Power Control Module
PCM2

The Next Generation Intelligent Power Distribution Module

Installation and User Guide for PCM2 Firmware and Tool Version 1.47

With Membrane Switch Panel and Steering Wheel Controller Version 2.9

OBR *Control Systems*

Version 2.71 – October 2018

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1 Introduction

The award winning PCM2 takes the whole Power Control Module concept much further than conventional modules. Based on our experience and success of the first generation module, PCM2 is a very powerful, flexible and technically advanced module. PCM2 is a huge step ahead of the old model, in technology, features and its very high current handling ability.
It provides an effective and inspired alternative to conventional relays, circuit breakers, fuses and wires that can so often be a tangle of complexity and untidiness around a typical racing car's power junction box.
PCM2 is a compact and light weight module, measuring 191 x 176 x 36 mm (excluding the Autosport connectors).

PCM2 has 48 power output channels, arranged as:
-   26 normal power channels, each max 8 A continuous power supply.
-   2 normal and wiper motor power channels, each max 8 A continuous power supply.
-   4 low power channels with PWM, each max 8 A continuous power supply.
-   14 high power channels, each max 20 A continuous power supply.
-   2 high power channels with PWM, each max 20 A continuous power supply.
-   2 very high power channels, each max 20 A continuous power supply, inrush current up to 200A.

All outputs are protected against reversed battery polarity.

Current draw can be measured on all 48 power channels:
-   From 50 mA on 4 low power channels (not in current software release)
-   From 200 mA on all other channels.

Any of these channels can be controlled by various types and combinations of inputs:
-   14 digital inputs with automatic sensing of high, low and floating potential.
-   16 analogue 0..5 Volt sensor inputs with 16 bit resolution.
-   64 individually programmable CAN inputs, 11 or 29 bit identifiers, with bit operator.
-   4 individually programmable CAN ports.

PCM2 is also equipped with 4 tri-state outputs. A tri-state output is only for use as an ECU trigger signal. Do not connect any of these four channels to any output load.

In addition to the 4 CAN ports, PCM2 is also equipped with a LIN bus. PCM2 can be configured as either a LIN bus master or slave.
Use the LIN bus for example to control the alternator charge current or to control the wiper motor. Not in current software release.

Instead of using a conventional control program, PCM2 benefits from a multitasking operating system.
Furthermore, PCM2 is equipped with a real time clock and also has a built-in data recording facility with a memory capacity of typically 2 Gb, depending on requested data card capacity.
Data is downloaded via the Ethernet connection (not in current software release).

Please note that the maximum recommended current draw per channel is limited by the connector contacts - not by PCM2's driver stages. We have rated the individual channel's current draw in relation to the connector manufacturer's specifications.

PCM2 is programmed to shut overloaded channels down if the current draw and internal junction temperatures exceed pre-set levels.
Board temperatures are monitored and can be exported via CAN.

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For normal running conditions, the user can set limits for inrush current level and time, the fused threshold for continuous current draw plus the number of retries and retry time intervals for each output channel.
A manual reset function of all channels in fault mode is also available.

The current draws and channel status can be exported via one of the available CAN bus.

PCM2 offers CAN routing between ay of the 4 available CAN ports.

Please note that the PCM is not intended to be used to control safety-critical systems on a vehicle, such as ABS braking, power steering, etc.

OBR Control Systems Inc. shall not be responsible for any incidental or consequential damages or injuries that may occur if the unit is used to control these, or similar, safety-critical systems.

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2 Hardware

The PCM2 enclosure is CNC machined to the highest standards.
The two parts of the casing are sealed by an O-ring, located in a recess in the main half. A lip in the lid presses on the O-ring and assures a water tight sealing. The connectors are individually sealed.

Connector #1 is a Deutsch Autosport Heavy Duty single pin connector, type ASHD0 14-1 PN. This is a specially developed connector, designed to conduct very high currents with very low losses and to withstand high temperatures.
We recommend using a 35 sq.mm heavy duty battery cable as the main power supply.
The mating connector on the wiring loom must be ASHD6 14-1 SN C35.

Connector #2 is a Deutsch Autosport connector, type AS2 20-16 SN. This connector has 16 size AWG 16 contacts and each contact is designed to handle a maximum current of 20 A.
The mating connector on the wiring loom must be a Deutsch AS6 20-16 PN or a Souriau 8STA6 20-16 PN.

Connector #3 is a Deutsch Autosport connector, type AS2 20-39 SA. It has a different keyway to connector 2, preventing incorrect mating of connectors.
This connector has 37 size AWG 20 contacts and 2 size AWG 16 contacts. Each AWG 20 contact is designed to handle max 8 A current.
The two size AWG 16 contacts (pins m and r) in this connector are power ground connections and must be connected to earth.
The mating connector on the wiring loom must be Deutsch AS6 20-39 PA or a Souriau 8STA6 20-39 PA (yellow coding).

Connector #4 is a Deutsch Autosport connector, type AS2 16-35 SN. This connector has 55 size AWG 22 contacts and is used for signal, sensor supplies and data connections.
The mating connector on the wiring loom must be a Deutsch AS6 16-35 PN or a Souriau 8STA6 16-55 SN.

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3 Software installation

The software does not need any installation, it can be run from a program folder which contains the main initialisation file, the executable file and – if used – the device driver for the Peak System PCAN interface.
The software can be down loaded from our web site – www.obr.uk.com.

3.1 Software installation from web-download
It is possible to download the PCM2 support tab from our web site. Go to www.obr.uk.com and select the Support tab.

When you have downloaded the PCM2 software, open the folder where you saved the file and double click on the installation file. This file is called SETUP PCM2 vX_YZ.EXE where X_YZ refers to the software release version.

3.2 PC Software and Firmware Releases
Each new release of PCM2 firmware requires an updated, specific PC tool release.
Any new release of the PC tool is backwards compatible, meaning that it will support earlier PCM2 firmware releases.
Please note, that new features visible in the new tool will not functioning if used in conjunction with old firmware versions.
It is strongly recommended always to use the latest software releases and always make sure you use tool and firmware having the same release version number.

3.3 Connection to system
Communication between the PC tool and a PCM2 is established via any of the available 4 CAN ports, using a USB CAN interface. Connection is automatic; no user commands are required.

Support for three different versions of interfaces are provided with the system:
-    Blue CANUSB interface from Lawicel.
-    PCAN USB CAN interfaces from Peak Systems.
-    EFI Technology USB-CAN interface (EFP02 or EFT20)

If you use the Peak System PCAN interface, it is essential that the file PCANBASIC.DLL is located in the same PCM2 folder as the programme files.
Separate installation of interface drivers is required.

Access to the system may be limited due to the assigned user rights, please see section 4.5 and section 7.

If you disconnect from the system, communication will be re-established when you plug the cable in again.

3.4 Wiring Harness

OBR can supply complete, custom made wiring harnesses for bespoke installations.
Our harnesses are manufactured by specialists, using only the best suitable materials for use in the harsh environment of a modern racing or rally car.

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4 Main Menu

The PC tool has 6 main menu sections:
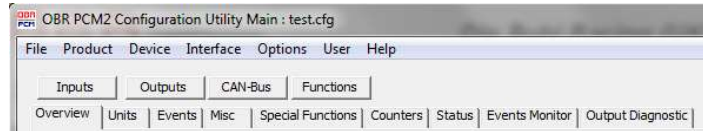
4.1 File

You can open an existing configuration file by clicking on FILE and then select OPEN.
Use **F2** as a hot key to open a new configuration file.
Default file location is in this folder: c:\program files\obr control systems\powerbox

You can save a configuration file on your PC by clicking on FILE, then SAVE. Now select the folder where you want to save the file (by default c:\program files\obr control systems\powerbox), type a file name and click OK. Use **F3** as a hot key to save a configuration file.
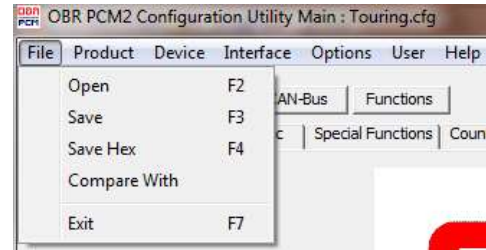
Click on *Save Hex* to save a configuration file as a hex file. Use **F4** as a hot key for this function.

You can display differences between two configuration files by selecting the function COMPARE WITH. Please refer to section 6.

Click on EXIT to close the PCM2 tool. Use **F7** as a hot key to close the programme.

4.2 Product

This tool supports two versions from the PCM2 product family:
- PCM2 is this 48-channel module.
- hPCM_AC is the 8-channel module, which has these main features:
  - o 8 high side outputs
  - o 2 CAN port with full routing option
  - o 8 analogue 0..5V sensor inputs
  - o 8 digital inputs
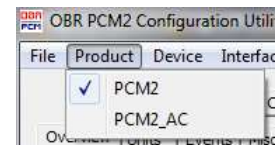
4.3 Device

4.3.1 Read

You can read the PCM2 configuration file by clicking on READ in the menu DEVICE.
Use **F8** as a hot key to read the configuration from PCM2.

4.3.2 Write

You can upload a new configuration from the PC tool to PCM2 by clicking on WRITE.
Use **F9** as a hot key to write a new configuration file to PCM2. Once the new configuration file has been transmitted to the PCM2, the module is re-booted automatically.
An error message may pop up:
It is not possible to send a configuration file to PCM2 if more than one event controls a single output.
Please see section 5.3.
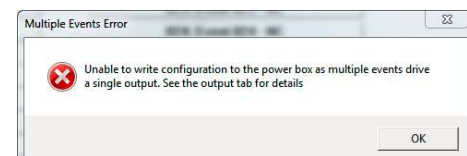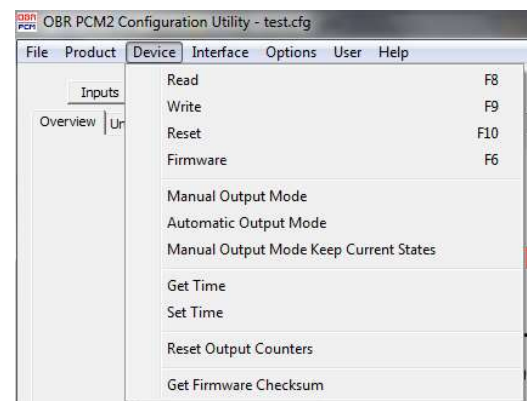
Please note, that a configuration file can only be uploaded if the battery supply voltage is above 10 Volts.

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4.3.3 Reset

Use **F10** as a hot key to re-boot the PCM2 manually.
PCM2 is automatically reset after a firmware update and also after uploading a new configuration.

4.3.4 Firmware

Click on FIRMWARE to update the PCM2 firmware. Once the firmware has been transmitted, PCM2 performs an automatic re-boot.
A new firmware includes new PCM2 features and it is essential that you also update your PC tool, too. The latest PC tool released is always backwards compatible. It can be used with older versions of firmware, but new features in the tool will of course not work without a firmware update.
Use **F6** as a hot key to update firmware.

4.3.5 Manual Output Mode

Manual Output Mode is used to check the switching and current draw of any output, manually controlled by the PC tool.
When power is applied to PCM2 it starts by default in automatic mode.
In Manual Output Mode all events are deactivated and no automatic or programmed switching is possible. Instead, it is only possible to switch each single output ON and OFF using the PC tool.
Go to section OUTPUTS for further information.

4.3.6 Automatic Output Mode

By clicking Automatic Output Mode PCM2 is switched back into automatic mode. Automatic mode is also re-established if the PC tool is disconnected from PCM2.

4.3.7 Manual Output Mode, Keep Current States

When this option is selected, PCM2 is in manual operating mode, but keeps its setting from the instant when it is switched into manual mode. Any output which were switched on, remains on in this mode, but can be switched off manually if required.

4.3.8 Get Time

Click Get Time to read date and time from PCM2's internal real time clock.

4.3.9 Set Time

Click Set Time to update PCM2's real time clock with the date and time from the PC connected. Ensure that your PC clock has the required time.

4.3.10   Reset Output Counters

Click this option to reset all diagnostic counters and error messages.

4.3.11   Get Firmware Checksum

Click this option to display current firmware version checksum. This is an essential feature if your system is homologated using specific firmware releases, for example in accordance with FIA's requirements for WTC and WRC.

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4.4 Interface

Click *Interface* and then select the USB-CAN interface in use. Once the right interface is selected, communication will be established between PCM2 and the PC tool. No other action is required.

These interfaces are currently supported:

- CANUSB blue interface from Lawicel
- PCAN-USB interface from Peak Systems
- EFP02 or EF20 CAN interfaces from EFI Technology can be used
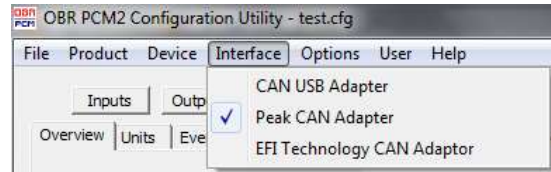
Communication status is displayed in the tool by a coloured LED in the upper right hand corner:

- Purple   No or incorrect interface connected.
- Red   No CAN communication.
- Green   CAN communication OK.

4.5 Options

4.5.1 Reset Display

When disconnecting from PCM2 all display screens in the PC tool would normally be reset when disconnecting from the PCM2.

Tick this option to retain display information on display screens when disconnecting from PCM2.
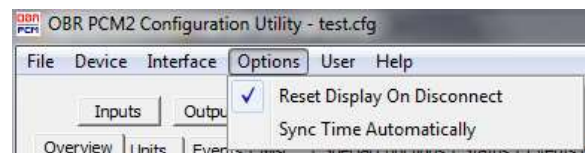
4.5.2 Sync Time Automatically

When connecting to PCM2, it is possible to automatically synchronise its real time clock with the PC connected. Tick this option to synchronise the time and date between PCM2 and the PC.

4.6 User

It is possible to protect PCM2 from unauthorised access by configuring up to 5 individual user levels and individually selected passwords:

- Read Only
- Read / Write
- Supervisor
- Administrator
- Partner (full access by default)

Please refer to section 7 for description of this feature.

4.7 Help

Click HELP TOPICS to open the PCM2 help file.
Use **F1** as a hot key to open the help file. (Feature not implemented in this release).

Click About to display tool release version.

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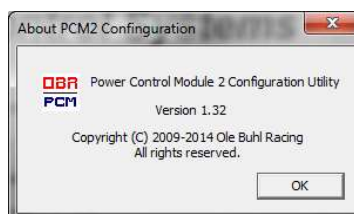
5 Functions

The PCM2 PC tool is divided into sub sections.
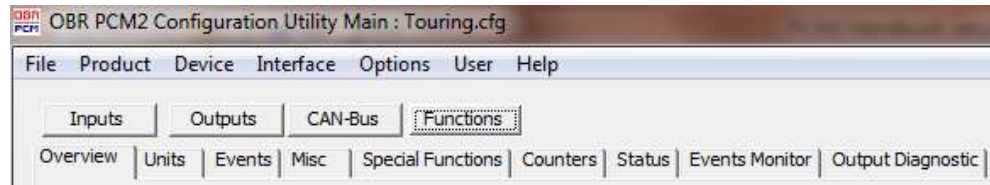
When the programme opens, it displays the *Overview* section by default.

5.1 Overview
This section displays the following PCM2 information:

Serial Number
PCM2 production serial number.
Information entered by OBR during assembly.

Intended Serial Number
The actual configuration can only be used with a PCM2 having this serial number.

Hardware version
PCM2 hardware release version. Information entered by OBR during assembly.

Power Box Name
Reference name for actual powerbox. Maximum 15 characters can be used.

The PC tool displays the actual firmware version in this section, see "Configuration Utility Version".

5.2 Units
Use this section to assign a unit to analogue and CAN channels. These settings can be applied in INPUTS, sections "Analogue Inputs" and "CAN Inputs".

5.3 Event Handling
PCM2 is controlled by configurable events. Events are used to create simple as well as complex logic conditions. For example, a digital input can switch a single output using a single event, or by a complex string of events.
Please note that an output must be controlled by a single event.
512 individual events are available and each can be defined as a specific type:

5.3.1 Event Type

Select between the following types of control strategies.

5.3.1.1 Input follow
Name the event to make it easy to trace it later.
Select the input trigger for the event.
Set the conditions for switching between true and false.
For example, selecting a digital input, the event is ON when the switch is ON. It is OFF when the digital switch is OFF.
Select the output to trigger. Select NONE if this is a conditional event only.

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5.3.1.2 Input toggle
Name the event to make it easy to trace it later.
Select the input trigger for the event.
Set the conditions for switching between true and false.
For example, selecting a digital input, the event will switch ON when the switch is pressed momentary ON. It will switch OFF when the digital switch is pressed again momentary.
Select the output to trigger. Select NONE if this is a conditional event only.

5.3.1.3 AND gate
The AND gate combines up to five events to set switching conditions.
All added events have to be true for the final event to be true.

Input A	Input B	Output
0	0	0
0	1	0
1	0	0
1	1	1

Select the output to trigger. Select NONE if this is a conditional event only.

5.3.1.4 OR gate
The OR gate combines up to five events to set switching conditions.
Any of the added events have to be true for the final event to be true.

Input A	Input B	Output
0	0	0
0	1	1
1	0	1
1	1	1

Select the output to trigger. Select NONE if this is a conditional event only.

5.3.1.5 NOR gate
The NOR gate combines up to five events to set switching conditions.
If any of the added events are true, the final event will be false.

Input A	Input B	Output
0	0	1
0	1	0
1	0	0
1	1	0

Select the output to trigger. Select NONE if this is a conditional event only.

5.3.1.6 XOR gate
The XOR gate combines up to five events to set switching conditions.
When one and only one of the added events are true, the final event will be true.

Input A	Input B	Output
0	0	0
0	1	1
1	0	1
1	1	0

Select the output to trigger. Select NONE if this is a conditional event only.

Not Used
Input Follow
Input Toggle
AND Gate
OR Gate
NOR Gate
XOR Gate
NOT Gate
Flash
Delay Input On
Delay Input Off
Counter Increment
Counter Decrement
Reset
Clock
Always On
Tri-State Output
Wiper Output
Evt Flash
Evt Delay On
Evt Delay Off
Evt Wiper

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5.3.1.7 NOT gate
The NOT gate inverts a single input event.

