MoTeC   SDL User Manual

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Introduction

Thank you for purchasing a *MoTeC* SDL Dash / Logger.

SDL

The *MoTeC* SDL Dash / Logger is a combined LCD dash unit and high performance data logger. Note that a 'display only' version of the SDL is also available

This Manual Covers:

- Overview of the SDL capabilities

- Installation

- Overview of the *MoTeC* SDL and Sport Dash Manager software

Software Information

For detailed information on using the various software programs refer to the online help supplied with the program.

Other Manuals

Separate Manuals are available for:

- *MoTeC* Lap Beacon / BR2

- Interpreter Data Analysis Software

Sensor Details

Drawings are available for all *MoTeC* sensors and can be found on the MoTeC Resource CD (included with the SDL) or on the MoTeC website at www.motec.com.au . The drawings detail the mounting and wiring requirements for each sensor.

Overview

Display

The SDL display is a high contrast, high temperature, custom made LCD display.

The display contains a Bar Graph, three Numeric Displays, a Centre Numeric Display and a Bottom Alpha / Numeric Display.

Bar Graph
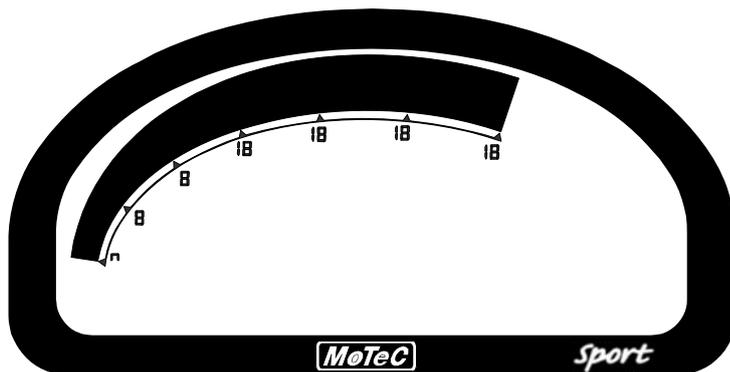
The 70 segment bar graph has a user definable range and is typically used as a tacho, however it can be used to display any other value. When used as a tacho it may be configured for up to 19,000 RPM.

A programmable shift point can be displayed.

Numeric Displays
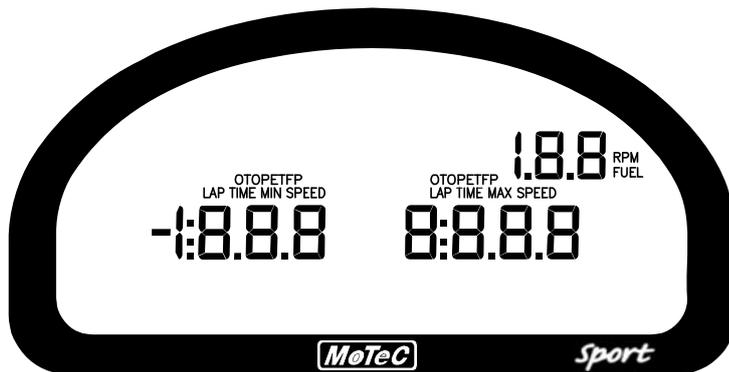
The three numeric displays (Left, Right and Top Right) can be programmed to display any value.

Note that each of the three numeric displays has a different number of digits and are therefore suited to displaying different values. For example the Top Right display can only show values up to a maximum of 199 and is therefore not suitable for displaying Lap Times, but is suitable for displaying many other values such as Lap Number, Fuel Remaining, Engine Temperature etc.

The numeric displays can show any channel value plus an override value, shown each time the value is updated. This is useful for values that are updated periodically, for example Lap Time. The override values are shown for a programmable period of time, for example a numeric display could normally show the Running Lap Time (which is continuously updating) then be overwritten by the Lap Time for 10 seconds each time the Lap Time is updated.

Enunciators for some of the common display values are provided above the numeric displays, eg. ET (Engine Temperature), OP (Oil Pressure).

Centre Numeric Display
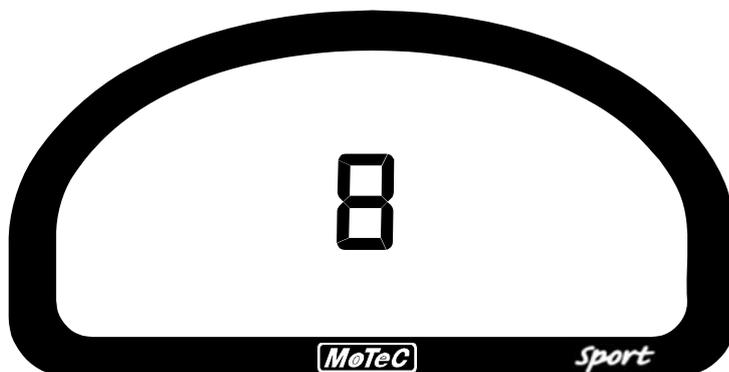
The Centre Numeric display is incorporated to show the current gear but may be used for other purposes.

Bottom Display
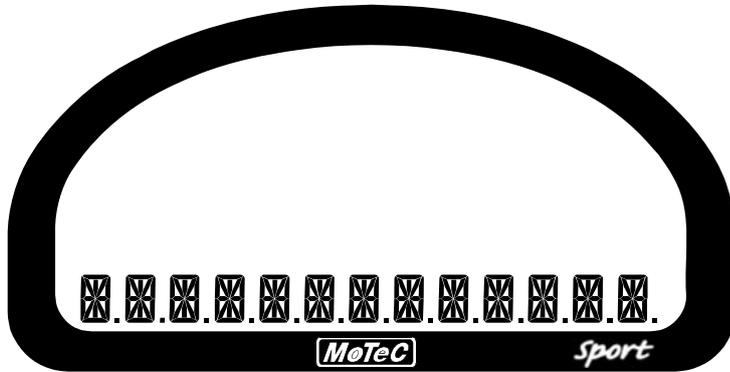
The 13 digit alpha numeric display can display up to 10 lines of information that can be scrolled up or down using the external buttons. Each of the 10 lines can display up to 3 channel values at a time.

Additionally the bottom display can show an override value, similar to the numeric displays.

The bottom display will also show any active alarm messages, which will override all other values until the alarm is cleared.

Display Formatting

Units

The display units can be changed to suit the driver, for example the driver may prefer to see the engine temperature in Fahrenheit rather Celsius. This is independent of the units used for other purposes.

Decimal Places

The number of decimal places can be reduced for display purposes, for example the engine temperature is measured to 0.1 °C but is better displayed with no decimal places. This is normally done automatically.

Alarms

When an alarm is activated a message is shown on the bottom line of the display, a warning light can also be activated which is recommended to draw the drivers attention to the display.

The message displayed can be defined and can also include the current sensor reading or the sensor reading when the alarm was triggered.
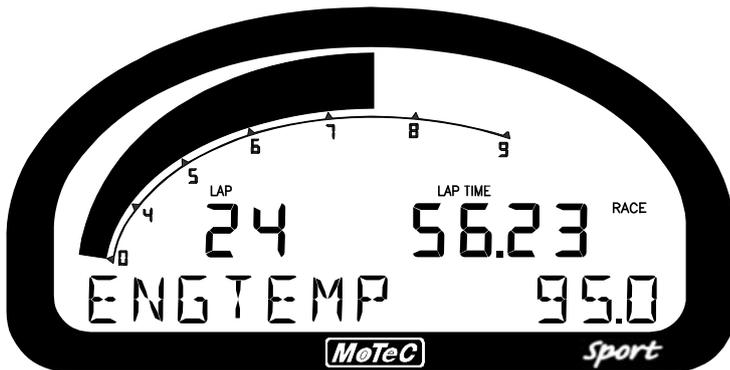
The alarms remain active until they are acknowledged, either by a driver activated switch or automatically after a defined period of time.

The warning alarm limits are fully programmable and may include up to 2 comparisons to ensure that the alarms are only activated at the correct time. For example, an engine temperature alarm may activate at 95 °C if the ground speed has been above 50 km/h for 30 seconds. The speed comparison avoids the alarm showing during a pit stop due to heat soak. Additionally another comparison could be set at a higher temperature to cover all other situations.

Data Logging

Data logging allows the sensor readings (or any calculated value) to be stored in the SDL for later analysis.

Logging Memory

The SDL comes with an optional 8Mbytes log memory enabled. It is also possible to purchase a 'display only' SDL without the memory option enabled.

Data is logged continuously logs data to memory whenever the Start Condition is true (and the Stop Condition is false).

When the logging memory is full the SDL begins to overwrite the oldest data, which ensures that the most recent data is always available. This is referred to as cyclic logging.

Power

The SDL power can be turned off at any time without losing the logged data. The SDL uses FLASH memory which does not require an internal battery to keep it alive.

Logging Rate

The SDL can store any value at up to 200 times per second, which can be individually set for each logged item.

The rate at which the values are logged is very important – the value must be logged fast enough to record all variations in the reading. If the value is logged too slowly then the readings can be totally meaningless. For example suspension position normally needs to be logged at 100 times per second or more.

Note, however, that if a value is logged faster than necessary it will not improve the accuracy of the logged data, it will just reduce the total logging time available. For example, the engine temperature only needs to be logged at once per second.

Logging Time

The maximum logging time is dependent the number of items logged and the rate at which they are logged. The configuration software will report the logging time, taking these factors into account.

Logging Rates

The logging Rate may be individually set for each value between 1 to 200 times per second.

Start and Stop Logging Conditions

Two options are provided; the default is to log data while the engine is running. The condition is to start when Engine RPM >= 200 rpm for 2 seconds. Logging will stop when Engine RPM < 200 rpm for 20 seconds. This requires that the Engine RPM channel is present in the configuration.

The alternative is to specify start and stop logging conditions to suit the application. For example logging might start when the vehicle exceeds 50

km/h, and stop when the engine RPM is below 500 RPM for 10 seconds. Note that the Start Condition must be true and the Stop Condition must be false before logging will start.

Retrieving the Logged Data

A laptop or desktop PC is used to unload the logged data from the SDL. The logged data is then stored on the computer hard disk.

The logged data may be retrieved at very high speed (approximately 2.5 seconds per Mbyte when using USB or 20sec Mbyte when using CAN).

After each unload the user has the option to clear the logging memory.

The unload may be interrupted part way through if necessary by disconnecting the computer. The partial unload will contain the most recently logged data and will be stored on the computer hard disk. In this case the SDL logging memory is not cleared and logging will continue as normal at the end of the existing data. Next time the logged data is unloaded both the new data and the previously partly unloaded data will be retrieved.

Track Map Sensor Requirements

In order for the logging analysis software to plot a track map the following sensors are required and must be logged.

- Lateral G force (inbuilt in the SDL)

- Wheel Speed

- Lap Beacon (from either MoTeC Beacon kit or a switch. Note that the 'Beacon' Channel must be logged)

- Longitudinal G force (Optional: See Below)

A Longitudinal G force sensor should be used if the vehicle has only one wheel speed sensor. This allows the analysis software to eliminate wheel lockups which is essential when creating or using a track map.

Other Functions

The SDL can perform many other functions and calculations including the following:

Functions:

- Shift Lights – Controls up to 3 staged shift lights.

