Click “Read Module Setup” – you should see the screen shown below. If you get a “No response” message then check the ADC03 is correctly connected, the power supply is on and that the correct COM Port is selected in the Module Setup software.
5. Make the changes required and then click the “Write Setup to Module” button.




***Note: When any change is made using the Module Setup Software the POWER MUST BE CYCLED for the change to take effect!***

**CAN Operating Modes**

Mode 0 Racelogic Polled CAN Mode
Mode 1 User Polled CAN Mode
Mode 2 Timed CAN Mode

***Racelogic Polled CAN Mode – Mode 0***
This mode should be set if the module 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 need be set or indeed will have any effect.

***User Polled CAN Mode - Mode 1***
This mode allows a customer's own datalogging system to poll the module for data using the CAN bus. In this way, the output timing of the sensor can be synchronised with other CAN information. The following parameters are all used and so must be set:
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 - Mode 2***
In this mode the module will send CAN data at intervals determined by the Timer value. The following parameters are all used and so must be set:
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 signal data is sent using industry standard 32bit floating point format unless specified.**

**Setup Parameters**

*Baud Rate*
Baud Rate sets the bit rate of the CAN messages (not the frequency at which the messages are sent). The range of values that can be entered is 0 to 65535 however only the values indicated in the Setup Parameters Table should be used. A value other than these will cause the module to change the Baud Rate value to 500kbit/s on the next power cycle.

*Tx Count*
This TX count is the number of CAN channels transmitted so for the 8 channel ADC03 this should be set to 8.

*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 value data values may be repeated on successive cycles. If a value of 0 is entered the module will change it to 1 on the next power cycle.

Frequency output can be calculated as follows:
Freq = (1/Timer) * 1000

The Timer value for a required frequency can be calculated as follows:
Timer = (1/Freq) * 1000

Some example Timer values are shown against the frequency output.

| Timer Value [ms] | Frequency [Hz] |
|---|---|
| 10 | 100 |
| 50 | 20 |
| 100 | 10 |
| 400 | 2.5 |
| 1000 | 1 |

*Extended Identifiers*
Extended Identifiers can be set either ON or OFF. If they are off the CAN identifier type will be standard (11 bit). If they are on 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 module is connected to.

Entering a value of “off”, “OFF” or “0” will turn Extended Identifiers off. Any non-zero value, “on” or “ON” will turn Extended Identifiers on.

*Conversion Identifiers*
The Conversion Identifier only has an effect in User Polled Mode. When the module receives this identifier with zero data bits it will sample its inputs. This is set as separate command to a data request identifier so that it gives the module time to make a data conversion before having to send the data on the CAN bus.

*Packed*
Byte-packing can be used to reduce the number of CAN messages required to transmit ADC03 data. When turned OFF, each of the eight channels will be sent using a separate CAN

Identifier message, each with a Data Length Code (DLC) of 4 bytes. When Byte packing is turned ON, channels will be combined into pairs for transmission over CAN, each message with a DLC of 8, as follows:

| CAN ID: | First 4 Data Bytes: | Last 4 Data Bytes: |
|---|---|---|
| CAN ID set for Channel 1 | Channel 1 Data | Channel 2 Data |
| CAN ID set for Channel 3 | Channel 3 Data | Channel 4 Data |
| CAN ID set for Channel 5 | Channel 5 Data | Channel 6 Data |
| CAN ID set for Channel 7 | Channel 7 Data | Channel 8 Data |

*Data Format*
This option allows you to change the format in which data is transmitted in stand-alone mode. The available Format options are:

- IEEE 32-bit float
- 32-bit unsigned integer
- 16-bit signed integer
- 16-bit unsigned integer
- Racelogic float
- 32-bit signed integer

