Racelogic CAN Display

## User Guide

10/11/2005

CAN Display Introduction

The Racelogic CAN Display is a versatile tool for displaying real-time CAN data. Intended for use by both test engineers and network engineers, the CAN Display is capable of displaying Raw CAN frames and individual CAN signals from a CAN database. The CAN Display has a free, built-in CAN database of limited signals from a range of vehicle manufacturers. The CAN Display also has the facility to associate database files, so if the user has a DBC format database file for the vehicle that they are working on, the CAN Display can decode and display signals from the database. The PC software supplied with the CAN Display allows the user to read and download up to 64 signals from their own industry standard DBC format database.

Features:

- **Compact size**
- **Simple graphical interface**
- **Free built-in database for most manufacturers, where possible including:**
  - **RPM**
  - **Steering angle**
  - **Throttle pedal**
  - **4 wheel speeds or vehicle speed**
- **Use standard DBC database files**
- **Display Raw CAN data or database signals**
- **Automatically detect CAN data rate**
- **Scan CAN bus for list of all identifiers**

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Operation

The CAN Display uses a rotary push-button knob to control all functions and to navigate menu options. By rotating the knob when a menu is displayed, the user can select various menu items. To select a menu item, the user can press the knob in the centre.
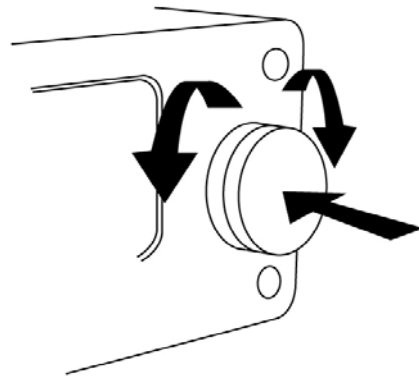
Rotate knob to select menu
item and press to activate

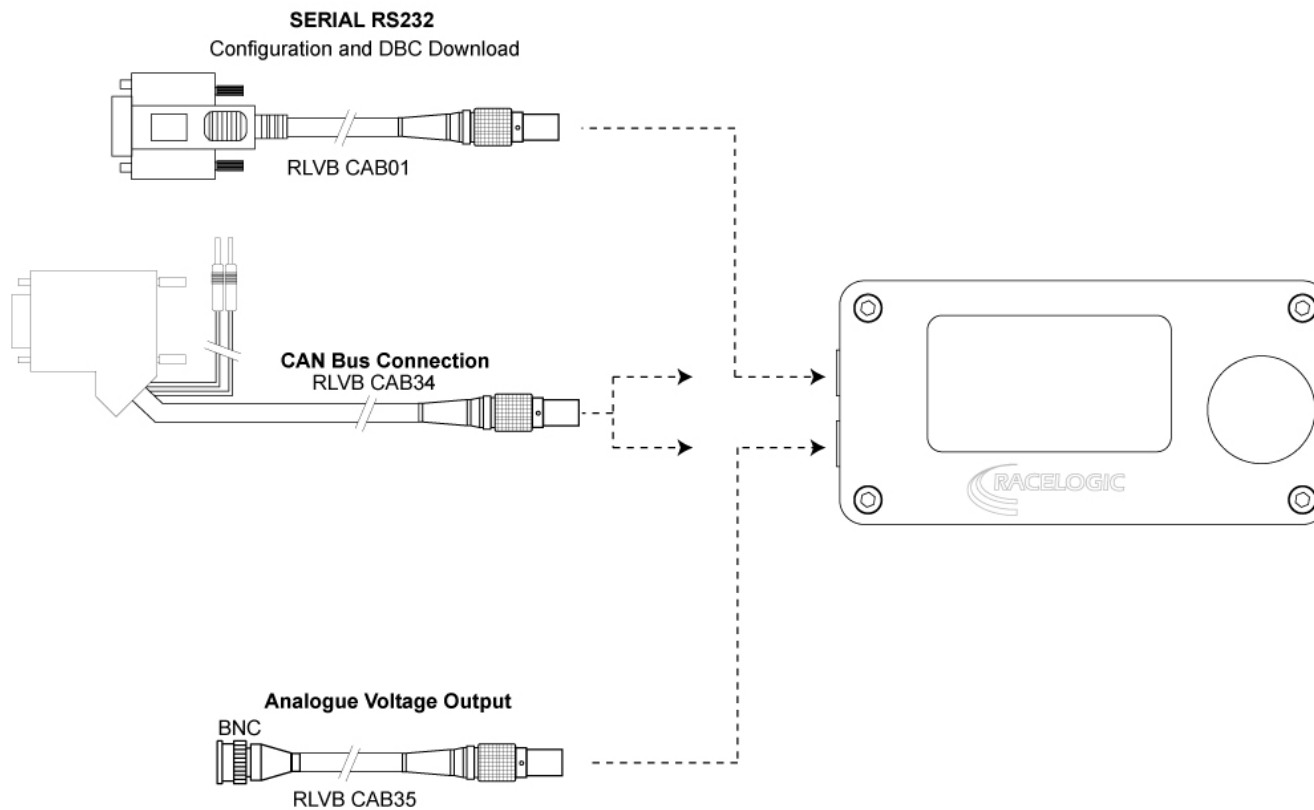The CAN Display is supplied with a general purpose connecting cable. The cable has a 5 way LEMO connector for connection to the CAN Display and a 9 pin sub-D connector for easy access to the CAN bus. The cable also features two 4mm plugs for connecting the CAN Display to a power supply – Black (Ground) and Red (+V power). Power to the CAN Display should be in the range 6v to 28v DC.
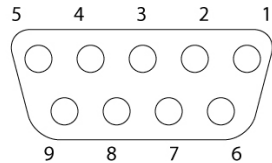
Pin 2 = CAN Low
Pin 7 = CAN High