- Engine Log – Can be used to record engine running times during the specified condition

Calculations:

The SDL can calculate and display any of the following:

- Lap Time, Running Lap Time, Lap Number.

- Ground Speed, Drive Speed, Lap Distance, Trip Distance, Odometer.

- Lap Time Gain / Loss continuously displays how far behind or ahead the vehicle is compared to a reference lap.

- Current Gear.

- Minimum Corner Speed, Maximum Straight Speed.

- Fuel Used, Fuel Remaining.

- Two 2D and two 3D Lookup Tables

Measurement Inputs

The SDL measurement inputs can be connected to a wide variety of sensors. This allows the SDL to measure vehicle parameters such as: Suspension Movement, Wheels Speeds, Steering Angle, Engine Temperature etc.

Input Types

The SDL has a number of different input types which are designed to suit the different types of sensors.

The following inputs are available:

- 8 Voltage Inputs

- 4 Temperature Inputs

- 1 Optional Wide Band Air Fuel Ratio Input (Lambda Input)

- 2 Switch Inputs

- 2 Digital Inputs

- 2 Wheel Speed

Expander Inputs

Additionally one E888 expander may be connected to read from 8 K-type thermocouples.

Internal Sensors

The SDL also includes internal sensors for G-Force Lateral, G-Force Vertical, Battery Voltage and SDL Internal Temperature.

Sensors

Different types of sensors are available to suit different types of measurements.

Sensors convert a physical measurement (e.g. Pressure) into an electrical signal (e.g. Volts). Different types of sensors generate different types of electrical signals. For example most temperature sensors convert the temperature into a variable resistance signal which may be measured by the SDL Temperature inputs, however most wheel speed sensors generate a variable frequency signal which must be connected to either a Digital input or a Speed input.

Calibration

Calibration is the process of converting the electrical value, e.g. Volts into a number that represents the physical value, e.g. Temperature.

All inputs can be calibrated to suit the connected sensor.

The calibrations can be selected from a number of predefined calibrations provided by *MoTeC*, or they can be entered by the user.

Analog Voltage Inputs

The 8 Analog Voltage inputs are normally used to measure the signals from analog voltage type sensors, i.e. sensors with variable voltage outputs, such as:

- Rotary or linear potentiometers

- Signal conditioned 3 wire pressure sensors

- Thermocouple amplifiers

- Accelerometers

These inputs can also be used to measure two wire variable resistance sensors if an external pullup resistor is connected from the input to the 5V sensor supply. Additionally, on/off switch signals may be connected, which may also require an external pullup resistor.

Measurement Methods

These inputs can be configured to use several measurement methods to suit the various types of sensors:

- Absolute Voltage: The sensor voltage is independent of the sensor supply voltage

- Ratiometric Voltage: The sensor voltage is proportional to the 5V sensor supply voltage

- Variable Resistance: The sensor resistance can be entered directly.

- On/Off : The voltage for on and off can be defined

Input Voltage Range

The measurable input voltage range is 0 to 5.5V on inputs AV1 to 4 and is 0 to 15 Volts on all other AV inputs.

Specifications

For full specifications see *Appendix D: Input Characteristics*.

Analog Temp Inputs

The 4 Analog Temp inputs are identical to the Analog Voltage inputs, except that they contain a 1000 ohm resistor which is connected internally from the input pin to the 5V sensor supply. This allows the Analog Temp inputs to be used with two wire variable resistance sensors such as:

- Two wire thermistor temperature sensors

- Two wire variable resistance pressure sensors

Some voltage output sensors can also be used if they can drive the 1000 ohm resistor without causing an error in their reading (eg **MoTeC** Thermocouple Amplifier). Additionally, on/off switch signals may be connected.

Measurement Methods

These inputs use the same measurement methods as the Analog Voltage Inputs.

Input Voltage Range

The measurable input voltage range is 0 to 15 Volts. This allows selection from a wide range of sensors.

Specifications

For full specifications see *Appendix D: Input Characteristics.*

Wide Band Lambda Input

The single high accuracy, fully temperature compensated Wide Band Air Fuel Ratio measurement input can be used if the Lambda Option is enabled.

This input connects directly to a *MoTeC* 4 wire Wide Band Lambda Sensor and is accurate to 1.5% up to 1.2 Lambda under all load and temperature conditions.

Note that this is the Bosch LSM sensor and not the 5 wire Bosch LSU sensor.

Note that NTK Lambda sensors should be connected to an Analog Voltage input via the appropriate amplifier.

Switch Inputs

The 2 switch inputs are generally used for the external switches required to operate the SDL display. They can also be connected to a brake switch or other switch.

These inputs have a 4700 ohm resistor connected internally from the input pin to the 5V sensor supply so that a switch can be simply connected between the input pin and 0 volts.

Specifications

For full specifications see *Appendix D: Input Characteristics.*

Digital Inputs

The 2 digital inputs are identically to the switch inputs except that they include the following additional measurement methods:

- Frequency: The frequency of the input signal is measured

- Period: The time between successive pulses is measured

- Pulse width: The low time of the pulse is measured

- Count: Counts the number of pulses

Specifications

For full specifications see *Appendix D: Input Characteristics.*

Speed Inputs

The 2 Speed Inputs are identical to the Digital Inputs except that they can also be configured to suit Variable Reluctance (Magnetic) sensors such as some wheel speed sensors. Because the amplitude of the signal from these sensors varies with speed of rotation, variable trigger levels are required, which must vary with the frequency of the input signal.

The Speed Inputs can also be used with Hall Effect type wheel speed sensors.

- Note also that the Pulse Width measurement method measures the high time of the pulse rather than the low time as measured by the Digital Inputs.

Specifications

For full specifications see the Appendices.

Internal Sensors

The SDL includes internal sensors for G force lateral, G force Vertical, battery voltage and internal temperature.

Expander Thermocouple Inputs

An E888 expander may be connected to the SDL to read the 8 thermocouple inputs. These are added and calibrated when the CAN comms template "E8xx Rx EGT" is selected as one of the 6 possible CAN devices.

Auxiliary Outputs

The SDL has 4 Auxiliary Outputs which may be used to control various vehicle functions such as: Gear Change Lights, Warning Lights, Thermatic Fan, Gear Box Oil Pump, etc. The outputs are On/Off only and do not support variable frequency or duty cycle control.

The Auxiliary Outputs switch to ground and can drive up to 0.5 Amps. Devices that consume more than 0.5 Amps such as motors should be driven via a relay.

Communications Overview

The SDL has various communications ports which are used to communicate with other devices.

USB Communications Port

The USB communications port is used to communicate with a PC. See Appendix J: USB Wiring for wiring details.

RS232 Communications Port

The RS232 communications port can be connected to an ECU, GPS or similar device.

CAN Communications Port

The CAN (Control Area Network) communications port can be connected to other devices with a compatible CAN port. The advantage of CAN is that many devices can be connected to the CAN bus at once, which allows all connected devices to communicate with each other, also the CAN port communicates at very at high speed.

Other *MoTeC* products that use CAN for intercommunication include the M800, BR2, PLM and MDD.

Note that these devices communicate at 1Mbit/sec, so any other devices connected on the CAN bus must also communicate at 1Mbit/sec.

ECU Connection

The SDL can be connected to many Engine Management Systems (ECUs). This avoids duplication of sensors and allows the SDL to display and log many ECU parameters.

The ECU may send up to 40 values to the SDL. The update rate of these values depends on how many values are transmitted, the communications baud rate and if sent using CAN or RS232. For RS232 the typical update rate is about 20 times per second and for CAN it is about 50 times per second. Note that logging the ECU values faster than these rates is unnecessary and will reduce the total logging time.

- Note that if the SDL is connected to a **MoTeC** M800 ECU the M800 sensors should be calibrated in metric otherwise special scaling will be required.

Lap Beacon

A Lap Beacon can be connected to the SDL in order to record Lap Times for display and to provide lap reference information for the data logging analysis software.

The **MoTeC** Lap Beacon consists of a Transmitter which is mounted beside the track and a Receiver which is mounted in the vehicle.

A switch can also be used to generate lap times, although this is significantly less accurate than a lap beacon system.

For further details refer to the Lap Beacon manual.

Options

Various options allow the SDL to be upgraded to perform additional functions, specifically wide band lambda measurement and Pro Analysis.

The options can be enabled at any time by calling your MoTeC dealer, purchasing the upgrade and then entering the upgrade password.

See *Appendix B: Options Summary* for details.

Software

The SDL comes with software packages for managing the SDL and analysing the logged data. All software required is available on the CD provided, or can be downloaded from the internet. Go to www.motec.com.au and follow the links to "Software".

The software must be run on a laptop or desktop computer running Windows 98/2000/XP.

The following software programs are provided:

SDL Sport Dash Manager

MoTeC Sport Dash Manager is used for configuration, testing, retrieving the logged data and for general management of the SDL.

An overview of Sport Dash Manager is included later in this manual.

Sport Dash Manager communicates with the SDL via a USB cable. See Appendix J: USB Wiring for wiring details.

Interpreter

Interpreter is used to analyse the logged data, this is covered in a separate manual.

BR2Config

This program is used to configure the BR2 beacon receiver via a CAN connection. BR2 configuration is covered in the BR2 Manual.

Updateable Firmware

The SDL control software (firmware) is field updatable so that new software features can be used as they become available.

Installation

Mounting

Mounting Dimensions

Refer to the product dimensions in the Appendices.

Attachment

Use washers between the unit and the mounting panel to ensure that the unit is mounted only at the mounting points (to avoid twisting the case). The SDL has three threaded mounting posts.

Do not over tighten the mounting screws (to avoid twisting the case).

Vibration isolation may be desirable if the vehicle vibrates severely.

Orientation

For best contrast, the display should be viewed at approximately 20 degrees above normal, however the SDL will give good contrast between 0 and 40 degrees. Display reflections should also be considered when determining the mounting angle.

Note that for accurate readings from the inbuilt vertical G sensor the SDL should be mounted as close to vertical as possible.

20°
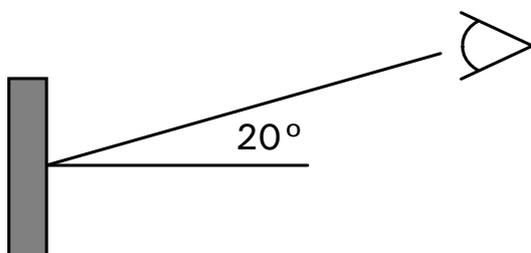
Connector Access

Mount so that the connector may be easily accessed.

Display Care

Take care when cleaning the display, use a soft cloth to avoid scratching the display and avoid aggressive solvents.

Wiring

Pin Connection Details

The SDL pin connection list appears at the back of this manual.

Wire

Use 22# Tefzel wire (Mil Spec M22759/16-22)   (5 amps max at 100 °C)

Note that the Tefzel wire is difficult to strip unless the correct stripping tool is used. Be careful not to nick the wires as this may result in wire failure or poor crimping.

Some sensor connectors may not be available with 22# terminals, in which case doubling the wire over gives the equivalent of an 18# wire, which is suitable for many of the common sensor terminals.

For full wire specifications see Appendix P: Wire Specifications.

Connector

The SDL uses a 37 pin Auto Sport connector, see *Appendix N: Connector* for full details.