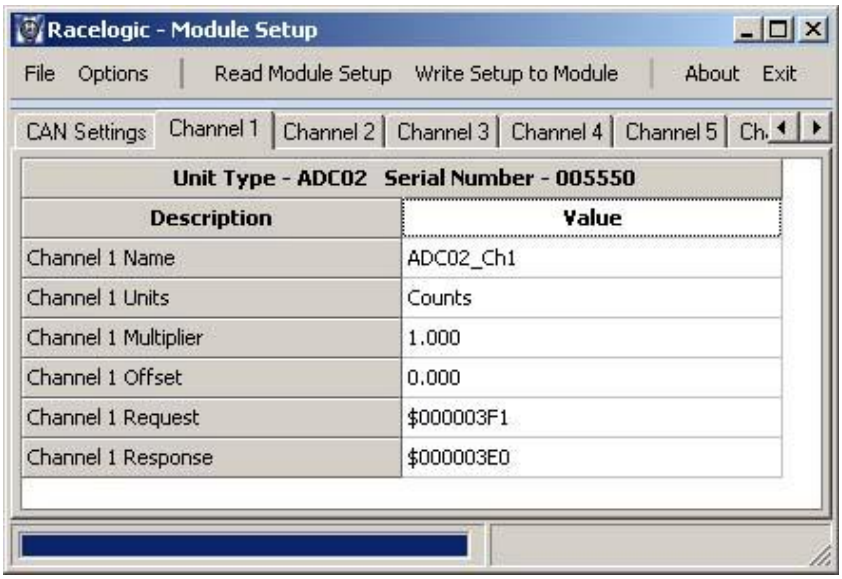
**Setup Parameters Table**

| Parameter | Options | Value to Enable | Comments |
|---|---|---|---|
| CAN Mode | Racelogic Polled mode | 0 | VBOX compatible mode.<br>In this mode no other parameter has any effect. |
| | User Polled mode | 1 | Baud Rate must be set.<br>Extended Identifiers must be set.<br>Request Identifiers must be set.<br>Response Identifiers must be set. |
| | Timed mode | 2 | Timer must be set.<br>Baud Rate must be set.<br>Extended Identifiers must be set.<br>Response Identifiers must be set. |
| Baud Rate [kbit/s] | 1000 kbit/s | 1000 | If a Baud Rate value other than those specified is entered it will be changed to a default value of 500kbit/s. |
| | 500 kbit/s | 500 | “ |
| | 250 kbit/s | 250 | “ |
| | 125 kbit/s | 125 | “ |
| TX Count | 0-max no of module channels | 8 (for normal ADC03 use) | |

| Parameter | Options | Value to Enable | Comments |
|---|---|---|---|
| Timer [ms] | (message interval in ms) | 10-65535 | Minimum value is 10 (100Hz) – below this value data may be erroneous.<br>If the Timer value is set to 0ms and Timed CAN Mode is on then Timer value will be changed to 1ms. |
| Extended Identifiers | Standard (11 bit) | OFF | Request and Response Identifier range is 0 – 0x7FF (0 – 2047). |
| | Extended (29 bit) | ON | Request and Response Identifier range is 0 – 0x19FFFFFF (0 – 436207615). |
| Packed | Byte-packing disabled | OFF | Each CAN ID has 1 channel and DLC 4. |
| | Byte-packing enabled | ON | Each CAN ID has 2 channels and DLC 8. |
| Data Format | IEEE 32-bit float | 0 | |
| | 32-bit unsigned integer | 1 | |
| | 16-bit signed integer | 2 | |
| | 16-bit unsigned integer | 3 | |
| | Racelogic float | 4 | |
| | 32-bit signed integer | 5 | |

**Channel setup parameters**

The channel setup tab allows adjustment of individual channels settings. In the example for ADC02 shown below it can be seen that multiplier and offset values are available to allow the user to re-scale the output data. In the case of the ADC03, its native output is in Volts so no scale is needed to read in volts. However, the scale and offset could for example be changed to rescale the output value to anything else.