Input A	Output
0	1
1	0

Select the output to trigger. Select NONE if this is a conditional event only.

5.3.1.8 Flash
Defining a flash event it is possible to set:
- Time ON (how long time is the output switched ON)
- Time OFF(how long time is the output switched OFF)
- Initial status, ON or OFF (Flash starts with output switched ON or OFF)

Select the output to trigger. Select NONE if this is a conditional event only.

5.3.1.9 Delay input ON
Using this event it is possible to set a delay timer for switching the event to true.

5.3.1.10   Delay input OFF
Using this event it is possible to set a delay timer for switching the event from true to false.

5.3.1.11   Counter Increment
This event is used to count sequence increments and is linked with the counters defined in section 5.6.
This event will generate a count each time the event it is linked to, changes from false to true.
The sequence in which it counts is defined in section 5.6, Counters.

Use this event within any other event to trigger outputs or conditions when certain count values are reached.

5.3.1.12   Counter Decrement
This event is used to count sequence decrements and is linked with the counters defined in section 5.6.
This event will generate a count each time the event it is linked to, changes from false to true.
The sequence in which it counts is defined in section 5.6, Counters.

Use this event within any other event to trigger outputs or conditions when certain count values are reached.

5.3.1.13   Reset
Use this event to define a reset function for output channels. The reset function will restart outputs which are in a fault status only. No other channels are influenced.
The reset function can be used with any input or output and any channel status or current draw.
A typical installation combines the fault warning light and a reset switch.
PCM2 has a dedicated output for a fault warning light. Pin 42 in connector #4 provides a 5 volt signal out in case one of the output channels goes into a fault mode.

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It is recommended to use a LED with a 1 kOhm resistor in-line as a warning light, but a conventional light bulb can be used, too.
Observe the current draw does not exceed 1A.
The reset function could be based on grounding the warning light signal when ON, creating a fault.
Grounding the warning lamp will cause a current draw in excess of 1A so you must ensure your wiring can withstand such current level.
Creating a Reset event on this strategy, proceed this way:

- Select RESET as an event type.
- Name the event, for example "RESET".
- Select "Fault – Warning Lamp" as source input
- Set "Turn ON" as ">1".
- Set "Turn OFF as "< 2".

We can supply a combined switch and a 5 volt LED warning light.
Refer to section 5.9 for fault message codes.

5.3.1.14 Clock
Use this event to link the switching to the real time clock.

5.3.1.15 Always ON
Use this event to switch the event to true once power is applied to the PCM2, for example when the master switch is ON.

5.3.1.16 Tri-state output
The tri-state outputs are used as triggers for external systems. Their value can change between 0, 2.5 and 5.0 volts.
Do not expose these outputs to any load, they are trigger channels only.

5.3.1.17 Wiper output
Two dedicated wiper channels are available. These channels are fitted with braking diodes, ensuring the wipers stop when the park signal is detected.
Create an event for the park signal. The park signal can be either a ground or battery power signal.
Import this event as the Stop event.
Select an input to trigger the wiper. When this input is switched OFF, the wiper motor will continue running until the park signal is detected.
Please refer to section 5.3.1.21 for an event controlled wiper function.

5.3.1.18 Event Flash
Use this function if an event is required to trigger the flash function.
See 5.3.1.8.

5.3.1.19 Event Delay On
Use this function if it is required to delay switching an event controlled output ON.

5.3.1.20 Event Delay Off
Use this function if it is required to delay switching an event controlled output OFF.

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5.3.1.21   Event Wiper

The wiper function can also be controlled by an event instead of a direct input as described in section 5.3.1.17.

Using this function makes it possible to combine wiper strategies, for example combining the wipe wash and wipe delay with normal wiper function.

5.3.2   Event Name

Name the even for easy identification.

5.3.3   Source Input

Select the input controlling this event.

Inputs can be:
- Digital inputs
- Analogue inputs
- Current draws
- Fault status
- CAN inputs (from all four CAN ports)
- Counters
- Temperature

5.3.3.1   Fault Status

To detect a failed PCM2 output create an event for each output.

- Select Event Type as Input Follow.
- Name the event, for example Fault LP01.
- Select the input as the Fault for the actual output, for example called Fault LP01.
- Set the threshold for detecting an error to "**>1**".
- Set the threshold for detecting no fault to "**<2**".
- Click Save.

The value for registering an error must be greater than 1 (>1) because 0 indicates OFF while 1 indicates ON. An error condition generates a code value of typical 16 and greater.

No error codes will have values less than 2, therefore the cancellation of error detection must be set to a value less than 2 (<2).

5.3.4   Turn ON / Turn OFF

Select the conditions for switching On (or OFF):
- =   Equal to
- <   Less than
- >   Greater than
- <=   Less than or equal to
- >=   Greater than or equal to
- !=   Not equal to

5.3.5   Event 1 / 2 / 3 / 4 / 5

Select events as inputs to set conditions in these types of events:
- AND gate
- OR gate
- NOR gate
- XOR gate
- NOT gate

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- Tri-state outputs
- Wipers
- Event Flash
- Event Delay On
- Event Delay Off

5.3.6 Time (ms)

Set the On and OFF timers for use with these functions:
- Flash
- Delay Input On
- Delay Input Off

5.3.7 CAN Inputs – Lost CAN Action

For safety reasons it is possible to set conditions for channels controlled via CAN.
If the CAN bus communication is lost at any time for a defined time interval (in milliseconds) the following actions can be defined, individually for each CAN invent:
- Do nothing (keep current status)
- Turn Off (switch the output off when the CAN lost timer expires)
- Turn On (switch the output on when the CAN lost timer expires)

5.3.8 CAN Lost Timer

This defines a time interval for receiving CAN messages. If a given CAN message is not updated within the time interval, the system considers the CAN bus has gone into fault mode.
DO NOT SET THIS INTERVAL TO 0 (ZERO)!
It is recommended to use an interval of app. 2.5 times the message update rate. For example, if the update interval is 100 msec, it is recommended to set the time interval to 250 msec. During this time interval the system should recognise 2 messages, confirming the CAN bus is functioning.
Select which output this event controls.
Select NONE if this is a conditioning event which is part of a logic switch string.
It is essential that only one (1) event controls a given output. If multiple switching conditions apply, these must be joined in a single, final event, for example an AND, OR etc event,

5.3.9 Start State

Use this function to define whether a flash function starts having the output switched ON or OFF.

5.3.10 Output

Select an output to be triggered by the event. If the actual event is a conditional event, no output is selected.

5.3.11 Multiplier

Not in use in this software release.

5.3.12 Counter

Refer to sections 5.3.1.11, 5.3.1.12 and 5.6 for a description of the counter features.
Select a configured counter to use with the Counter event.

5.3.13 Clock

This feature is used with the Clock event.
Set time for switching On and set a time for switching Off.
Click "Save" to save the event configuration.
Click on the "Visualise" button to open the visualisation display. See section 8.

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5.4 Miscellaneous

- PCM2 minimum voltage (recommended setting 6,000 mV)
  The battery voltage level has to drop below this low threshold for 10 seconds before outputs are switched off. The voltage level has to rise above the minimum voltage level plus 500 mV for minimum 10 seconds before outputs are turned on again.
- PCM2 maximum voltage (recommended setting 30,000 mV)
  The battery voltage level has to rise above this high threshold for 10 seconds before outputs are switched off. The voltage level has to drop below the maximum voltage level minus 500 mV for minimum 10 seconds before outputs are turned on again.

5.5 Special Functions

It is possible to assign outputs to switch ON or to switch OFF when specific events are selected, independent of the event status.
Switching outputs are controlled by this order of priority:
- 1st order of priority is Special Functions OFF
- 2nd order of priority is Special Functions ON
- 3rd order of priority is normal event handling

5.5.1 Special function ON

It is possible to switch outputs ON when selected events becomes true.

This switch status overrides normal event handling as it has the highest applied priority.
It is possible to select up to 8 individual events controlling the special function ON.
For each of these events it is possible to select individual outputs which must switch ON when the condition is true.
To turn a specific output ON when the input event is true tick the box for the outputs as shown.
Please note that tri-state outputs are forced to +5V when activated through special event ON.

5.5.2 Special function OFF

It is possible to switch outputs OFF when selected events become true.
This switch status overrides normal event handling as it has the highest applied priority.
It is possible to select up to 8 individual events controlling the special function OFF.
For each of these events it is possible to select individual outputs which must switch ON when the condition is true.
For example, to preserve battery power during cranking, PCM2 is requested to switch high current consumption outputs off.
Create an event for activating the starter solenoid.
Set this event for example as EVENT 01.
Click on Set Output Map to open the configuration tables. Each PCM2 output can be linked to 8 conditioning events.
To turn a specific output OFF when the input event is true tick the box for the outputs as shown.

Please note, that special function maps have overall priority over any event controlled function.

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5.6 Counters

This section is used to define PCM2's ability to count sequences.

16 individual counters are can be configured.

Two types of counters are available; one counting up to maximum 255 and one counting down from maximum 255.

Sequences are counted from 0 to the value in **End** or from the value in **End** to 0.

It is possible to cycle counts using a count number different to 0 by entering a value in **Start**.

Counters which are defined in this section are used in events to create conditions – please see sections 5.3.1.11 and 5.3.1.12.

Counters count up or down in steps of 1.

5.6.1 Increment Action

It is possible to set a maximum number of counts. This can be any number between 0 and 255.

The maximum number of counts is entered in the column named **End**.

In column **Start** is set the sequence number at which the counts cycle from. This can be any number between 0 and the number entered in **End**.

It is possible to select the required action for the increment counter.

In column **Inc Action** it is possible to select between:

- **Stop at End**
  With this setting the counter will count up from **0** only once to until reaching the value set in **End**.
- **Loop End to Start**
- With this setting the counter will count up from **0** until it reaches the value in **End**, then return to **Start** and start counting up again.
- **Loop End to Zero**
- With this setting the counter will count up from **0** until it reaches the value in **End**, then return to **0** and start counting up again.

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5.6.2 Decrement Action

It is possible to set a maximum number of counts. This can be any number between 0 and 255.
The maximum number of counts is entered in the column named **End**.
In column **Start** is set the sequence number at which the counts cycle from. This can be any number between 0 and the number entered in **End**.
It is possible to select the required action for the increment counter.
In column **Dec Action** it is possible to select between:

- **Stop at Start**
  With this setting the counter will count down only once from the value in **End** until reaching the value set in **Start**.
- **Stop at Zero**
  With this setting the counter will count down only once from the value in **End** until reaching **0**.
- **Loop Start to End**
  With this setting the counter will count down from the value in **End** until it reaches the value in **Start**, then return to **End** and start counting down again.
- **Loop Zero to End**
- With this setting the counter will count down from the value in **End** until it reaches **0**, then return to **End** and start counting down again.
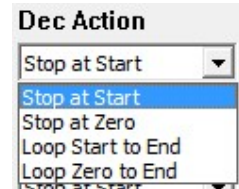
5.7 Status

This section displays the general PCM2 status.
- Status for digital switches are shown as Open, Low or High.
- Analogue channels displays sensor input voltage.
- PCM2 on-board temperature measurement in degrees Celsius on signal and power boards.
- CAN channels displays decimal channel values.
- Counters are not yet implemented.
- Vehicle battery voltage and total actual current consumption
- Tri-state output voltages.
- Real time current draws for low power outputs
- Real time current draws for low power PWM outputs
- Real time current draws for high power outputs
- Real time current draws for very high power outputs
- Real time current draws for high power PWM outputs
- Status of the three analogue sensor reference voltage supply (VREF).
- Warning light status.
- Real time current draws for wiper outputs

5.7.1 Warning Light Status

The warning light will flash error codes, making it easy to trace an eventual fault:
The following shows the priority list and the warning light will flash codes in relations to this list.
For example, if you have a fault on both CAN 1 and CAN 2, it will flash once.
If there is a fault on CAN 2 but not on CAN1 it will flash twice.

1 flash	Error on CAN 1 (you can select in tool if you want to enable this option). Displays value "1" in tool on status page.
2 flashes	Error on CAN 2 (you can select in tool if you want to enable this option). Displays value "2" in tool on status page.
3 flashes	Error on CAN 3 (you can select in tool if you want to enable this option). Displays value "4" in tool on status page.
4 flashes	Error on CAN 4 (you can select in tool if you want to enable this option). Displays value "8" in tool on status page

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5 flashes   Power output.
Displays value "16" in tool on status page.
6 flashes   Miscellaneous output.
Displays value "32" in tool on status page.
7 flashes   Real time clock.
Displays value "64" in tool on status page.
8 flashes   Faulty configuration.
Displays value "128" in tool on status page.

This diagnostics can also display a combination of errors.

5.8 Events Monitor

This section displays the status of PCM2 events.
- Green resembles a TRUE event.
- Blue resembles a FALSE event.
- Events not assigned are coloured grey or you are off-line.

5.9 Output Diagnostic

This section displays the PCM2 system diagnostic:

The columns illustrate:

Current   Displays actual real time current draw, measured in mA.

Peak   Displays highest recorded peak current, measured in mA.

OCH   Number of times the output current draw has exceeded the fixed Over Current High setting (75 A in LP, 100 A in HP).

OCL   Number of times the output current draw has exceeded the user-defined Over Current Low threshold (low hardware setting).

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OCS   Number of times the output current draw has exceeded the software threshold, Over Current Soft, the fuse value.

Thm   Thermal shut down due to high junction temperatures.

Stat   Status of output channel:

Fault status	Fault Hex Value	Fault Decimal Value
Output OFF	0x00	0
Output ON	0x01	1
Shutdown, too high voltage	0x02	2
Shutdown, too low voltage	0x04	4
Shutdown, open load	0x08	8
Shutdown, over current low OCL	0x10	16
Shutdown, over current high OCH	0x20	32
Shutdown, too high temperature	0x40	64
Shutdown, over current software OCS	0x80	128
Shutdown, over current software OCS retry	0x100	256

Please note these limitations:
-    Low power 29, 30, 31 and 32 do not support open load display.
-    All PWM channels do not support open load, temperature, high or low voltage.
-    All tri-state outputs do not support any faults.
-    All VREF sensor supplies only supports OCH, On and Off.

- If you see a value of 0 the channel is switched off.
- If you see a value of 1 the channel is switched on.
- If you see a value of 8 the channel is switched off and has no load connected to it.

Error status codes are normally shown as a combination of numbers:

- If you see a value of 17 the PCM2 is trying to switch the channel on, but the current draw has exceeded the low hardware (OCL) threshold and has gone into an error status.
- If you see a value of 33 the PCM2 is trying to switch the channel on, but the current draw has exceeded the high hardware (OCH) threshold and has gone into an error status.
- If you see a value of 129 the PCM2 is trying to switch the channel on, but the current draw has exceeded the software (OCS) threshold and has gone into an error status.

Using the Reset event to restart any outputs in failure status does not clear this diagnostic, only the status column if the fault has been removed.

In general, switching a channel OFF then ON will attempt a restart even if the channel has failed earlier.
Only channels which have failed will be reset.

Please Note:
All error counts and peak currents detected and shown in this section are **NOT** affected by a power cycle of PCM2. They remain stored in PCM2's diagnostics, safe for later analysis.
To clear output diagnostic data, look in the tools main menu in "Device". Clicking on "Reset Output Counters" will reset diagnostics. See section 4.2.9.

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6 Compare two Calibration Files

PCM2 can compare 2 configuration files, but this feature depends on the settings in User Access Rights, please see section 7.

If the configuration allows file comparison, first load the main configuration file.
Now click on **File**, and then click on **Compare With** and load the file to compare with.

In this example the main configuration file is called TEST.CFG and the file to compare with is called OBR-SET1.CFG.

Any sections where the tool detects differences between the two files are marked yellow.
To view the differences click on a section marked in yellow.
Shown in the example, there are differences in Inputs in section Analogue Inputs. Move the cursor over channel 06 in the column Name. A window pops up, showing the alternative name in the comparison file.
Right click on the channel name and a window opens in which there is an option for pasting the name from the comparison configuration file into the active file.

Comparing a CAN input, all differences are marked in yellow, being name, CAN port, position in address and scaling will be marked in yellow.
Click on Copy Compare to copy all setting with one single click.
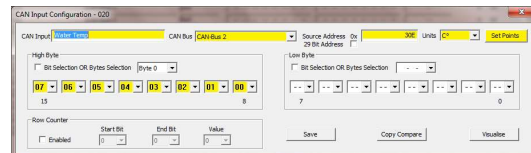
Comparing an analogue, all differences are marked in yellow, being name, CAN port, position in address and scaling will be marked in yellow.
Click on Copy Compare to copy all setting with one single click.
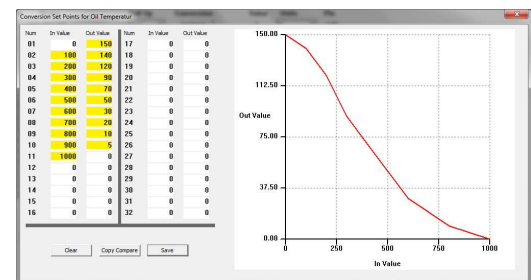
Unloading the compare file is done by clicking on **File**, then click on **Compare With** and press ESC.

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7 User Access Rights

Access rights set in PCM2 overrides settings in the tool.
User access levels "Supervisor", "Administrator"
and "Partner" can change access rights for lower
level users and also set individual passwords.
It is recommended that the Administrator or
Partner defines the new access passwords,
overwriting OBR's default passwords.
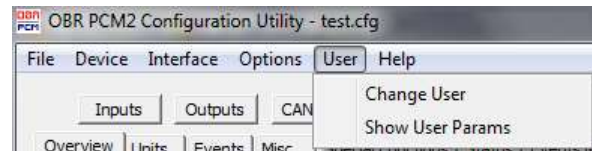
7.1.1 Change User

When installed, the tool opens in Read Only mode by default. Once
another user access level has been selected by entering the correct
password, this setting is stored within PCM2 and the tool. When the tool is
re-connected to a PCM2, it will check for user rights and if the PCM2
setting matches the tool setting, the tool will apply the previous selected
user access level.
If the access rights in PCM2 do not correspond with tool setting, the tool
will revert to Read Only and the user must select the desired access level and key in the correct
password, if known.