To ensure that the connector is sealed plug unused holes with filler plugs. A heat shrink boot may also be used if desired.

Crimping

Ensure that the correct crimping tool is used for all contacts to ensure a reliable connection.

The correct mil spec crimping tool must be used for the SDL crimp pins. See Appendix N: Connector for details.

- Note that the Crimp Contacts are type 22D which is needed to set the crimp tool correctly.

Power Wiring

Power the SDL via a separate switch and a 5 Amp fuse. The separate switch is recommended so that the computer can communicate with the SDL without needing to turn the rest of the vehicle power on.

Ground Wiring

Ground the SDL to a good ground. The ground should have a direct connection to the vehicle battery.

USB Wiring

See Appendix J: USB Wiring for USB wiring details.

CAN Bus Wiring

Refer to Appendix H: CAN Wiring for details.

Sensor Wiring

MoTeC can supply wiring details for all sensors.

External Buttons

A number of external buttons are required for various functions of the SDL.

Typically these buttons are used for:

- Display Next Line

- Alarm Acknowledge

- Lap Number Reset

- Fuel Used Reset (can also be done by holding the alarm acknowledge button for 2 seconds)

These buttons are normally wired to the SDL Switch Input pins, but may also be wired to the Digital or Analog Inputs, if the Switch Inputs are occupied.

Note that it is possible to configure the ADL to use the Alarm Acknowledge button to reset the Lap Number and Fuel Remaining by holding it for a period of time. This reduces the number of buttons required.

The buttons should be wired between an SDL input and SDL 0V pins.

Note that if wired to an Analog Voltage input an external pull-up resistor must be connected between the input pin and the 5V sensor supply.

External Lights

All lights including the Shift Lights & Warning Lights must be wired externally. This allows a choice of lights and allows the lights to be placed in the optimum position.

The *MoTeC* Shift Light Module (SLM) can be used for this purpose, otherwise LEDs or LED arrays can be used.

SLM

The SLM includes 8 LEDs that can be programmed to any colour and can be used for both warning lights and multiple shift lights plus many other functions.

The SLM is connected to the SDL via the CAN bus so it does not occupy any of the auxiliary outputs.

LEDs

LEDs may be wired to any of the four Auxiliary Outputs.

The LEDs must be wired between one of the Auxiliary Outputs and battery positive and must include a current limiting resistor.

Thermocouples

Thermocouples must be wired to the SDL via a thermocouple amplifier.

The *MoTeC* Thermocouple Amplifier (TCA) may be used with K Type thermocouples and may be connected to either the Analog Voltage or Analog Temperature inputs of the SDL.

Connecting to a MoTeC ECU

An ECU may be connected to the SDL which will make information in the ECU available to the SDL for display or logging or any other purpose.

MoTeC M400/M600/M800/M880 ECUs may be connected via CAN or via RS232.

The *MoTeC* M4, M48 & M8 ECUs must be connected via RS232.

Connection via RS232

The telemetry feature of the *MoTeC* ECU is used to send data to the SDL via an RS232 connection.

See Appendix G: ECU to SDL Wiring (RS232) for wiring details.

ECU Setup

The ECU 'Telemetry Set' and 'Telemetry Baud Rate' should be selected to suit an RS232 communications template supported by the SDL.

SDL Setup

Setup for the SDL is done in the 'Inputs | Communications' setup screen.

Select a communications template that matches the ECU type and ECU telemetry set.

In the displayed channel list, check those channels that you wish to receive in the SDL

Interruption of the Data

Note that when using RS232, the data flow to the SDL will be interrupted while a computer is connected to the ECU and will not resume for up to 10 seconds after the computer has been unplugged. During this period any value that comes from the ECU, such as RPM or Engine Temperature will not be updated and will normally be displayed as zero. On later versions of the ECU software the 10 second delay is reduced to 1 second.

Connection via CAN

The SDL and ECU must be connected on the same CAN bus.

See *Appendix H: CAN Wiring* for wiring details.

ECU Setup

Set the 'CAN Data Set' to a set supported by the SDL (normally set 1).

The 'CAN Address' must also be set. Normal value for SDL is 1520. This is a decimal value that corresponds to a hexadecimal value of 0x5F0 in the SDL.

SDL Setup

Setup for the SDL is done in the 'Inputs | Communications' setup screen.

Select a communications template that matches the ECU type and ECU set.

In the displayed channel list, check those channels that you wish to receive in the SDL.

ECU Sensor Calibrations

Metric Calibration of the sensors should be used in the ECU otherwise special scaling is required in the SDL communications setup.

Sport Dash Manager Software

Introduction

The following is an overview of the main concepts of the Sport Dash Manager software. More detailed information is available from the online help provided with Sport Dash Manager. Online help is not currently available (Version 1.1.0.49) but will be available at a later stage.

The Sport Dash Manager software is used for:

- Editing the configuration files

- Sending configuration files to the SDL

- Retrieving the logged data from the SDL

- Testing the SDL

- Enabling SDL options

- Upgrading the SDL software version

- Changing event, venue and vehicle details

Computer Requirements

The Personal Computer (PC) must be an IBM PC compatible running Windows 98/2000/XP.

Recommended Minimum Specifications

Pentium III, 64Mb RAM, USB1.0 or Parallel Port

USB Port or Printer Port

The PC must have a USB1.0 or compatible USB port or a Printer port.

The USB port is the recommended connection method because it is much faster however if necessary a *MoTeC* CAN Cable may be used instead which should be connected to the printer port.

Installing Sport Dash Manager

From a CD-ROM

Place the CD-ROM into the CD drive of the pc.

A new window will appear. This can be navigated in the same way as a web page.

If it does not appear, click on the Windows *Start* button and select Run. Type 'D:\index.htm'

Click on the button marked 'Software Archive'.

Select the version of Sport Dash Manager (or other software) that you wish to install and click on the name.

When the dialog appears asking you to 'Open' or 'Save' the selected file, choose 'Open' and then follow the setup program instructions.

From the Internet

Go to the ***MoTeC*** web site at www.motec.com.au and select *Software Updates* then *Current Release Software.* Click on one of the *SDL Sport Dash Manager* link to start the down load and choose to save the file to a location where it can be easily located after downloading (such as the desktop). After downloading double click on the file to start the installation process.

Mouse & Keyboard

The Sport Dash Manager Software may be operated using the keyboard or a mouse.

On many Notebook PCs the pointing device (mouse substitute) is difficult to use and in many cases it is much easier and faster to use the keyboard. For details on using the keyboard refer to the topic on Windows Keyboard Use later in this manual.

Main Menu
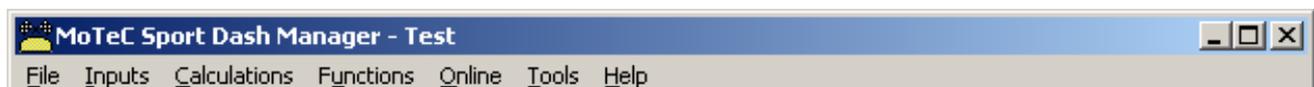
The main menu is used to access all of the features of the Sport Dash Manager software. Click the mouse on one of the menu items or press the Alt key together with the underlined letter, for example press Alt + F to select the File menu.
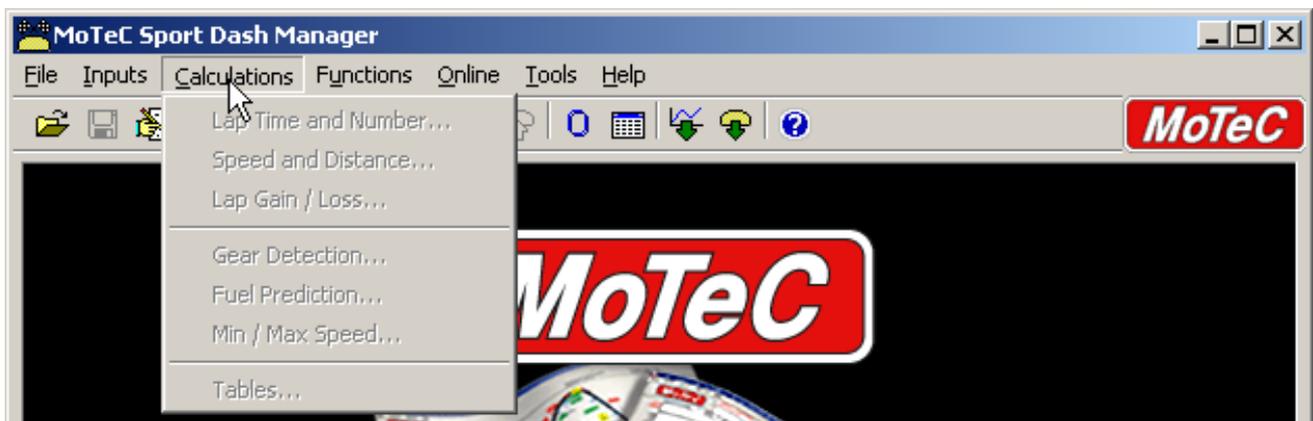
Unavailable Menu Items

When Sport Dash Manager is started the items related to changing the configuration will be unavailable, this is because a configuration file has not been selected.

Unavailable items appear grey as shown below.

Toolbar

The Tool Bar provides an alternative way of activating some of the commonly used items on the main menu. To find out what each item does hold the mouse pointer over the button of interest until a hint appears.

On line / Off line

All changes to the SDL configuration are performed 'Off Line', i.e. without the PC communicating with the SDL. Once the configuration changes have been made and saved to a file, they can be sent to the SDL which is an 'On line' process, i.e. the PC is communicating with the SDL.

Many other functions are also performed 'On line', for example, Get Logged Data, Zero Sensors, Monitor Active channels etc.

To consolidate the Online concept, all on line activities are placed in the 'Online' Menu item. All other menu items perform Off Line activities.

Configuration

The configuration of the SDL determines exactly how it operates.

The strength of the SDL lies in its flexibility of configuration. All aspects of the SDL can be configured including, which sensor is connected to which input, the calibration of each sensor, what to display and where to display it, what to log and how fast to log it, tacho range, warning alarms, multi stage shift lights, etc, etc.

Configuration Files

The SDL configurations are stored in files on the PC hard disk and can be sent to the SDL at any time.

When changing the configuration, changes are only made to the file on the PC. The file must be sent to the SDL before the changes take affect.

Creating a New Configuration File

A new configuration file can be created by selecting *File | New* from the main menu, this will create a new configuration based on one of a number of predefined templates.

After a new configuration has been defined, it should be saved with a meaningful name by selecting *File | Save* from the main menu, the file may then be sent to the SDL by selecting *Online | Send Configuration* from the main menu.

Alternatively a new file can be created by loading an existing configuration file and saving it to a new file by selecting *File | Save As* from the main menu.

Opening an Existing File

Before an existing configuration file can be modified or sent to the SDL it must first be opened.

To open a configuration file select *File | Open* from the main menu and select the desired file.

Note that the most recently used files appear at the bottom of the File menu, which is often the easiest way to open a recently used file.

Sending the Configuration to the SDL

The currently open configuration file can be sent to the SDL by selecting *Online | Send Configuration* from the main menu.

When a configuration file is sent to the SDL any changes are automatically saved to the file.