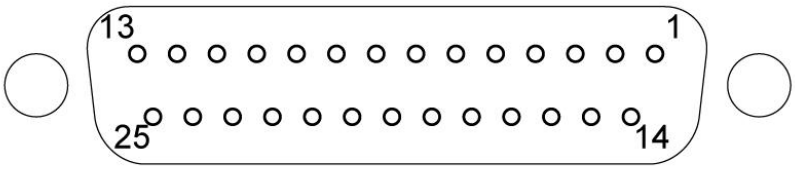



*Request and Response Identifiers*
The Request Identifiers only have an effect in User Polled CAN Mode. They set the identifier values that the module will filter for. If a CAN message is received that matches a Request Identifier then the module will respond by sending the corresponding channel data 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 module 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 $7FF. Entering a value higher than this may result in unexpected results, for instance a Response Identifier of $00FFAA23 will result in a message being sent with Identifier $223. To avoid anything unexpected the request and response identifiers should be set appropriately for use with Standard Identifiers by observing the range of values in the Setup Parameters Table.

## Connector Assignments




25 way socket connections

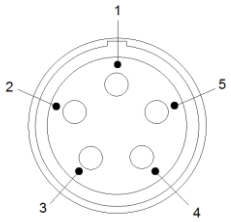
**Input Connector 25 way D type female**

| Pin | Function | Pin | Function |
|---|---|---|---|
| 1 | A/D Channel 1 + | 14 | +Vbatt. **Must use 100mA fuse !** |
| 2 | A/D Channel 1 - | 15 | GND |
| 3 | A/D Channel 2 + | 16 | Isolated 5 Volt supply (+ve) |
| 4 | A/D Channel 2 - | 17 | Isolated 5 Volt supply (-ve) |
| 5 | A/D Channel 3 + | 18 | Isolated 12 Volt supply (+ve) |
| 6 | A/D Channel 3 - | 19 | Isolated 12 Volt supply (-ve) |
| 7 | A/D Channel 4 + | 20 | GND |
| 8 | A/D Channel 4 - | 21 | GND |
| 9 | A/D Channel 5 + | 22 | GND |
| 10 | A/D Channel 5 - | 23 | A/D Channel 8 - |
| 11 | A/D Channel 6 + | 24 | A/D Channel 8 + |
| 12 | A/D Channel 6 - | 25 | A/D Channel 7 - |
| 13 | A/D Channel 7 + | | |

# LEMO Socket connections

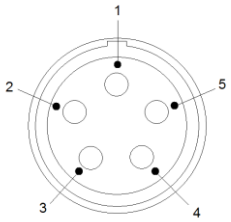
**Connector 1 – CAN/POWER IN**

| Pin | I/O | Function |
|---|---|---|
| 1 | I/O | Direct connection to Connector 2 pin 1 |
| 2 | I/O | Direct connection to Connector 2 pin 2 |
| 3 | I/O | CAN High |
| 4 | I/O | CAN Low |
| 5 | O | +12 V Power |
| Chassis | | Ground |



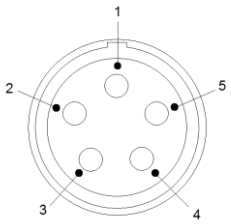

**Connector 2 – CAN/POWER OUT**

| Pin | I/O | Function |
|---|---|---|
| 1 | I/O | Direct connection to Connector 1 pin 1 |
| 2 | I/O | Direct connection to Connector 1 pin 2 |
| 3 | I/O | CAN High |
| 4 | I/O | CAN Low |
| 5 | O | +12 V Power |
| Chassis | | Ground |




**Connector 3 – Serial Configuration**

| Pin | I/O | Function |
|---|---|---|
| 1 | O | TxD, Serial Data Transmit |
| 2 | I | RxD, Serial Data Receive |
| 3 | | |
| 4 | | |
| 5 | O | +12 V power |
| Chassis | | Ground |