7.1.1.1 Default Passwords

It is strongly recommended to define personalised passwords to avoid unwanted access to part of
PCM2's features by unauthorised users.
The default passwords are:

- Administrator   = Adm1n
- Supervisor   = Sup3r
- Read/Write   = Writer

7.1.2 Show User Params

Any user who has access to this feature can change the access
rights for users below the actual level.
A supervisor can change access rights for Read Only and
Read/Write users, while an administrator can change access
rights for Read Only, Read/Write and Supervisor.

Changing access rights, select the user level in User.
It is possible to re-name the user level in Name.
In Password, leave the text as it is to keep the existing password
or key in a new password. Confirm the new password.
Access to files and features are done by ticking boxes for
individual features.
If the new settings are correct, either click SAVE to store the
settings within the tool and PCM2 or click on EXPORT to save
settings both in the tool, the PCM2 and in a settings file, stored
within the configuration file folder.

If the new settings are not desired, click on CANCEL.

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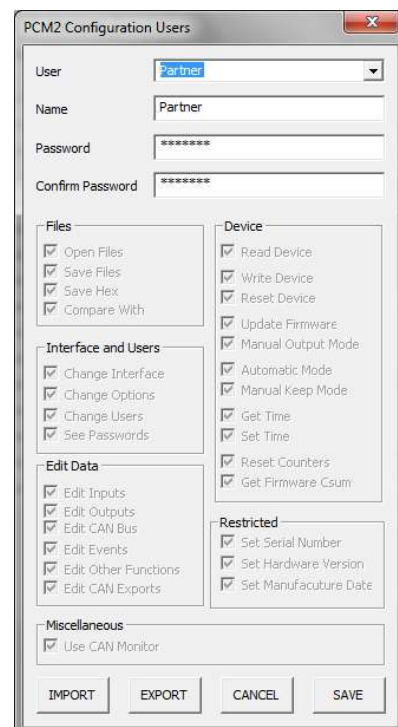
If the new settings initially are not desired, close the user window by clicking on the "X" in its upper right hand corner. The settings are temporarily stored in the tool, but will be cancelled if the PCM2 is switch off or the tool is closed.

Actual PCM2 user levels and passwords can be exported to a file which is stored within the configuration file folder.

7.1.2.1 Import and Export of User Access Rights
It is possible to store user settings on disc and these settings can be imported and programmed into other PCM2's.
Supervisor, administrator or partner can export and import user access files.
When importing access rights from a file, only access rights of user levels the currently selected user level will be updated.

When a user has configured access rights and passwords for lower level users, these settings are save by clicking the EXPORT button. At this time the file is generated and the PCM2 is updated.

Any of the three higher user levels can import settings, but the tool will only import and change access rights for lower level users.

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8 Inputs

PCM2 has 14 digital and 16 analogue inputs. These inputs can be used with sensors or switches. Furthermore, PCM2 has 4 individual CAN lines with a maximum of 64 CAN channels and unlimited assigning of identifiers.
PCM2 is fitted with 2 internal temperature sensors for system monitoring.

8.1 Digital Inputs
14 digital inputs are available as switch inputs.

Input names can be up to 15 characters long.

Digital inputs can be triggered by:
- connecting to ground
- connecting to open circuit
- connecting to battery voltage
- any combination of these in a single switch
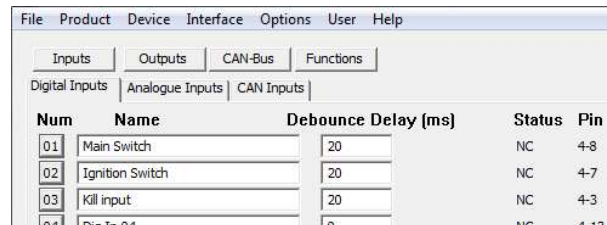
Configuration of switch condition is set within the event handling.

Latching or momentary switches can be used. Configuring the signal is defined within the event handling.

Click on the number button to the left of the digital channel name to open the visualisation display. See section 10.

Set the minimum debounce time required for the system to acknowledge a change in the switch signal status.

Channel status is displayed as:
- 0 = off
- 1 = switched low
- 2 = switched open
- 3 = switched high

8.1.1 Pin Configuration Digital Inputs

Digital Input	Connector 4	Pin
1	AS2 16-35 SN	8
2	AS2 16-35 SN	7
3	AS2 16-35 SN	3
4	AS2 16-35 SN	13
5	AS2 16-35 SN	2
6	AS2 16-35 SN	6
7	AS2 16-35 SN	1
8	AS2 16-35 SN	12
9	AS2 16-35 SN	5
10	AS2 16-35 SN	20
11	AS2 16-35 SN	4
12	AS2 16-35 SN	11
13	AS2 16-35 SN	10
14	AS2 16-35 SN	19

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8.2 Analogue Inputs

PCM2 has 16 analogue 0..5V sensor inputs with a 10 bit resolution and sampled at typically 10 Hz.
Furthermore, these inputs can be grouped to create 8 differential inputs (not implemented yet).
Input names can be up to 15 characters long.
Analogue signals below 100mV are displayed as 0.
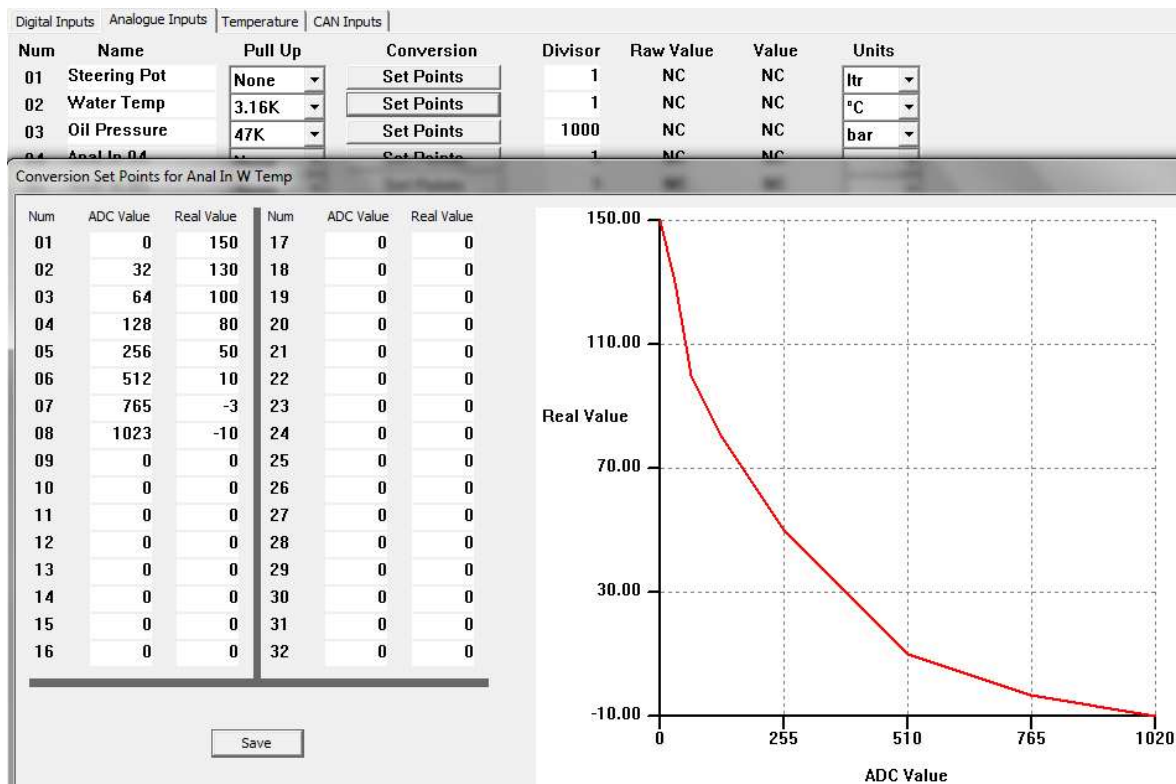
Click on the number button to the left of the analogue channel name to open the visualisation display.
See section 8.

Analogue inputs can be assigned having different characteristics:
- Pull-up to VREF through a 3.16 kOhm resistor (only intended for use with NTC temperature sensors)
- Pull-up to VREF through a 47 kOhm resistor (allows detection of broken sensor wires)
- Floating input – preferred selection for all sensors except NTC temperature sensors.

Section *Conversion* gives access to a linearization table having 32 breakpoints. Any number of breakpoints can be used; a 2-point calibration of a pressure sensor only requires two.
If a sensor A/D value is below the minimum breakpoint, the minimum value is applied.
If a sensor A/D value is above the maximum breakpoint, the maximum value is applied.
Leaving all breakpoints at 0 (zero) channel values are displayed in millivolts.
The "In Value" is entered in millivolts.

Sensor scaling is normally entered in for example millibar, millilitres, milliampere etc.

Sensor channel values are displayed in real time in millivolts if the calibration table is left blank.
If the calibration table is used, the value displayed is the converted channel data.

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If an analogue channel is exported on any of the CAN ports, the value exported is depending on the calibration table:
- Analogue channel values are exported in in millivolts if the calibration table is left blank.
- Analogue channel values are exported as scaled values when the calibration table is used.

Please note that the analogue inputs are disabled in the instant when power to the PCM2 is switched off.

8.2.1 Pin Configuration Analogue Inputs

Analogue Input	Connector 4	Pin
1	AS2 16-35 SN	48
2	AS2 16-35 SN	49
3	AS2 16-35 SN	53
4	AS2 16-35 SN	43
5	AS2 16-35 SN	54
6	AS2 16-35 SN	50
7	AS2 16-35 SN	55
8	AS2 16-35 SN	44
9	AS2 16-35 SN	51
10	AS2 16-35 SN	45
11	AS2 16-35 SN	52
12	AS2 16-35 SN	37
13	AS2 16-35 SN	46
14	AS2 16-35 SN	38
15	AS2 16-35 SN	39
16	AS2 16-35 SN	31

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8.3 CAN Inputs

PCM2 has 4 individual CAN ports with a total of 64 input channels. Each CAN port can be defined using 11 or 29 bit identifiers. Additionally, each CAN port can be individually terminated in software and the baud rate for each is also selectable, ranging from 10 kbps to 1 Mbit/s.

CAN 1 and CAN 2 can each handle up to 64 individual identifiers, while CAN 3 and CAN 4 can handle a maximum of 5 individual identifiers each plus the PC tool.
Please see section 11 for CAN bus configuration.
To visualise a CAN channel live it must be defined in this section plus have an event linked to it.

8.3.1 CAN Overview

The overview window gives a clear view of the CAN settings, 16 channels displayed on each of the 4 pages.

Num	Name	CAN-Bus	Address	High Byte	Low Byte	Row Counter	Value	State	
01	Fuel Pump Man	CAN-Bus 2	0x401	-- -- -- -- -- -- -- --	-- -- -- -- -- -- -- 56	--	0	NC	Edit
02	EPS Manual	CAN-Bus 2	0x401	-- -- -- -- -- -- -- --	-- -- -- -- -- -- 57 --	--	0	NC	Edit
03	Spare	CAN-Bus 2	0x401	-- -- -- -- -- -- -- --	-- -- -- -- -- 58 -- --	--	0	NC	Edit
04	Rain Light	CAN-Bus 2	0x401	-- -- -- -- -- -- -- --	-- -- -- -- 60 -- -- --	--	0	NC	Edit
05	Cockpit Fan	CAN-Bus 2	0x401	-- -- -- -- -- -- -- --	-- -- 61 -- -- -- -- --	--	0	NC	Edit
06	Heated Screen	CAN-Bus 2	0x401	-- -- -- -- -- -- -- --	-- 62 -- -- -- -- -- --	--	0	NC	Edit
07	Ignition	CAN-Bus 2	0x725	-- -- -- -- -- -- -- --	39 38 37 36 35 34 33 32	--	0	NC	Edit
08	Start	CAN-Bus 2	0x725	-- -- -- -- -- -- -- --	63 62 61 60 59 58 57 56	--	0	NC	Edit
09	Lights	CAN-Bus 2	0x401	-- -- -- -- -- -- -- --	-- -- -- -- -- 50 -- --	--	0	NC	Edit
10	ECU RPM	CAN-Bus 2	0x300	07 06 05 04 03 02 01 00	15 14 13 12 11 10 09 08	--	0	NC	Edit
11	ECU Fuel Pump	CAN-Bus 2	0x0	-- -- -- -- -- -- -- --	-- -- -- -- -- -- -- --	--	0	NC	Edit
12	Flash CAN	CAN-Bus 2	0x720	-- -- -- -- -- -- -- --	31 30 29 28 27 26 25 24	--	0	NC	Edit
13	High Beam CAN	CAN-Bus 2	0x0	-- -- -- -- -- -- -- --	-- -- -- -- -- -- -- --	--	0	NC	Edit
14	Engine Temp	CAN-Bus 2	0x725	23 22 21 20 19 18 17 16	31 30 29 28 27 26 25 24	--	0	NC	Edit
15	PitLmt_Active	CAN-Bus 2	0x725	-- -- -- -- -- -- -- --	39 38 37 36 35 34 33 32	--	0	NC	Edit
16	Wiper Steer SW	CAN-Bus 2	0x720	-- -- -- -- -- -- -- --	39 38 37 36 35 34 33 32	--	0	NC	Edit

- **Num** — Click to open the graphic visualisation (see section 10).
- **Name** — CAN input channel name, max 15 characters.
- **Address** — Identifier in HEX (the lower the number, the higher its priority). NOTE: Maximum value is 7FF when using an 11 bit identifier.
- **High Byte** — Position in high byte, bit range shown.
- **Low Byte** — Position in low byte, bit range shown.
- **Row Counter** — Location and value of row counter for channel.
- **Value** — Output value for channel, shown in raw data or in scaled value. Please note, the tool only displays a value if the channel is linked to an event.
- **State** — Channel status.
- **Edit** — Access to channel setting editor.

8.3.2 CAN Channel Editing

Click EDIT to open the channel editor:

- Each of the 64 available CAN inputs can be named individually.
- Select which of the four available CAN ports the actual channel is imported.
- Set the identifier in which the actual channel is included. This value must be in hex, for example 0x300. Maximum value is 7FF when using an 11 bit identifier.
- Select the unit of the channel, for example RPM, bar, deg etc.

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- Section *Set Points* gives access to a linearization table having 32 breakpoints. Any number of breakpoints can be used; a 2-point calibration of a pressure sensor only requires two.
  If a sensor A/D value is below the minimum breakpoint, the minimum value is applied.
  If a sensor A/D value is above the maximum breakpoint, the maximum value is applied.
  The "In Value" is entered in bits.
- Leaving all breakpoints at 0 (zero), channel values are displayed in bits (for channels sent as **byte** or **word**) or in a decimal value (if the channel is transmitting **bit** values).
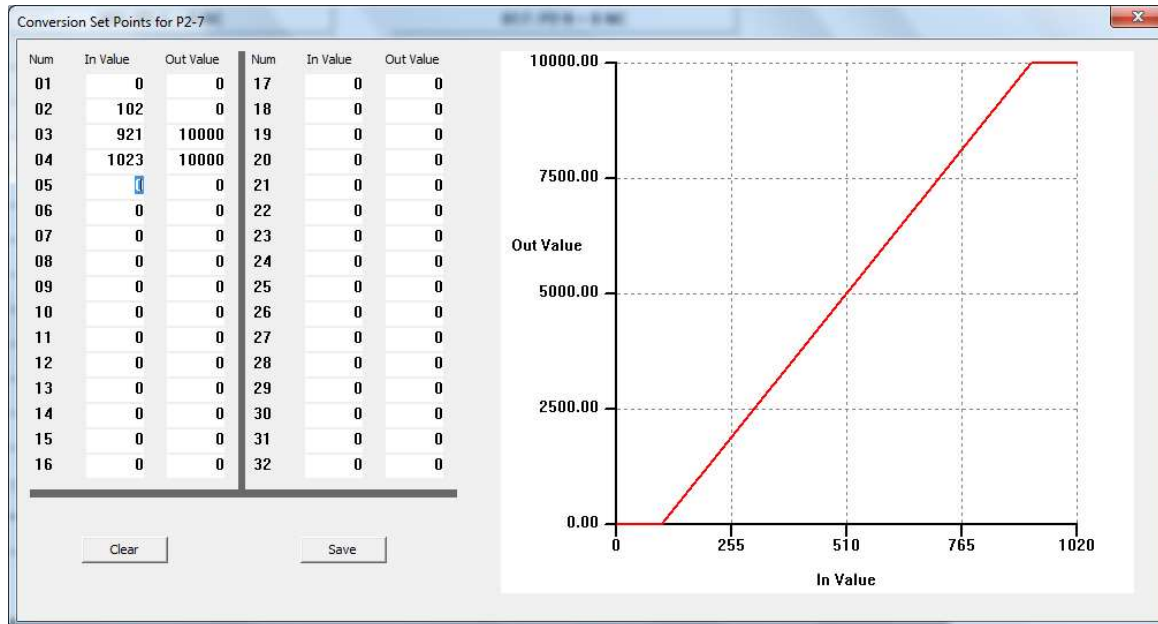
CAN 1 and CAN 2 can each handle up to 64 individual identifiers, while CAN 3 and CAN 4 can handle a maximum of 5 individual identifiers each plus the PC tool.

CAN identifiers can be individually selected, and they do not have to be arranged in special groups. The lower the address number, the higher the data priority.

CAN channels can contain switch status, using up to 8 individual bits in a byte, 8 bit data channels or 16 bit data channels.
Inputs can be read as the status of a single byte, two bytes or by each individual bit in each byte or combinations hereof.
An 8 bit data channel reads data in the range between 0..255 and uses 1 byte.
A 16 bit data channel reads data in the range between 0..65535 and uses 2 bytes.