Retrieving the Configuration from the SDL

The configuration can be retrieved from the SDL if necessary by selecting *Online | Get Configuration* from the 'Online' menu. However this is not normally necessary unless the original file is not available on the PC.

Backups

Whenever a file is saved, the previous contents of the file are saved in the 'Save Backups' directory. The total number of files is limited to 100.

When a file is sent to the SDL the existing SDL data is retrieved and stored in the 'From Dash Backups' directory, this is in case the data in the SDL needs to be restored. The total number of files is limited to 10.

File Management

The configuration files may be Renamed, Deleted, sent to a Memory stick etc, by clicking the right mouse button on the desired file when the Open File screen is displayed.

Changing the Configuration

Once an existing configuration file has been opened, or a new one created, the various parts of the configuration may be modified by choosing the appropriate items from the main menu. The configuration setup items are accessed from the main menu items: *Inputs*, *Calculations* and *Functions*.

Configuration Sequence

The configuration is best setup in the following order:

1. Inputs   (Input Pins & Communications)

2. Calculations   (Lap Time, Fuel Prediction etc)

3. Functions   (Logging, Display, Alarms, Auxiliary Outputs etc)

This simplifies the setup procedure by ensuring that the required channels are available for the functions that use them.

- Note that channels cannot be used until they have been generated by an input, calculation or function.

Versions and Updating

Updating

The software inside the SDL can be updated by the user at any time to take advantage of the latest features offered by **MoTeC**.

To update the SDL software version select *Online | Upgrade Dash Version* from the Sport Dash Manager main menu.

Matching Versions

The version of software inside the SDL must match the version of Sport Dash Manager software on the PC. If the versions do not match, Sport Dash Manager will show a warning when it attempts to communicate with the SDL.

To check the version of Sport Dash Manager select *Help | About **MoTeC** Sport Dash Manager* from the main menu.

To view the SDL firmware version, power up the SDL – the version is displayed on the bottom line of the display for 2 seconds.

Configuration File Version

After the SDL version has been upgraded the configuration file in the SDL must also be updated to match the new version. The display will show a warning until a new configuration has been sent to the SDL.

Note that there is an option to automatically upgrade the configuration file in the SDL when performing an upgrade. This eliminates the necessity to manually upgrade the file and then sending it. (see Converting Older Version Files)

Channels

Channels are used to convey information between the various systems of the SDL. For example an input pin may feed a channel called 'Engine Temperature', this channel may then be used by any other system, such as the Display or Data Logging systems.

Channel Connection Example

Sensors   **ECU**

| Analog Inputs | Speed Inputs | RS232 Comms |

Data Logging System

Logging Memory

Display System

LCD Display

Alarm System

Gear Detection

Auxiliary Outputs

Warning Light

Fuel Pressure
Oil Pressure
Wheel Speed Front
Wheel Speed Rear
Engine RPM
Engine Temperature
Alarm Warning Light
Gear
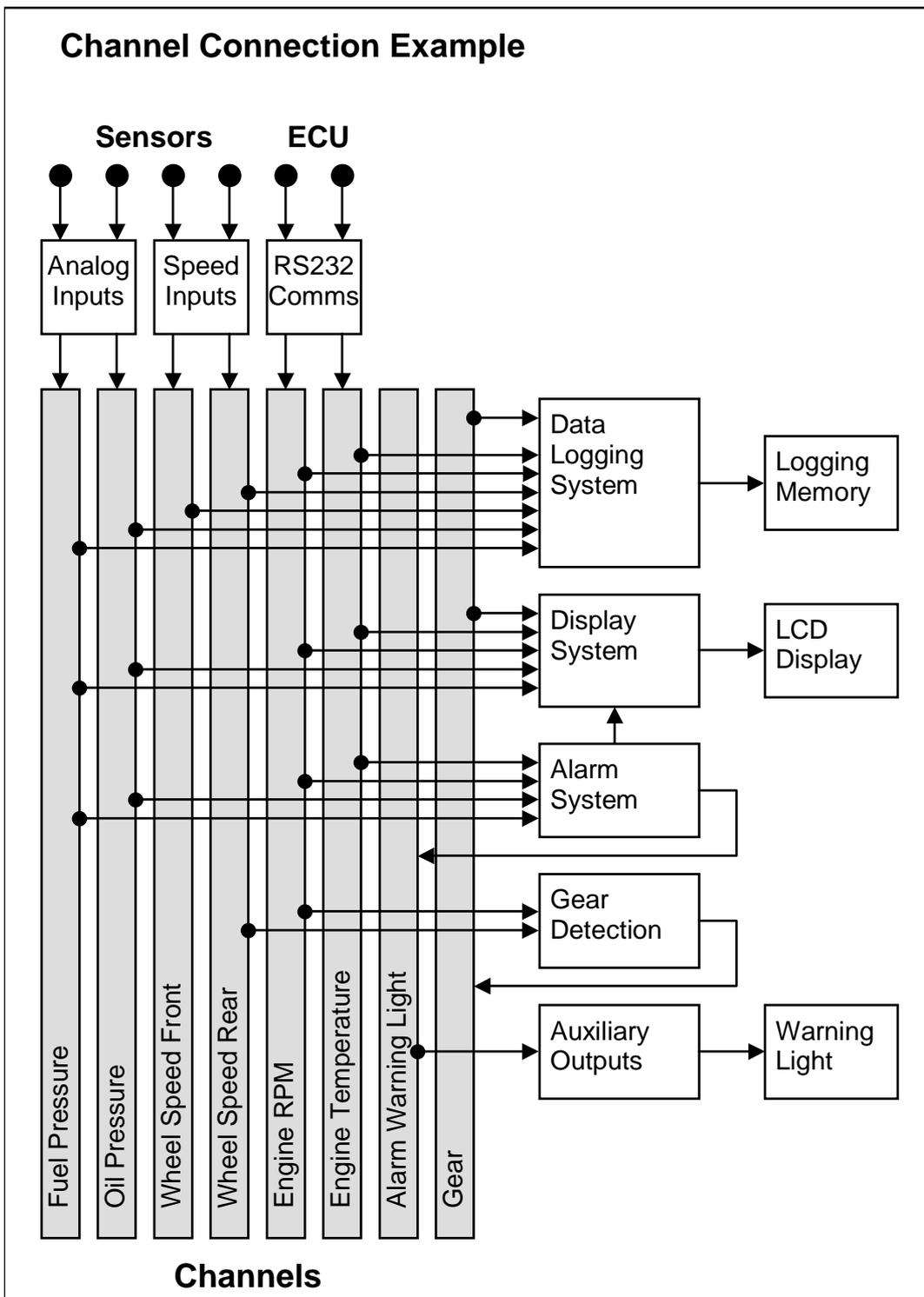
Channels

Channel List

MoTeC has defined an extensive list of channels. All systems within the SDL that generate values must choose to feed into one of these channels.

General Purpose Channels

Since the use of all channels can not be predetermined, a number of general purpose channels have been included for occasions when a suitable predefined channel is not available.

These channels may be required when measuring an uncommon value, or when a general purpose function needs to generate a special output channel, for example a 3D table may generate an output channel to control a valve of some sort, in which case a general purpose channel may be used and renamed appropriately.

Channel Usage

The SDL channel scheme allows complete flexibility in channel usage, as any available channel can be used by any other function, i.e. any channel can be logged, displayed, used in alarms, used as an input to the user definable tables, etc.

Channel Properties

For each channel the following properties have been defined, some of which may be modified by the user.

Note that it is only possible to modify channels that are already present in the configuration.

Properties that may be modified by the user:

- Name
- Abbreviation
- Units (eg. Celsius, Fahrenheit etc)

Fixed Details

- Measurement Type (Temperature etc)
- Resolution (eg. 0.1 °C for Engine Temperature)
- Suitable Logging rates

- Suitable Display filtering

- Minimum and Max Range

Predefining these properties makes the channels easy to use throughout the rest of the software, for example knowing the measurement type allows the channels to be displayed in any units suitable for that type, with automatic conversion between the units. For example all temperature channels can be displayed in Celsius, Fahrenheit or Kelvin.

Channel Names & Abbreviations

The channels names may be changed if necessary. However name changes should be limited to name preferences rather than redefining the purpose of the channel, except for the general purpose channels which may be renamed to suit the current use.

Channel Units

The units for a channel can be selected from a predefined list, for example the Engine Temperature channel may have units of Celsius, Fahrenheit or Kelvin. Conversion between units is automatically handled by the software.

Note that the units are used for display purposes only. This means that the units can be changed at any time with out affecting the calibration of the channel.

Channel Resolution

The resolution of all channels is fixed, for example the resolution of the Engine Temperature channel is fixed at 0.1 °C.

Fixed channel resolutions ensure that the unit conversion system works properly and that channel comparisons can be performed correctly.

# Selecting Channels

There are two methods of selecting channels, either the Category Method or the Search Method.

Category Method

This method divides all the channels into categories and sub categories, so that the list can be narrowed down to a small list of channels. For example, the 'Engine Sensors / Cooling' category shows a list of channels associated with the cooling system of the engine.

When selecting a channel from the complete list of channels, it is usually easiest to use the category selection method, for example when assigning a channel to an input pin.

To expand a category click on the + sign next to the category name.
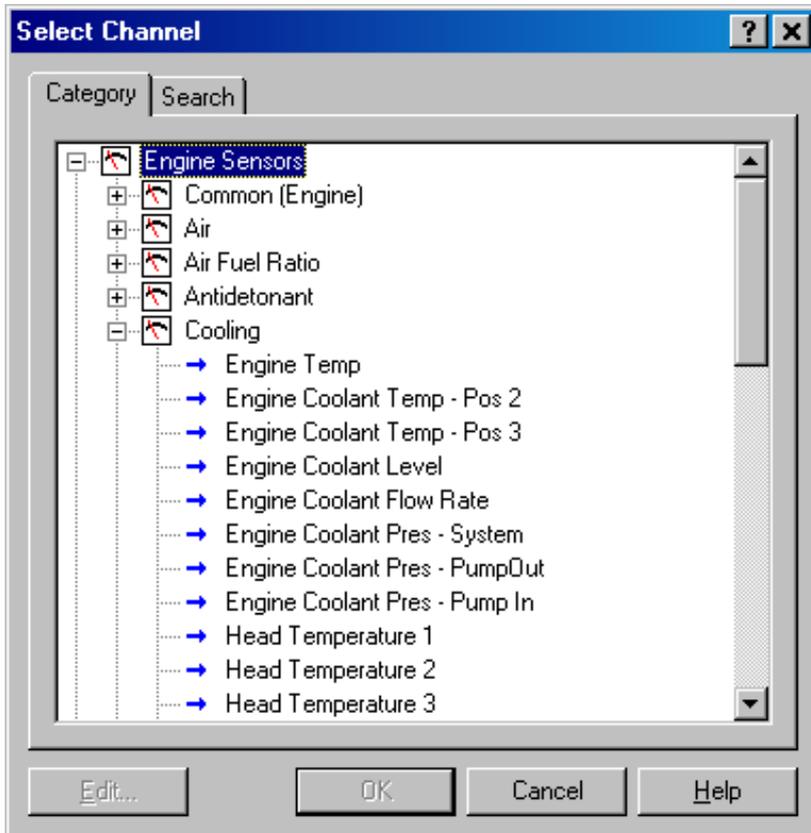
Search Method

This method lists all channels in alphabetical order and allows a channel to be found either by typing the first few letters of any word in the channel name, or by scrolling through the list.

