Contents

PN 63029 V3.1, August 2009

Introduction

The PDMs replace conventional relays, fuses and circuit breakers by providing electronically switched power to the various electrical systems in the vehicle, including motors, lamps, ECUs and data systems. This simplifies wiring and switch requirements, while increasing reliability.

There are four PDM versions: PDM16, PDM32, PDM15 and PDM30. Throughout this manual all versions will be referred to as the PDM except where details specific to a particular version are discussed.

Features

	PDM16	**PDM32**	**PDM15**	**PDM30**
Inputs	12	23	16	16
8 Amp Outputs	8	24	7	22
20 Amp Outputs	8	8	8	8
Connectors	Autosport		Waterproof connectors M6 stud	
Case size *Length* *Width* *Height*	 130 mm 60 mm 28 mm	 180 mm 60 mm 28 mm	 107 mm 133 mm 39 mm	 107 mm 133 mm 39 mm

- Each output is over-current, short circuit and thermal overload protected
- Outputs are programmable in 1 A steps
- Outputs are controllable via a combination of switch inputs, CAN messages and logic functions
- Switch inputs are ranging from 0 to 51 V, resolution 0.2 V
- Performing up to 200 logic operations using operators like Flash, Pulse, Set/Reset, Hysteresis, Toggle, And, Or, Less than, Greater than, Not equal to, Equal to, True, False etc.
- Performing functions such as flashing indicator lights and controlling thermofan and fuel pump
- Using logic functions to selectively turn off systems during low battery voltage or engine starting, reducing drain on the battery

- Providing full diagnostic information, including output currents and voltages, input voltages, and error status
- Transmitting diagnostic information via CAN to a display or data logging device or monitoring directly on a PC
- Protected against unauthorised access by a password feature.

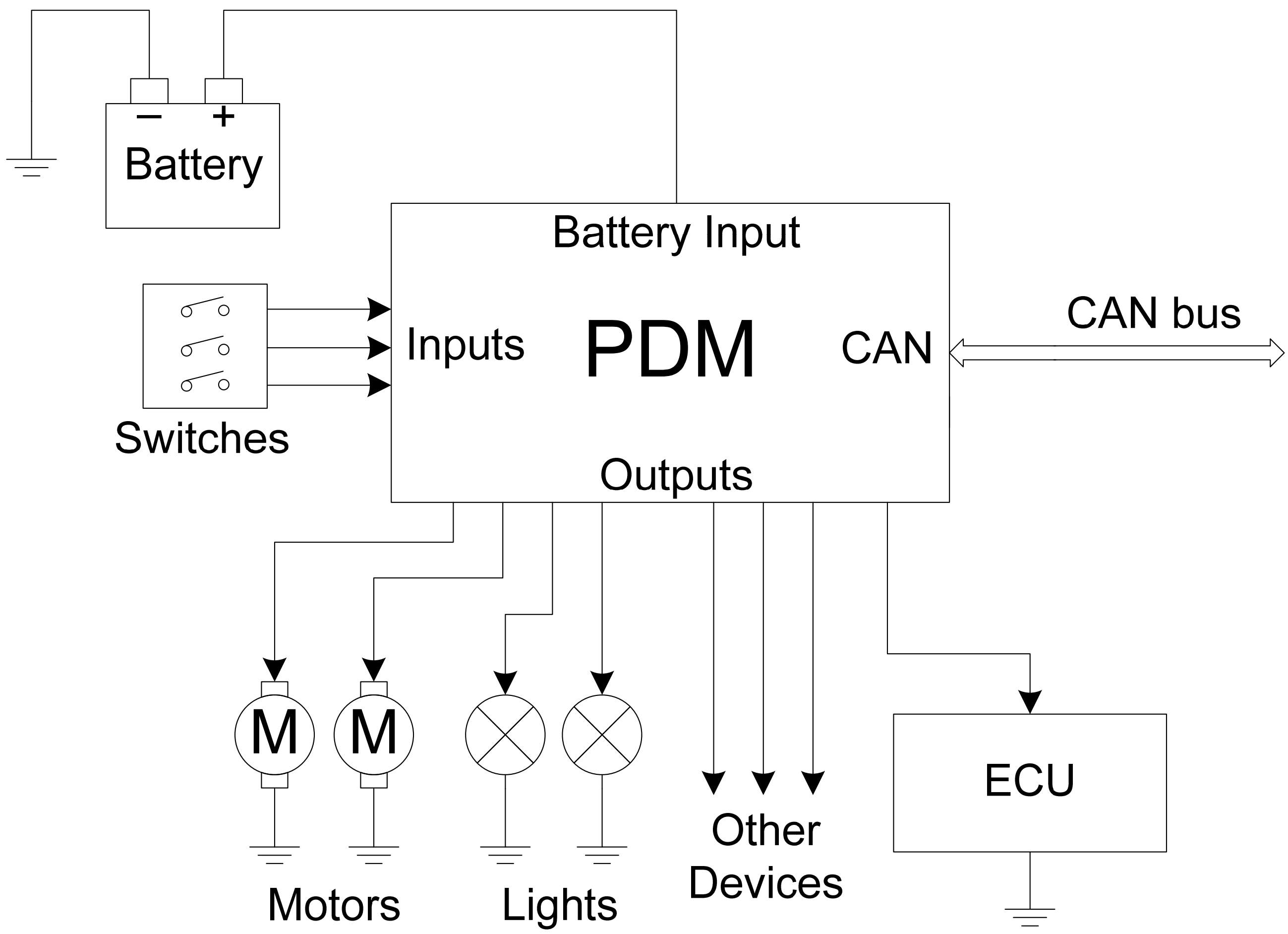
Compatibility

- All MoTeC Dash Loggers: SDL, ADL2, ADL3, ACL
- 'Hundred series' ECUs: M400, M600, M800, M880

Accessories

- MoTeC UTC (USB to CAN adaptor) #61059
  (Note: PDMs are not compatible with MoTeC CAN cable)

System Overview



Installation

Mounting

When mounting the PDM take into account that the PDM may get very hot during operation.

Ensure the PDM is mounted in a well ventilated area and not against a hot surface. For case dimensions see *Mounting Dimensions*.

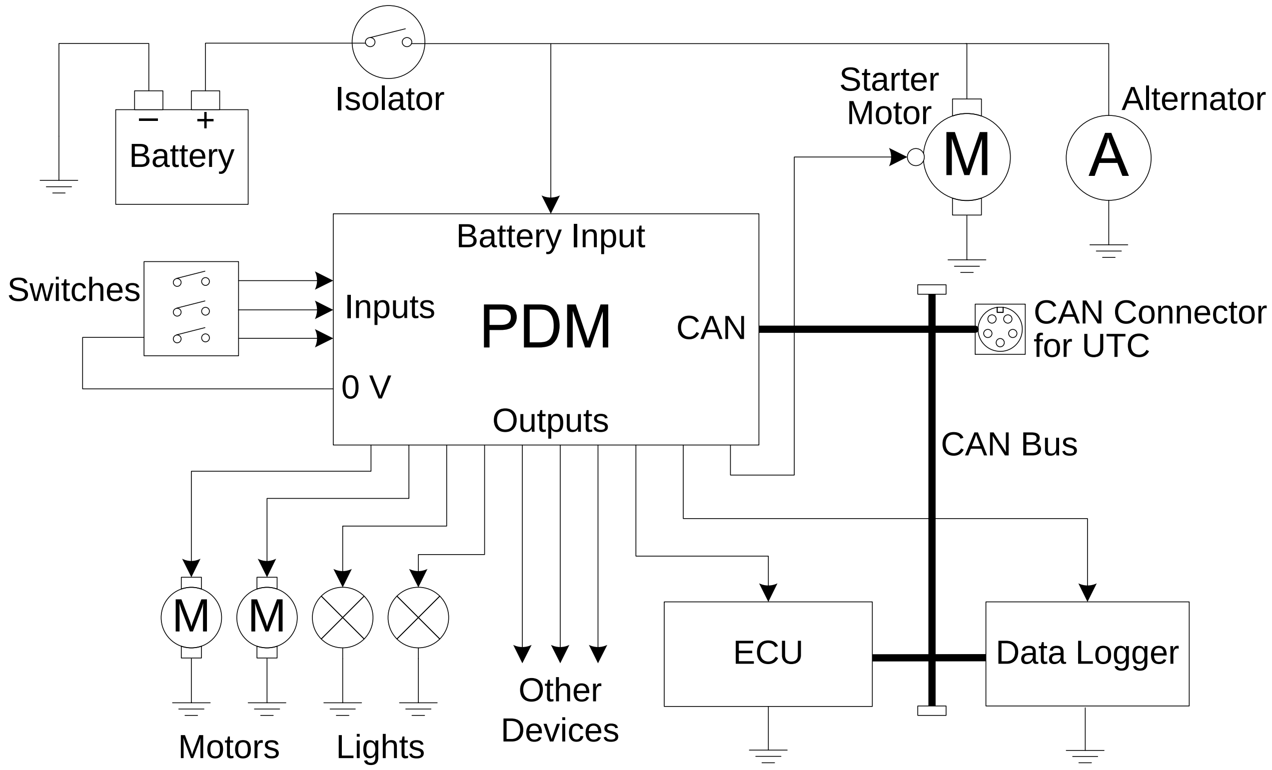
The internal temperature is highly dependent on ambient temperature and also on the total load current—a higher current will cause a higher temperature.

> **Tip:** The internal temperature can be checked in PDM Manager (see *Operation*) or transmitted via CAN to be logged. Allow for sufficient time for the temperature to stabilise. This may take 30 minutes or more.

If the internal temperature of the PDM exceeds the specified maximum values (see *Specifications)*, cooling may be achieved by one or more of the following:

- relocating the PDM to a cooler mounting position
- increasing air circulation around the PDM case
- ducting cool air over the PDM case
- fitting a heatsink to the back surface of the PDM case

Wiring



Battery Positive

Battery positive is supplied to the PDM via the single pin connector to suit wire sizes 16 mm^2 (6#) or 25 mm^2 (4#).

The PDM16 and PDM32 use an Autosport connector, PDM15 and PDM30 use a 6 mm eyelet to suit the wire size.

The wire gauge should be chosen according to the wire temperature limit and acceptable voltage drop. Tefzel wire must not exceed 150 °C.

The temperature of the wire is affected by the ambient temperature, air circulation, current, wire gauge, the temperature of any surrounding wires and the covering sheath.

See *Wire Specification* and *Connectors and Pinout* for details.

Battery Isolator Switch

Battery positive must generally be connected via an isolator switch or relay.

The isolator must isolate the battery from all devices in the vehicle including the PDM, starter motor and alternator. The isolator must be rated to handle the starter motor current.

When the battery is isolated, the engine may continue to run due to power supplied by the alternator. To avoid this, the isolator switch should have a secondary switch that is connected to a shutdown input on the ECU.

If the ECU does not have a shutdown input, the switch can be connected to a PDM input. The PDM can then turn off power to the ignition system or the ECU, which will cause the engine to stop.

Battery Negative

Both of the Batt**–** pins should be wired to battery negative via 20# wire.

These pins normally only carry the very low operating current, however during a load dump they carry the load dump current which may be 50 ampere or higher.

CAN Wiring

The PDM communicates over CAN with other devices connected to the same CAN bus. The CAN bus must be wired according to *CAN Bus Wiring Requirements*.

The PC also communicates to the PDM via the CAN bus. See *Connecting the PDM to a PC.*

Input Wiring

The PDM Switch Inputs are intended for use with a switch that is directly wired between a PDM input pin and a PDM 0 V pin. Each input has an internal 10 kilo-ohm pull-up resistor to Batt+.

If it is required to connect a switch that is wired to another system in the vehicle, ensure that the voltage levels are set appropriately as there may be ground voltage variations between devices.

> **Tip:** If standby current is important, wire the switches so that they are normally open during standby. This will reduce the standby current.

Input Switch Connected to Battery

When an input is driven from a device that switches to battery, the switch should if possible, be rearranged so that it switches to 0 V.

If the signal comes from an electronic device such as an ECU that has an output that can only switch to battery (e.g. a signal that indicates when to turn the fuel pump on), this might not be possible. In this case an external pull-down resistor is required. The resistor should be 1500 ohm 0.25 watt and should be connected between the input pin and the 0 V pin.