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Connecting to the CAN Display

The schematic below shows the possible connection options and cable types.
A CAN connection cable can be used in either socket. The Serial connection is associated with the top socket only and the Analogue output is associated with the bottom connector only

SERIAL RS232
Configuration and DBC Download

RLVB CAB01

CAN Bus Connection
RLVB CAB34

Analogue Voltage Output
BNC

RLVB CAB35

Example Connection

The following schematic shows a typical vehicle connection with analogue output cable.
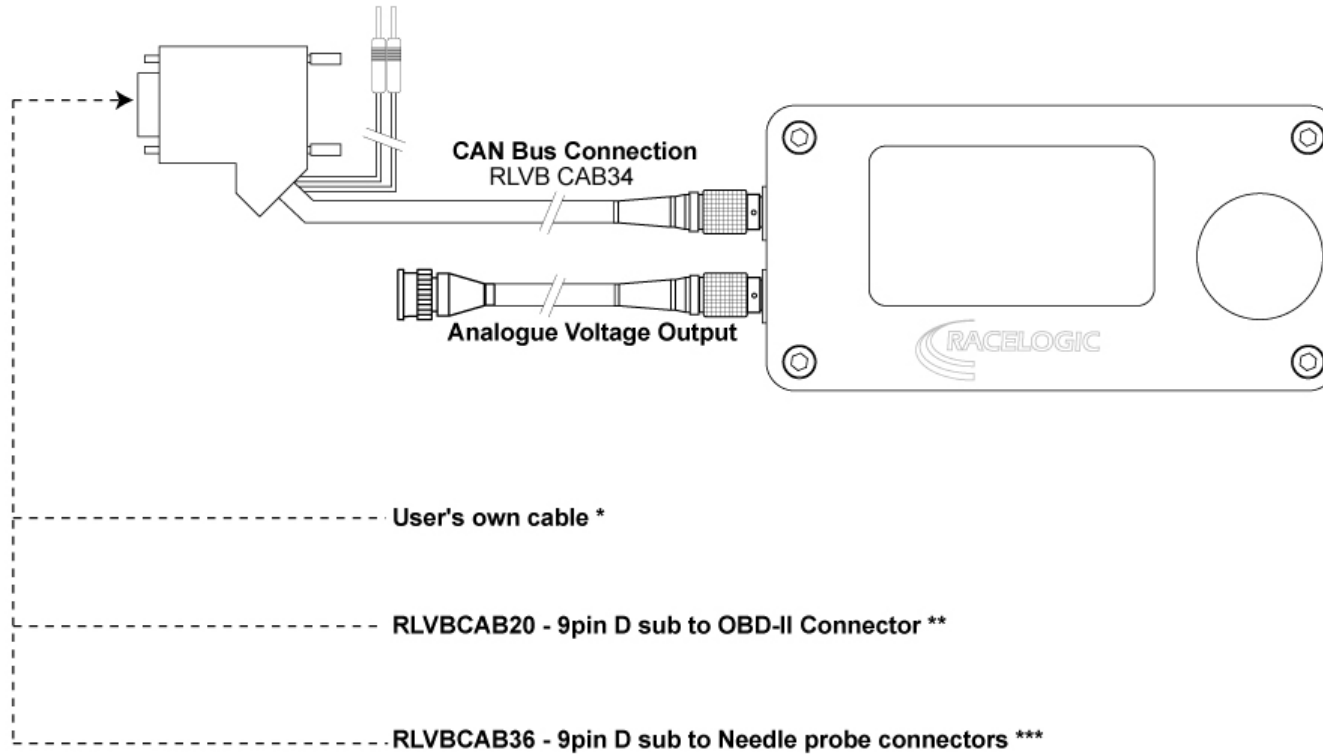
* The user's own cable must have the D sub wired up as shown on page 4.
** Not all manufactures have CAN available on the OBD-II socket.
*** In situations where a CAN connection is required to be made directly onto the CAN twisted pair cables then a needle probe cable can be used.