Note that the words may be typed out of order so that 'Engine Oil Temperature' could be found by typing "temp eng oil" or "oil t eng" or "e o t"
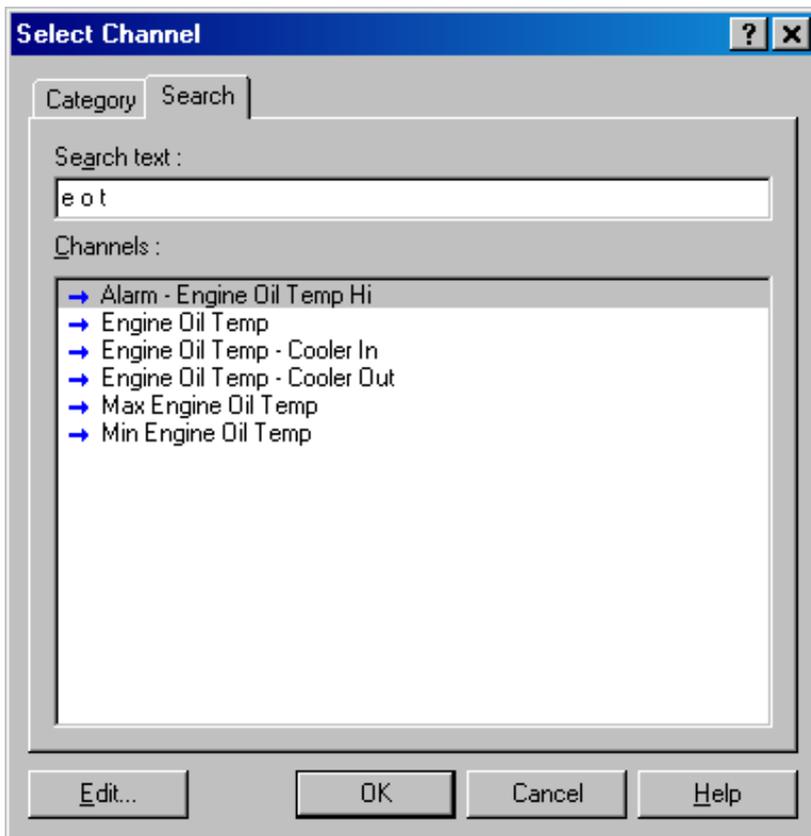
This method is most useful when selecting a channel from the available channels. For example, if 'Engine Temperature' has been assigned to an input pin, it can be easily located in the Search list, since this list normally only contains 50 to 100 items.

Conditions Overview

Conditions are used extensively throughout the software to define a true / false condition based on comparing one or more channels to a value. Conditions can be performed using 2 comparisons.

Conditions are used to define features such as when to start logging, or when to activate an alarm.

For example an Engine Oil Pressure alarm may read as: Activate the alarm when: Engine Oil Pressure < 200 kPa for 1 second AND Engine RPM > 1500

RPM for 2 seconds. Note that a second alarm could be defined which would cover the range from 500 to 1500 RPM, and which might read as: Engine Oil Pressure < 50 kPa for 1 second AND Engine RPM > 500 RPM for 5 seconds.

The following shows an example of an Engine Oil Pressure alarm condition.
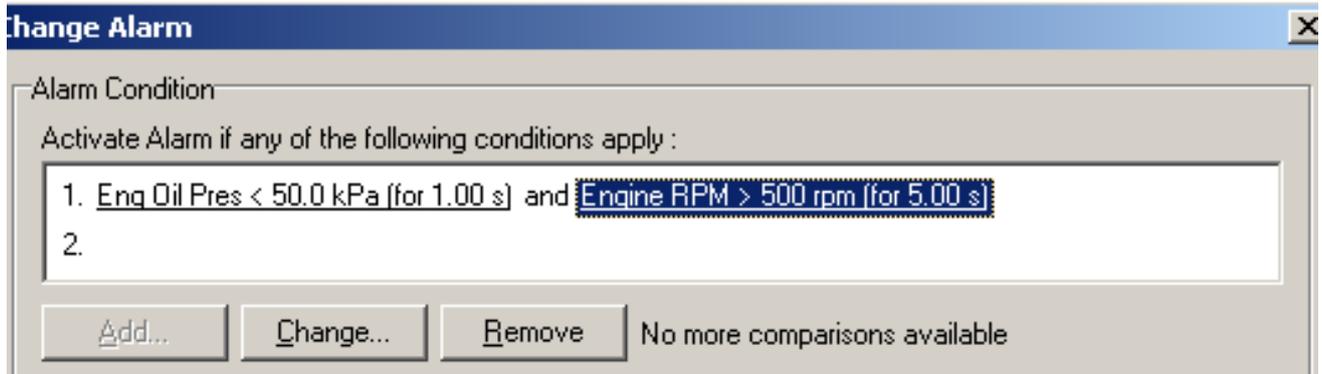
Checking Operation

Monitor Channels

The currently active channels can be monitored to allow checking of the operation of all functions and measurements.

To monitor the active channels select *Online | Monitor Channels* from the main menu.

Oscilloscope Screen

Any channel may also be shown on an oscilloscope style screen by pressing the *Utilities | Oscilloscope* button on the *Monitor Channels* screen.

Tests

A number of tests are provided to check the operation of the SDL, such as the Analogue Input and Auxiliary Output Tests. The Auxiliary Output test is very useful for checking wiring and operation of shift lights for example. The Analogue Input test is very useful when checking sensor wiring.

To run one of the tests select the appropriate test from the *Online* menu.

Sensor Zeroing

Some sensors require regular zeroing, for example Steering Angle, Suspension Position, Ride Heights, G Force Sensors & Throttle Position. Sport Dash Manager provides a screen to allow easy zeroing of all these sensors.

To zero the sensors select *Online | Zero Sensors* from the main menu.

Details Editor

The Details Editor allows details about the Event, Venue, & Vehicle to be entered.

This data is attached to the logged data file for later reference.

Some of this data is also attached to the configuration to determine the operation of some functions, for example, the Fuel Tank Capacity is used to determine Fuel Remaining, if used.

To change the details select *File | Edit Details* from the main menu.

Windows Keyboard Use

This section gives details on how to use the keyboard with Windows applications.

Main Menu

The Main Menu can be accessed by holding down the Alt key then pressing the key corresponding to the underlined letter in the menu name, followed by the underlined letter of the item in the drop down menu. Eg Alt F, N for File New.

Alternatively press and release the Alt key then select the desired menu item using the arrow keys, then press enter to activate it.

Closing a Window

Enter = OK or Close (Only works when the OK or Cancel button has a bold line around it)

Esc = Cancel or Close

Getting Help

To get help on the current screen or screen item press the F1 key, or press Alt + H if the screen has a Help button.

To access the main help system select Help from the Main Menu.

Selecting an Item in a Window

To access the various items in a window hold down the Alt key and press the key corresponding to the underlined letter of the item of interest, for example to select the 'Flash Light' item press Alt F

Alternatively the Tab key may be used to progress from one item to the next (use Shift Tab to move backwards). The selected control is usually indicated by a dotted line around it, or by highlighting the text or item selected within the control.

Using the Selected Item

The method of using the selected item (or control) depends on what type of control it is. The common controls are detailed below:

Button

Buttons are generally used to show another screen or perform a particular function.

Hold down the Alt key then press the underlined Letter (<u>S</u>), or navigate to the button using the Tab key then press the Enter key or the Space Bar.

Check Box

A check box is used to tick on or off a particular option.

Hold down the Alt key then press the underlined Letter (<u>A</u>), or navigate to the Check Box using the Tab key then press the Space Bar.

Radio Buttons

Radio buttons are used to select an item from a group of options.

Hold down the Alt key then press the underlined Letter of the desired option (<u>D</u> , <u>t</u> or <u>F</u>), or navigate to the Radio Buttons group using the Tab key then use the arrow keys to select the desired item.
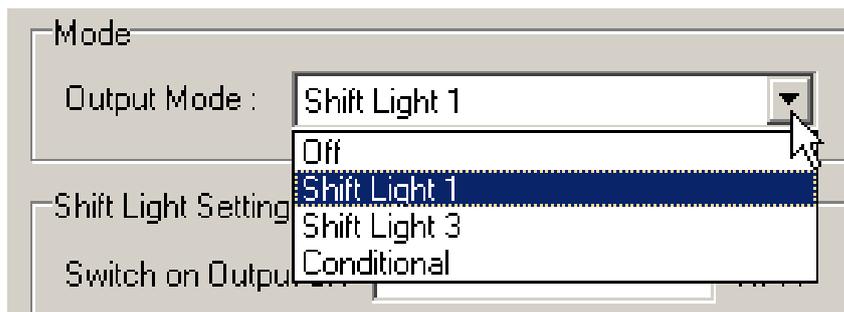
Edit

An edit control is used to enter a value or text.

Hold down the Alt key then press the underlined Letter of the text above the edit box (<u>T</u>) or navigate to the button using the Tab key then type in the new value or text. Use the Backspace key or Delete key to remove unwanted characters

Drop down List

A drop down list is used to select from a number of items, but only the selected item is shown until a new item needs to be selected.

Hold down the Alt key then press the underlined Letter of the text above the list (L) or navigate to the button using the Tab key then select the desired item using the Arrow keys, Press the Enter key to close the list.

Tabs

Tabs are used to select the different tab pages of a screen.

To select the next tab hold down the Ctrl key then press the Tab key. To select the previous tab hold down the Ctrl key and Shift keys then press the Tab key.