The input trigger levels should be set to 4 V and 5 V to guarantee correct triggering for all possible battery voltages.

Output Wiring

All outputs are high side type outputs; they switch Batt+ to the output pin. They all have hardware thermal overload protection, fault logic and over-current logic.

Paralleled Outputs

Two or more output pins can be connected in parallel to increase current capacity. Outputs that are connected in parallel must all be of the same type; either all 8 Amp or all 20 Amp outputs.

Wire Gauges

The wire gauge must be chosen to suit the current consumed by the connected device and to ensure that the voltage drop is acceptable. On long runs it may be necessary to use a heavier gauge wire to minimise voltage drop.

The wire gauge must also be compatible with the connector pin; using a smaller than recommended wire gauge may result in a poor crimp.

Suitable wire gauges are 24# to 20# for the 8 Amp outputs and 20# to 16# for the 20 Amp outputs. See *Wiring* for details.

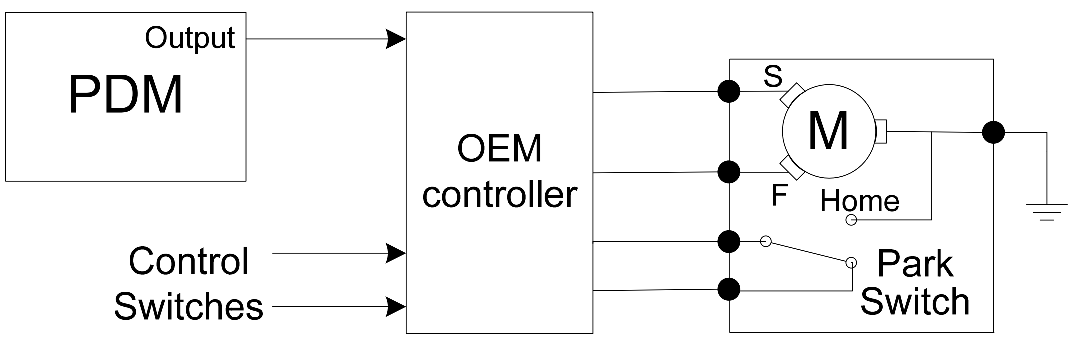
Output Devices

Windscreen Wipers

The PDM can drive windscreen wiper motors; however the PDM cannot be connected to both the fast and slow motor windings at the same time. The voltage generated by the slow winding during fast operation will cause braking of the motor and possible damage to the PDM.

A wiper unit can be wired in a number of ways. The following schematics are shown for 'common-ground' wiper units. For 'common-positive' wiper units the schematics must be adjusted accordingly.

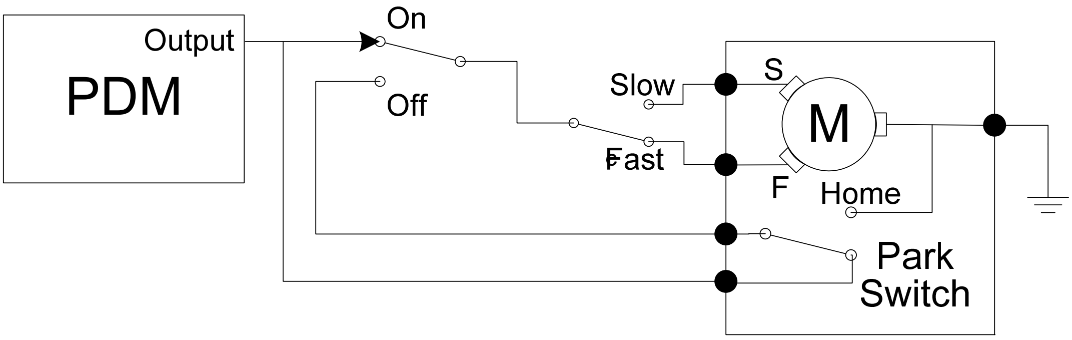
1. OEM Controller Method



The wiper unit can be wired using an OEM wiper controller with the PDM supplying the power only.

The OEM controller performs the intermittent and motor braking functions.

2. Two Switch Method



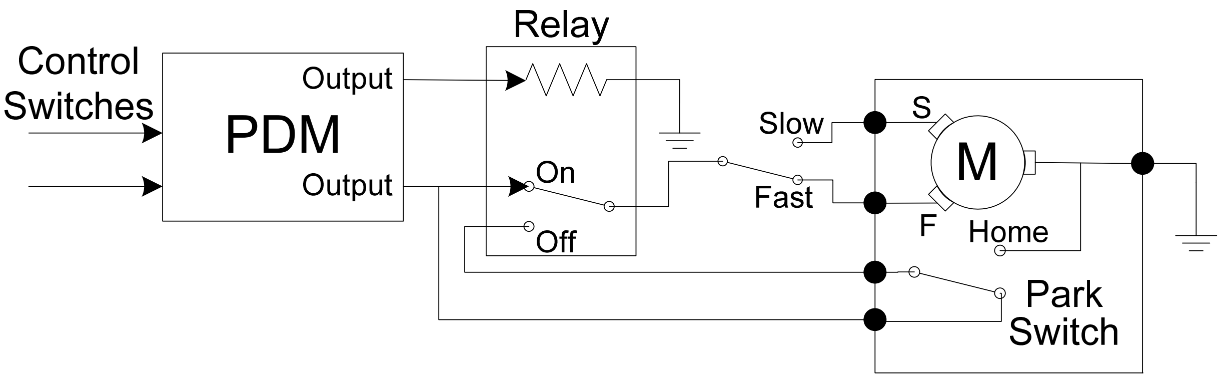
The wiper unit can be wired in a simple two switch arrangement; one switch for power and the other to select fast or slow. The PDM supplies power only.

Wiper motor braking is performed by the combination of the park switch and the on/off switch.

This arrangement cannot perform intermittent operation since the wiper will not park if the PDM simply removes power.

The switches must be able to handle the wiper motor current (typically 4 ampere).

3. Relay Method



The two switch method can be modified for intermittent operation by replacing the on/off switch with a relay. The PDM controls the relay to perform the intermittent function. This requires two PDM outputs; one to supply power and the other to control the relay.

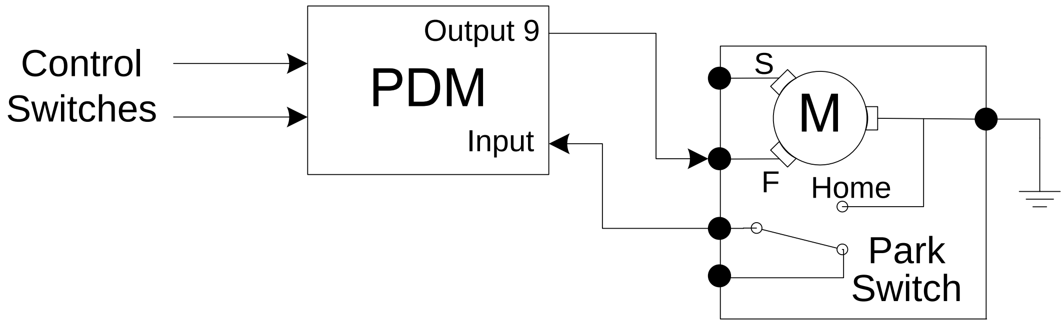
Motor braking is performed by the combination of the park switch and the relay switch.

The PDM must be configured with the appropriate logic to perform on/off and intermittent operation based on the state of the control switches.

Slow operation can be achieved using the switch or using intermittent operation to give a similar effect which avoids the need for a high current switch.

The fast/slow switch and on/off relay must handle the wiper motor current (typically 4 ampere). The control switches can be low current types since they only connect to PDM inputs.

4. Direct Method



The wiper unit can be wired directly to the PDM as long as it is only connected to one output.

In this method the park switch is wired directly to a PDM input so the park logic must be configured in the PDM.

This method requires the use of Output 9 which performs motor braking. The PDM performs motor braking by momentarily shorting the output to ground when the output turns off.

The PDM must be configured with the appropriate logic to perform on/off and intermittent operation based on the state of the control switches.

Slow operation can be achieved using a switch between the fast and slow windings as used in the other methods or intermittent operation can be used to wipe less frequently.

The control switches can be low current types since they only connect to PDM inputs.

Solenoids

The current drawn by a normal single coil solenoid ramps up from zero to its steady state value over a period of time. The time taken to do this depends on the inductance and resistance of the solenoid but is normally very short (less than 0.1 second). This has no affect on the PDM.

A solenoid will generate a voltage spike when turned off; this is clamped and absorbed by the PDM. The amount of energy absorbed by the PDM depends on the inductance and current in the solenoid. The PDM is capable of absorbing the energy of most normal solenoids in a vehicle.

Two Stage Solenoids

Some solenoids have two windings; one is used to turn the solenoid on, the other is used to hold it on once it has switched. This ensures optimum turn on characteristics with minimum holding current.

The current drawn by the turn on winding may be higher than the current drawn by the holding winding. Ensure the Output Load is well clear of 100% during turn on and during holding.

Starter Solenoids

In many cases it is possible to run starter solenoids from a single 20 Amp output even though they typically draw more than 20 ampere (possibly as much as 40 ampere).

The Over-Current Shutdown feature allows excess current for a period of time. This feature will shut down the output after about 10 to 20 seconds of cranking. See the *Over-Current Shutdown* section for details.

The wire can be rated for 20 ampere, also ensuring that the starter motor does not overheat during excess cranking. A larger wire gauge might be required if the voltage drop is not acceptable.

Alternatively two 20 Amp outputs may be paralleled allowing cranking for any period of time (subject to overheating of the starter motor).

Electronic Devices

The PDM can supply power to electronic devices such as engine management systems, data acquisition systems, radios etc.

Many electronic devices will have a short inrush current. The PDM will largely ignore this due to the Output Load filtering. See the *Over-Current Shutdown* section for details.

The PDM provides reverse battery protection and load dump clamping to protect itself and the connected devices.

Ignition Systems

Inductive Ignition Systems

Most inductive ignition systems draw a peak current of about 8 ampere, some draw as much as 20 ampere; however the average current is much lower.

In most cases inductive ignition systems can be connected to an 8 Amp output however the Output Load current must be checked to ensure it stays well clear of 100%.

The average current will increase with increasing RPM so the Output Load should be checked at maximum RPM.

CDI Ignition Systems

CDI ignition systems can draw peak currents of as much as 50 ampere. It is recommended that all CDI ignition systems are connected to a 20 Amp output.

The average current will increase with increasing RPM so the Output Load should be checked at maximum RPM.

Engine Management Systems

The current drawn by an engine management system will depend on the type of loads it is connected to and the operating conditions.

Fuel injectors draw current in pulses. The maximum average current drawn by the fuel injectors is when they are at maximum duty cycle.

For servo devices such as Drive by Wire motors maximum current is drawn when making large transitions.

Check that the Output Load is clear of 100% under worst case operating conditions, i.e. when the injectors are operating at maximum duty cycle, servo devices are making large transitions and any auxiliary loads are drawing maximum current.

PDM Manager Software Installation

The PDM Manager software is used to:

- Change the PDM configuration
- Monitor the PDM operation including the output currents and diagnostics
- Test the outputs by manually turning them off and on
- Set and unlock security password
- Update the firmware

PC Requirements

PDM Manager runs under Windows XP or Vista operating systems. The minimum recommended PC specification is a Pentium 90 with 16 MB RAM and a USB port.

Installing PDM Manager Software

- Go to the MoTeC website at www.motec.com and navigate to downloads/software/latestreleases/PDM Manager software
  OR Locate PDM Manager software on the MoTeC Resource Disc
- Save the selected file in your preferred location (for example desktop)
- When downloading is finished, double click on the file and select run
- Follow the instructions on the InstallShield Wizard
- To start the program after installation, click
  Start > All Programs > MoTeC > PDM Manager

Updating PDM Manager Software

Software updates are available to give access to the latest features. Download the latest software version from the website and follow the software installation instructions to update to the new version.

To update the associated firmware in the device select *Update Firmware* from the *Online* menu. For more information refer to *Operation.*

Connecting the PDM to a PC

The PC communicates with the PDM via the CAN bus.

To connect the PC to the CAN bus, a mating connector for MoTeC's UTC (USB to CAN adaptor) must be wired to the PDM CAN port.