16 bit channels can be arranged as either Big Endian (Motorola format) or Little Endian (Intel format).
When configured as Big Endian the two bytes are arranged as [(MSB);(LSB)], for example byte 0 is "High" (MSB) and byte 1 is "Low" (LSB).
When configured as Little Endian the two bytes are arranged as [(LSB);(MSB)].

Bit management within each of the 8 bytes in an identifier is available.
Each byte contains 8 bits which are numbered this way:
- Byte 0 = 0..7 bits
- Byte 1 = 8..15 bits
- Byte 2 = 16..23 bits
- Byte 3 = 24..31 bits

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- Byte 4 = 32..39 bits
- Byte 5 = 40..47 bits
- Byte 6 = 48..55 bits
- Byte 7 = 56..63 bits

Using the bit wise operator it is possible to address for example status of 8 individual switches. The decimal values of the bits in a byte are:
- Bit 0 = 1
- Bit 1 = 2
- Bit 2 = 4
- Bit 3 = 8
- Bit 4 = 16
- Bit 5 = 32
- Bit 6 = 64
- Bit 7 = 128

A single byte can contain status from 8 switches. In this case each switch is allocated in a unique position. This could be arranged as in this example:
The PUMP switch command is located in the sixth bit within the byte and it global position within the data packager sent is within the 37th bit.
If the PUMP is switched ON, the value of byte 4 changes its value from 0 to 32 if no other switches are active.

BYTE 4:

BIT	0	1	2	3	4	5	6	7
DEC VALUE	1	2	4	8	16	32	64	128
BIT POS	32	33	34	35	36	37	38	39
SWITCH	IGN	Wiper	Lights	Fan	Start	Pump	Screen	Pit Lim

Switching the WIPER on, the value of the byte changes to (2+32) = 34.
Switching the fan on, too, the byte value will now be (2+8+32) = 42.

A CAN input for a dedicated switch can be configured to display 0 or 1 when toggling between ON and OFF. When reading data from the CAN bus, any switch position can be allocated to any bit position in the CAN input byte. Having the CAN input to toggle between 0 and 1, allocate the switch status from the CAN bus to bit position 0, leaving all other bits unallocated in the byte.

For example, to define a CAN input exclusively for the PUMP function, you can proceed this way:
- Define the identifier for the byte in which to look for PUMP status.
- Do not assign any other data channels to this byte.
- In section *Low Byte* un-tick "Bit Selection OR Byte Selection".
- Click on the arrow down and select the byte containing the data information, byte 0.
- Now tick the box "Bit Selection OR Byte Selection".
- Click on the first bit window, "0", and select "37".
- Deselect reading of data from bits 1, 2, 3, 4, 5, 6 and 7 by selecting the option "- -" from the scroll down menu for each of these bits.
An easy way to proceed is to click once on one of the bit windows, then press END (now the selection "- -" is displayed). Use the TAB key jump to the next bit, press END, and then the TAB key again etc.

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- The channel will displays "0" when the PUMP switch is not activated and it will display "1" when the switch is activated.

If you want the channel to display the decimal number related to its position within the byte you can alternatively configure the low byte this way:

- Define the identifier for the byte in which to look for PUMP status.
- Do not assign any other data channels to this byte.
- In section *Low Byte* un-tick "Bit Selection OR Byte Selection".
- Click on the arrow down and select the byte containing the data information, byte 5.
- Now tick the box "Bit Selection OR Byte Selection".
- Click on the sixth bit window, "5", and select "37".
- Deselect reading of data from bits 0, 1, 2, 3, 4, 6 and 7 by selecting the option "- -" from the scroll down menu for each of these bits.
  An easy way to proceed is to click once on one of the bit windows, then press END (now the selection "- -" is displayed). Use the TAB key jump to the next bit, press END and then the TAB key again etc.
- The channel will displays "0" when the PUMP switch is not activated and it will display "32" when the switch is activated.
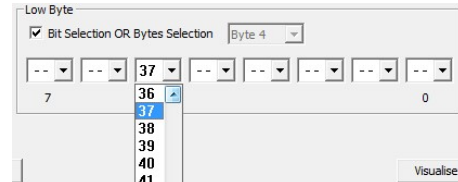
Click on the "Visualise" button to open the visualisation display. See section 8.

PCM2 can detect and report an error on any CAN bus by flashing the warning lamp (if fitted).
If the CAN bus is exposed to a short circuit, the CAN communication will recover when the cause of the fault has been fixed.

OBR membrane switch panel (MSP) commands are transmitted via CAN.
To configure our MSP panel, refer to section 10.

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8.3.3 CAN Row Counts

PCM2 supports row counters on CAN input channels.
Row counters allows multiple channels being transmitted within the same identifier and the system will look for rotating data channels. This feature will help reducing the CAN bus load.

In the example below, 3 data channels are imported within the same position, bytes 2 and 3 in identifier 0x300.
PCM2 will read "Shift Pressure" from this location when the row count value is 0, it will read "Oil Pressure" from this location when the row count value is 1 and it will read "Fuel Pressure" from this location when the row count value is 2.

Num	Name	CAN-Bus	Address	High Byte	Low Byte	Row Counter
33	Shift Pressure	CAN-Bus 1	0x300	23 22 21 20 19 18 17 16	31 30 29 28 27 26 25 24	0->1=0
34	Oil Pressure	CAN-Bus 1	0x300	23 22 21 20 19 18 17 16	31 30 29 28 27 26 25 24	0->1=1
35	Fuel Pressure	CAN-Bus 1	0x300	23 22 21 20 19 18 17 16	31 30 29 28 27 26 25 24	0->1=2
36	CAN In 36	CAN-Bus 1	0x0			

To use input row counters tick the box **Enabled** in this section.
In **Start Bit** and **End Bit** key in the location of the row counter.
In **Value** key in the row count number for the actual CAN input.

Row Counter — ☑ Enabled — Start Bit: 0 — End Bit: 2 — Value: 1

8.3.4 Pin Configuration for CAN Ports

Name	Connector 4	Pin
CAN1 H	AS2 16-35 SN	24
CAN1 L	AS2 16-35 SN	23
CAN2 H	AS2 16-35 SN	16
CAN2 L	AS2 16-35 SN	15
CAN3 H	AS2 16-35 SN	9
CAN3 L	AS2 16-35 SN	22
CAN4 H	AS2 16-35 SN	14
CAN4 L	AS2 16-35 SN	21

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9 Outputs

PCM2 has 48 power channels with current measurement plus 4 tri-state outputs. Additional 3 VREF 5V sensor supplies plus a fault warning light are available, providing max 1A each.
All power outputs are designed for use in harsh environments and include self-recovery features.
Power outputs are designed to handle loads with high inrush current as well as motors and all types of resistive and inductive loads.
All outputs are protected against reversed battery polarity and too high temperatures

The power channels are divided into groups:
- Low power outputs (ON/OFF switches)
- Low power wiper outputs (ON/OFF switches) – with recirculation diodes
- Low power outputs with pulse width modulation (PWM)
- High power outputs (ON/OFF switches)
- High power outputs with pulse width modulation (PWM)
- Very high power outputs (ON/OFF switches)

The tri-state analogue outputs cannot be used as power supplies; they can only be used as trigger signals.

It is possible to connect two or more identical power outputs in parallel to increase the allowed current draw.
Please note that any of the PWM channels may never be connected in parallel!

Click on the number button to the left of the output name to open the visualisation display.
See section 8.

Please note that the current draw per channel is limited by the connector - not by the driver stages. We have rated the individual channel's current draw in relation to the connector manufacturer's specifications.

9.1 Tri-State
Tri-state outputs **cannot** be used as a power supplies. They are designed as logic switches and are used only as trigger signals for analogue inputs on other modules, for example an ECU.
Maximum current draw must stay below 30 mA (milli ampere).
They are controlled by the event handling and the output signals can have these values:
- 0 Volt
- 2.5 Volts
- 5.0 Volts

9.1.1 Pin Configuration Tri-State Outputs

Tri-state	Max current, milliA	Connector 3	Pin
1	30	AS2 20-39 SA	Y
2	30	AS2 20-39 SA	B
3	30	AS2 20-39 SA	Z
4	30	AS2 20-39 SA	C

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9.2 Low Power Outputs

This section gives access to:

- Naming of output
- Set inrush current threshold
- Set time interval for inrush current
- Set the normal fused threshold
- Set the number of retries once a fault is detected before switching off
- Set the time interval for fault resetting

26 low power outputs are available, supplying a maximum continuous current of 13..25 A each channel.

Please observe that our default maximum current level for each channel is set in accordance with Deutsch's current limit for the size AWG20 contacts in the Autosport 20-39 connector.

Current draws can be measured on all outputs.

On outputs 1..22 current can be measured from 200 mA to full load. Outputs 23..26 all have increased resolution making them a preferred selection for lift pumps, for example.

The driver stages can deliver significantly more current, but it is important to avoid overloading the wiring and contacts in the connector.

Once an output is turned on, the current draw depends on the attached load.

- If this load is a resistive load, there will hardly be any inrush current.
- If the output drives a motor or a lamp, for example, there can be a substantial inrush for a certain amount of time. The current draw will quickly decrease and reach a steady state level.

Outputs are protected by three current thresholds and three timers:

- OCH is the high current threshold of 75 A.
- OCL is the user defined continuous current threshold, selectable between 7.5 A to 25 A.
- OCS is the software selected current threshold.

Switching an output ON, an inrush current up to and in excess of 75 A is allowed for a 20 usec time interval.

After these 20 usec the current level must be below OCH which is 75 A.

Within a time interval, selectable between 0.15 to 155 msec, from switching the output ON, the current draw must have fallen below the OCL threshold. This threshold can be set to 7.5 / 10 / 12.5 A…25 A.

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In column "*INIT ms"* key in the time delay for applying the steady state fuse level defined in "*NORM mA"*. This interval must exceed the time interval selected for OCL, suggested value > 200 msec. Maximum time is limited to 10 seconds.

After the time interval INIT, the initial time from switching the output ON, the current draw must be below the user defined software fuse level, OCS. If the current draw exceeds this threshold, the output will be switched off.

In column *NORM mA* key in the steady state fuse level required. This value must be lower than the maximum fuse level, OCL. Maximum current threshold is 25,000 mA.

If the current draw on an output exceeds the NORM fuse setting, the output will switch off.

In *SW Time* set the time interval in milliseconds during which the current draw is allowed to exceed the OCS fuse level.

Time interval is selectable between 25 ms to 250 ms.

In *Retry* set the maximum number of automatic re-activation of an output channel after is has been shut down caused by a short circuit or an overload. It is strongly recommended not to exaggerate the number of retries – select a number < 10.

In *Retry ms* set the time interval between retries in milliseconds.

The status window will show the real time current draw of the output in mA.

Use the *Manual* option to test the output connection. When *Manual* is active (see section **4.3**), PCM2's event handling has been deactivated and all channels are OFF by default.

Click the ON button for each individual channel to switch the output ON.

Click the ON button again to switch the output OFF.

Clicking on *Trigger* will open the main event controlling this output. A warning may appear if several events are used to control it.

9.2.1 Parallel Coupling

Outputs can be activated in parallel if increased current handling is required.

If simultaneous switching of two outputs is essential, they should be coupled this way:

Parallel Pair	LP Ouputs	Connector 3	Pin
1	LP1 + LP2	AS2 20-39 SA	e + N
2	LP3 + LP4	AS2 20-39 SA	f + P
3	LP5 + LP6	AS2 20-39 SA	q + R
4	LP7 + LP8	AS2 20-39 SA	g + S
5	LP9 + LP10	AS2 20-39 SA	h + T
6	LP11 + LP12	AS2 20-39 SA	i + U
7	LP13 + LP14	AS2 20-39 SA	d + K
8	LP15 + LP16	AS2 20-39 SA	n + L
9	LP17 + LP18	AS2 20-39 SA	p + M
10	LP19 + LP20	AS2 20-39 SA	c + J
11	LP21 + LP22	AS2 20-39 SA	G + H
12	LP23 + LP24	AS2 20-39 SA	F + b
13	LP25 + LP26	AS2 20-39 SA	D + E

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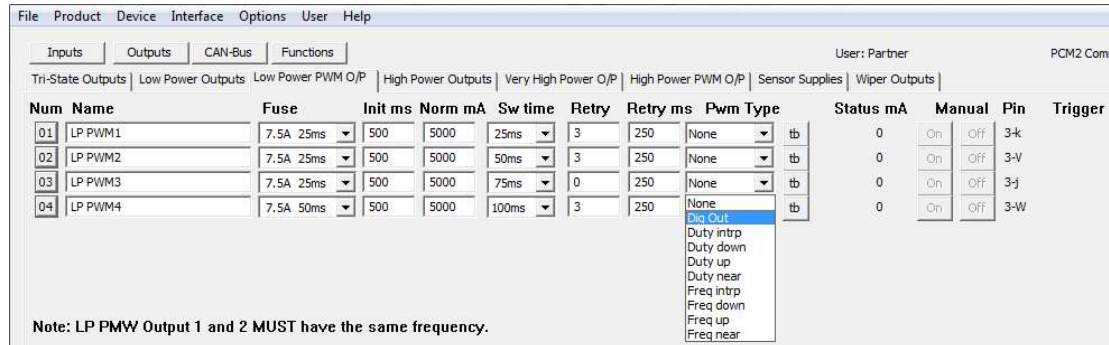
9.2.2 Pin Configuration Low Power Outputs

LP OUT	Max continuous current, A	Max recommended current, A	Connector 3	Pin
1	25	13	AS2 20-39 SA	e
2	25	13	AS2 20-39 SA	N
3	25	13	AS2 20-39 SA	f
4	25	13	AS2 20-39 SA	P
5	25	13	AS2 20-39 SA	q
6	25	13	AS2 20-39 SA	R
7	25	13	AS2 20-39 SA	g
8	25	13	AS2 20-39 SA	S
9	25	13	AS2 20-39 SA	h
10	25	13	AS2 20-39 SA	T
11	25	13	AS2 20-39 SA	i
12	25	13	AS2 20-39 SA	U
13	25	13	AS2 20-39 SA	d
14	25	13	AS2 20-39 SA	K
15	25	13	AS2 20-39 SA	n
16	25	13	AS2 20-39 SA	L
17	25	13	AS2 20-39 SA	p
18	25	13	AS2 20-39 SA	M
19	25	13	AS2 20-39 SA	c
20	25	13	AS2 20-39 SA	J
21	25	13	AS2 20-39 SA	G
22	25	13	AS2 20-39 SA	H
23	25 (high resolution current measurement)	13 (high resolution current measurement)	AS2 20-39 SA	F
24	25 (high resolution current measurement)	13 (high resolution current measurement)	AS2 20-39 SA	b
25	25 (high resolution current measurement)	13 (high resolution current measurement)	AS2 20-39 SA	D
26	25 (high resolution current measurement)	13 (high resolution current measurement)	AS2 20-39 SA	E

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9.3 Low Power PWM Outputs

This section gives access to:

- Naming of output
- Set inrush current threshold
- Set time interval for inrush current
- Set the normal fused threshold
- Set the number of retries once a fault is detected before switching off
- Set the time interval for fault resetting
- Select the type of PWM applied
- Define duty cycle or frequency map

4 low power outputs are available with PWM capability applying frequencies from 30 Hz up to 25 kHz and of supplying a maximum, recommended continuous current of 13..25 A each channel.
Please observe that our default maximum current level for each channel is set in accordance with Deutsch's current limit for the size AWG20 contacts in the Autosport 20-39 connector.
The driver stages can deliver significantly more current, but it is important to avoid overloading the wiring and contacts in the connector.

WARNING: Do NOT connect any PWM output in parallel with any other output!

9.3.1 Half Bridge – Full Bridge

These PWM outputs are true half bridge drivers, having a top and bottom transistor.
Contrary to conventional outputs the PWM outputs are connected to ground when switched off.

By combining 2 PWM outputs you can create a full bridge which for example could be used to drive a DC motor, turning it clockwise or anti clockwise. In this example you connect one PWM output to one of the DC motor terminals, a second PWM output to the other DC motor terminal. Depending on which output you activate you can make the DC motor rotate.
You can configure the PWM drivers as either digital outputs or as frequency, duty cycle controlled outputs. In this configuration you will be able to control the speed at which the motor rotates.
The control can be extended to included position control via an analogue or digital input or by the current draw.

9.3.2 Current Draws

Current draws can be measured on all outputs and displays the maximum current draw, neglecting the OFF periods.

Outputs are protected by three current thresholds and three timers:
- OCH is the high current threshold of typical 75 A.
- OCL is the user defined continuous current threshold, selectable between 7.5 A to 25 A.
- OCS is the software selected current threshold.

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Switching an output ON, an inrush current up to and in excess of 75 A is allowed for a 20 usec time interval.
After these 20 usec the current level must be below OCH which is 75 A.
Within a time interval, selectable between 0.15 to 155 msec, from switching the output ON, the current draw must have fallen below the OCL threshold. This threshold can be set to 7.5 / 10 / 12.5…25 A.

In column "*INIT ms*" key in the time delay for applying the steady state fuse level defined in "*NORM mA*". This interval must exceed the time interval selected for OCL, suggested value > 200 msec.
Maximum time is limited to 10 seconds.

After the time interval INIT, the initial time from switching the output ON, the current draw must be below the user defined software fuse level, OCS. If the current draw exceeds this threshold, the output will be switched off.

In *SW Time* set the time interval in milliseconds during which the current draw is allowed to exceed the OCS fuse level.
Time intervals are selectable from 25 ms to 250 ms.

In column *NORM mA* key in the steady state fuse level required. This value must be lower than the maximum fuse level, OCL. Maximum current threshold is 25,000 mA.
If the current draw on an output exceeds the NORM fuse setting, the output will switch off.

In *Retry* set the maximum number of automatic re-activation of an output channel after is has been shut down caused by a short circuit or an overload. It is strongly recommended not to exaggerate the number of retries – select a number < 10.

In *Retry ms* set the time interval between retries in milliseconds.