Tree View

A Tree View is used to select items from a hierarchical list

Up Arrow = Move the cursor up (selects the item above)

Down Arrow = Move the cursor down (selects the item below)

Right Arrow = Expand (Expandable branches indicated by a +)

Left Arrow = Collapse (Collapsible branches indicated by a -)
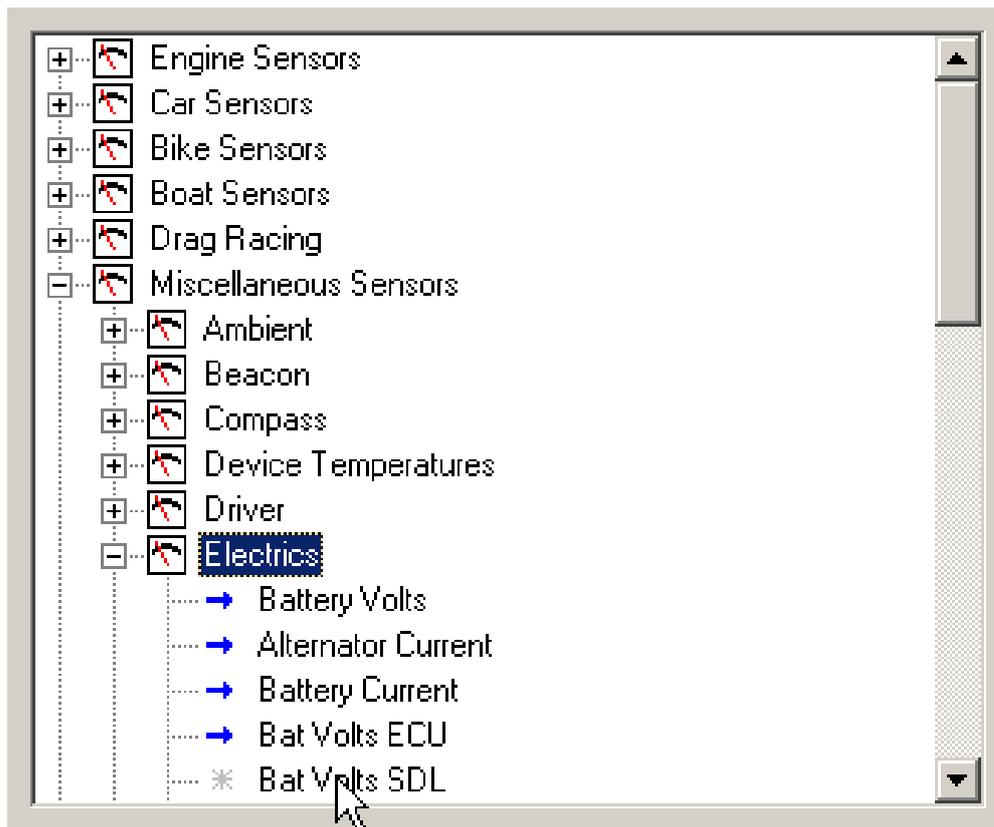
Appendices

Appendix A: General Specifications

Physical

Case Size   SDL: 180.5 x 91.5 x 18.0 mm (7.1 x 3.6 x 0.7 inches)

Weight   385 grams (0.85 lb)

Power Supply

Operating Voltage: 7 to 22 Volts DC

Operating Current: 0.15 Amps Typical (excluding sensor currents)

Reverse Battery Protection

Battery Transient Protection

Operating Temperature

Internal Temperature Range   -10 to 80°C

Ambient Temperature Range   -10 to 70°C typical

Sensor Supply Current

5V Sensor Supply : 0.2 Amps Max

8V Sensor Supply : 0.3 Amps Max

Internal Sensors

G Force Lateral

G Force Vertical

Battery Voltage

Dash Temperature

Appendix B: Options Summary

The following options are available:

Pro Analysis Option

Advanced Analysis features in the Interpreter software, including:

- multiple graph overlays
- time variance between 2 laps
- statistical zoom on sections of data
- suspension analysis
- user math expressions
- track map section times
- track statistics
- lap maps
- XY graphs

Lambda Option

1 Wide Band Lambda (Air fuel ratio) measurement input.

Logging

Enables 8Mb of log memory

Appendix C: Sport Dash Manager Command Line

Usage:

sportdash.exe -c[connection] -d -x -l -e -t -s [config file name]

[config file name]
(Optional)
Fully qualified path to the configuration file.
(eg "c:\motec\dash\config\SDL\bathurst.u11")
Note: the path must included the file extension (eg .u11)

Options :

Each of the following options can be given as "/[character]" or "-[character]".
They are shown here as "-[character]".

-c[Connection Name]
(Optional)
Select a preconfigured connection by name as configured in the dash
connections dialog.
(eg -c"Primary CAN Connection").
Note: There must not be a space between the c and the connection name.

-d
(Optional)
Causes the debug console to be displayed.
Only available for debug builds.

-x
(Optional)
Causes the app to terminate when one the following tasks has been
performed.

Tasks :

One or more of the following may be specified.

-l
(Optional)

Perform a "Get Logged Data" operation.

-e
(Optional)
Perform a "Get Engine Log" operation.

-t
(Optional)
Perform a " Get Tell-tale Values" operation.

-p
(Optional)
Perform a "Print Summary" operation.
Note: The config file must be specified using a fully qualified path including
the file extension.
(eg -p "c:\motec\dash\config\SDL\bathurst.u11")
Note: There must be a space between -p and config name.

-s
(Optional)
Perform a "Send Configuration" operation.
Note: The config file must be specified using a fully qualified path including
the file extension.
(eg -s "c:\motec\dash\config\SDL\bathurst.u11")
Note: There must be a space between -s and config name.

-u
(Optional)
Perform an "Upgrade Dash Version" operation.

Appendix D: Input Characteristics

Analog Voltage Inputs

Suitable for: Potentiometers, Voltage output sensors & Variable resistance sensors with a pullup resistor

Measurement Voltage Range:

Inputs 1 to 4:	0 to 5.5 V
Inputs 5 to 8:	0 to 15.3 V

- Note that voltages outside this range may affect the readings on other inputs.

Input Resistance: 100k ohms to 0V

Resolution:

Inputs 1 to 4:	1.35 mV
Inputs 5 to 8:	3.74 mV

Measurement Methods: Ratiometric, Absolute, Variable Resistance, Off/On

Update Rate (Inputs 1 to 4): 1000 times / second (for anti-aliasing)

Update Rate (Other inputs): 500 times / second (for anti-aliasing)

Filter: 150Hz 1st order

Calibration Accuracy

Gain (Ratiometric operation)	0.05% max
Gain (Absolute operation)	0.15% max
Offset	$\pm$ 6 mV max
Linearity	$\pm$ 6 mV max
Temperature Stability	60 ppm/$^\circ$C max
Calibration Schedule	12 Months

Analog Temp Inputs

Suitable for: 2 wire variable resistance sensors and some voltage output sensors.

Measurement Voltage Range: 0 to 15 V

* Note that voltages outside this range may affect the readings on other inputs.

Input Resistance: 1000 ohms pullup to 5V sensor supply + 100k to 0V

Resolution: 3.74 mV

Measurement Methods: Ratiometric, Absolute, Variable Resistance, Off/On

Update Rate: 500 times / second

Filter: 150Hz 1st order

Calibration Accuracy

Gain (Ratiometric operation)	0.05% max
Gain (Absolute operation)	0.15% max
Offset	± 6 mV max
Linearity	± 6 mV max
Temperature Stability	60 ppm/°C max
Calibration Schedule	12 Months

Lambda Input

Type: Wide Band *MoTeC*

Measurement Range: 0.75 to 1.50 Lambda (or 0 to 1V)

Accuracy: 1.5 % up to 1.20 Lambda

Update Rate: 100 times / second

Switch Inputs

Suitable for: Switch to 0V, or Off / On Voltage signal

Pullup Resistor: 4700 ohms to 5V

Voltage Range: 0 to 15V

Positive Trigger Threshold: 3.5 V max

Negative Threshold: 1.0 V min

Hysteresis: 0.5 V Min

Measurement Methods: Off/ On only

Filter Time Constant: 22usec

Digital Inputs

Suitable for: Switch to 0V, Logic signal & open collector device (eg Hall Switch)

Pullup Resistor: 4700 ohms to 5V

Voltage Range: 0 to 15V

Positive Trigger Threshold: 3.5 V max

Negative Threshold: 1.0 V min

Hysteresis: 0.5 V Min

Update Rate: 100 times / second

Filter Time Constant: 22usec

Digital Input Measurement Methods

Frequency

Resolution 0.1 Hz

Maximum Frequency: 3200 Hz

Rising Edge Triggered

Period 1 usec

Measures period between rising edges

Resolution: 1 usec

Maximum: 32 msec

Period 100 usec

Measures period between rising edges

Resolution: 100 usec

Maximum: 3.2 sec

Pulse Width 1 usec

Measures pulse low time

Resolution: 1 usec

Maximum: 32 msec

Pulse Width 100 usec

Measures pulse low time

Resolution: 100 usec

Maximum: 3.2 sec

Speed Inputs

Can be used in two modes: Hall or Magnetic.

In Hall mode a 4700 ohm pullup resistor is connected to 5V and the trigger levels are fixed.

In Magnetic mode the pullup resistor is disengaged and the trigger levels can be varied depending on the input frequency.

Update Rate: 100 times / second

Filter Time Constant: 25usec

Speed Input Measurement Methods

Frequency

Resolution 0.1 Hz

Maximum Frequency: 3200 Hz

Falling Edge Triggered

Period 1 usec

Measures period between falling edges

Resolution: 1 usec

Maximum: 32 msec

Period 100 usec

Measures period between falling edges

Resolution: 100 usec

Maximum: 3.2 sec

Pulse Width 1 usec

Measures pulse high time

Resolution: 1 usec

Maximum: 32 msec

Pulse Width 100 usec

Measures pulse high time

Resolution: 100 usec

Maximum: 3.2 sec

Speed Input Modes

HALL Mode

Suitable for switch to 0V, Logic signal or open collector device (eg Hall Switch)

Pullup Resistor: 4700 ohms to 5V

Voltage Range: 0 to 15V

Positive Trigger Threshold: 3.0 V max

Negative Threshold: 2.8 V min

Hysteresis: 0.19 V Min

MAGNETIC Mode

Suitable for: Two wire magnetic sensor (Variable reluctance sensor)

Input Resistance: 100k ohms to ground (No Pullup)

Voltage Range: -100V to +100V

Programmable trigger levels

Analog Input Sampling

The following specifies the order in which the Analog input channels are sampled and the time between samples.

Inter channel period is 14usec, except that for every 8 channels there is a 60usec gap.

Sampling alternates between Group1 and Group2 and is scheduled every 1.000msec

Group1	Group2
AV1	AV1
AV2	AV2
AV3	AV3
AV4	AV4
AV5	
	Internal SDL Temp
AV6	
	Internal Battery Voltage
AV7	
	Internal Ref/2 AD2
AV8	
	Internal Ref/2 AD3
AT1	LA1
AV9	Internal 0V AD2
AT2	
AV10	Internal 0V AD3
AT3	Internal Abs Ref 4V5
	Internal Ref AD2
AT4	Internal Ref/2 AD1
	Internal Ref AD3

Appendix E: Auxiliary Output Characteristics

Output Type: Open Collector (Drives to ground) with weak pullup (10k ohms) to battery positive.

Control is by On/Off condition only, the Auxiliary outputs do not support variable frequency or duty cycle control.

Current: 0.5 Amp max, current limited & thermal overload protected

Output Clamp: 50V Flyback Clamp (No Clamp Diode to supply).

Appendix F: CAN Bus Specification

CAN Bus

Data Rate: 1Mbit/sec

Terminating impedance and data cable impedance: 100 ohms: dictated by the PC communications cable (CAN cable)

Maximum length: 16 m (including the CAN Cable if present).

Appendix G: ECU to SDL Wiring (RS232)

The following details the methods for connecting the various *MoTeC* ECUs to the SDL via RS232. In all cases this is done using the serial data stream generated by the Telemetry function of each ECU.

In the case of the M800, M880 and M4e the SDL may be directly wired to the ECU because these ECUs use RS232 interface levels. On the M48, M4 (pre M4e) and the M8 a Computer Interface Module (CIM) or a PCI cable is required to convert the signals to RS232.