If there are no other CAN devices connected refer to *PC Connection Wiring* otherwise refer to *CAN Bus Wiring Requirements*.

Note: MoTeC's CAN cable cannot be used with the PDM.

Configuration

The PDM requires various settings to be configured such as the maximum current settings for the outputs and the circumstances in which to turn the outputs on.

The configuration settings are stored in a configuration file on the PC.

Changes to the PDM configuration are performed ‘Offline’, i.e. without the PC communicating with the PDM. The changes are saved in the configuration file on the PC. The file must be sent to the PDM before the changes take effect. See *Operation.*

Configuration File

From the *File* menu the following options are available:

- *New:* creates a new configuration file
- *Open:* selects an existing configuration file
  Right-click the configuration file to Rename, Delete, Send to a disk etc.
- *Close:* closes the current configuration file
- *Save:* after a new configuration has been defined, it should be saved with a meaningful name
- *Save as:* can be used to create a copy of an existing configuration file by giving it a new name
- *Check Channels:* verifies that all channels are correctly generated
- *Exit:* exits the program

To create a new configuration file

- On the *File* menu, click *New*.
- Select the PDM type and enter the **Serial Number**
  The serial number can be found on the PDM label
  This will open the *Configuration Tree* panel and the *Channels* panel.

Tips:

- The most recently used files appear at the bottom of the *File* menu. This is often the easiest way to open an existing file.
- When changing the PDM type all configured inputs and outputs settings will be transferred to the relevant pin number in the new PDM type.
- Configuration files can be password protected, preventing unauthorised retrieving and sending of configuration files.

Channels

Channels are used to link the various systems within the PDM configuration.

For example: The input pin system generates two channels for each configured input pin. Depending on the state of the input pin the input channel value will be zero or one.

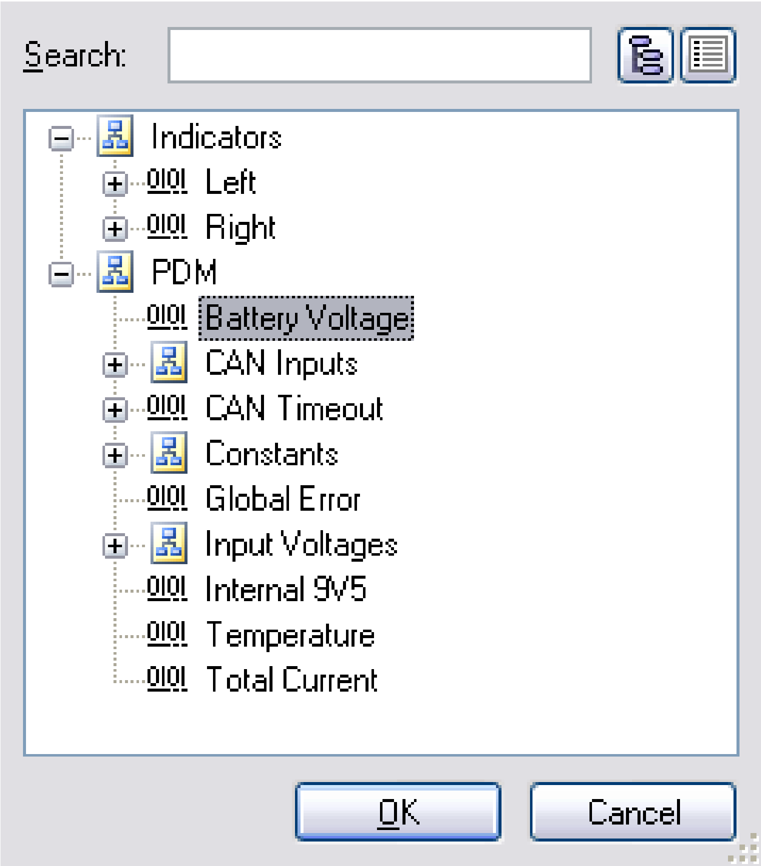
The channel can be selected to directly control a particular output. It can also be used as an input to a Condition. This is a complex logic function that combines a number of channels to create a new channel. This new channel can then be used to control an output, or as an input to another condition.

Each channel can only be generated once, but may be used by multiple outputs and conditions.

Channel Names

Each channel has a name to identify it. By including a dot between parts of the channel name, channels are arranged in a tree structure.

For example: Indicators.Left and Indicators.Right would appear as Left and Right under a node called Indicators.



The use of a dot between parts of the channel name is optional. The channel list will be a simple flat list rather than a tree structure if it is not used.

To rename a channel globally

- Right-click on the channel name in the *Channels* window and click *Rename*.
  This will rename the channel where it is generated as well as in all the places where it is used.

Configuration Tree

The Configuration Tree is used to configure the Global Setup, Input Pins, CAN Inputs, Conditions and Output Pins.

The input and output pins will be numbered according to the PDM type selected.

Global Setup

The *Global Setup* in the configuration tree is used to

- Enter the PDM type and serial number
- Set the base CAN address for incoming CAN communication
- Enable outgoing CAN messages and set their base address
- Set a Master Retry for all output pins

Master Retry

The Master Retry feature turns all outputs that are in error back on. If there is still a fault on a particular output, this output will go into error again and will go through the normal retry sequence.

To initiate a Master Retry by pressing a button

- Wire a button to a switch input
- Use the channel generated by this input as the trigger channel for the Master Retry.

Input Pins

Configuration of an input will create a Status and a Voltage channel. Both channels can be used in a condition or to directly control an output. They are transmitted via CAN.

To configure an Input Pin

- In the *Configuration Tree,* select *Input Pins*
- Double click the input to setup
- Type a **channel name** and select settings as required

The trigger voltages are fully programmable. The recommended trigger voltages are approximately 3.5 V for the low threshold and 4.2 V for the high threshold. The high threshold should be set below 6 V to ensure detection of a high level signal when the battery voltage is low.

To avoid switch bounce and/or to delay recognition when the switch changes state, the inputs also have programmable trigger times. A trigger time of 0.1 second will normally reject switch bounce.

Channel Name	Description	CAN Output
InputName	Input Status 0 = Off 1 = On	Yes
InputName.Voltage	Voltage on the input Resolution 0.2 V	Yes

CAN Inputs

The PDM can receive CAN messages allowing the outputs to be controlled by other devices.

The PDM receives CAN messages on any of four sequential CAN IDs. The IDs must be within the standard address range. The base CAN address is selected in *Global Setup* in the Configuration Tree.

The CAN communication rate of the PDM is 1 Mbit/sec. The communication rate in other devices must be set to the same speed.

Channels are extracted from the CAN messages by specifying a CAN address and an offset. The offset determines which byte in the message is used as the channel value.

Each CAN generated channel will be set to zero on start-up and stay zero until a matching CAN message is received.

If any of the CAN messages is not received for 1 second, the corresponding timeout channel will be set to TRUE. During the CAN timeout period the channel value remains at the last received value.

Tip: The timeout channel can be used in a condition.

8 Bit Values

The PDM can receive 8 bit values, which can be used directly or masked with a bit mask.

16 Bit Values

The PDM may receive 16 bit signed values. A divide factor must be specified to reduce the value to fit into the 8 bit result channel which has a range of 0 to 255 (unsigned).

For example, a 16 bit RPM value with resolution of 1 RPM could be divided by 100 to give a value with a resolution of 100 RPM. The maximum channel value of 255 will be equivalent to 25500 RPM.

If the value after division is greater than 255 then the result value will be clamped to 255. The PDM treats the received value as a signed 16 bit value (i.e. -32768 to 32767). Negative values are clamped to 0.

To configure a CAN input

- In the *Configuration Tree,* select *CAN Inputs*
- On the *Edit* menu, click *Add*
- Type a **channel name** and select settings as required

CAN Output

A fixed set of messages can be sent from the PDM via CAN to other devices. CAN outputs are enabled via *Global Setup*.

Most MoTeC logging devices have CAN communications templates available to receive these messages. The CAN communication rate of the PDM is 1 Mbit/sec. The communication rate in other devices must be set to the same speed as in the PDM.

The transmitted CAN messages include Output Voltage, Output Current, Output Load, Output Status, Input State, Internal Temperature, Battery Voltage, Global Error, and Total Current. See *Fuse Characteristics* for details.

The receiving device can use the messages for diagnostic purposes (particularly useful if the values are logged in a logging device), to show an alarm on a display or to activate a feature in another device depending on the value of a PDM input switch.

Conditions

A condition is a complex logic function that combines a number of channels to create a new channel. The logic operations include AND, OR, flash and many more.

The new channel, with a value of either TRUE (1) or FALSE (0), can be used to directly control an output or it can be used in another condition.

Number of Operations

There is a total of 200 logic operations available in the PDM. The number of operations used is shown in the status line.

> **Tip:** A condition can also be configured in the output pin setup. In this case the outcome of the logic function will not create a new channel but will be directly connected to the output channel.

To configure a Condition

- In the *Configuration Tree*, select *Conditions*
- On the *Edit* menu, click *Add*
- Type a **channel name** and select settings as required

Output Pins

All outputs are high side type outputs; they switch Batt+ to the output pin. All outputs have hardware thermal overload protection, fault logic and over-current logic.

Paralleled Outputs

When two or more output pins are connected in parallel, they must be configured to use a common channel or an identical condition to activate them.
Note: outputs that are connected in parallel must all be of the same type; either all 8 Amp or all 20 Amp outputs.

Output Protection

Over-Current Shutdown

An Over-Current Shutdown occurs when the Output Load exceeds 100%, which corresponds to the maximum current setting.

The Output Load value is filtered so that it normally increases (and decreases) slowly, modelling how the temperature of a wire responds to the current flowing through it. The resultant characteristic is very similar to a thermal circuit breaker which is often used in motorsport applications. It is also similar to a slow blow fuse. See *Fuse Characteristics* for details.

The filtering of the load value ensures that the start-up current (inrush current) of motors and lamps does not cause the output to shutdown during this period. It also allows for short term overloads to occur without the output shutting down.

A large over-current such as a short circuit will cause the Output Load value to increase rapidly, causing the output to shutdown in a short period of time to protect the wire and the PDM output. The filtering is set with a time constant of 20 to 50 seconds based on the maximum current setting. These values conservatively suit the appropriate wire gauge for the selected current setting and are not adjustable.

Tips:

- The Output Load and Output Current values are transmitted via CAN so that they can be logged by another device. Check the logged Output

Load value to ensure it is not too close to 100% during normal operation and during start-up.

- The Output Load and Output Current values can also be monitored using PDM Manager. See *Checking Operation.*

Fault Shutdown

A Fault Shutdown occurs when the output voltage is lower than expected. This can be caused by a short circuit or thermal overload of the output.

A short circuit may cause a Fault Shutdown before the Over-Current Shutdown occurs.

Output Settings

To configure an Output Pin

- In the *Configuration Tree,* select *Output Pins*
- Double click the output to setup
- Type a **channel name** and select settings as required

Maximum Current

This sets the current at which the output will shutdown. The output current may exceed this value for a period of time which allows for the start-up (inrush) current of devices such as motors and lamps.

The maximum current can be set to 10 ampere on the 8 Amp outputs and 25 ampere on the 20 Amp outputs to be clear of the normal running current, even for devices that draw the maximum specified current of 8 or 20 ampere.

Number of Retries and Retry Delay

When an Over-Current Shutdown or a Fault Shutdown occurs, the PDM will attempt to turn the output on again if the Number of Retries is configured. The Number of Retries determines how many times an output will attempt to turn on again.

The Retry Delay determines how long an output remains shutdown before it is turned on again.

The retry count for an output is reset whenever the condition driving the output changes to FALSE and then to TRUE (i.e. when the condition driving the output turns off then on again).