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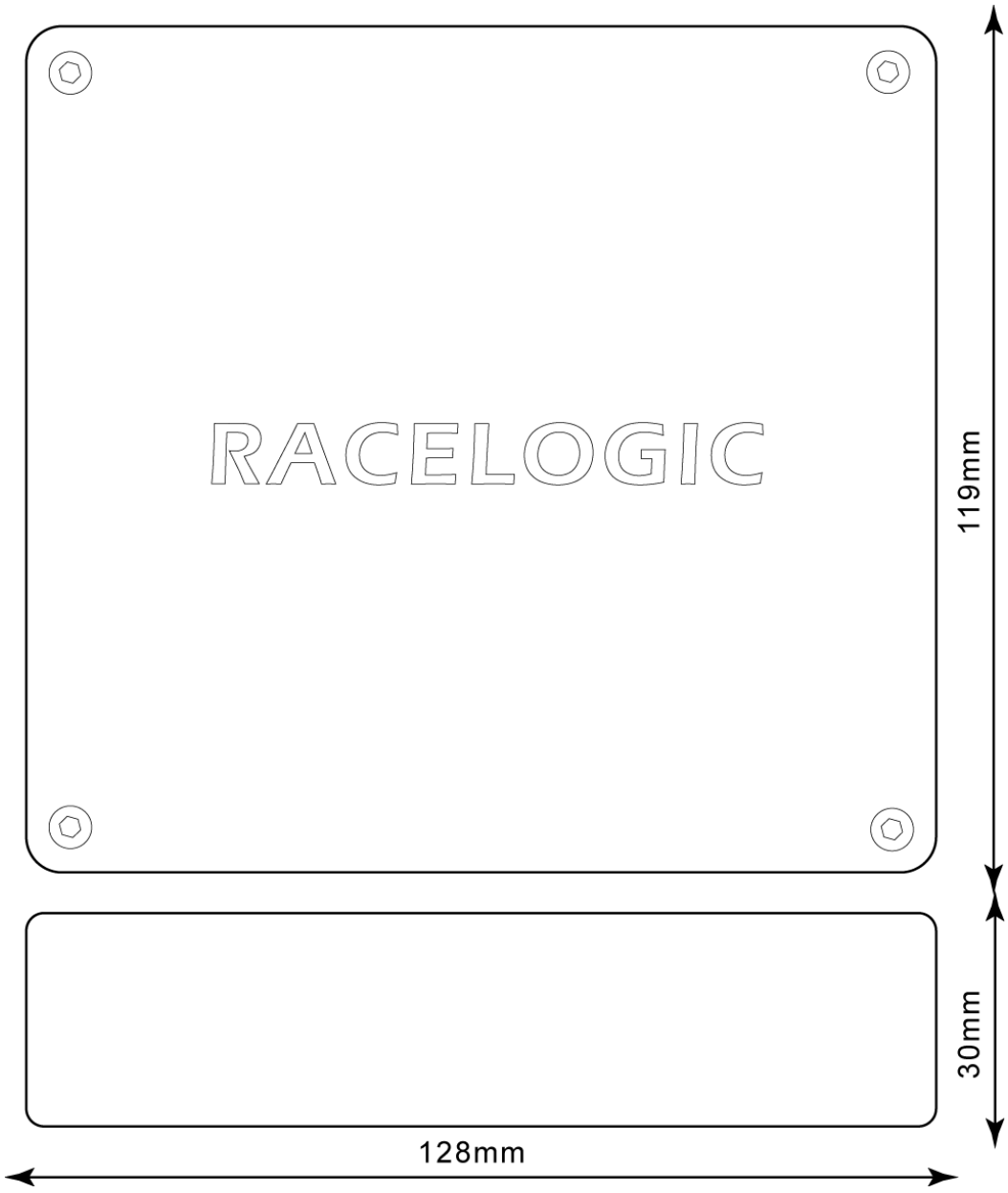
## Module Dimensions



## Document updates

| Revision | Description | Date |
|---|---|---|
| 1 | First issue. CLS | 17/03/03 |
| 2 | 2nd Issue. CLS | 29/07/03 |
| 3 | 3rd Issue. CLS. Modified for new CAN Protocol | 9/10/03 |
| 4 | Stand alone explanation added | 21/10/05 |
| 5 | Additional facilities added to Standalone mode | 6/01/06 |
| 6 | Inclusion of Declaration of Conformity Statement | 05/06/07 |
| 7 | Updated contact details | 30/04/08 |