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Menus

On power-up, the CAN Display will show the MAIN MENU screen. However, if a database signal was last displayed, it will revert back to the database display; pressing the menu button will show the DBC VIEW MENU. Options can then be selected by turning the button and pressing it to activate.

MAIN MENU Options

SCAN BUS	The SCAN BUS option will first prompt the user for a data rate, which can be selected from the menu. If the data rate is unknown the Auto option will sample the CAN bus to determine the CAN data rate before scanning the CAN bus for a list of the current identifiers available. Once a list of the identifiers is built, the user can jump straight into the VIEW DATA display.
VIEW DATA	The VIEW DATA display mode will show complete CAN frames in hexadecimal.
VIEW DATABASE	View individual CAN signals stored as a database. This can be either a user specified database loaded using the software supplied or one of the built-in vehicle databases.
SEND CAN	Send a user configurable message on the CAN bus.
SETUP MENU	The SETUP MENU allows the user to change settings of the CAN Display. Setup options are: DBC OPTIONS (display options), LCD CONTRAST, ANALOGUE OUT.

Note
The baud rate auto-detect relies on precise timing of the bit-time of the CAN bus. Slight variations in the measured bit time can sometimes cause the CAN Display to detect a baud rate close to, but not exactly, the real baud rate of the CAN bus. Therefore, if you know the real baud rate of the CAN bus that you are connected to, it is always preferable to manually configure the data rate using the SELECT DATA RATE menu.

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SETUP MENU Options

DBC OPTIONS	Selecting DBC OPTIONS allows the user to select the current database display view from MULTIPLE SIGNALS, SINGLE SIGNAL, SINGLE GRAPH or SINGLE BAR views.
LCD CONTRAST	Selecting LCD CONTRAST allows the user to alter the display contrast either by selecting ADJUST and setting a value between 1 and 63 or by selecting DEFAULT.
ANALOGUE OUT	Selecting ANALOGUE OUT allows the user to select first a database and then a specific signal in that database which will be output as an analogue signal. The output is scaled such that 0V represents the minimum value specified for the signal and 10V represents the maximum value specified for the signal. It is recommended that the user perform their own calibration before using the analogue output, since the output voltage is dependant upon the selected signal's settings. NB: The output is not updated while in a menu view. It is updated only while in Raw data or database display modes.
MAIN MENU	Return to MAIN MENU.

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VIEW DATA – Raw Display Mode

The Raw display mode is useful for debugging and analysing CAN bus systems. To use Raw mode, first select SCAN BUS from the MAIN MENU, then select the required data rate. The CAN Display will then listen to the CAN bus and build up a list of all the identifiers that it can detect. Select VIEW DATA to make it show the Raw data view as shown below. By turning the control button, the user can switch viewing between the identifiers in the list.

Identifier: The identifier of the currently viewed CAN frame.

CAN data rate: This can be selected by the user or automatically detected by using the SCAN BUS option on the MAIN MENU.

IDENTIFIER	4 of 23
0x0210413bx	500.0k
DATA	
BB02 3F FF 26 E0 1C 6F	

Data: The data contained in the CAN frame. This can be from 0 to 8 bytes of data.

Scroll bar: The scroll bar gives a visual indication of the displayed CAN frame's position in the list of stored identifiers. As the control button is turned, the CAN Display will show each identifier in the list in turn.

Pressing the button while in Raw mode will show the MAIN MENU. To return from the MAIN MENU back to Raw view, select VIEW DATA from the MAIN MENU.

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VIEW DATABASE Mode

The database viewing mode in the CAN Display allows individual signals to be monitored.