Tips:

- There is a Master Retry feature available in *Global Setup*

- Ensure that the maximum current has been set appropriately by checking that the Output Load value is less than 100% under all operating conditions.
- The wire used must be capable of carrying the current specified in the maximum current setting. See *Wire Specification.*
- Set the maximum current well clear of the normal operating current of the device but within the current rating of the wire. Use a larger wire to achieve this if necessary. For example, for a device that draws no more than 5 ampere (except at start-up) use a wire that is rated at 8 ampere and set the maximum current to 8 ampere to give a clear margin.
- Consider the voltage drop of the wire when selecting the wire size. Sometimes this dictates that a larger wire gauge is needed than the current rating would suggest.
- Setting the current close to the normal current of the device to try and protect the device is unlikely to be effective and could result in an inadvertent shutdown. The purpose of the maximum current setting is to protect the wire from overheating, not to protect the connected device.
- Some devices draw more current under circumstances such as high or low battery voltage. Also, a motor will draw increased current when under more load. Set a good margin and where possible check the Output Load value under these varying circumstances.

Configuration of an output will create a number of channels, some of which are transmitted via CAN. OutputName.Status channel is used for output status information on CAN. The output should be on for any non-zero value.

Channel Name	**Description**	**CAN Output**
OutputName	Output Control Status 0 = Off 1 = On (Note: the output may be off due to Over-current Shutdown or Fault Shutdown)	No
OutputName.Voltage	Voltage on the output Resolution 0.2 V	Yes
OutputName.Current	Output Current in amps Resolution 0.5 A on Outputs 1 – 8 Resolution 0.2 A on Outputs 9 – 32	Yes
OutputName.Load	Output Load. Filtered current as a percentage of the maximum current setting.	Yes

Channel Name	Description	CAN Output
	Resolution 1%	
OutputName.Status	0 = Off 1 = On Active 2 = Over-Current Shutdown 4 = Fault Shutdown	Yes
OutputName.Status. Active	0 = Output is off 1 = Output is on	No
OutputName.Status. OverCurrent	0 = OK 1 = Over-Current Shutdown	No
OutputName.Status. Fault	0 = OK 1 = Fault Shutdown	No

Fault Indicator

When an output fault occurs the PDM sets the value of the Global Error channel to TRUE (PDM.Global Error). A fault indicator light can be connected to any PDM output and configured to turn on when the Global Error channel is TRUE.

The Global Error channel can also be transmitted via CAN to a display device and used to show an alarm message and activate an alarm light.

Maximum Current for Typical Output Devices

Lamps

- Tungsten Lamps

Typically used for tail lights, indicator lights and general lighting.

Tungsten lamps draw additional current during turn on. Typically this peaks at about 5 times the steady state current and dies out in about 0.1 second. The PDM will largely ignore this due to the Output Load filtering.

- Halogen Lamps

Halogen lamps are commonly used in headlights and are more efficient than Tungsten lamps.

Halogen lamps have similar characteristics to Tungsten lamps.

- Xenon (HID) Lamps

Xenon lamps are also used in headlights and are more efficient than Tungsten and Halogen lamps.

Xenon lamps have a long duration inrush current that peaks at about 4 times the steady state current. The inrush current decays over a period of about 10 seconds. This puts a high load on the PDM output during start-up.

To avoid Over-Current Shutdown during start-up it may be necessary to set a higher Maximum Current than normal particularly if the battery voltage is low.

For example, a Xenon lamp with a steady state current of 3 ampere may need a Maximum Current setting of 6 to 8 ampere. The wire should also be rated at this current.

Unlike other lamps, Xenon lamps draw more current as the battery voltage decreases. At 10 volt the lamp will draw 40% more current than at 14 volt. For example a lamp that draws 3 ampere at 14 volt will draw 4.2 ampere at 10 volt. This must be allowed for when setting the Maximum Current.

To ensure that the Maximum Current is set appropriately, check that the Output Load value stays safely below 100% during turn on when the battery is at 12 volt (not charging).

Motors

Electric motors draw additional current during start-up. Typically the start-up current is 3 to 5 times the steady state current and it dies out in less than a second.

This start-up current is largely ignored by the PDM due to the Output Load filtering.

The current in a motor increases with increasing load on the motor. A motor draws maximum current when it is stalled. The Maximum Current setting should take this into account.

A motor may draw more current as it or the device that it is connected to ages; this should be allowed for when setting the Maximum Current.

Note: motor speed control is currently not supported.

Operation

CAUTION: The PDM may get very hot, do not touch the PDM during operation.

To perform any of the activities in the *Online* menu, the PC needs to communicate with the PDM.

When a configuration file is open in PDM Manager, it will connect to the PDM with the matching serial number.

If there is no file open, all connected PDMs will be displayed. PDM Manager can be connected to a selected PDM.

Sending and Retrieving Configuration Files

- On the *Online* menu, click *Send Configuration* to send the currently open configuration file to the connected PDM
- On the *Online* menu, click *Get Configuration* to retrieve the current configuration file in the connected PDM

Checking Operation

Monitor Channels

- On the Online menu, click Monitor Channels

Monitor Channels shows the value of each channel in the original tree structure.

Monitor PDM

- On the *Online* menu, click *Monitor PDM*

Monitor PDM shows the input-, output-, CAN input-, condition- and PDM status channels in separate screen areas in an easy to view layout.

Test Outputs

- On the *Online* menu, click *Test Outputs*

All outputs may be manually turned on and off in PDM Manager to check the current levels.

To be able to test an output, it must first be configured in PDM Manager.

Serial Number

- On the *Online* menu, click *Show Serial Number*

A configuration file can only be sent to the PDM with the matching serial number.

This allows multiple PDMs to be used without special device configuration requirements and also ensures that each PDM has the correct configuration file.

Firmware Versions and Updating

- On the Online menu, click Update Firmware

The software inside the PDM (firmware) can be updated by the user at any time to take advantage of the latest features.

Matching Versions

The firmware version must match the version of the PDM Manager software on the PC in order to communicate. PDM Manager will show a warning if the versions do not match.

Tip:
To check the version of PDM Manager software, click *About MoTeC PDM Manager* on the *Help* menu.
To check the firmware version in the PDM click *Show Serial Number* on the *Online* menu

Matching Configuration File

Configuration files created with new software including new features can not be used with older version of the software. If required, create backup files before updating.

Password Protection

- On the *Online* menu, click *Set Password*

The password will prevent unauthorised retrieving and sending of configuration files.

It is not possible to update firmware if the PDM is password protected.

Standby Mode

The PDM enters a low current Standby Mode when all outputs are off and there is no CAN activity. The PDM exits Standby Mode when the state of any input changes or CAN activity resumes.

Appendices

Specifications

General

Battery voltage	30 V max, 6.5 V min			
Current consumption	35 mA typical operating 5 mA typical standby			
Total output current (continuous)	PDM16	PDM32	PDM15	PDM30
	100 A	120 A	80 A	100 A
Reverse battery protection	Protection for PDM and all connected devices			
Load dump transient protection	Protection for PDM. Also assists in protecting connected devices.			
Operating temperature	110 °C max internal (100 °C recommended) Typical 85 °C max ambient for 120 A total load (for 110 °C internal) depending on mounting, air circulation and load distribution. These specifications apply for a 12 V battery. For a 24 V battery reduce specified temperatures by 20 °C.			
Weight	PDM16	PDM32	PDM15	PDM30
	330 g (0.72 lbs)	405 g (0.89 lbs)	260 g (0.57 lbs)	270 g (0.59 lbs)
Length	130 mm (5.1")	180 mm (7.1")	107 mm (4.2")	107 mm (4.2")
Width	60 mm (2.4")	60 mm (2.4")	133 mm (5.2")	133 mm (5.2")
Height	28 mm (1.1")	28 mm (1.1")	39 mm (1.5")	39 mm (1.5")
Case	Machined aluminium		Magnesium	
Environmental protection	Rubber seal on lid and connectors, conformal coating on PCB		Conformal coating on PCB	

20 Amp Outputs

Number of 20 A outputs	PDM16	PDM32	PDM15	PDM30
	8	8	8	8
Maximum output current	20 A continuous, 115 A transient (typical)			
Over-current shutdown	Programmable in steps of 1 A			
Protection	Short circuit and thermal overload protection			
Inductive load clamp voltage	–17 V (relative to Batt–)			
Maximum inductive load energy	1.5 J (junction temperature = 150 °C, load current = 20 A)			

8 Amp Outputs

Number of 8 A outputs	PDM16	PDM32	PDM15	PDM30
	8	24	7	22
Maximum output current	8 A continuous, 60 A transient (typical)			
Over-current shutdown	Programmable in steps of 1 A			
Protection	Short circuit and thermal overload protection			
Inductive load clamp voltage	Output 9: –0.7 V (relative to Batt–) Other Outputs: –42 V (relative to Batt+)			
Maximum inductive load energy	0.3 J (junction temperature = 150 °C, load current = 20 A)			

Inputs

Number of inputs	PDM16	PDM32	PDM15	PDM30
	12	23	16	16
Pull-up resistor	10 kilo ohm to Batt+			
Measurement	Range of 0 to 51 V, resolution 0.2 V (8 bits)			
Calibration	High and low trigger voltage, high and low trigger times			

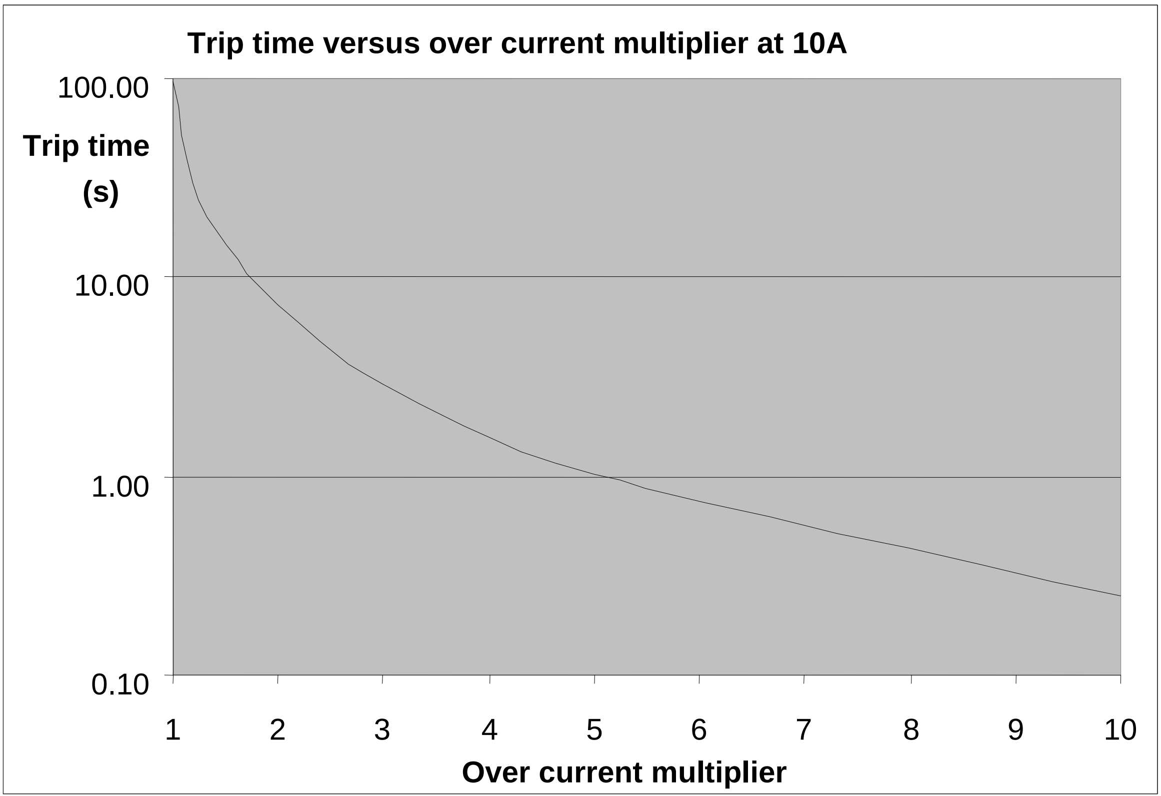
CAN Input

Number of messages	4 messages, 8 bytes per message

CAN Output

Message rate	20 Hz

Fuse Characteristics



Max current setting [A]	Trip time multiplier
4	76%
6	84%
8	92%
10	100%
15	120%
20	140%

Example:

For 25 A current where max current setting is 5 A:

Over current multiplier: 25 A / 5 A = 5

From Graph: Trip time (at 10 A) is approx 1 second

From Table: Trip time multiplier (at 5 A) is approx 80%

Trip time (at 5 A) = 1 x 80% = 0.8 seconds

Connectors and Pinout

PDM16

Connector A	
26 pin Autosport Mating connector #65040	
Pin	**Function**
A_A	8 A Output 9
A_B	8 A Output 10
A_C	8 A Output 11
A_D	Digital/Switch Input 1
A_E	Digital/Switch Input 2
A_F	Digital/Switch Input 3
A_G	0 V
A_H	0 V
A_J	CAN Low
A_K	CAN High
A_L	8 A Output 12
A_M	8 A Output 13
A_N	8 A Output 14
A_P	8 A Output 15
A_R	8 A Output 16
A_S	Digital/Switch Input 4
A_T	Digital/Switch Input 5
A_U	Digital/Switch Input 6
A_V	Digital/Switch Input 7
A_W	Digital/Switch Input 8
A_X	Digital/Switch Input 9
A_Y	Digital/Switch Input 10
A_Z	Digital/Switch Input 11
A_a	Digital/Switch Input 12
A_b	Batt–
A_c	Batt–

Connector B	
1 pin Autosport Mating connector #68093 (wire gauge #6 AWG) #68094 (wire gauge #4 AWG)	
Pin	**Function**
B_1	Batt+

Connector C	
8 Pin Autosport Mating Plug: Deutsch AS616-08SN	
Pin	**Function**
C_A	20 A Output 1
C_B	20 A Output 2
C_C	20 A Output 3
C_D	20 A Output 4
C_E	20 A Output 5
C_F	20 A Output 6
C_G	20 A Output 7
C_H	20 A Output 8

PDM32

Connector A	
37 pin Autosport Mating connector #68089	
Pin	**Function**
A_1	Digital/Switch Input 1
A_2	Digital/Switch Input 2
A_3	Digital/Switch Input 3
A_4	Digital/Switch Input 4
A_5	Digital/Switch Input 5
A_6	0 V
A_7	0 V
A_8	0 V
A_9	0 V
A_10	CAN Low
A_11	CAN High
A_12	Digital/Switch Input 6
A_13	Digital/Switch Input 7
A_14	Digital/Switch Input 8
A_15	Digital/Switch Input 9
A_16	Digital/Switch Input 10
A_17	Digital/Switch Input 11
A_18	Digital/Switch Input 12
A_19	Digital/Switch Input 13
A_20	Digital/Switch Input 14
A_21	Digital/Switch Input 15
A_22	0 V
A_23	0 V
A_24	0 V
A_25	0 V
A_26	Digital/Switch Input 16
A_27	Digital/Switch Input 17
A_28	Digital/Switch Input 18
A_29	Digital/Switch Input 19
A_30	Digital/Switch Input 20
A_31	Digital/Switch Input 21
A_32	Digital/Switch Input 22
A_33	Digital/Switch Input 23
A_34	Not Connected
A_35	Not Connected
A_36	Not Connected
A_37	Not Connected

Connector B	
26 pin Autosport Mating connector #65040	
Pin	**Function**
B_A	8 A Output 9
B_B	8 A Output 10
B_C	8 A Output 11
B_D	8 A Output 12
B_E	8 A Output 13
B_F	8 A Output 14
B_G	8 A Output 15
B_H	8 A Output 16
B_J	8 A Output 17
B_K	8 A Output 18
B_L	8 A Output 19
B_M	8 A Output 20
B_N	8 A Output 21
B_P	8 A Output 22
B_R	8 A Output 23
B_S	8 A Output 24
B_T	8 A Output 25
B_U	8 A Output 26
B_V	8 A Output 27
B_W	8 A Output 28
B_X	8 A Output 29
B_Y	8 A Output 30
B_Z	8 A Output 31
B_a	8 A Output 32
B_b	Batt–
B_c	Batt–

PDM32 continued

Connector C	
1 pin Autosport Mating connector #68093 (wire gauge #6 AWG) #68094 (wire gauge #4 AWG)	
Pin	***Function***
C_1	Batt+

Connector D	
8 pin Autosport Mating connector #68092	
Pin	***Function***
D_A	20 A Output 1
D_B	20 A Output 2
D_C	20 A Output 3
D_D	20 A Output 4
D_E	20 A Output 5
D_F	20 A Output 6
D_G	20 A Output 7
D_H	20 A Output 8

PDM15

Connector A	
34 pin waterproof connector Mating connector #65044	
Pin	**Function**
A_1	20 A Output 1 (with A10)
A_2	8 A Output 9
A_3	20 A Output 2 (with A12)
A_4	8 A Output 10
A_5	20 A Output 3 (with A14)
A_6	8 A Output 11
A_7	20 A Output 4 (with A16)
A_8	8 A Output 12
A_9	20 A Output 5 (with A17)
A_10	20 A Output 1 (with A1)
A_11	8 A Output 13
A_12	20 A Output 2 (with A3)
A_13	8 A Output 14
A_14	20 A Output 3 (with A5)
A_15	8 A Output 15
A_16	20 A Output 4 (with A7)
A_17	20 A Output 5 (with A9)
A_18	Not used
A_19	Digital/Switch Input 2
A_20	Not used
A_21	Digital/Switch Input 4
A_22	Not used
A_23	Digital/Switch Input 7
A_24	Not used
A_25	Not used
A_26	Battery Negative
A_27	Digital/Switch Input 1
A_28	0 V
A_29	Digital/Switch Input 3
A_30	Digital/Switch Input 5
A_31	Digital/Switch Input 6
A_32	Digital/Switch Input 8
A_33	Digital/Switch Input 9
A_34	Digital/Switch Input 10

Connector B	
26 pin waterproof connector Mating connector #65045	
Pin	**Function**
B_1	Not used
B_2	Not used
B_3	20 A Output 6 (with B9)
B_4	Not used
B_5	20 A Output 7 (with B11)
B_6	Not used
B_7	20 A Output 8 (with B13)
B_8	Not used
B_9	20 A Output 6 (with B3)
B_10	Not used
B_11	20 A Output 7 (with B5)
B_12	Not used
B_13	20 A Output 8 (with B7)
B_14	Not used
B_15	Digital/Switch Input 13
B_16	Not used
B_17	Digital/Switch Input 15
B_18	Battery Negative
B_19	Not used
B_20	Digital/Switch Input 11
B_21	Digital/Switch Input 12
B_22	0 V
B_23	Digital/Switch Input 14
B_24	Digital/Switch Input 16
B_25	CAN Low
B_26	CAN High

Connector C	
M6 stud Mating: eyelet and M6 nut	
Pin	**Function**
C_1	Battery +

PDM30

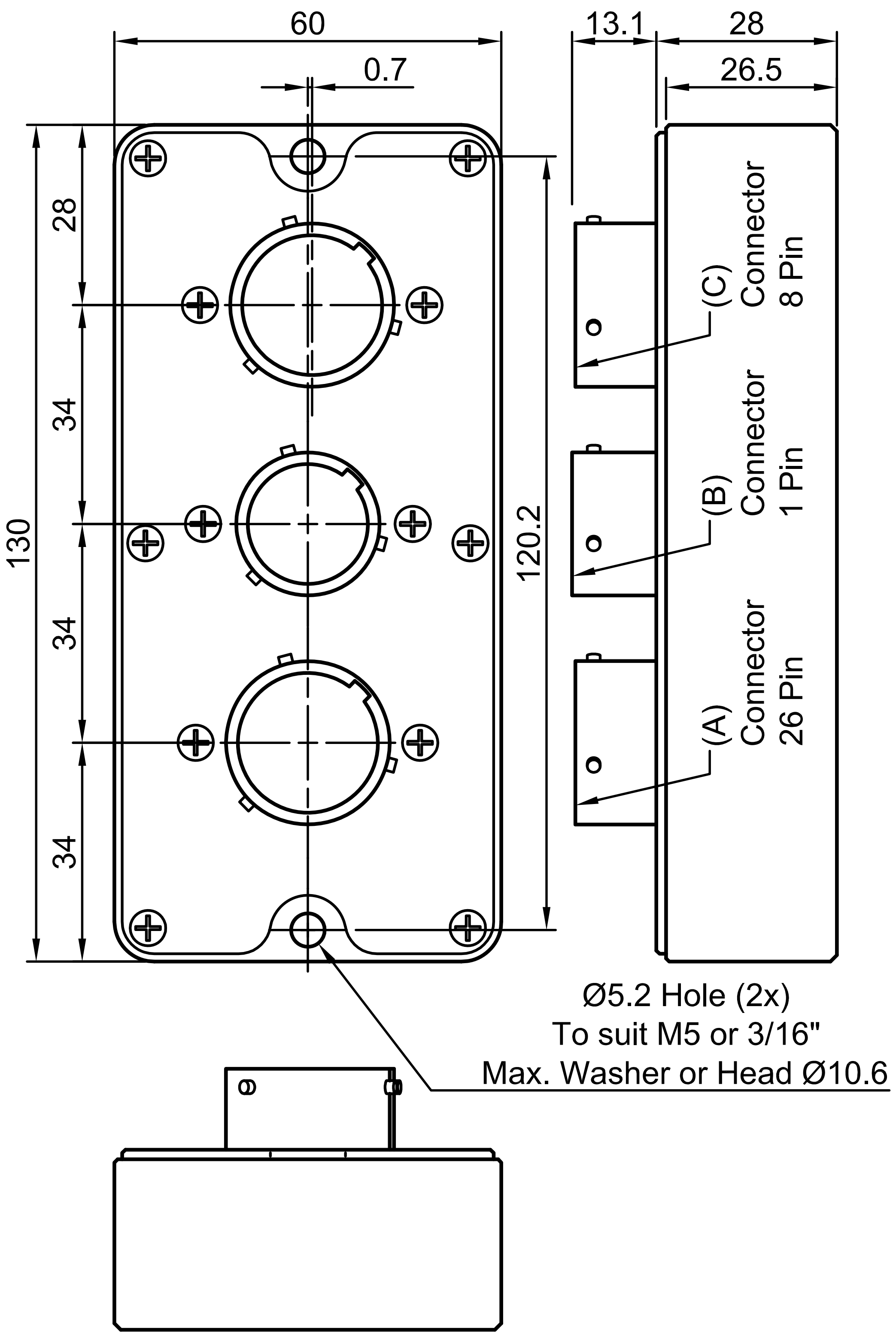
Connector A	
34 pin waterproof connector Mating connector #65044	
Pin	**Function**
A_1	20 A Output 1 (with A10)
A_2	8 A Output 9
A_3	20 A Output 2 (with A12)
A_4	8 A Output 10
A_5	20 A Output 3 (with A14)
A_6	8 A Output 11
A_7	20 A Output 4 (with A16)
A_8	8 A Output 12
A_9	20 A Output 5 (with A17)
A_10	20 A Output 1 (with A1)
A_11	8 A Output 13
A_12	20 A Output 2 (with A3)
A_13	8 A Output 14
A_14	20 A Output 3 (with A5)
A_15	8 A Output 15
A_16	20 A Output 4 (with A7)
A_17	20 A Output 5 (with A9)
A_18	8 A Output 16
A_19	Digital/Switch Input 2
A_20	8 A Output 17
A_21	Digital/Switch Input 4
A_22	8 A Output 18
A_23	Digital/Switch Input 7
A_24	8 A Output 19
A_25	8 A Output 20
A_26	Battery Negative
A_27	Digital/Switch Input 1
A_28	0 V
A_29	Digital/Switch Input 3
A_30	Digital/Switch Input 5
A_31	Digital/Switch Input 6
A_32	Digital/Switch Input 8
A_33	Digital/Switch Input 9
A_34	Digital/Switch Input 10

Connector B	
26 pin waterproof connector Mating connector #65045	
Pin	**Function**
B_1	8 A Output 21
B_2	8 A Output 22
B-3	20 A Output 6 (with B9)
B_4	8 A Output 23
B-5	20 A Output 7 (with B11)
B_6	8 A Output 24
B_7	20 A Output 8 (with B13)
B_8	8 A Output 25
B_9	20 A Output 6 (with B3)
B_10	8 A Output 26
B_11	20 A Output 7 (with B5)
B_12	8 A Output 27
B_13	20 A Output 8 (with B7)
B_14	8 A Output 28
B_15	Digital/Switch Input 13
B_16	8 A Output 29
B_17	Digital/Switch Input 15
B_18	Battery Negative
B_19	8 A Output 30
B_20	Digital/Switch Input 11
B_21	Digital/Switch Input 12
B_22	0 V
B_23	Digital/Switch Input 14
B_24	Digital/Switch Input 16
B_25	CAN Low
B_26	CAN High