PWM Type is used to define the functionality of the PWM feature:
- None   Output disabled
- Dig out   No PWM used, output is off or on 100%
- Duty intrp   Interpolation between duty cycle breakpoints
- Duty down   Duty cycle from nearest lower breakpoint applied
- Duty up   Duty cycle from nearest higher breakpoint applied
- Duty near   Duty cycle from nearest lower or higher breakpoint applied
- Freq intpr   Interpolation between frequency breakpoints
- Freq down   Frequency from nearest lower breakpoint applied
- Freq up   Frequency from nearest higher breakpoint applied
- Freq near   Frequency from nearest lower or higher breakpoint applied

The frequency option is only available on LP PWM3 and LP PWM4.

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Duty Cycle Maps
Duty cycle maps are designed with variables on both X and Y axis.

Use the drop down menus to select the channels used for the X and Y axis of the table.
It is not necessary to use the full table and all breakpoints in the maps nor to use both axis's.
Using a two-axis calibration, start filling the map out from upper left hand corner.
Using a single axis calibration, select the X or Y-axis as the input reference, using only the first row or column of the other axis.

The map can be imported and exported to Excel.
An easy way to create a duty cycle map is to follow this procedure:
- Open the duty cycle map
- Click "Copy"
- Paste into Excel
- Modify table
- Mark the table and copy
- Return to the tool and click past
- Set frequency in Hz; minimum applied value is 30 Hz, maximum value is 15 kHz
- Please note that LP PWM1 and LP PWM2 must use the same frequency!

Frequency Maps
Frequency maps are single axis maps; the duty cycle percentage must be kept constant.
Please note that frequency mapping is only available on LP PWM3 and LP PWM4.

Use the drop down menus to select the channel used for the single axis of the table.

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The map can be imported and exported to Excel.
An easy way to create a frequency map is to follow this procedure:
- Open the frequency map
- Click "Copy"
- Paste into Excel
- Modify table
- Mark the table and copy
- Return to the tool and click past
- Set the applied duty cycle percentage; values can be between 5 and 99%

The *Status* window shows the real time current draw of the output in mA.

Use the *Manual* option to test the output connection. When *Manual* is active (see section **4.3**),
PCM2's event handling has been deactivated and all channels are OFF by default.
Click the ON button for each individual channel to switch the output ON.
Click the ON button again to switch the output OFF.

Clicking on *Trigger* will open the main event controlling this output. A warning may appear if
several events are used to control it.

The status window will show the real time current draw of the output in mA.
Use the *Manual* option to test the output connection. When *Manual* is active (see section **4.3**),
PCM2's event handling has been deactivated and all channels are OFF by default.
Click the ON button for each individual channel to switch the output ON.
Click the ON button again to switch the output OFF.
Clicking on *Trigger* will open the main event controlling this output. A warning may appear if
several events are used to control it.

9.3.3 Pin Configuration Low Power PWM Outputs

LP PWM OUT	Max continuous current, A	Max recommended current, A	Connector 3	Pin
1	25	13	AS2 20-39 SA	k
2	25	13	AS2 20-39 SA	V
3	25	13	AS2 20-39 SA	j
4	25	13	AS2 20-39 SA	W

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9.4 High Power Outputs

This section gives access to:

- Naming of output
- Set inrush current threshold
- Set time interval for inrush current
- Set the normal fused threshold
- Set the number of retries once a fault is detected before switching off
- Set the time interval for fault resetting

12 high power outputs are available, supplying a maximum continuous current of 26..50 A each channel.

Please observe that our default maximum current level for each channel is set in accordance with Deutsch's current limit for the size AWG16 contacts in the Autosport 20-16 connector.

Current draw can be measured on all outputs.

The driver stages can deliver significantly more current, but it is important to avoid overloading the wiring and contacts in the connector.

Once an output is turned on, the current draw depends on the attached load.

- If this load is a resistive load, there will hardly be any inrush current.
- If the output drives a motor or a lamp, for example, there can be a substantial inrush for a certain amount of time. The current draw will quickly decrease and reach a steady state level.

Outputs are protected by three current thresholds and three timers:

- OCH is the high current threshold of 100 A.
- OCL is the user defined continuous current threshold, selectable as 15, 20 or 25..50 A.
- OCS is the software selected current threshold.

Switching an output ON, an inrush current up to and in excess of 100 A is allowed for a 20 usec time interval.

After these 20 usec the current level must be below OCH which is 100 A.

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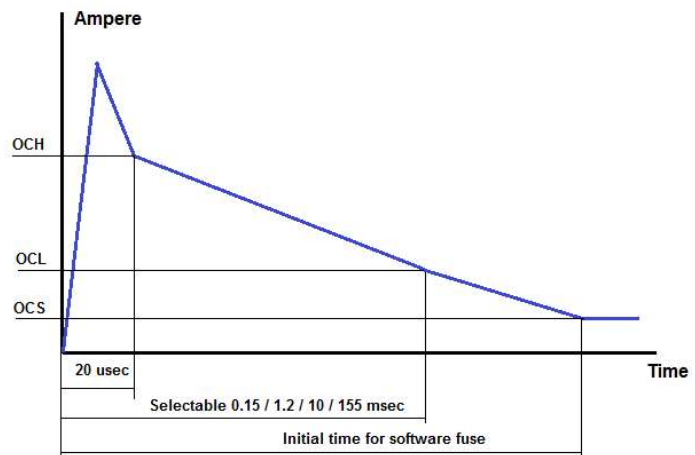
Within a time interval, selectable between 0.15 to 155 msec, from switching the output ON, the current draw must have fallen below the OCL threshold. This threshold can be set to 15 / 20 / 25 A.

In column "*INIT ms*" key in the time delay for applying the steady state fuse level defined in "*NORM mA*". This interval must exceed the time interval selected for OCL, suggested value > 200 msec. Maximum time is limited to 10 seconds.
After the time interval INIT, the initial time from switching the output ON, the current draw must be below the user defined software fuse level, OCS. If the current draw exceeds this threshold, the output will be switched off.

In column *NORM mA* key in the steady state fuse level required. This value must be lower than the maximum fuse level, OCL. Maximum current threshold is 50,000 mA.
If the current draw on an output exceeds the NORM fuse setting, the output will switch off.

In *SW Time* set the time interval in milliseconds during which the current draw is allowed to exceed the OCS fuse level.
Time intervals are selectable from 25 ms to 250 ms.

In *Retry* set the maximum number of automatic re-activation of an output channel after is has been shut down caused by a short circuit or an overload. It is strongly recommended not to exaggerate the number of retries – select a number < 10.

In *Retry ms* set the time interval between retries in milliseconds.

The status window will show the real time current draw of the output in mA.

Use the *Manual* option to test the output connection. When *Manual* is active (see section **4.3**), PCM2's event handling has been deactivated and all channels are OFF by default.
Click the ON button for each individual channel to switch the output ON.
Click the ON button again to switch the output OFF.

Clicking on *Trigger* will open the main event controlling this output. A warning may appear if several events are used to control it.

9.4.1 Pin Configuration High Power Outputs

Channel	Max continuous current, A	Max recommended current, A	Connector 2	Pin
3	50	26	AS2 12-16 SN	M
4	50	26	AS2 12-16 SN	K
5	50	26	AS2 12-16 SN	F
6	50	26	AS2 12-16 SN	N
7	50	26	AS2 12-16 SN	R
8	50	26	AS2 12-16 SN	S
9	50	26	AS2 12-16 SN	D
10	50	26	AS2 12-16 SN	A
11	50	26	AS2 12-16 SN	L
12	50	26	AS2 12-16 SN	J

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9.5 High Power PWM Outputs

This section gives access to:

- Naming of output
- Set inrush current threshold
- Set time interval for inrush current
- Set the normal fused threshold
- Set the number of retries once a fault is detected before switching off
- Set the time interval for fault resetting
- Set frequency for pulse width modulation (PWM)
- Define duty cycle map

2 high power outputs are available with PWM capability applying frequencies up to 25 kHz and of supplying a maximum continuous current of 26..50 A each channel. Please observe that our default maximum current level for each channel is set in accordance with Deutsch's current limit for the size AWG16 contacts in the Autosport 20-16 connector. The driver stages can deliver significantly more current, but it is important to avoid overloading the wiring and contacts in the connector.

WARNING: Do NOT connect any PWM output in parallel with any other output!

9.5.1 Half Bridge – Full Bridge

These PWM outputs are true half bridge drivers, having a top and bottom transistor.
Contrary to conventional outputs the PWM outputs are connected to ground when switched off.

By combining 2 PWM outputs you can create a full bridge which for example could be used to drive a DC motor, turning it clockwise or anti clockwise. In this example you connect one PWM output to one of the DC motor terminals, a second PWM output to the other DC motor terminal. Depending on which output you activate you can make the DC motor rotate.
You can configure the PWM drivers as either digital outputs or as frequency, duty cycle controlled outputs. In this configuration you will be able to control the speed at which the motor rotates.
The control can be extended to included position control via an analogue or digital input or by the current draw.

9.5.2 Current Draws

Current draw can be measured on all outputs.
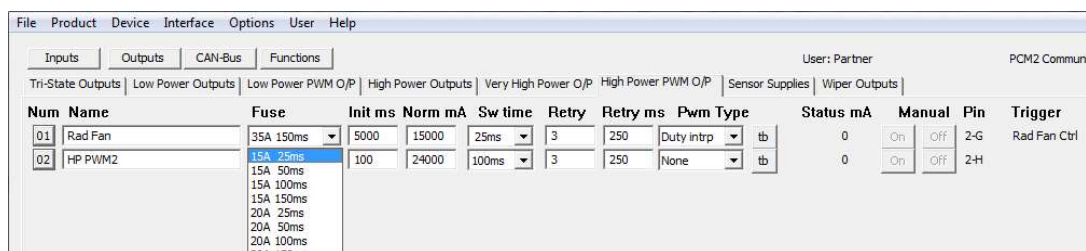
Outputs are protected by three current thresholds and three timers:
- OCH is the high current threshold of 100 A.
- OCL is the user defined continuous current threshold, selectable as 15, 20 or 25..50 A.
- OCS is the software selected current threshold.

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Switching an output ON, an inrush current up to and in excess of 150 A is allowed for a 20 usec time interval.
After these 20 usec the current level must be below OCH which is 100 A.
Within a time interval, selectable between 0.15 to 155 msec, from switching the output ON, the current draw must have fallen below the OCL threshold. This threshold can be set to 15 / 20 / 25..50 A.

In column "*INIT ms*" key in the time delay for applying the steady state fuse level defined in "*NORM mA*". This interval must exceed the time interval selected for OCL, suggested value > 200 msec.
Maximum time is limited to 10 seconds.
After the time interval INIT, the initial time from switching the output ON, the current draw must be below the user defined software fuse level, OCS. If the current draw exceeds this threshold, the output will be switched off.

In column *NORM mA* key in the steady state fuse level required. This value must be lower than the maximum fuse level, OCL. Maximum current threshold is 26,000 mA.
If the current draw on an output exceeds the NORM fuse setting, the output will switch off.

In *SW Time* set the time interval in milliseconds during which the current draw is allowed to exceed the OCS fuse level.
Time intervals are selectable from 25 ms to 250 ms.

In *Retry* set the maximum number of automatic re-activation of an output channel after is has been shut down caused by a short circuit or an overload. It is strongly recommended not to exaggerate the number of retries – select a number < 10.

In *Retry ms* set the time interval between retries in milliseconds.

PWM Type is used to define the functionality of the PWM feature:
- None   Output disabled
- Dig out   No PWM used, output is off or on 100%
  DO NOT USE THIS OPTION ON PCM2 SERIAL <076
- Duty intrp   Interpolation between duty cycle breakpoints
- Duty down   Duty cycle from nearest lower breakpoint applied
- Duty up   Duty cycle from nearest higher breakpoint applied
- Duty near   Duty cycle from nearest lower or higher breakpoint applied

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Duty Cycle Maps
Duty cycle maps are designed with variables on both X and Y axis.

Use the drop down menus to select the channels used for the X and Y axis of the table.
It is not necessary to use the full table and all breakpoints in the maps nor to use both axis's.
Using a two-axis calibration, start filling the map out from upper left hand corner.
Using a single axis calibration, select the X or Y-axis as the input reference, using only the first row or column of the other axis.

The map can be imported and exported to Excel.
An easy way to create a duty cycle map is to follow this procedure:
- Open the duty cycle map
- Click "Copy"
- Paste into Excel
- Modify table
- Mark the table and copy
- Return to the tool and click past
- Set frequency in Hz; minimum applied value is 30 Hz, maximum value is 15 kHz
- HP PWM1 and HP PWM2 must use the same frequency

The *Status* window shows the real time current draw of the output in mA.

Use the *Manual* option to test the output connection. When *Manual* is active (see section **4.3**), PCM2's event handling has been deactivated and all channels are OFF by default.
Click the ON button for each individual channel to switch the output ON.
Click the ON button again to switch the output OFF.

Clicking on *Trigger* will open the main event controlling this output. A warning may appear if several events are used to control it.

The status window will show the real time current draw of the output in mA.

Use the *Manual* option to test the output connection. When *Manual* is active (see section **4.3**), PCM2's event handling has been deactivated and all channels are OFF by default.
Click the ON button for each individual channel to switch the output ON.
Click the ON button again to switch the output OFF.

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Clicking on *Trigger* will open the main event controlling this output. A warning may appear if several events are used to control it.

9.5.3 Pin Configuration High Power PWM Outputs

HP PWM OUT	Max continuous current, A	Max recommended current, A	Connector 2	Pin
1	50	26	AS2 20-16 SN	G
2	50	26	AS2 20-16 SN	H

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9.6 Very High Power

This section gives access to:
- Naming of output
- Set inrush current threshold
- Set time interval for inrush current
- Set the normal fused threshold
- Set the number of retries once a fault is detected before switching off
- Set the time interval for fault resetting

2 very high power outputs are available, supplying a maximum continuous current of 26..100 A each channel.
Please observe that our default maximum current level for each channel is set in accordance with Deutsch's current limit for the size AWG16 contacts in the Autosport 20-16 connector.

Current draw can be measured on all outputs.

The driver stages can deliver significantly more current, but it is important to avoid overloading the wiring and contacts in the connector.

Once an output is turned on, the current draw depends on the attached load.
- If this load is a resistive load, there will hardly be any inrush current.
- If the output drives a motor or a lamp, for example, there can be a substantial inrush for a certain amount of time. The current draw will quickly decrease and reach a steady state level.

Outputs are protected by three current thresholds and three timers:
- OCH is the high current threshold of 300 A.
- OCL is the user defined continuous current threshold, selectable as 2 x30 (60A) to 2 x 50 A (100A).
- OCS is the software selected current threshold.

Switching an output ON, an inrush current up to 300 A is allowed for a 20 usec time interval.
After these 20 usec the current level must be below OCH which is maximum 80..100 A.

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Within a time interval, selectable between 0.15 to 155 msec, from switching the output ON, the current draw must have fallen below the OCL threshold. This threshold can be set to 30 / 40 A.

In column "*INIT ms*" key in the time delay for applying the steady state fuse level defined in "*NORM mA*". This interval must exceed the time interval selected for OCL, suggested value > 200 msec. Maximum time is limited to 10 seconds.
After the time interval INIT, the initial time from switching the output ON, the current draw must be below the user defined software fuse level, OCS. If the current draw exceeds this threshold, the output will be switched off.

In *SW Time* set the time interval in milliseconds during which the current draw is allowed to exceed the OCS fuse level.
Time intervals are selectable from 25 ms to 250 ms.

In column *NORM mA* key in the steady state fuse level required. This value must be lower than the maximum fuse level, OCL. Maximum current threshold is 26,000 mA.
If the current draw on an output exceeds the NORM fuse setting, the output will switch off.

In *Retry* set the maximum number of automatic re-activation of an output channel after is has been shut down caused by a short circuit or an overload. It is strongly recommended not to exaggerate the number of retries – select a number < 10.

In *Retry ms* set the time interval between retries in milliseconds.

The status window will show the real time current draw of the output in mA.

Use the *Manual* option to test the output connection. When *Manual* is active (see section **4.3**), PCM2's event handling has been deactivated and all channels are OFF by default.
Click the ON button for each individual channel to switch the output ON.
Click the ON button again to switch the output OFF.

Clicking on *Trigger* will open the main event controlling this output. A warning may appear if several events are used to control it.

9.6.1 Pin Configuration Very High Power Outputs

Channel	Max continuous current, A	Max recommended current, A	Connector 2	Pin
VHP1	50	26	AS2 12-16 SN	B
VHP2	50	26	AS2 12-16 SN	C

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9.7 Wiper Outputs

2 dedicated outputs for wiper motors are available. These two channels have additional protection diodes and can handle the load dump created when the wiper motor stops.
Wiper motors can also be controlled by the LIN bus (in preparation).
The 2 power outputs can supply a maximum continuous current of 13..25 A each channel.
Please observe that our default maximum current level for each channel is set in accordance with Deutsch's current limit for the size AWG20 contacts in the Autosport 20-39 connector.
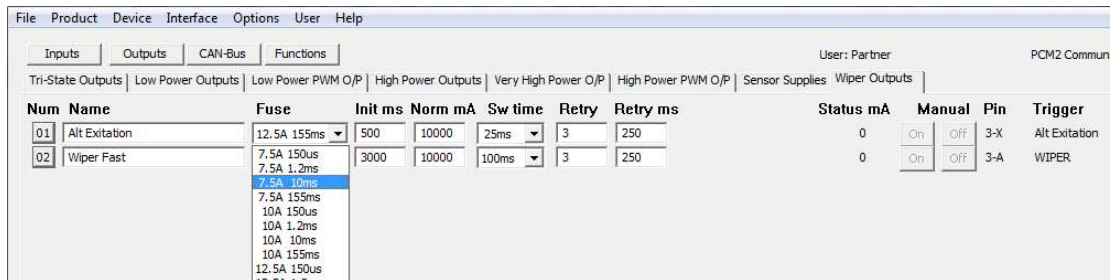
The driver stages can deliver significantly more current, but it is important to avoid overloading the wiring and contacts in the connector.
Please note, that if the wipers operates on a dry windscreen, the current draw will be much higher than when used on a wet screen.