After selecting the VIEW DATABASE mode from the MAIN MENU a SELECT DATABASE menu appears. This menu contains a list of databases from most manufacturers plus a USER DATABASE option.

Each manufacturer's database, where possible, includes:
- RPM
- Steering angle
- Throttle pedal
- 4 Wheel speeds or vehicle speed

If the user of the CAN Display has access to a database file (called a DBC file) for the vehicle or system that they are working on, signals from this file can be loaded into the CAN Display for viewing. This loaded database is then accessed through the USER DATABASE listing in the SELECT DATABSE menu.

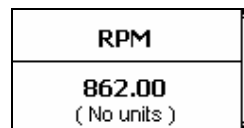**Changing the Database Viewing Mode**

Pressing the button whilst in the VIEW DATABASE mode will show the DBC VIEW MENU. From this menu it is possible to switch between multiple, single, graph and bar views. If the view mode was previously single graph mode, it is also possible to adjust the graph display UPDATE RATE from 1Hz to 10Hz where 1Hz = 1 pixel per second and 10Hz = 10 pixels per second. These selections can also be made in the DBC OPTIONS menu. Some examples are shown below.
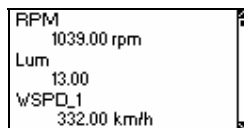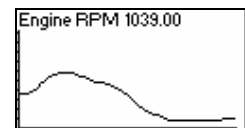
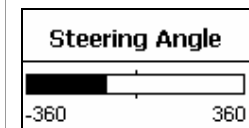| MULTIPLE SIGNAL	SINGLE SIGNAL	SINGLE GRAPH	SINGLE BAR
Three signals are displayed at once in a scrollable real-time list.	Rotating the adjuster will switch between each DBC signal in the current database.	Graph limits are taken from the database. Update rate of the graph is user adjustable in the DBC VIEW menu, accessed by pushing the button. Rotating the adjuster will switch between each DBC signal in the current database.	Limits are taken from the database file. Rotating the adjuster will switch between each DBC signal in the current database.

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UPDATE RATE (single graph only)	Adjust update / scrolling rate of graphical display. The rate can be adjusted from Hz (1 pixel per second) to 10Hz (10 pixels per second). Not available in DBC OPTIONS menu.
MULTIPLE SIGNAL	Multiple signal display will show one CAN signal at a time from the currently loaded database. Turning the control button in this view will cycle through the loaded CAN signals.
SINGLE SIGNAL	Single signal display will show one CAN signal at a time from the currently loaded database. Turning the control button in this view will cycle through the loaded CAN signals.
SINGLE GRAPH	Displays the currently-selected CAN signal as a scrolling graph. Turning the control button in this view will cycle through the loaded CAN signals. The maximum and minimum limits of the graph are taken from the max and min values in the DBC file.
SINGLE BAR	Displays the currently-selected CAN signal as a bar. Turning the control button in this view will cycle through the loaded CAN signals. The maximum and minimum limits of the graph are taken from the max and min values in the DBC file.
MAIN MENU / SETUP MENU	Switch to MAIN MENU. If accessed through the SETUP MENU, this is replaced with an option to return to the SETUP MENU.

Note
The DBS VIEW MENU options can also be accessed through the DBC OPTIONS menu, found in the SETUP MENU. The DBC OPTIONS menu has two differences, however:
1: The graph UPDATE RATE is not accessible in the DBC OPTIONS menu.
2: The option to return to the MAIN MENU button is replaced with an option to return to the SETUP MENU instead.

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Transmitting CAN

Send CAN mode allows the user to configure and send a message on the CAN bus at the current data rate. Turning the control will move through the six menu options, are described below.

SEND CAN Options

ID	Pressing the control button with the ID option highlighted allows the user to adjust the message ID that will be sent. Turning the control moves through the eight digits that make up a 29-bit identifier. Pressing the control now will select the currently highlighted digit, which can then be altered by turning the control. Pressing the button again will allow the user to select the next digit to be altered. When all digits have been configured as required, highlighting the ID option and pressing the control will return to the SEND CAN menu. The first digit can only be 0 or 1 (the maximum 29-bit identifier is 0x1FFFFFFF). NB: If 11-bit identifiers are selected all higher bits will be masked off. Setting EXT.ID to YES will un-mask the higher bits.
EXT.ID	Pressing the control button with EXT.ID selected allows the user to select 11 or 29-bit message identifiers.
DLC (Data Length Code)	Pressing the control button with DLC selected allows the user to select the number of bytes to be sent. The bytes are numbered from the left of the screen (for example "DLC: 2" would send the two bytes on the left of the DATA section).
DATA	Pressing the control button with DATA selected allows the user to configure the message data that is to be sent. This works in the same way as the ID option.
SEND	Pressing the control button with SEND selected will send a message on the bus according to the current configuration.
MAIN MENU	Switches back to the MAIN MENU.