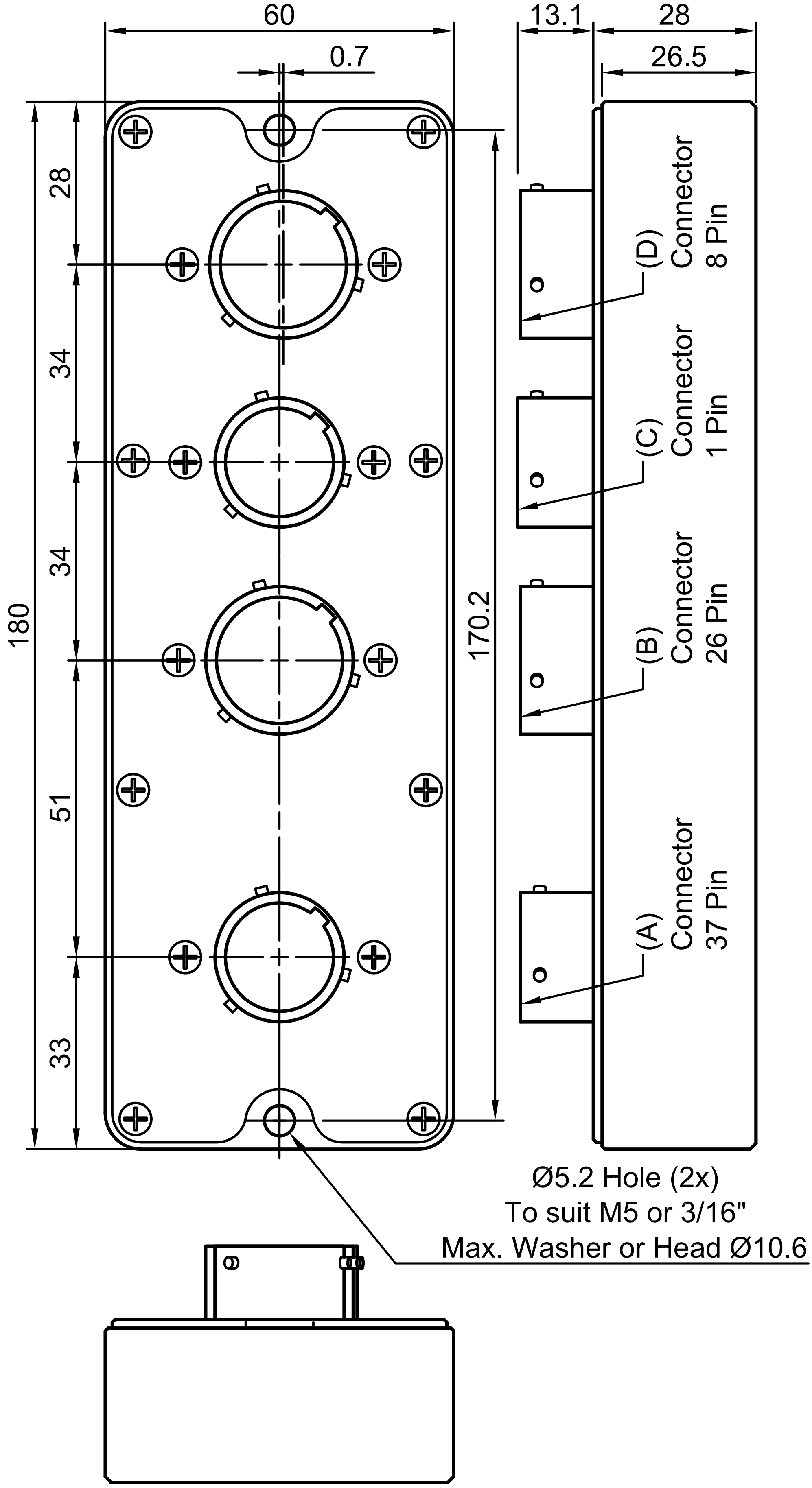
Connector C	
M6 stud Mating: eyelet and M6 nut	
Pin	**Function**
C_1	Battery +

Mounting Dimensions

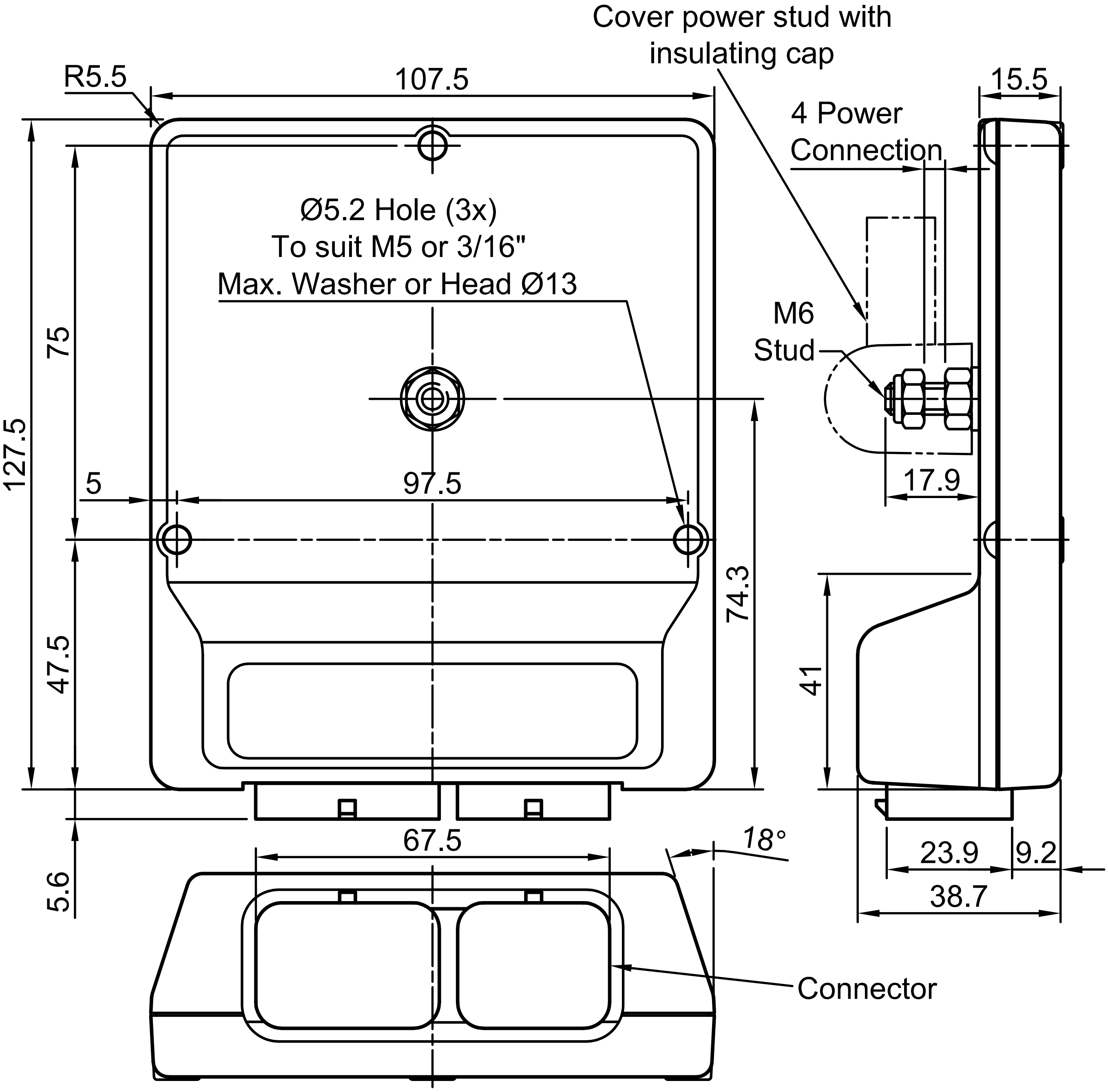
PDM16



PDM32


60
0.7
13.1
28
26.5
28
34
34
51
33
180
170.2
(D) Connector 8 Pin
(C) Connector 1 Pin
(B) Connector 26 Pin
(A) Connector 37 Pin
Ø5.2 Hole (2x)
To suit M5 or 3/16"
Max. Washer or Head Ø10.6

PDM15 and PDM30



Wiring

Wire Specification

M22759/16

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

Wire Gauge (AWG)	*Current Rating at 80 °C ambient [A]**	*Current Rating at 100 °C ambient [A]**	*Resistance [ohm/m]*	*Resistance [ohm/1000 ft]*
24#	4.5	4	0.071	22
22#	6	5	0.045	14
20#	8	6	0.028	8.5
18#	11	9	0.018	5.5
16#	15	12	0.014	4.3
14#	22	18	0.009	2.7
6#	90‡	75‡	0.0015	0.44
4#	120‡	100‡	0.0009	0.28
2#	150‡	120‡	0.0006	0.18

*The current ratings above are an indication only and will not apply in all circumstances.

The actual maximum current rating is determined by the maximum allowed temperature for the wire (150 °C).

The temperature of the wire is affected by many factors including the temperature of adjacent wires, how the wires are bundled and covered, the ambient temperature and the current.

‡current rating for a single wire in free air

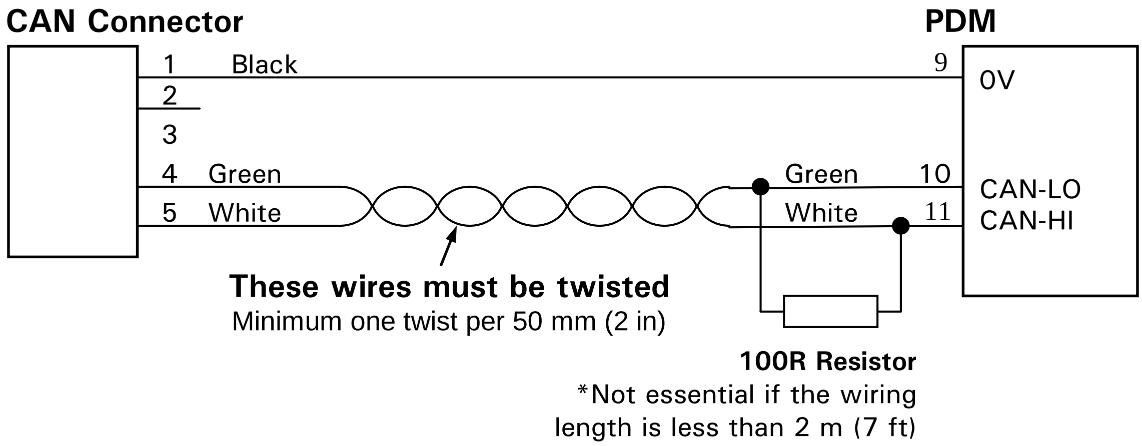
Recommended Wire Gauge	*Output*
24# to 20#	8 Amp outputs
20# to 16#	20 Amp outputs
4# to 2#	Battery pos

PC Connection Wiring

The PDM connects to the USB port on the PC. This requires a CAN connector in the loom for MoTeC's UTC (USB to CAN adaptor and USB cable).

If the PDM does not connect to any other CAN device, it can be directly wired to the CAN connector.

If the wiring length is less than 2 m (7 ft) the terminating resistor is recommended but not essential.