Once an output is turned on, the current draw depends on the attached load.
- If this load is a resistive load, there will hardly be any inrush current.
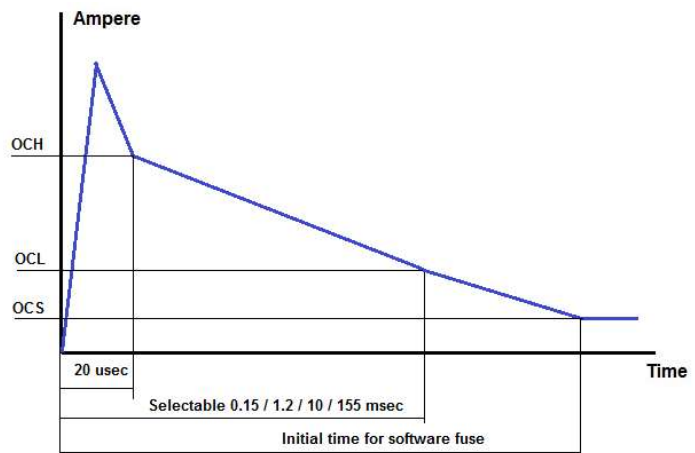- If the output drives a motor or a lamp, for example, there can be a substantial inrush for a certain amount of time. The current draw will quickly decrease and reach a steady state level.

Outputs are protected by three current thresholds and three timers:
- OCH is the high current threshold of 75 A.
- OCL is the user defined continuous current threshold, selectable between 7.5 A to 12.5...25 A.
- OCS is the software selected current threshold.

Switching an output ON, an inrush current up to and in excess of 75 A is allowed for a 20 usec time interval.
After these 20 usec the current level must be below OCH which is 75 A.
Within a time interval, selectable between 0.15 to 155 msec, from switching the output ON, the current draw must have fallen below the OCL threshold. This threshold can be set to 7.5 / 10 / 12.5..25 A.

In column "*INIT ms*" key in the time delay for applying the steady state fuse level defined in "*NORM mA*". This interval must exceed the time interval selected for OCL, suggested value > 200 msec.

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Maximum time is limited to 10 seconds.
After the time interval INIT, the initial time from switching the output ON, the current draw must be below the user defined software fuse level, OCS. If the current draw exceeds this threshold, the output will be switched off.

In column *NORM mA* key in the steady state fuse level required. This value must be lower than the maximum fuse level, OCL. Maximum current threshold is 13,000 mA.
If the current draw on an output exceeds the NORM fuse setting, the output will switch off.

In *SW Time* set the time interval in milliseconds during which the current draw is allowed to exceed the OCS fuse level.
Time intervals are selectable from 25 ms to 250 ms.

In *Retry* set the maximum number of automatic re-activation of an output channel after is has been shut down caused by a short circuit or an overload. It is strongly recommended not to exaggerate the number of retries – select a number < 10.

In *Retry ms* set the time interval between retries in milliseconds.

The status window will show the real time current draw of the output in mA.

Use the *Manual* option to test the output connection. When *Manual* is active (see section **4.3**), PCM2's event handling has been deactivated and all channels are OFF by default.
Click the ON button for each individual channel to switch the output ON.
Click the ON button again to switch the output OFF.

Clicking on *Trigger* will open the main event controlling this output. A warning may appear if several events are used to control it.

9.7.1 Pin Configuration Wiper Outputs

WPM OUT	Max continuous current, A	Max recommended current, A	Connector 3	Pin
WP1	25	13	AS2 20-39 SA	X
WP2	25	13	AS2 20-39 SA	A

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9.8 Sensor Supplies

PCM2 has 3 stabilised 5.0 Volts sensor supplies (VREF) for use with the analogue sensor inputs. Maximum current draw from each output is 1.0 A.

9.8.1 Pin Configuration 5 Volt VREF Outputs

Channel	Max continuous current, A	Max recommended current, A	Connector 4	Pin
VREF1	1.0	1.0	AS2 16-35 SN	32
VREF2	1.0	1.0	AS2 16-35 SN	40
VREF3	1.0	1.0	AS2 16-35 SN	47

9.9 Warning Light

PCM2 is equipped with a warning light for error detection. The driver output is found in connector 4, pin 42. If a fault is detected, the channel switches 5.0 volts ON, maximum current draw is 1.0 A.

9.10   Fault Reset

You can reset all output channels in error status by briefly connecting the selected reset channel to ground.
A reset channel can be assigned as an event. In this case any input - analogue, digital or CAN – and the dedicated warning light output can be assigned.
Use the event settings to define the switching conditions.

Resetting PCM2 only affects channels in error state. The reset function will not reboot the PCM in general and has no influence on outputs in normal operation state. It will only reboot channels which have switched off after their pre-defined automatic resetting conditions.

Please see section 5.3.1.13 for setting up a reset event.

The reset will reboot channels which were shut down due to overload of OCH, OCL and OCS.

9.10.1   Pin Configuration Warning Light Output

Channel	Max current, A	Connector 4	Pin
WL1	5.0 Volts @ 1.0 A	AS2 16-35 SN	42

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10   Visualisation

A graphic visualisation is available in the tool. This feature displays links between any inputs, events and outputs.
On-screen editing of event configuration and settings of inputs and outputs is available.
Inputs are green, events are blue and outputs are orange.

Please note, that the displayed string does not show every single connection for each of the component in the string.
Note the example to the right. Top shows the link to the primary starter solenoid. The lower picture shows the link when clicking on the starter event.
Only the string which includes the primary connections linked to the input, event or output selected is shown. The main box which was used to open the visualisation display is marked with a red ring.
By clicking on any of the other boxes in the priority will change and the string will be redrawn.
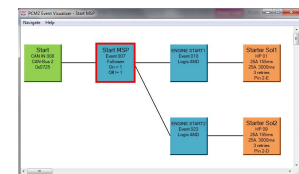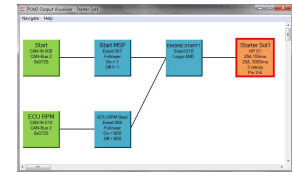
Scroll the display up and down the PC arrow keys or the wheel on the mouse.
Press and hold the shift key and use the mouse scroll wheel to move the display left and right.

A "Navigate" button gives access to these features:
- move backwards through recently opened visualisation windows
- move forward through recently opened visualisation windows
- switch from the visualisation window to the tool configuration window

The "Help" button opens a support window.

10.1   Digital Inputs
The visualisation display is opened by clicking the number button to the left of the digital channel name.
The digital input box displays:
- Switch name
- Digital input channel number
- Debounce time
- Pin position in connector #4

Right click the box to jump to the digital input configuration page.
Left click the button to redraw the visualisation display, based on the selected digital input.

10.2   Analogue Inputs
The visualisation display is opened by clicking the number button to the left of the analogue channel name.
The digital input box displays:
- Analogue input name
- Analogue input channel number
- Selected pull-up resistor
- Pin position in connector #4

Right click the box to jump to the analogue input configuration page.
Left click the button to redraw the visualisation display, based on the selected analogue input.

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10.3 CAN Inputs

The visualisation display is opened by clicking the visualisation button found in the lower right hand corner of the CAN input configuration window.

The digital input box displays:

- CAN input name
- CAN input channel number
- Selected CAN bus (1, 2, 3 or 4)
- Identifier number in hex
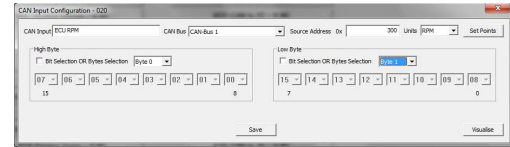
Right click the box to jump to the CAN input configuration page.

Left click the button to redraw the visualisation display, based on the selected CAN input.

10.4 Events

The visualisation display is opened by clicking the visualisation button found in the lower right hand corner of the event configuration window.

The event input box displays:

- Event name
- Event number
- Event type
- Event conditions for "true / false".
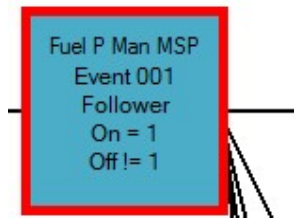
Right click the box to open the event configuration page.

Saving changes to the event by clicking the Save button will re-draw the visualisation display.

Left click the button to redraw the visualisation display, based on the selected event.

10.5 Outputs

The visualisation display is opened by clicking the number button to the left of the output channel name.

The output box displays:

- Output name
- Output channel number
- OCL fuse setting
- OCS fuse setting
- Number of retries when in fault mode
- Pin position in connector #4
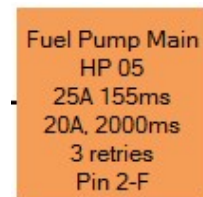
Right click the box to jump to the output channel configuration page.

Left click the button to redraw the visualisation display, based on the selected output.

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11   CAN BUS

11.1   Data Bus

PCM2 has 4 separate CAN ports:

The CAN display screen shows status for each of the 4 available CAN bus:
- Status displays if the CAN bus is active.
- "T" displays whether the CAN us is terminated or not.
- "Tx" and "Rx" displays whether there is traffic on the CAN bus.

If a CAN bus fails, for example after a short circuit, PCM2 will automatically reset the CAN stream.

11.1.1   CAN Bus Name

Each CAN bus can be labelled individually to ease identification. Maximum 15 characters can be used.

11.1.2   CAN Bus Speed

Baud rate for each CAN bus can be selected as:
- 10 kbps
- 20 kbps
- 50 kbps
- 125 kbps
- 250 kbps
- 500 kbps
- 1 Mbps

11.1.3   CAN Maximum Identifiers

There are limitations to how many individual identifiers (addresses) each CAN bus can handle:
CAN 1 & CAN 2 – Up to 64 individual identifiers.
CAN 3 & CAN 4 – Maximum 5 different identifiers.
Maximum identifier value is 7FF when using an 11 bit identifier.

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11.1.4   Termination

To function correctly a CAN bus requires a termination resistor between the two CAN wires.
This is done by fitting two 120 Ohm termination resistors between CAN H and CAN L, one each end of the CAN string.
All additional modules having CAN communication which will be connected to the CAN bus must have their termination resistors disabled. It is essential for the stability of the CAN bus that two and only two resistors are fitted.
It is possible to enable internal termination resistors in PCM2, terminating one end of the CAN string.
Each CAN bus can be individually terminated. By ticking the box, a 120 Ohm resistor within PCM2 is connected between CAN H and CAN L on the selected CAN bus.

Please note that a CAN connection should not exceed 16 metres (for 1 Mbits/s baud rate).
CAN wires must be laid out as twisted pairs.
This must be respected for each individual CAN bus.

The diagram shows an example of the correct layout of a CAN bus. The devices should be daisy chained and not starred. The termination resistors should be at the extreme ends of the bus. The diagram shows the two terminating resistors one physical resistor added to the cable near the ECU and the second internal termination in the PCM2.
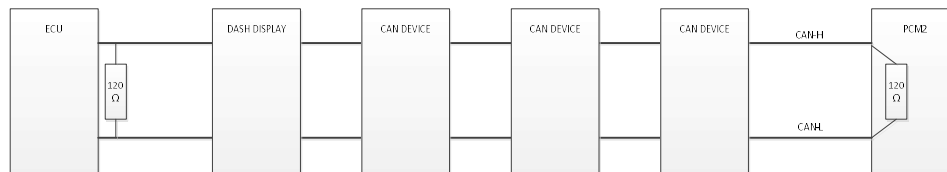
11.1.4.1   Correctly Terminated CAN Bus

It is very important that a CAN bus is terminated correctly. If it is terminated with 1 or 3 resistors, the data exchange will not work correctly and the car will have serious running issues.
Please note the oscilloscope screen shot displaying a **correctly** terminated CAN bus:

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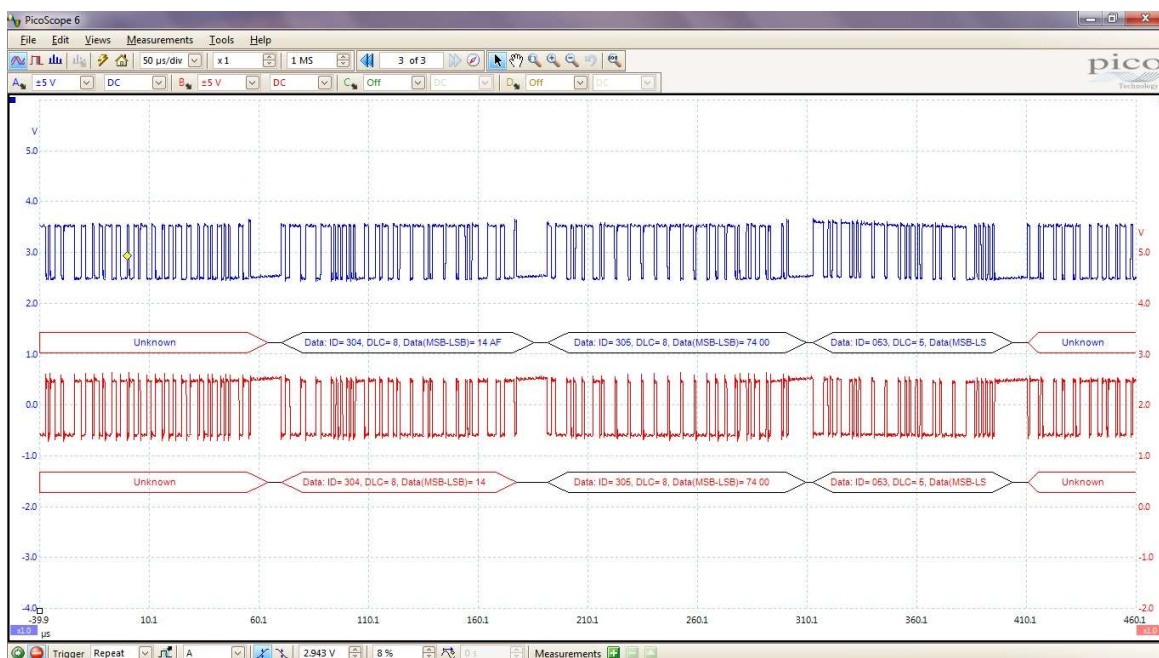
11.1.4.2 Incorrectly Terminated CAN Bus

If the CAN bus is incorrectly terminated, having NO termination resistors, the data transfer will be instable. Please note the shift in voltage level and wave forms:
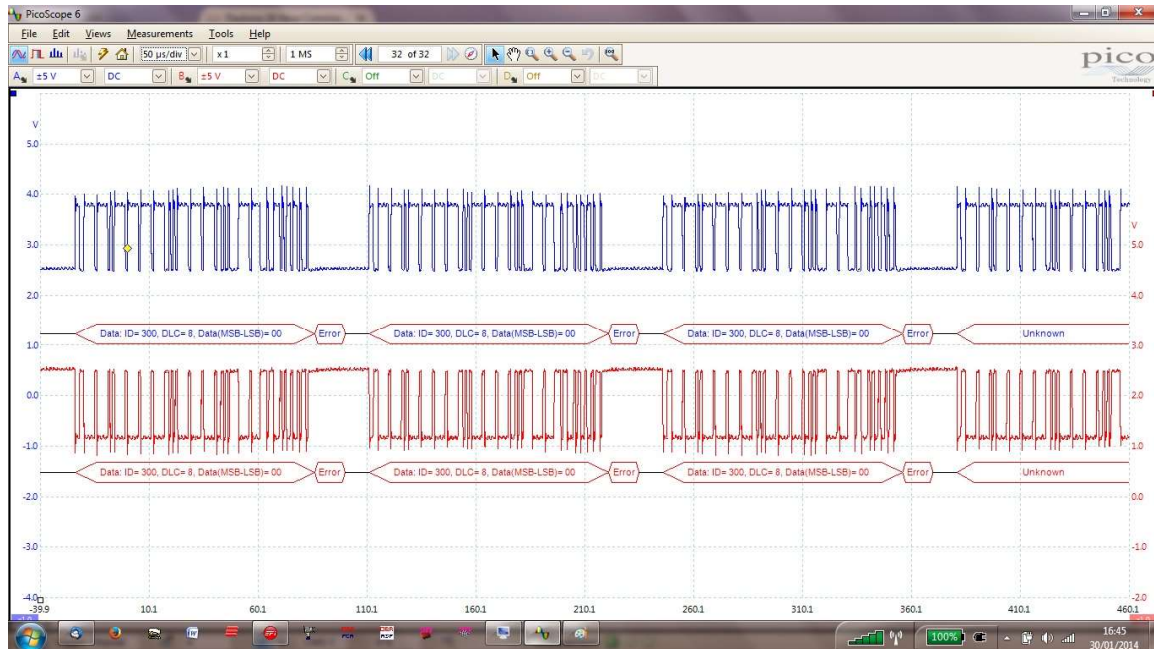
If the CAN bus is incorrectly terminated, having only one single termination resistor, the data transfer will be instable. Please note the shift in voltage level and wave forms:

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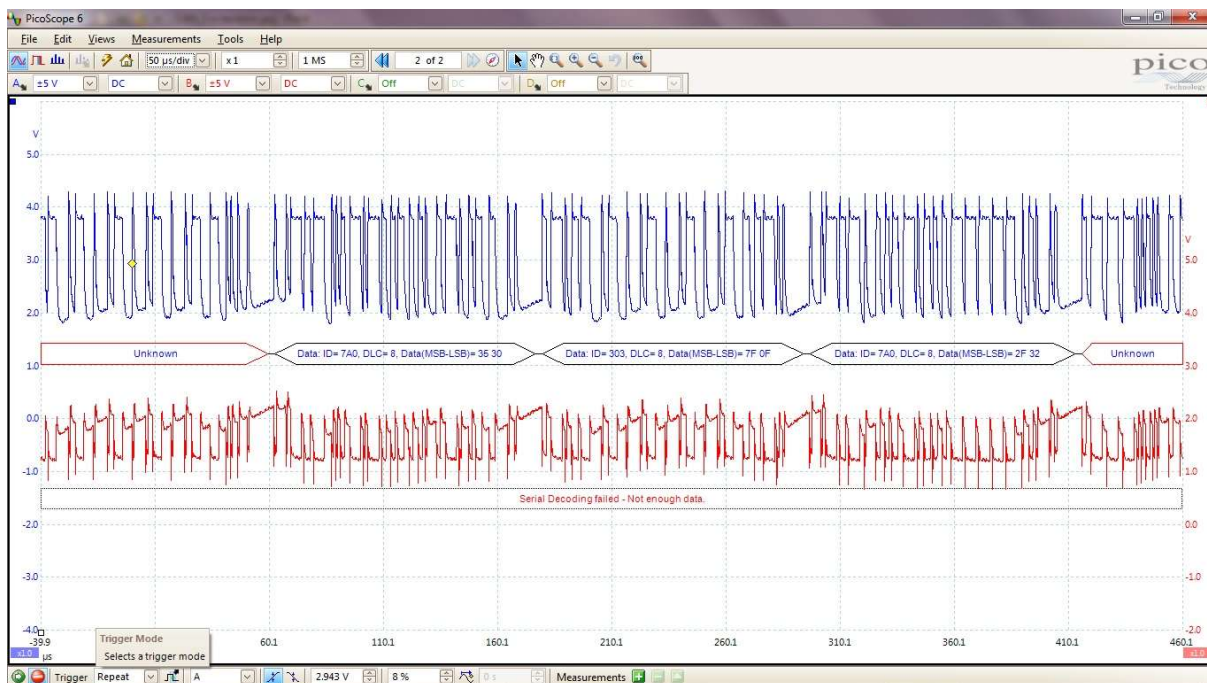
If the CAN bus is incorrectly terminated, having three termination resistors, the data transfer will be instable. Please note the shift in voltage level and wave forms:
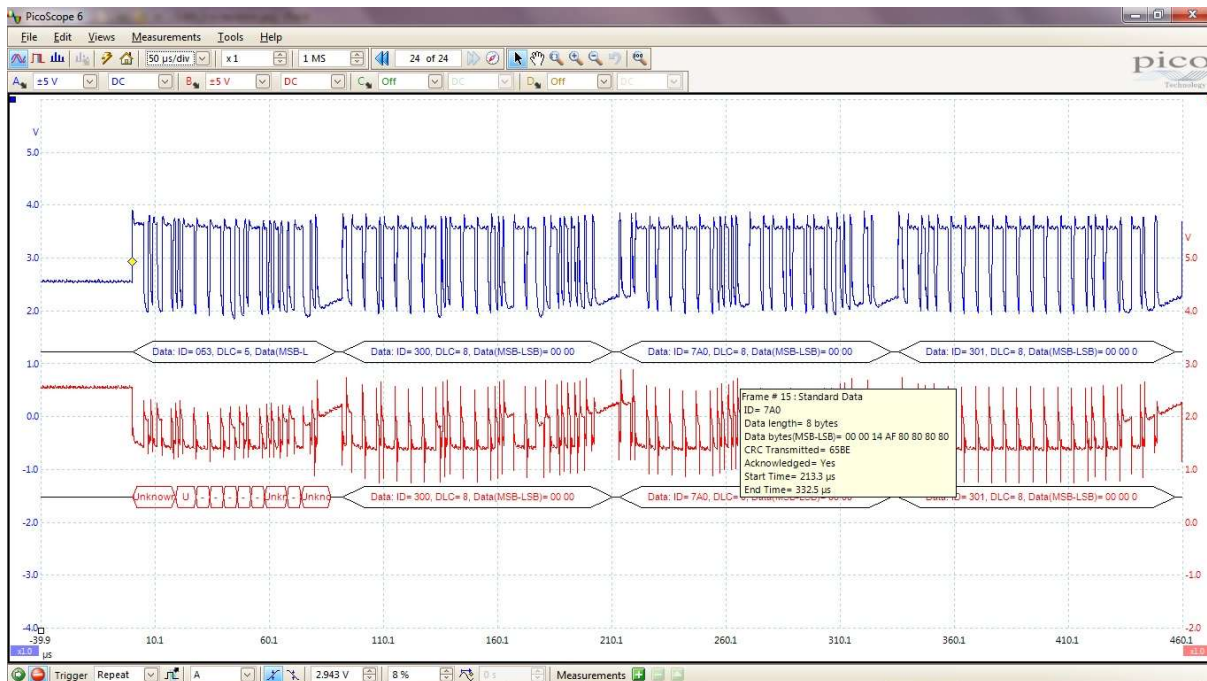
11.1.5   Error Report

Tick the box to enable reporting of errors on each individual CAN bus.
Only tick this box if the CAN bus is actually in use constantly. If one CAN bus is used for PC communication only then do NOT tick this option.

11.1.6   CAN Bus Identity

Set the base send and receive identifiers for each CAN bus.
This must be set for each individual CAN bus.

11.2   CAN Monitor

A CAN bus analysing tool is included within the PC tool.

By default the monitor displays the load on the actual CAN bus.
The monitor is only active once the "Monitor On" box is ticked.

Tick the box "Monitor On" to display the data detected on the bus.
The analyser displays all traffic on the bus it is connected to.

It is possible to filter the messages so that only selected CAN messages are shown. To activate this feature tick the "Filter On" box.
Next click the button "Filter" and type the required CAN identifiers in hex. The CAN monitor will now only display messages having the selected identifiers.

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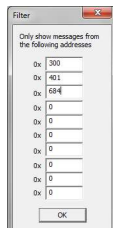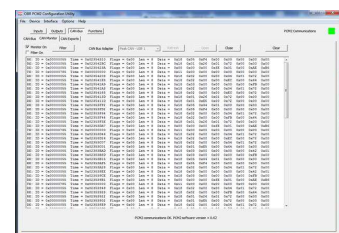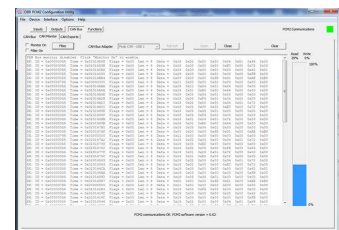
11.3   CAN Export

PCM2 can export up to 64 individual messages on any of the four CAN ports.

Num	Name	CAN-Bus	Address	Interval	Byte 7							Byte 0	
01	EPS + Eng Fan	CAN-Bus 2	0x730	300	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	Edit
02	Engine Power 1	CAN-Bus 2	0x731	50	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	Edit
03	Engine Power 2	CAN-Bus 2	0x732	50	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	Edit
04	Fuel Pump	CAN-Bus 2	0x733	200	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	Edit
05	Light	CAN-Bus 2	0x734	300	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	Edit
06	Light 2	CAN-Bus 2	0x735	300	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	Edit
07	Start - Wiper	CAN-Bus 1	0x736	200	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	Edit
08	Various	CAN-Bus 2	0x737	300	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	Edit
09	Logger	CAN-Bus 2	0x738	200	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	Edit
10	EWP + HScreen	CAN-Bus 2	0x739	300	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	OCL4	OCM4	Edit
11	CAN Export 11	CAN-Bus 1	0x0	0	NU	NU	NU	NU	NU	NU	NU	NU	Edit
12	CAN Export 12	CAN-Bus 1	0x0	0	NU	NU	NU	NU	NU	NU	NU	NU	Edit
13	CAN Export 13	CAN-Bus 1	0x0	0	NU	NU	NU	NU	NU	NU	NU	NU	Edit
14	CAN Export 14	CAN-Bus 1	0x0	0	NU	NU	NU	NU	NU	NU	NU	NU	Edit
15	CAN Export 15	CAN-Bus 1	0x0	0	NU	NU	NU	NU	NU	NU	NU	NU	Edit
16	EPS_TX	CAN-Bus 1	0x17C	10	NU	NU	NU	NU	NU	NU	AL	AM	Edit

The opening screen displays the general setting for 16 CAN export channels on each of four pages.
On each page is displayed:
- Channel number
- Channel name
- Active on which CAN bus
- Address in hex
- Transmission time interval
- Code for information sent in each byte, displayed from byte 7 -> byte 0 from left to right

11.3.1   Configuration of Export Channels

It is possible to export the following information on any of the 4 CAN ports.
- Constant value (used to identify a row count)
- Digital input status
- Analogue input
- Outputs ON / OFF status
- Output current draw
- Output tri-state voltage level
- Output fault status
- Vehicle voltage
- Event status
- PCM2 temperature
- Accumulated vehicle current draw
- PWM frequencies
- PWM duty cycles
- CAN inputs (full routing)
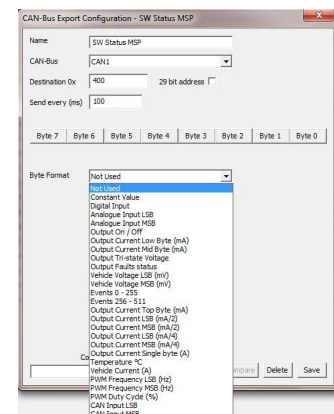
Click the EDIT button to get access to individual channel parameters.

Name
Use this section to give each of the 4 CAN ports a unique name.

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CAN-Bus
Select the CAN port on which you are going to define the export.

Destination
Set the CAN identifier as a hex value for the export.

Send every (ms)
Set the identifier transmission interval in milliseconds.
NOTE: Maximum value is 7FF when using an 11 bit identifier.

11.3.2 Definition of Export Bytes

For each bit, byte or word it is possible to export these values:

"NU" - Byte not used
If no export is required in a specific byte, select "Not Used".

"CON" - Constant Value
Use this section to define a constant value of a selected byte. This is used to define a row count.

"DS" - Digital Input Status
One byte can export status of 4 digital inputs.
Select which digital input status to be exported in bits 0, 2, 4 and 6.
Status is displayed as:
- 0 = off
- 1 = switched low
- 2 = switched open
- 3 = switched high

"AL" - Analogue Input LSB
Any analogue input channel can be exported on a CAN bus.
The LSB channel can export values between 0..255.

"AM" - Analogue Input MSB
Any analogue input channel can be exported on a CAN bus.
The MSB channel can export values between 256..65,535.
Combining export of the LSB and MSB channels, values between 0..65,535 can be exported.
These channels can be arranged in Motorola format (MSB,LSB) or Intel format (LSB,MSB).

"OS" - Output ON or OFF Status
Each individual bit in the selected byte can be used to display the operation status of any output:
- 0 = off
- 1 = on

"OCL" - Output Current Low Byte
Current draw from each of the 48 power outputs can be measured.
Using 1 byte for each output this section defines an export of current draw from any channel, measured in mA and up to 255 mA.

"OCM" - Output Current Mid Byte
Current draw from each of the 48 power outputs can be measured.
This byte export current draws between 256..65,535 mA.
Combining Output Current Low Byte and Output Current Mid Byte PCM2 exports currents between 0..65,535 mA.

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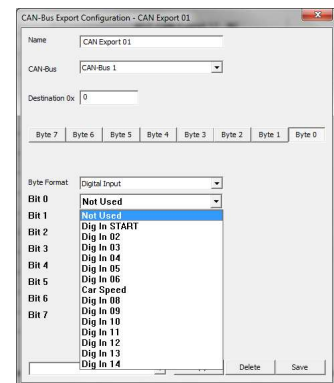
"TO" - Output Tri-State Voltage
Status of each tri-state output can be exported using 2 bits in each byte.
Status is displayed as:
- 0 = 0 V
- 1 = 2,5 V
- 2 = 5 V

"OFL" - Output Fault Status LSB
Status of an operational fault status for any output channel can be sent, using 1 byte each channel.
The fault status is transmitted as a combination of:

Fault status	Fault Hex Value	Decimal Value
Output OFF	0x00	0
Output ON	0x01	1
Shutdown, too high voltage	0x02	2
Shutdown, too low voltage	0x04	4
Shutdown, open load	0x08	8
Shutdown, over current low OCL	0x10	16
Shutdown, over current high OCH	0x20	32
Shutdown, too high temperature	0x40	64
Shutdown, over current software OCS	0x80	128
Shutdown, over current software OCS retry	0x100	256

Channels not supported are:
- Low power 29, 30, 31 and 32.
- All PWM channels
- All tri-state outputs
- All VREF sensor supplies
- Displaying a value of 0 the channel is switched off.
- Displaying a value of 1 the channel is switched on.
- Displaying a value of 8 the channel is switched off and has no load connected to it.

Error status codes are normally shown as a combination of numbers:

- Displaying a value of 17, PCM2 is trying to switch the channel on, but the current draw has exceeded the low hardware (OCL) threshold and has gone into an error status.
- Displaying a value of 33, PCM2 is trying to switch the channel on, but the current draw has exceeded the high hardware (OCH) threshold and has gone into an error status.
- Displaying a value of 129, PCM2 is trying to switch the channel on, but the current draw has exceeded the software (OCS) threshold and has gone into an error status.

Using the Reset event to reset any outputs in error status does not clear this diagnostic.
In general, switching a channel OFF then ON will attempt a restart even if the channel has failed earlier.
Only channels which have failed will be reset.
To clear diagnostic, look in the tools main menu in "Device". Clicking on "Reset Output Counters" will reset diagnostics. See section 4.2.9.

"VVL" & "VVM" - Vehicle Battery Voltage
Battery voltage is handled in mV.
Battery voltage between 0..255 mV is exported in LSB.
Battery voltage between 256..65,535 mV is exported in MSB.
Battery voltage in mV can be exported using 2 or 1 bytes, depending on the required resolution.

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"EVL" & "EVH" - Event Status
The export of event status is divided into two sections, one for the first 0..255 events (EVL) and one for the following 256..512 events (EVH).
Each byte in one identifier can display status of 8 events:
- 0 = False
- 1 = True

"OCH" - Output Current Top Byte
Current draw from each of the 48 power outputs can be measured.
This byte export current draws exceeding 65,536 mA.
Combining Output Current Low Byte, Output Current Mid Byte and Output Current Top Byte PCM2 it is possible to export current measurements exceeding 65.5A.

"OCL2" - Output Current LSB Byte (mA/2)
Current draw from each of the 48 power outputs can be measured.
This byte export current draws between 0..512 mA.

"OCM2" - Output Current MSB byte (mA/2)
Current draw from each of the 48 power outputs can be measured.
This byte export current draws between 512..131,070 mA.
Combining Output Current LSB Byte (mA/2) and Output Current MSB Byte PCM2 exports currents between 0..131,070 mA.

"OCL4" - Output Current LSB Byte (mA/4)
Current draw from each of the 48 power outputs can be measured.
This byte export current draws between 0..1,023 mA.

"OCM4" - Output Current MSB byte (mA/4)
Current draw from each of the 48 power outputs can be measured.
This byte export current draws between 1,024..262,140 mA.
Combining Output Current LSB Byte (mA/2) and Output Current MSB Byte PCM2 exports currents between 0..262,140 mA.

"OCS" - Output Current Single byte (A)
Current draw from each of the 48 power outputs can be measured.
This section exports current draw for any channel, scaled at 1 A/bit with a range up to 255 A.

"TP" - Temperature Degrees Celcius
Temperatures are measured at the hottest points on the two PCM2 internal boards, signal and power. These values can be exported in one signed byte each. Scaling is 1 deg C/bit, no offset and with a range between -127 deg C to +128 deg C.
Please note that these channels are only updated with a time interval of 1,5 sec.

"VC" - Vehicle Current (A)
This section exports the accumulated current draw by the vehicle.
The channel is a single byte scaled at 1A/bit, range is 0.255 A.

"PFL" - PWM Frequency LSB
The frequency of the pulse width modulation channels can be exported.
The LSB channel can export values between 0..255 Hz.

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"PFM" - PWM Frequency MSB
The frequency of the pulse width modulation channels can be exported.
The MSB channel can export values between 256..65,525 Hz.
Combining export of the LSB and MSB channels, frequencies between 0..65,535 Hz can be exported. Channels can be arranged in Motorola format (MSB,LSB) or Intel format (LSB,MSB).

"PDC" - PWM Duty Cycle
The duty cycle of the pulse width modulation channels can be exported using a single byte, showing values between 0..100%.

"CIL" - CAN Input LSB
Any CAN input channel can be exported on a CAN bus.
The LSB channel can export values between 0..255.

"CIM" - CAN Input MSB
Any CAN input channel can be exported on a CAN bus.
The MSB channel can export values between 256..65,535.
Combining export of the LSB and MSB channels, values between 0..65,535 can be exported.
These channels can be arranged in Motorola format (MSB,LSB) or Intel format (LSB,MSB).

"OFH" – Operational Fault Status
The MSB channels exports fault status values between 256…65535.

"CCL" – Over Current Low
Over current low byte.

"CCH" – Overcurrent High
Over current high byte.

"CTH" – Thermal Status
Counts thermal faults caused by output driver chip exceeding upper temperature threshold.

"CCS" – Overcurrent Soft
Counts faults caused by current draw exceeding the software fuse level threshold.

"CPK" – Peak Current Single
Peak current output on a single channel, expressed I A.

Copy From
It is possible to copy the settings from one address to another address.
Open the CAN address to configure.
From the drop down menu select the address to copy, then click the COPY button.

Save
Click on SAVE to save the CAN address changes.

Delete
Click on DELETE to clear a CAN address.

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11.3.3   CAN bus export with row count

PCM2's CAN export can be designed to work with row counts.
It is possible to define which byte to use as the row count and it is possible to let all bytes rotate, exporting whatever is required.
It is simple to define this strategy:

First data in row count:
- Open a CAN export window
- Rename
- Select CAN bus for export
- Set identifier
- Set transmission interval
- Click on the byte to use as row count, for example Byte 0
- In Byte Format, select Constant Value
- In Value, select number, any value will do, for example 0
- For all remaining bytes select which channels to export

Second data in row count:
- Open a CAN export window
- Rename
- Select same CAN bus for export (all 4 works now, from fw 116)
- Set same identifier as for first row count
- Set same transmission interval as for first row count
- Click on same byte as selected as row count 1, for example Byte 0
- In Byte Format, select Constant Value
- In Value, select number, any value different from row count 1 will do, for example 1
- For all remaining bytes select which channels to export

There are NO limitations on which byte to use as row count, it is possible to use up to 64 row counts and there are no limitations on which bytes to rotate.

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12   LIN Bus – Wiper Motor Control

In addition to CAN and serial data ports PCM2 has a capability to control external modules via its LIN bus.
The LIN bus has been introduced from software version 1.47.

Access to the LIN bus settings are found in section 'CAN Bus' in the main menu.