M800 / M880
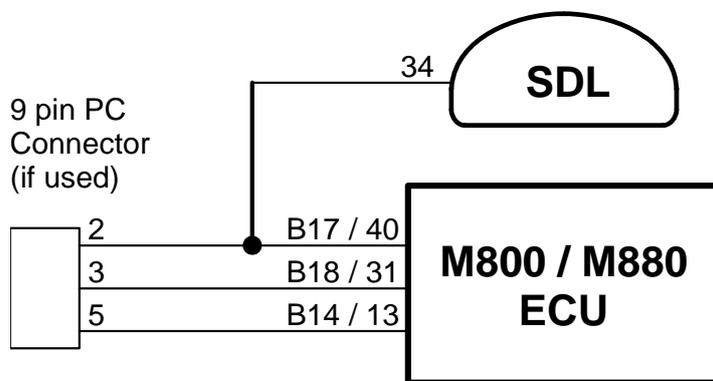
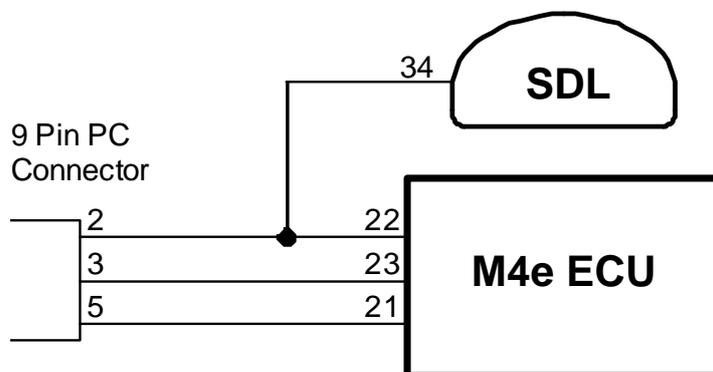Note that the data to the SDL will be interrupted while a PC is connected (DOS software only)

Note that the 9 pin connector is not used if using the Windows Calibration software.

Note that data may be sent to the SDL via the CAN bus as an alternative to the serial connection.

M4e

Note that Older M4 ECUs require a different connection method

Note that the data to the SDL will be interrupted while a PC is connected.

M48, M4 (pre M4e) and M8

The M48 & M8 and M4 (pre M4e) require the use of a CIM module or a PCI Cable to convert the logic level signals used by these ECU's into RS232 levels.

Using a CIM Module
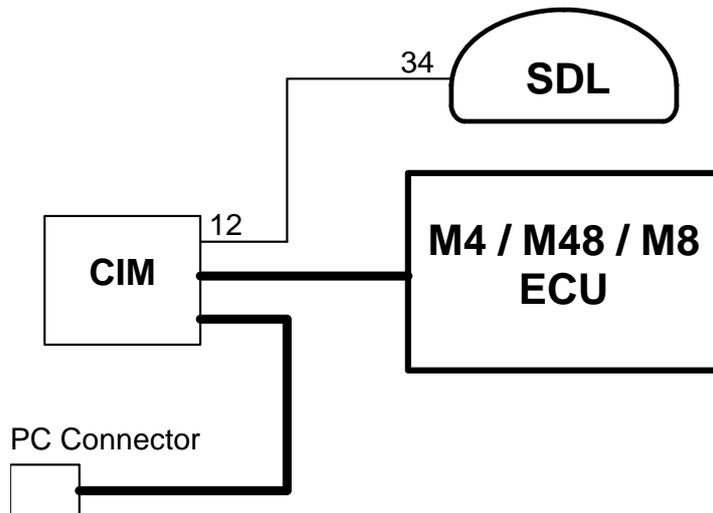
Refer to the CIM module drawing for full wiring details.

Note that the data to the SDL will be interrupted while a PC is connected.

Using a PCI Cable - Direct Connection
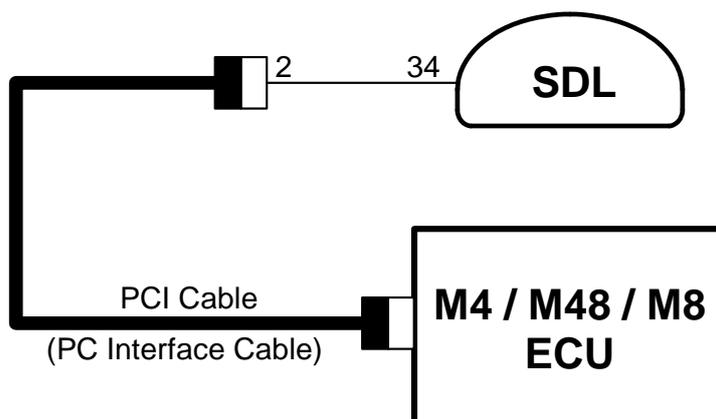
To connect a PC to the ECU disconnect the Computer Interface Cable from the SDL and attach it to the PC.

Appendix H: CAN Wiring

The CAN bus should consist of a twisted pair trunk with 100R (0.25Watt) terminating resistors at each end of the trunk.

The preferred cable for the trunk is 100R Data Cable but twisted 22# Tefzel is usually OK.

The maximum length of the bus is 16m (50ft)

CAN Devices (such as *MoTeC* SDL, BR2 etc) may be connected to the trunk with up to 500mm (20in) of twisted wire.

Note that the "CAN Cable Connector" is not normally used since the SDL uses USB for communications.
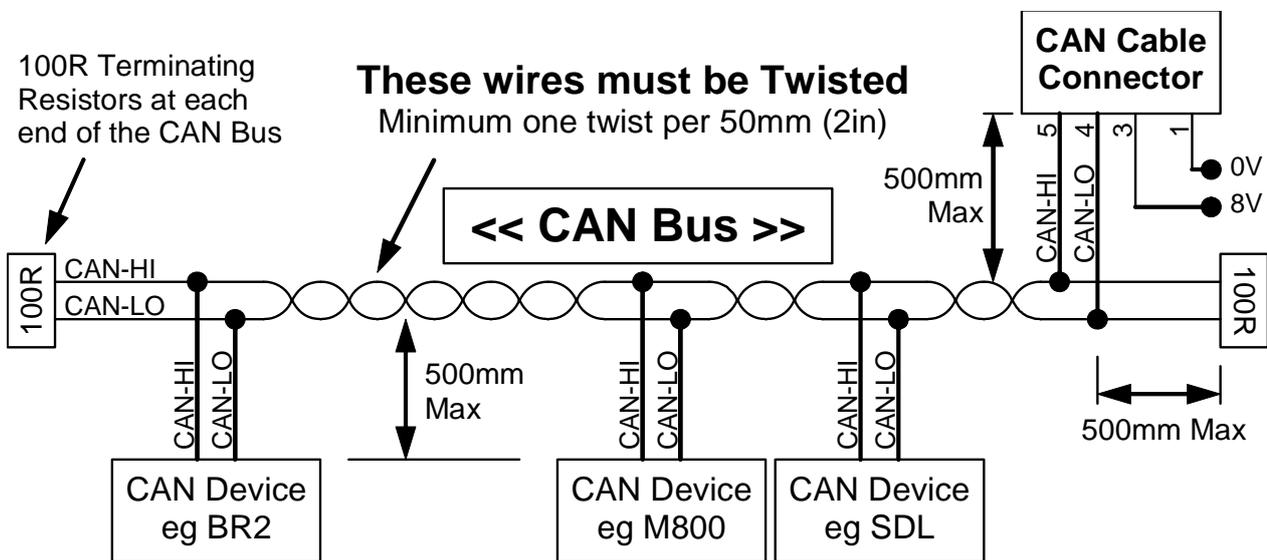
Appendix J: USB Wiring

The USB connection should be made by wiring a USB cable to the SDL main connector as shown below:

The USB cable should have a type B socket so that a standard USB A to B cable can be used to connect between it and the PC. *MoTeC* can provide a suitable cable (these are not commonly available).

Note that the maximum length from ADL to the PC is 5m (16ft) when using a normal USB cable. This can be extended in steps of 5m (16ft) up to a maximum of 25m (80ft) by using <u>Active</u> USB extender cables or hubs.

Wiring Details:

It is recommended that the USB wires are reterminated to 22# Tefzel to avoid wire breakage

SDL

USB-VCC	10	Red
USB-DM	24	White
USB-DP	25	Green
USB-GND	9	Black
		Shield

USB B Type Socket

50mm (2in) Max

Must be USB certified cable

Maximum length 5m (16ft) including the cable to the PC
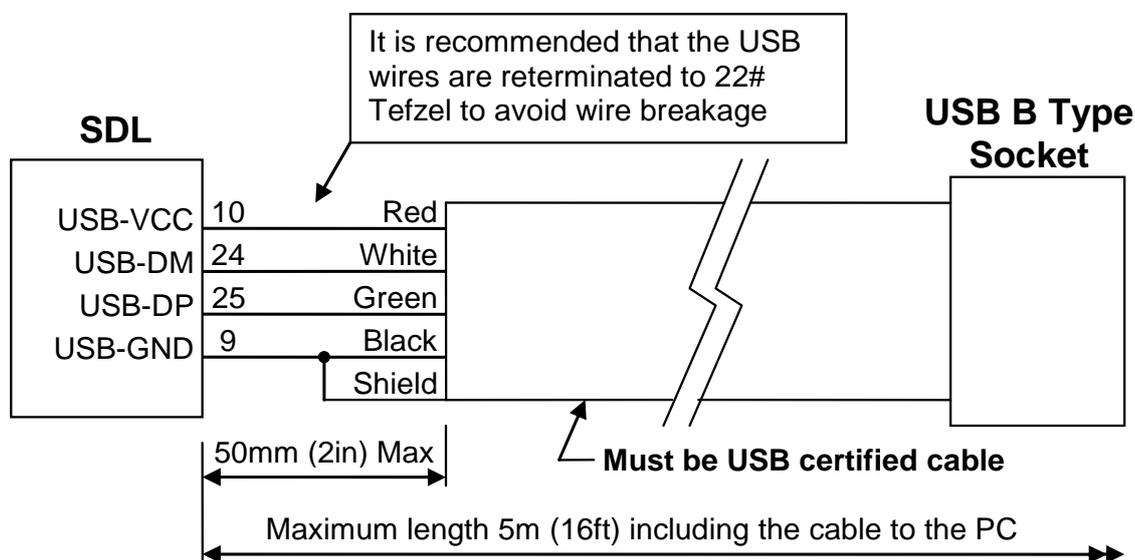
Note: When inserting the pins into the Autosport connector check that all the pins are latched correctly by pulling on each wire – it is very easy for a pin not to latch correctly which will give an intermittent connection.

Appendix K: Typical Wiring (with BR2)

The wiring below shows typical wiring for BR2 on CAN plus USB for PC connection.