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Example 1

```
ID:    0x0000053D
EXT.ID: NO    DLC: 8
DATA
A5 3E 1 A AA 8 A AA DA AA
SEND         MAIN MENU
```

Example 2

```
ID:    0x0D001007
EXT.ID: YES  DLC: 3
DATA
65 3E 1 B 04 8F A2 DA 76
SEND         MAIN MENU
```

In Example 1 pressing the control with SEND selected will send 11-bit identifier (0x53D) with 8 data bytes (0xA5 0x3E 0x1A 0xAA 0x8A 0xAA 0xDA 0xAA).
In Example 2 pressing the control with SEND selected will send 29-bit identifier (0x0D001007) with 3 data bytes (0x65 0x3E 0x1B).

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User Database Software

When a DBC file is loaded into the software by clicking the "Database" icon the available signals will be displayed in the left-hand list. Double-clicking on a signal in this list allows the user to view the signal details. For very large files the load can be cancelled by pressing the "Esc" key.
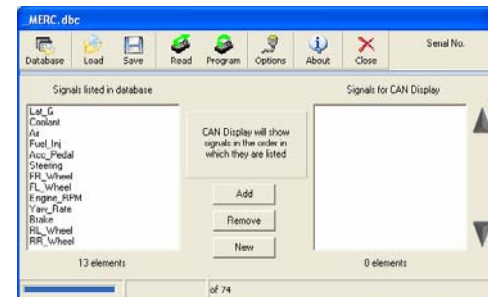

By selecting a signal from the list and clicking the "Add" button, signals may be added to the list on the right-hand side. The right-hand list shows the signals that will be downloaded to the CAN Display when the "Program" icon is clicked. To change the order of the signals in the right-hand list, click on one or more signals to highlight them and then click on the up/down arrows on the right to move them up or down the list. The "Save" icon can be used to save the current settings (as displayed in the right-hand list) to a .cdis file. These files can then be loaded later using the "Load" icon.
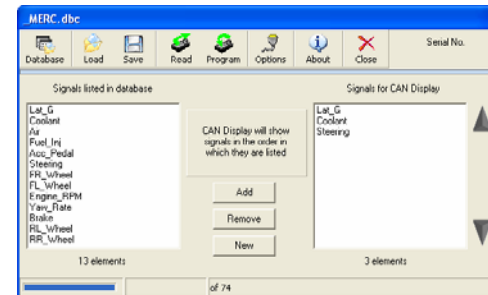
By double-clicking on a signal in the right-hand list, it is possible to display and make changes to the signal settings. This can be useful for adjusting the Max and Min Values for the signal, which are used as the graph limits when the CAN Display is in graphical mode. Click "Apply" to record any changes that are made then close the Signal Details window.

To download the selected signal list to the CAN Display, click the "Program" icon at the top of the window.
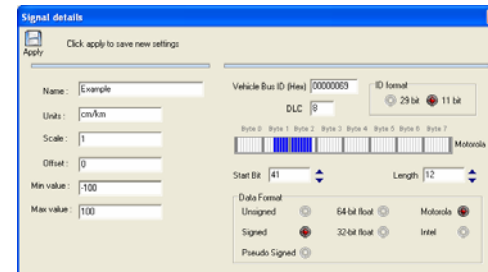
CAN Bus Overview