UTC Connector Type:

Deltron	716-0-0501	(Non-latching)
Neutrik	NC5FDL1	(Latching)

CAN Bus Wiring Requirements

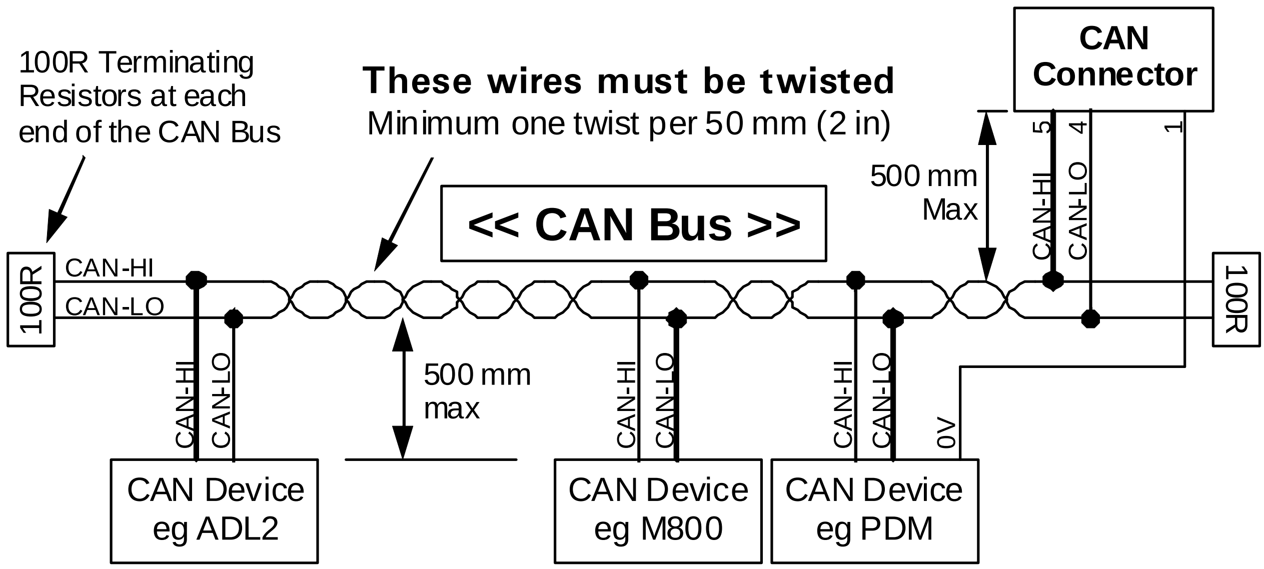
The CAN bus should consist of a twisted pair trunk with 100R (0.25 watt) terminating resistors at each end of the trunk.

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

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

CAN devices (such as MoTeC PDM, M800 etc) may be connected to the trunk with up to 500 mm (20 in) of twisted wire.

The CAN Connector for the UTC may also be connected to the trunk with up to 500mm (20in) of twisted wire and should be within 500mm of one end of the trunk. If desired two CAN connectors may be used so that the UTC may be connected to either side of the vehicle. Both connectors must be within 500mm of each end of the trunk.



Short CAN Bus

If the CAN Bus is less than 2 m (7 ft) long then a single termination resistor may be used. The resistor should be placed at the opposite end of the CAN bus to the CAN connector.

CAN Output Messages

The PDM transmits the following messages at 20 Hz.
Note: only relevant messages get transmitted

CAN ID	Byte	Bit	Channel	Scaling
Base Id + 0	0	4..7	Compound Id = 0	
	0	0	Input 1 State	0 = Inactive 1 = Active
	1	0	Input 2 State	
	2	0	Input 3 State	
	3	0	Input 4 State	
	4	0	Input 5 State	
	5	0	Input 6 State	
	6	0	Input 7 State	
	7	0	Input 8 State	
Base Id + 0	0	4..7	Compound Id = 1	
	0	0	Input 9 State	0 = Inactive 1 = Active
	1	0	Input 10 State	
	2	0	Input 11 State	
	3	0	Input 12 State	
	4	0	Input 13 State	
	5	0	Input 14 State	
	6	0	Input 15 State	
	7	0	Input 16 State	
Base Id + 0	0	4..7	Compound Id = 2	
	0	0	Input 17 State	0 = Inactive 1 = Active
	1	0	Input 18 State	
	2	0	Input 19 State	
	3	0	Input 20 State	
	4	0	Input 21 State	
	5	0	Input 22 State	
	6	0	Input 23 State	
Base Id + 0	0	4..7	Compound Id = 3	
	1	0..7	PDM Internal Temperature	0 to 125 = 0 °C to +125 °C 1 °C steps
	2	0..7	PDM Battery Voltage	0 to 255 = 0 V to 31 V 0.1216 V steps
	3	0..7	Global Error Flag	0 = OK 1 = one or more outputs is in either Fault or Over-Current error
	4	0..7	Total Current	0 to 255 = 0 to 255 A 1 A steps
	5	0..7	9.5V internal rail voltage	0 to 255 = 0 V to 15.68 V 0.0615 V steps Should read close to 9.5 V when the Battery voltage is > 10.5 V
	6	0..7	Reset Source	

CAN ID	Byte	Bit	Channel	Scaling
Base Id + 1	0	0..7	Compound Id = 0	
	1	0..7	Output 1 Current	0 to 255 = 0 to 127.5 A 0.5 A steps
	2	0..7	Output 2 Current	
	3	0..7	Output 3 Current	
	4	0..7	Output 4 Current	
	5	0..7	Output 5 Current	
	6	0..7	Output 6 Current	
	7	0..7	Output 7 Current	
Base Id + 1	0	0..7	Compound Id = 1	
	1	0..7	Output 8 Current	0 to 255 = 0 to 127.5 A 0.5 A steps
	2	0..7	Output 9 Current	0 to 255 = 0 to 51 A 0.2 A steps
	3	0..7	Output 10 Current	
	4	0..7	Output 11 Current	
	5	0..7	Output 12 Current	
	6	0..7	Output 13 Current	
	7	0..7	Output 14 Current	
Base Id + 1	0	0..7	Compound Id = 2	
	1	0..7	Output 15 Current	0 to 255 = 0 to 51 A 0.2 A steps
	2	0..7	Output 16 Current	
	3	0..7	Output 17 Current	
	4	0..7	Output 18 Current	
	5	0..7	Output 19 Current	
	6	0..7	Output 20 Current	
	7	0..7	Output 21 Current	
Base Id + 1	0	0..7	Compound Id = 3	
	1	0..7	Output 22 Current	0 to 255 = 0 to 51 A 0.2 A steps
	2	0..7	Output 23 Current	
	3	0..7	Output 24 Current	
	4	0..7	Output 25 Current	
	5	0..7	Output 26 Current	
	6	0..7	Output 27 Current	
	7	0..7	Output 28 Current	
Base Id + 1	0	0..7	Compound Id = 4	
	1	0..7	Output 29 Current	0 to 255 = 0 to 51 A 0.2 A steps
	2	0..7	Output 30 Current	
	3	0..7	Output 31 Current	
	4	0..7	Output 32 Current	

CAN ID	Byte	Bit	Channel	Scaling
Base Id + 2	0	0..7	Compound Id = 0	
	1	0..7	Output 1 Load	0 to 255 = 0 to 255% 1% steps
	2	0..7	Output 2 Load	
	3	0..7	Output 3 Load	
	4	0..7	Output 4 Load	
	5	0..7	Output 5 Load	
	6	0..7	Output 6 Load	
	7	0..7	Output 7 Load	
Base Id + 2	0	0..7	Compound Id = 1	
	1	0..7	Output 8 Load	0 to 255 = 0 to 255% 1% steps
	2	0..7	Output 9 Load	
	3	0..7	Output 10 Load	
	4	0..7	Output 11 Load	
	5	0..7	Output 12 Load	
	6	0..7	Output 13 Load	
	7	0..7	Output 14 Load	
Base Id + 2	0	0..7	Compound Id = 2	
	1	0..7	Output 15 Load	0 to 255 = 0 to 255% 1% steps
	2	0..7	Output 16 Load	
	3	0..7	Output 17 Load	
	4	0..7	Output 18 Load	
	5	0..7	Output 19 Load	
	6	0..7	Output 20 Load	
	7	0..7	Output 21 Load	
Base Id + 2	0	0..7	Compound Id = 3	
	1	0..7	Output 22 Load	0 to 255 = 0 to 255% 1% steps
	2	0..7	Output 23 Load	
	3	0..7	Output 24 Load	
	4	0..7	Output 25 Load	
	5	0..7	Output 26 Load	
	6	0..7	Output 27 Load	
	7	0..7	Output 28 Load	
Base Id + 2	0	0..7	Compound Id = 4	
	1	0..7	Output 29 Load	0 to 255 = 0 to 255% 1% steps
	2	0..7	Output 30 Load	
	3	0..7	Output 31 Load	
	4	0..7	Output 32 Load	

CAN ID	Byte	Bit	Channel	Scaling
Base Id + 3	0	0..7	Compound Id = 0	
	1	0..7	Output 1 Voltage	0 to 255 = 0 to 51 V 0.2 V steps
	2	0..7	Output 2 Voltage	
	3	0..7	Output 3 Voltage	
	4	0..7	Output 4 Voltage	
	5	0..7	Output 5 Voltage	
	6	0..7	Output 6 Voltage	
	7	0..7	Output 7 Voltage	
Base Id + 3	0	0..7	Compound Id = 1	
	1	0..7	Output 8 Voltage	0 to 255 = 0 to 51 V 0.2 V steps
	2	0..7	Output 9 Voltage	
	3	0..7	Output 10 Voltage	
	4	0..7	Output 11 Voltage	
	5	0..7	Output 12 Voltage	
	6	0..7	Output 13 Voltage	
	7	0..7	Output 14 Voltage	
Base Id + 3	0	0..7	Compound Id = 2	
	1	0..7	Output 15 Voltage	0 to 255 = 0 to 51 V 0.2 V steps
	2	0..7	Output 16 Voltage	
	3	0..7	Output 17 Voltage	
	4	0..7	Output 18 Voltage	
	5	0..7	Output 19 Voltage	
	6	0..7	Output 20 Voltage	
	7	0..7	Output 21 Voltage	
Base Id + 3	0	0..7	Compound Id = 3	
	1	0..7	Output 22 Voltage	0 to 255 = 0 to 51 V 0.2 V steps
	2	0..7	Output 23 Voltage	
	3	0..7	Output 24 Voltage	
	4	0..7	Output 25 Voltage	
	5	0..7	Output 26 Voltage	
	6	0..7	Output 27 Voltage	
	7	0..7	Output 28 Voltage	
Base Id + 3	0	0..7	Compound Id = 4	
	1	0..7	Output 29 Voltage	0 to 255 = 0 to 51 V 0.2 V steps
	2	0..7	Output 30 Voltage	
	3	0..7	Output 31 Voltage	
	4	0..7	Output 32 Voltage	

CAN ID	Byte	Bit	Channel	Scaling
Base Id + 4	0	6..7	Compound Id = 0	
	0	0..5	Output 1 Status	0 = Output off 1 = Output on 2 = Output Over-Current Error 4 = Output Fault Error
	1	0..7	Output 2 Status	
	2	0..7	Output 3 Status	
	3	0..7	Output 4 Status	
	4	0..7	Output 5 Status	
	5	0..7	Output 6 Status	
	6	0..7	Output 7 Status	
	7	0..7	Output 8 Status	
Base Id + 4	0	6..7	Compound Id = 1	
	0	0..5	Output 9 Status	0 = Output off 1 = Output on 2 = Output Over-Current Error 4 = Output Fault Error
	1	0..7	Output 10 Status	
	2	0..7	Output 11 Status	
	3	0..7	Output 12 Status	
	4	0..7	Output 13 Status	
	5	0..7	Output 14 Status	
	6	0..7	Output 15 Status	
	7	0..7	Output 16 Status	
Base Id + 4	0	6..7	Compound Id = 2	
	0	0..5	Output 17 Status	0 = Output off 1 = Output on 2 = Output Over-Current Error 4 = Output Fault Error
	1	0..7	Output 18 Status	
	2	0..7	Output 19 Status	
	3	0..7	Output 20 Status	
	4	0..7	Output 21 Status	
	5	0..7	Output 22 Status	
	6	0..7	Output 23 Status	
	7	0..7	Output 24 Status	
Base Id + 4	0	6..7	Compound Id = 3	
	0	0..5	Output 25 Status	0 = Output off 1 = Output on 2 = Output Over-Current Error 4 = Output Fault Error
	1	0..7	Output 26 Status	
	2	0..7	Output 27 Status	
	3	0..7	Output 28 Status	
	4	0..7	Output 29 Status	
	5	0..7	Output 30 Status	
	6	0..7	Output 31 Status	
	7	0..7	Output 32 Status	