For more detail on the CAN Bus wiring refer to *Appendix H: CAN Wiring.*

For more details on USB wiring refer to Appendix J: USB Wiring.
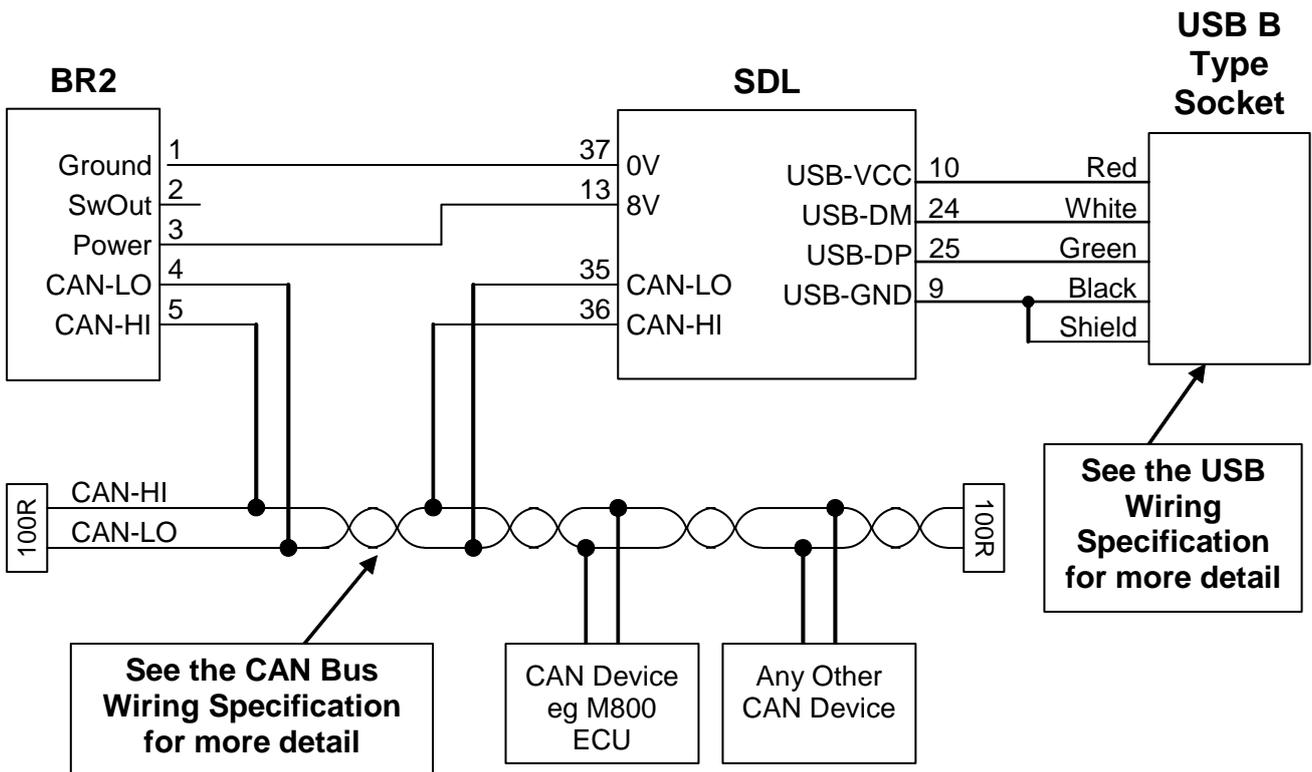
Appendix L: Pin List by Function

Pin	Name	Function

Battery Power
4	BAT-	Battery Negative
3	BAT+	Battery Positive

Analog Volt Inputs
15	AV1	Analog Voltage Input 1
16	AV2	Analog Voltage Input 2
17	AV3	Analog Voltage Input 3
18	AV4	Analog Voltage Input 4
1	AV5	Analog Voltage Input 5
2	AV6	Analog Voltage Input 6
19	AV7	Analog Voltage Input 7
20	AV8	Analog Voltage Input 8

Analog Temp Inputs
21	AT1	Analog Temp Input 1
22	AT2	Analog Temp Input 2
31	AT3	Analog Temp Input 3
32	AT4	Analog Temp Input 4

Lambda Input
29	LA-	Lambda Input Negative
30	LA+	Lambda Input Positive

Switch Inputs
11	SW1	Switch Input 1
12	SW2	Switch Input 2

Digital Inputs
27	DIG1	Digital Input 1
28	DIG2	Digital Input 2

Speed Inputs
23	SPD1	Speed Input 1
26	SPD2	Speed Input 2

Auxiliary Outputs

5	AUX1	Auxiliary Output 1
6	AUX2	Auxiliary Output 2
7	AUX3	Auxiliary Output 3
8	AUX4	Auxiliary Output

8V Sensor

13	8V	Sensor 8V

5V Analog Sensor

14	5V	Sensor 5V Analog Volt & Analog Temp

0V Analog Sensor

37	0V	Sensor 0V Analog Volt & Analog Temp

CAN Interface

35	CAN-LO	CAN-LO
36	CAN-HI	CAN-HI

USB

9	USB-GND	USB Ground (Black + Shield)
10	USB-VCC	USB Power (Red)
24	USB-DM	USB Data Minus (White)
25	USB-DP	USB Data Plus (Green)

RS232

33	TX	RS232 Output
34	RX	RS232 Input

Appendix M: Pin List by Pin Number

Pin	Name	Function
1	AV5	Analog Voltage Input 5
2	AV6	Analog Voltage Input 6
3	BAT+	Battery Positive
4	BAT-	Battery Negative
5	AUX1	Auxiliary Output 1
6	AUX2	Auxiliary Output 2
7	AUX3	Auxiliary Output 3
8	AUX4	Auxiliary Output 4
9	USB-GND	USB Ground (Black + Shield)
10	USB-VCC	USB Power (Red)
11	SW1	Switch Input 1
12	SW2	Switch Input 2
13	8V	Sensor 8V
14	5V	Sensor 5V
15	AV1	Analog Voltage Input 1
16	AV2	Analog Voltage Input 2
17	AV3	Analog Voltage Input 3
18	AV4	Analog Voltage Input 4
19	AV7	Analog Voltage Input 7
20	AV8	Analog Voltage Input 8
21	AT1	Analog Temp Input 1
22	AT2	Analog Temp Input 2
23	SPD1	Speed Input 1
24	USB-DM	USB Data Minus (White)
25	USB-DP	USB Data Plus (Green)
26	SPD2	Speed Input 2
27	DIG1	Digital Input 1
28	DIG2	Digital Input 2
29	LA1-	Lambda Input Negative
30	LA1+	Lambda Input Positive
31	AT3	Analog Temp Input 3
32	AT4	Analog Temp Input 4
33	TX	RS232 Output
34	RX	RS232 Input
35	CAN-LO	CAN Lo
36	CAN-HI	CAN Hi
37	0V	Sensor

Appendix N: Connector

SDL Mating Connector

37 way Deutsch: AS6-14-35SN

Wire

Wire to suit connector: 22# Tefzel, Mil Spec : M22759/16-22

Crimp Tool

Crimp Tool : M22520/2-01

Positioner for Crimp Tool : M22520/2-07

- Note that the Crimp Contacts are type 22D (needed to set the crimp tool correctly)

Wire Stripping Tool

The following tool is recommended

Ideal Industries 45-2133 stripping tool with LB1195 wire stop.

Heatshrink Boots

Straight: Raychem 202K142, Hellerman 155-42-G

Right Angle: Raychem 222K142, Hellerman : 1155-4-G

Appendix P: Wire Specifications

M22759/16 Wire Ratings (For Various Wire Gauges)

Insulation Material : Tefzel
Conductor : Tin Plated Copper
Voltage Rating : 600 V
Maximum Temperature : 150 °C

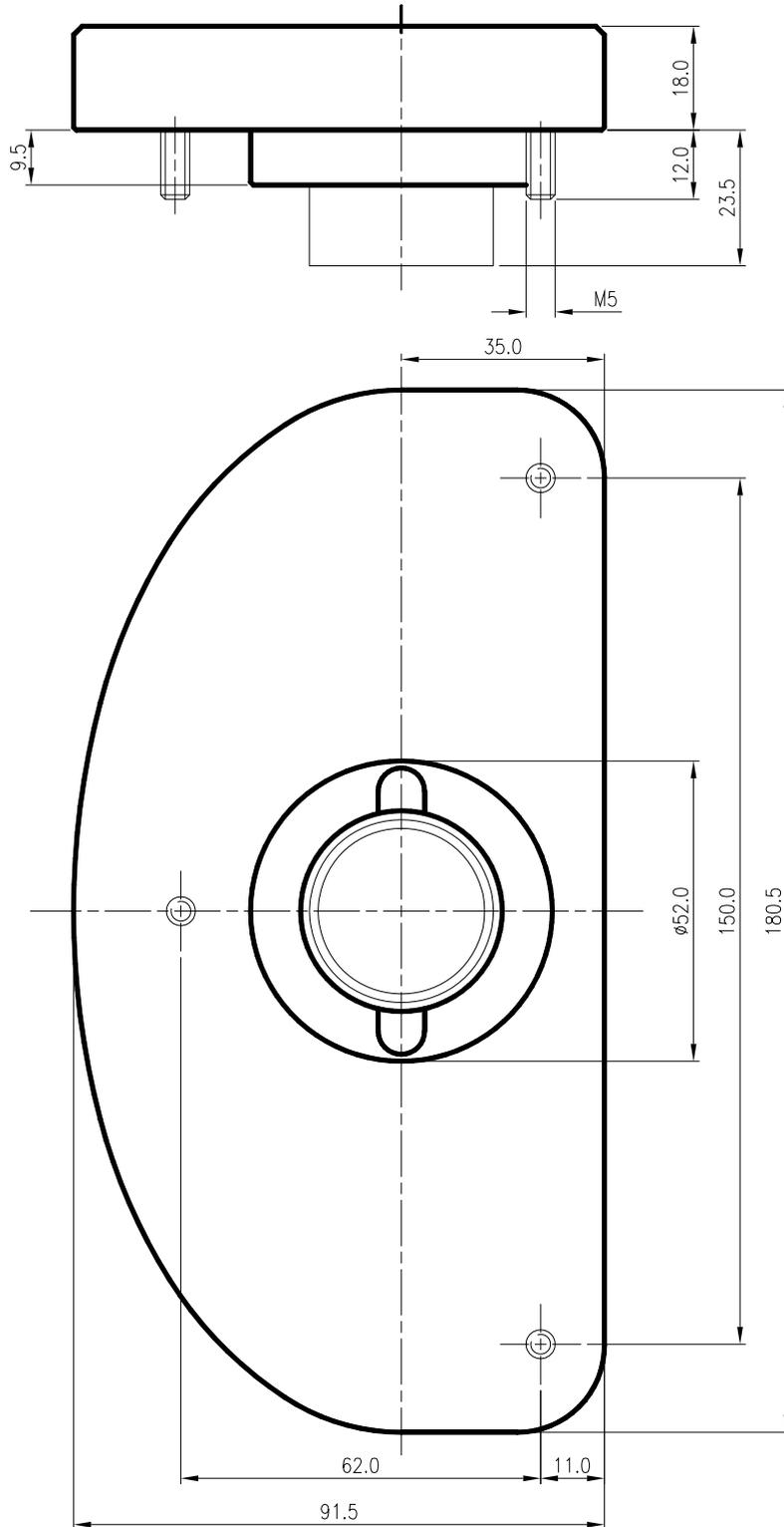| Wire Gauge (AWG)	Cross Sectional Area (mm^2)	Max Current at 100 °C Ambient (Amps)	Resistance (ohm / m)	Resistance (ohm / 1000 ft)
22	0.38	5	0.045	14
20	0.61	6	0.028	8.5
18	0.96	9	0.018	5.5
16	1.2	12	0.014	4.3
14	1.9	18	0.009	2.7
12	3.0	24	0.006	1.8

Wire Stripping Tool

The following tool is recommended

Ideal Industries 45-2133 stripping tool with LB1195 wire stop.

Appendix Q: Case Dimensions

SDL

NOTE:
1. ENSURE PRODUCT IS NOT STRESSED WHEN MOUNTED
2. DIMENSIONS INDICATE ACTUAL PRODUCT SIZE ALLOW FOR
   CLEARANCE WHEN MOUNTING.