CAN bus data is transmitted in packets or "frames" consisting of a packet identifier and a block of data. The packet identifier is usually just referred to as an **Identifier** and is used by control units on a CAN bus to determine the content of the corresponding data. The block of data is variable in size from 0 up to a maximum of 8 bytes. A number of signals (for example engine speed, temperature, throttle position) can be packed into the data block.

```
┌──────────────────────────────────────────────┐
│ Complete CAN Frame                             │
└──────────────────────────────────────────────┘

┌──────────────┐      ┌───────────────────────────┐
│ Identifier   │  +   │ Data                       │
│ 11bit or 29bit│      │ Up to 8 bytes of data     │
└──────────────┘      └───────────────────────────┘

┌──────────────┐ ┌──────────────┐ ┌──────────────┐
│ Example:     │ │ Example:     │ │ Example:     │
│ RPM signal   │ │ Speed signal │ │ Throttle signal│
└──────────────┘ └──────────────┘ └──────────────┘
```
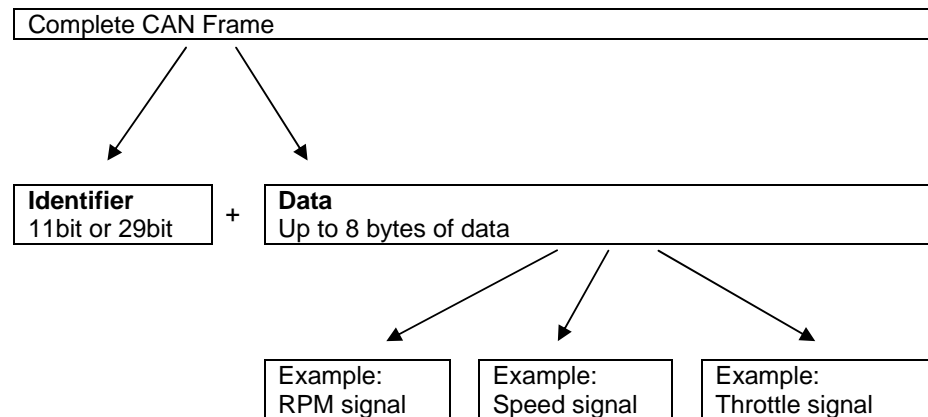
The CAN Display is capable of showing Raw CAN data. Raw CAN data refers to complete CAN frames, showing the identifier and all of the data for each frame in hexadecimal number format.

It is important to point out that the format for packing signal data into CAN frames, and the identifiers used for each frame, is up to the CAN system designer or vehicle manufacturer. The DBC database format developed by Vector is a database file format for describing how signals are encoded in a CAN message. Each vehicle manufacturer will typically have its own DBC file available for its engineers to use.

The View database mode in the CAN Display allows individual signals to be monitored. If the user of the CAN Display has access to a database file (called a DBC file) for the vehicle or system that they are working on, signals from this file can be loaded into the CAN Display for viewing.

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Specifications

| Parameter	Conditions
CAN bus	CAN bus ISO11898
CAN bit/s	10kbit/s to 1Mbit/s
Size	100mm x 50mm x 25mm / 3.9" x 1.9" x .98"
Weight	100g / 3.5oz
LCD display	128 x 64 pixel
	Green LED backlight
Operating temperature	-20 to 50°C
User input	Rotary push-button knob
Input voltage range	6 to 28V DC
Max current	Approx 120mA at 12V

Standard Inventory

Description	Qty
CAN Display	1
Connecting Cable – 5pin LEMO to 9pin Sub-D Male (RLVBCAB34)	1
RS232 Configuration Cable (RLVBCAB01)	1
User Guide	1
CD with DBC Loader Software	1

Optional Accessories

Description
Analogue Output Cable (RLVBCAB35)
Windscreen Suction Mounting with Adapter Plate

10/11/2005
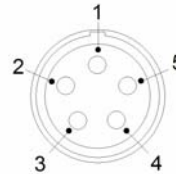
Connections

5pin LEMO Socket

Top LEMO – CAN Bus Connection with Serial Interface

Pin	I/O	Function	Note
1	O	TxD, Serial Data Transmit	Firmware upgrade
2	I	RxD, Serial Data Receive	Firmware upgrade
3	I/O	CAN High	Linked to bottom LEMO CAN High
4	I/O	CAN Low	Linked to bottom LEMO CAN Low
5	O	+V Power	
Chassis		Ground	Chassis

Bottom LEMO – CAN Bus Connection with Analogue Output

Pin	I/O	Function	Note
1	O	Analogue Output	
2	-	-	
3	I/O	CAN High	Linked to top LEMO CAN High
4	I/O	CAN Low	Linked to top LEMO CAN Low
5	O	+V Power	
Chassis		Ground	Chassis

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Firmware Updates

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

To upgrade the CAN Display, download the latest upgrade file from the Racelogic website. The file will have a .ruf file extension. Make sure that the CAN Display is powered. Using the CAB01 serial cable, connect the serial cable to the PC and then to the top Lemo socket on the CAN Display. 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
5 Little Balmer
Buckingham Ind Pk
Buckingham
MK18 1TF
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	18/9/2005	First Draft	KB
2	10/11/05	Correction to firmware upgrade connection text	KB
3			
4			
5			
6			

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