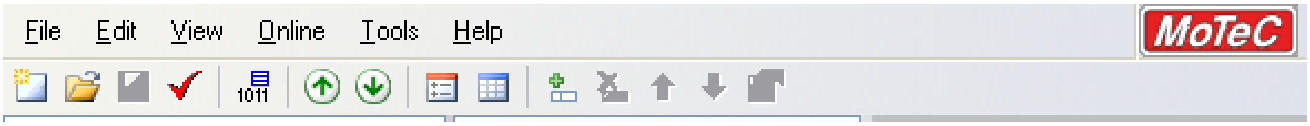
CAN ID	Byte	Bit	Channel	Scaling
Base Id + 5	0	0..7	Compound Id = 0	
	1	0..7	Input 1 Voltage	0 to 255 = 0 to 51 V 0.2 V steps
	2	0..7	Input 2 Voltage	
	3	0..7	Input 3 Voltage	
	4	0..7	Input 4 Voltage	
	5	0..7	Input 5 Voltage	
	6	0..7	Input 6 Voltage	
	7	0..7	Input 7 Voltage	
Base Id + 5	0	0..7	Compound Id = 1	
	1	0..7	Input 8 Voltage	0 to 255 = 0 to 51 V 0.2 V steps
	2	0..7	Input 9 Voltage	
	3	0..7	Input 10 Voltage	
	4	0..7	Input 11 Voltage	
	5	0..7	Input 12 Voltage	
	6	0..7	Input 13 Voltage	
	7	0..7	Input 14 Voltage	
Base Id + 5	0	0..7	Compound Id = 2	
	1	0..7	Input 15 Voltage	0 to 255 = 0 to 51 V 0.2 V steps
	2	0..7	Input 16 Voltage	
	3	0..7	Input 17 Voltage	
	4	0..7	Input 18 Voltage	
	5	0..7	Input 19 Voltage	
	6	0..7	Input 20 Voltage	
	7	0..7	Input 21 Voltage	
Base Id + 5	0	0..7	Compound Id = 3	
	1	0..7	Input 22 Voltage	0 to 255 = 0 to 51 V 0.2 V steps
	2	0..7	Input 23 Voltage	

Windows Keyboard Shortcuts

When using a laptop in and around a car, it is often not practical to use a mouse to navigate through the program.

Using the keyboard to select options is easier.

Main Menu



To access the main menu, press ALT + the key for the underlined letter in the menu, followed by the underlined letter of the item in the drop down menu. E.g. ALT + F, N for File New.

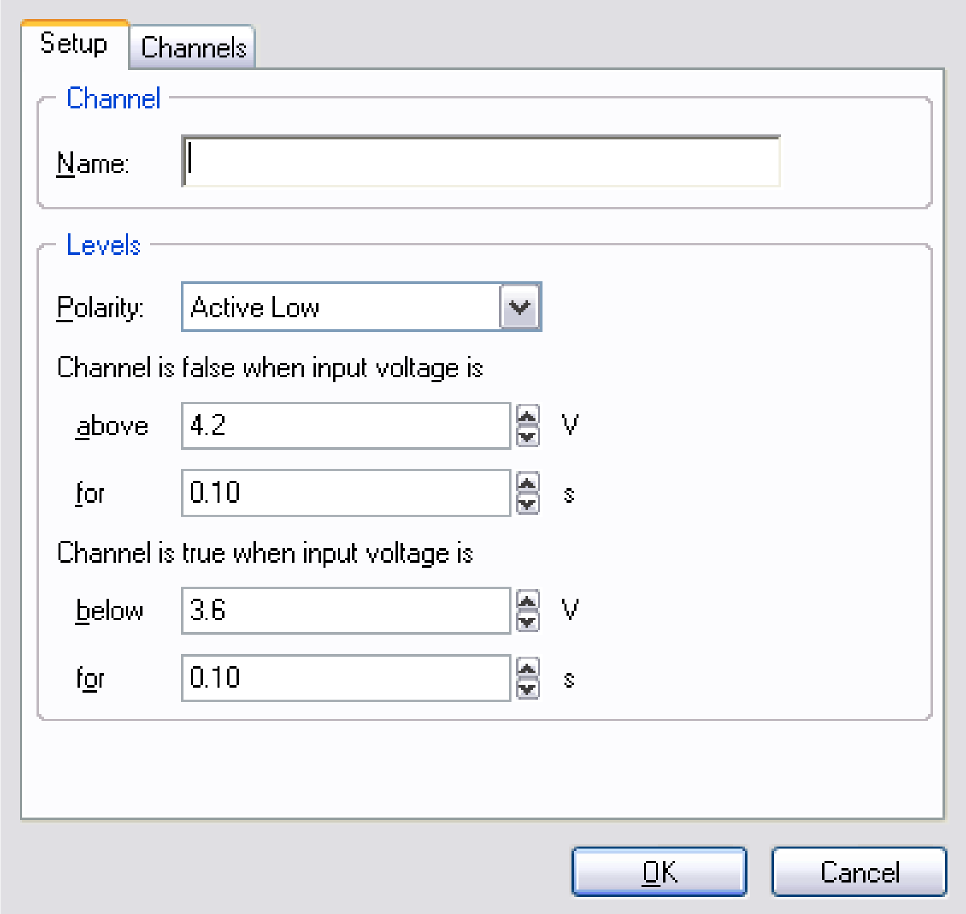
Alternatively press and release ALT, select the desired menu item using the arrow keys, press ENTER to activate it.

Closing a Window

Press ENTER for OK or Close (only when the OK or Close button has a bold line around it)

Press ESC to Cancel or Close

Selecting an Item in a Window



To access the various items in a window, press ALT + the key for the underlined letter of the item of interest, e.g. to select 'Polarity' press ALT + P

Alternatively use the TAB key to move through the dialog box (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 the type of control. The common controls are detailed below:

Check Box

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

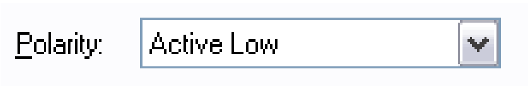
Press ALT + the key for the underlined letter, or use the TAB key to navigate to the Check Box. To select, press SPACEBAR.

Command Button

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

Press ALT + the key for the underlined letter, or use the TAB key to navigate to the command button. To select, press ENTER or SPACEBAR.

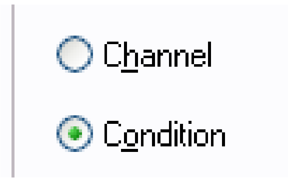
Drop-down List Box



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

Press ALT + the key for the underlined letter or use the TAB key to navigate to the Drop-down List Box. To select the desired item, use the arrow keys and press ENTER to close the list.

Group Box



The Group box is used to select an item from a group of options.

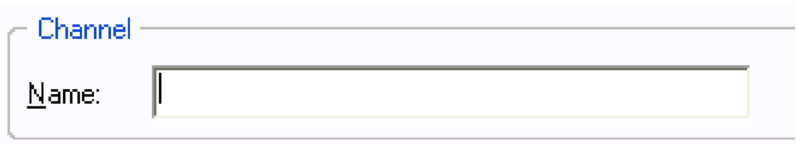
Press ALT + the key for the underlined letter, or use the TAB key to navigate to the Group box. To select, use the arrow keys.

Tabs

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

To select the next tab, press CTRL + TAB. To select the previous tab, press CTRL + SHIFT +TAB.

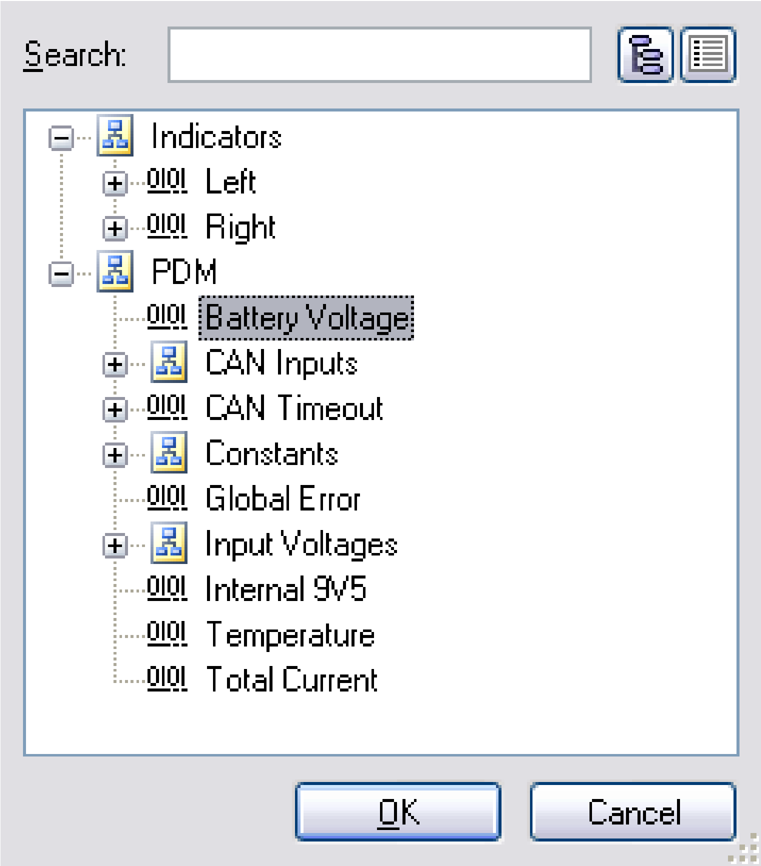
Text Box



A text box is used to enter a value or text.

Press ALT + the key for the underlined letter or use the TAB key to navigate to the Text Box, type in the new value or text. Use the BACKSPACE or DELETE to remove unwanted characters.

Tree Structure



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

The UP ARROW key moves the cursor up (selects the item above)

The DOWN ARROW key moves the cursor down (selects the item below)

The RIGHT ARROW key expands; expandable branches indicated by a plus sign (+)

The LEFT ARROW key collapses; collapsible branches indicated by a minus sign (-)

Glossary

MoTeC Devices

ACL	Advanced Central Logger
ADL2	Advanced Dash Logger - second generation
ADL3	Advanced Dash Logger - third generation
BR2	Beacon Receiver
BTX	Beacon Transmitter
CIM	Computer Interface Module
CLS	Central Logging System
DBW4	Drive By Wire expander
E816	Input/Output Expander
E888	Input/Output Expander
i2	MoTeC data analysis software
i2 Pro	MoTeC data analysis software, professional version
IEX	Ignition Expander
LTC	Lambda to CAN module
LTCD	Lambda to CAN Dual module
M2R	ECU dedicated to run 2 rotor engines
M4	ECU for engines with up to 4 cylinders or up to 2 rotors
M400	ECU for modern engines with up to 4 cylinders or up to 2 rotors
M48	ECU for engines with up to 8 cylinders and 2 rotors
M600	ECU for modern engines with up to 6 cylinders or up to 3 rotors
M800	ECU for modern engines with up to 12 cylinders or up to 4 rotors
M800 Plug-In	ECU for direct replacement of a factory ECU
M880	ECU for modern engines with up to 12 cylinders or up to 4 rotors
MDC	Mitsubishi Diff Controller
MDD	Mini Digital Display
MLS	ECU dedicated to run Chevrolet LS1 and Lexus/Toyota V8s
PCI cable	PC Interface cable
PDM15	Power Distribution Module with 15 outputs
PDM16	Power Distribution Module with 16 outputs

PDM30	Power Distribution Module with 30 outputs
PDM32	Power Distribution Module with 32 outputs
PLM	Professional Lambda Meter
RTC	Real Time Clock
SDC	Subaru Diff Controller
SDL	Sport Dash Logger
SGA	Strain Gauge Amplifier
SLM	Shift Light Module
SUU	Software Update Unit
TCM	Traction Control Module
UTC	USB to CAN adaptor
VIM	Versatile Input Module

Other

Calibration	The process of converting an electrical value into a physical value e.g. Volts into kilometres per hour
CAN	Controller Area Network - communication protocol
CDI	Capacitive Discharge Ignition
ECU	Engine Control Unit
GPS	Global Positioning System
MAF	Mass Air Flow
MAP	Manifold Absolute Pressure
PID	Proportional, Integral and Derivative gain
PWM	Pulse Width Modulated.
RPM	Revolutions Per Minute
RS232	Recommended Standard 232, communication protocol
RX	Receive
TDC	Top Dead Centre
TX	Transmit