The LIN bus has been implemented with a strategy to specifically control the Bosch WDA wiper motor.
This section will concentrate on the settings required for this wiper motor to function correctly.

In this example we have used digital inputs to control the wiper motor but it is of course possible to use an analogue or CAN input as well.

Leave the status of Kl.X and Kl.15 low.

You can select all 4 modes for the intermittent wiper action, the single sweep plus low and high speed selections.

In the main LIN bus section the bus can be named individually and the LIN bus speed is set to 19,200 bit/s.

Use section 'LIN Exports' to configure the LIN bus to control the wiper motor.

Set the communication address to **0x31** with the wiper motor with a refresh rate of **40** ms.

Configuration of byte 0:

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Configuration of byte 1:

Configuration of byte 2, 3, 4, 5, 6 and 7:

The wiper motor has a 4-way connector:

- Pin 1 = LIN bus signal, connect to PCM2 connector #4, pins 25+26, PCM2 has to be Master.
- Pin 2 = Not used.
- Pin 3 = Ground.
- Pin 4 = Battery power, connect to a PCM2 low or high power output.

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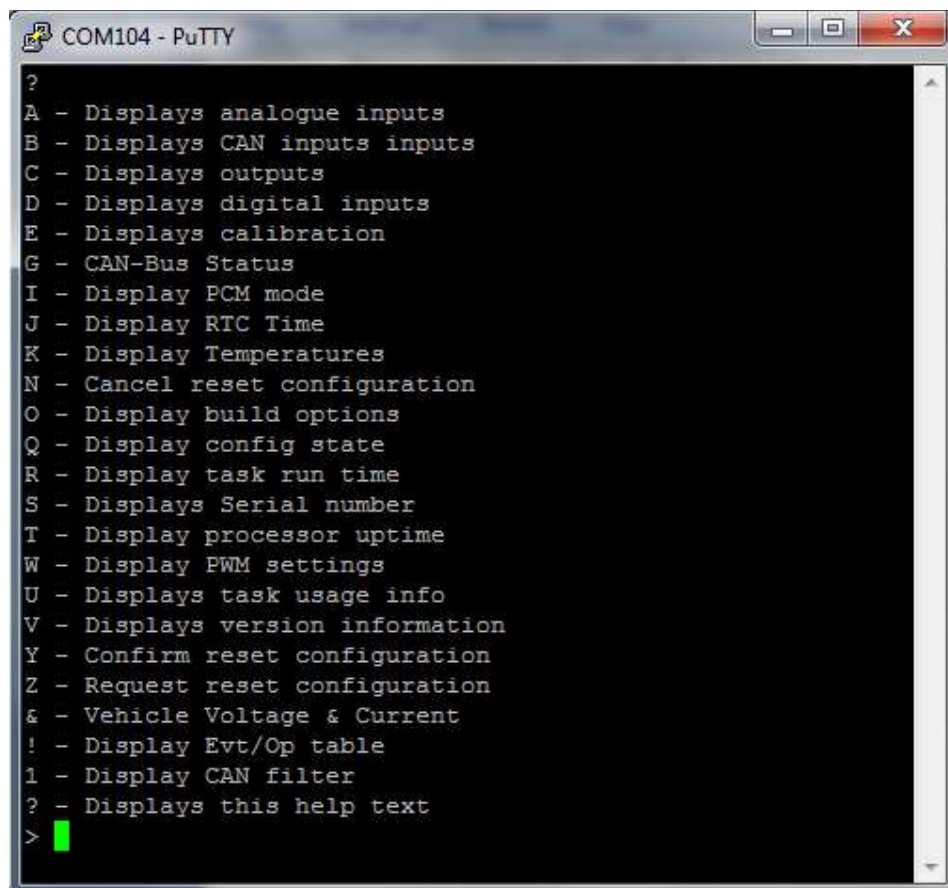
13   Serial Link

PCM2 has a serial link which can be viewed as an additional tool.

To enable the link connect three pins from connector #4 this way:
- Pin 17 in connector #4 (RS232 TX) to pin 2 in the serial DB9 connector
- Pin 18 in connector #4 (RS232 RX) to pin 3 in the serial DB9 connector
- Pin 33 in connector #4 (RS232 ground) to pin 5 in the serial DB9 connector

Use Hyper Terminal, PuTTY or similar program to display the information on the serial bus.
Set the baud rate to 9,600 and parity and flow control to NONE.

Once communication with PCM2 is established, press "?" to open the menu:

```
COM104 - PuTTY
?
A - Displays analogue inputs
B - Displays CAN inputs inputs
C - Displays outputs
D - Displays digital inputs
E - Displays calibration
G - CAN-Bus Status
I - Display PCM mode
J - Display RTC Time
K - Display Temperatures
N - Cancel reset configuration
O - Display build options
Q - Display config state
R - Display task run time
S - Displays Serial number
T - Display processor uptime
W - Display PWM settings
U - Displays task usage info
V - Displays version information
Y - Confirm reset configuration
Z - Request reset configuration
& - Vehicle Voltage & Current
! - Display Evt/Op table
1 - Display CAN filter
? - Displays this help text
>
```

Press any of the keys listed to view the information required.

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14   Membrane Switch Panel

OBR's membrane switch panels can be supplied with from 8 and up to 20 individually programmable switches.
OBR membrane panels are all backlit using an EL layer.
The panel can be configured with up to 10 individually programmable CAN exports and can control a wide variety of external modules.
Each MSP is highly configurable:

- Each switch can be configured as being either momentary or latching
- Initial switch status selectable as being either ON or OFF
- Each switch can have up to 8 individually programmable stages
- Switches can be arranged in groups
- 3 spare 0..5V analogue inputs
- Green LEDs display switch status, linked to switch or feedback from PCM output channel
- Red LEDs displays output channel error status or any user defined warnings
- ON and OFF activation timers for each switch
- Each key can be assigned to several CAN addresses
- Up to 10 independent definition of CAN identifiers
- Adjustable EL backlight and LED intensity

14.1   Software installation

There is no software to be installed. The program can ne run directly from the files supplied.
Make sure the program file "MSP_200.EXE" is located in a folder which must also contain these files:
-    CANSWITCON.INI
-    PCANBASIC.DLL
When the software is installed, right-click the MSP icon and select Properties. Now select Compatibility and tick the box "Run the program as an administrator".

14.2   Connection to system

Communication with the MSP is established using either a Peak System PCAN interface or EFI Technology's EFP02 and EFT20 CAN communication interfaces.
OBR or your wiring loom manufacturer can provide you with the cable suitable for your installation and selected connectors.
The mating communication connector required is a Deutsch ASL6-06-05 SN connector:
-    Pin 1 = CAN L
-    Pin 2 = CANH
-    Pin 3 = Ground
-    Pin 4 = Battery power
-    Pin 5 = Optional wake-up signal to OBR Master Switch

Connect the CAN interface to your PC and as soon as the CAN interface is plugged into the CAN connector, it will automatically establish communication with the MSP.

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14.3   Main Menu

The Main Menu contains three sections, FILE, DEVICE, INTERFACE and HELP.

14.3.1   File

Click on Open (or press **F2**) to load a configuration from disc.

Click on Save (or press **F3**) to save a configuration to disc.

Save Hex is an OBR feature only.

Admin is an OBR feature only.

Click on Exit (or press **F7**) to c lose the MSP tool.
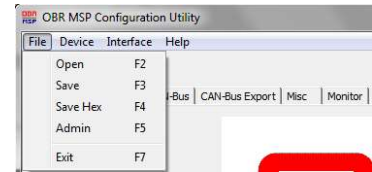
14.3.2   Device

Click on Read (or press **F8**) to read a configuration from the MSP.
Reading the configuration from the panel, the following information is displayed:
- Controller serial number.
- Panel version (keypad configuration).
- Hardware version, 1 (version 2009 to 2014) or 2 (the revised controller from 2015).
- Panel user name.
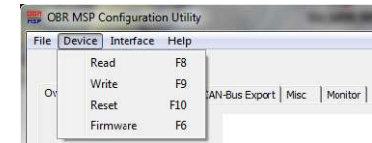
Click on Write (or press **F9**) to send a configuration file to the MSP.
The panel will reset and use the new configuration.

Click on Reset (or press **F10**) to reset the controller manually.
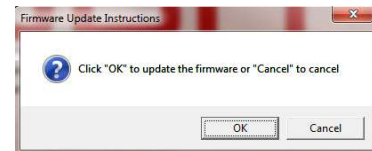
14.3.2.1   Firmware Update

It is possible to update the current version of firmware with new releases.
Click on Firmware (or press **F6**) to locate the firmware BIN file and click OK to load the firmware into the programmer.
The Firmware Update Instructions window opens, click OK to update the firmware in the controller.
Please note that firmware can **only** be updated if the tool and controller are set to communicate on addresses **0x60** (Panel Transmit, Send ID1) and **0x790** (Panel Receive, Receive ID1).
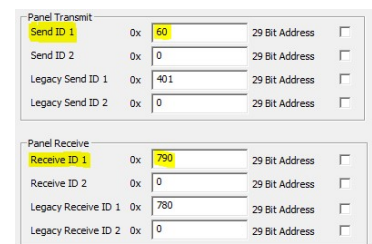
IMPORTANT: You must send the MSP configuration file to the panel after having updated firmware.

14.3.3   Interface

In this section you can select:
- Type of interface used, Peak or EFI Technology
- Baud rate used, select between 10 kbps up to 1 Mbps.

14.3.4   Help

- Click on Help Topics to open the help file.
- Click on About to check MSP software version.

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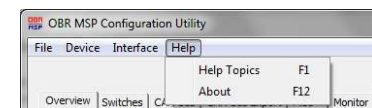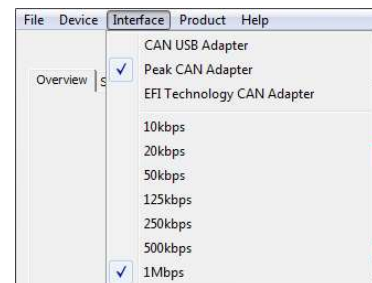
14.4   Switches

14.4.1   Position and Numbering

Panels are available with different layouts, but the switches are numbered according to this 20-key example matrix. Bytes are numbered 0..7:

Switch 17	Switch 18	Switch 19	Switch 20
Switch 13	Switch 14	Switch 15	Switch 16
Switch 9	Switch 10	Switch 11	Switch 12
Switch 5	Switch 6	Switch 7	Switch 8
Switch 1	Switch 2	Switch 3	Switch 4

Please note that switches #4, #8 and #12 do not exist in with the panels having 9 and 12 switches.
- 9-key panel uses switches #1-2-3-5-6-7-9-10-11
- 12-key panel uses switches #1-2-3-5-6-7-9-10-11-13-14-15

14.4.2   Switch name

Key in the name of each switch.
A maximum of 15 characters including spaces can be used.

14.4.3   Mode

Select the key mode as latching or momentary.
In latching mode the key is ON when pressed. Press again to switch OFF.
In momentary mode the key is ON only when pressed and hold pressed.

14.4.4   Initial

Each switch can have up to 8 selectable switch levels.
In standard switch mode, a switch can be OFF (status = 0) or ON (status = 1).
In advanced switch mode, a switch can be OFF (status = 0) or on with up to 7 switch levels (status = 1..7).
Set the level applied automatically when the membrane panel is powered on.
Please refer to section 11.5 for information about the different CAN modes.

14.4.5   Max

Select the maximum available switch levels.

14.4.6   New / Leg

Displays the switch status for both standard and advanced switch mode.

14.4.7   Press / Release

Set the time delay for switching ON or OFF.
Select 0 if no time delay for the switch action is required.

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14.4.8 Green LED's

Select the activation condition for the green LED for each switch.
Available modes are:

- **Local** = Turn LED on when switch is pressed.
- **Leg RX ID1** = Receive trigger signal from for example a PCM2.
  The LED will turn on when PCM2 confirms output is switched ON.
  Typically selected when the car has a single PCM2.
- **Leg RX ID2** = Receive trigger signal from for example a PCM2.
  The LED will turn on when PCM2 confirms output is switched ON.
  Typically selected when the car has dual PCM2's.

14.4.9 Red LED's

All red LED's will be ON if the membrane panel detects errors on the CAN bus.

Select the activation condition for the green LED for each switch.
Available modes are:
- **Local** = Disabled.
- **Leg RX ID1** = Receive trigger signal from for example a PCM2.
  The LED will turn on when PCM2 confirms the output is in fault mode.
  Typically selected when the car has a single PCM2.
- **Leg RX ID2** = Receive trigger signal from for example a PCM2.
  The LED will turn on when PCM2 confirms the output is in fault mode.
  Typically selected when the car has dual PCM2's.

14.4.10 Extra / Group

In addition to the regular CAN export, the panel may perform a secondary CAN export.
It is possible to define up to 8 additional CAN export packages, each can be defined as single byte or word. Individual identifiers can be assigned for each of these 8 packages.
Please see section 11.5 for further information on the CAN definition.

Click the **XTRA** button to access the switch condition for this feature.
Select the individual values to be assigned with each of the up to 8 switch levels.
If values up to 255 are used, data can be exported as a single byte.
If values between 256 and 65,535 are used, data is exported as a word (2 bytes).
Use the value 0 to define a level not used.
Furthermore, switches can be arranged in **groups**. By default, each switch represents its own group, but by joining for example two switches in a single group, it is possible to switch between two functions by pressing one or the other button. Pressing the second button will cancel the status of the first button and vice versa.
Pressing one of the buttons in a group will activate the switch, pressing it again will deactivate it. By un-ticking the group option "Allow no selection", it is no longer possible to turn the switch off unless any other switch in the group is pressed.
A switch can only belong to a single group.

14.4.11 Status

This column displays the status of the green and red LED's.

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14.5   CAN Bus

Standard CAN Protocol – Transmit from MSP

Tick the box "Use with old PCM". In this condition switch commands are transmitted on the CAN bus in the following manner. Please note that bits and bytes are numbered from 0..7.

- Switch 1 transmits on byte 7, bit 0 (absolute bit number 56).
- Switch 2 transmits on byte 7, bit 1 (absolute bit number 57).
- Switch 3 transmits on byte 7, bit 2 (absolute bit number 58).
- Switch 4 transmits on byte 7, bit 3 (absolute bit number 59).
- Switch 5 transmits on byte 7, bit 4 (absolute bit number 60).
- Switch 6 transmits on byte 7, bit 5 (absolute bit number 61).
- Switch 7 transmits on byte 7, bit 6 (absolute bit number 62).
- Switch 8 transmits on byte 7, bit 7 (absolute bit number 63).

- Switch 9 transmits on byte 6, bit 0 (absolute bit number 48).
- Switch 10 transmits on byte 6, bit 1 (absolute bit number 49).
- Switch 11 transmits on byte 6, bit 2 (absolute bit number 50).
- Switch 12 transmits on byte 6, bit 3 (absolute bit number 51).
- Switch 13 transmits on byte 6, bit 4 (absolute bit number 52).
- Switch 14 transmits on byte 6, bit 5 (absolute bit number 53).
- Switch 15 transmits on byte 6, bit 6 (absolute bit number 54).
- Switch 16 transmits on byte 6, bit 7 (absolute bit number 55).

- Switch 17 transmits on byte 5, bit 0 (absolute bit number 40).
- Switch 18 transmits on byte 5, bit 1 (absolute bit number 41).
- Switch 19 transmits on byte 5, bit 2 (absolute bit number 42).
- Switch 20 transmits on byte 5, bit 3 (absolute bit number 43).

In PCM2 a CAN input for a dedicated switch can be configured to display 0 or 1 when toggling between ON and OFF. When reading data from the CAN bus, any switch position can be allocated to any bit position in the CAN input byte. Having the CAN input to toggle between 0 and 1, allocate the switch status from the CAN bus to bit position 0, leaving all other bits unallocated in the byte.

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Again, with PCM2 for example, to define a CAN input for switch 1, you can proceed this way:

- Define the identifier for the byte in which to look for MSP key status.
  NOTE: Maximum value is 7FF when using an 11 bit identifier.
- Do not assign any other data channels to this byte.
- In section *Low Byte* un-tick "Bit Selection OR Byte Selection".
- Click on the arrow down and select the byte containing the data information, byte 7.
- Now tick the box "Bit Selection OR Byte Selection".
- Click on the first bit window, "0", and select "56".
- Deselect reading of data from bits 1, 2, 3, 4, 5, 6 and 7 by selecting the option "- -" from the scroll down menu for each of these bits.
  An easy way to proceed is to click once on one of the bit windows, then press END (now the selection "- -" is displayed). Using the TAB key jump to the next bit, press END and then the TAB key again etc.
- The channel will display "0" when switch 1 is not activated and it will display "1" when the switch is activated.
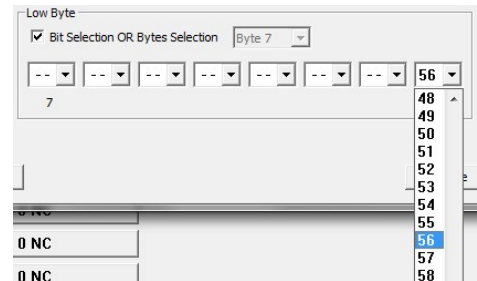
Repeat the configuration for the other MSP keys, replacing the absolute bit value in bit position 0 with the absolute bit number from the channel you are configuring.

If you want the CAN input to display the decimal number related to its position within the byte you can alternatively configure the low byte this way, for example for switch 13:

- Define the identifier for the byte in which to look for switch 13 status.
- Do not assign any other data channels to this byte.
- In section *Low Byte* un-tick "Bit Selection OR Byte Selection".
- Click on the arrow down and select the byte containing the data information, byte 6.
- Now tick the box "Bit Selection OR Byte Selection".
- Click on the fifth bit window, "4", and select "52".
- Deselect reading of data from bits 0, 1, 2, 3, 5, 6 and 7 by selecting the option "- -" from the scroll down menu for each of these bits.
  An easy way to proceed is to click once on one of the bit windows, then press END (now the selection "- -" is displayed). Using the TAB key jump to the next bit, press END and then the TAB key again etc.
- The channel will display "0" when switch 13 is not activated and it will display "16" when the switch is activated.
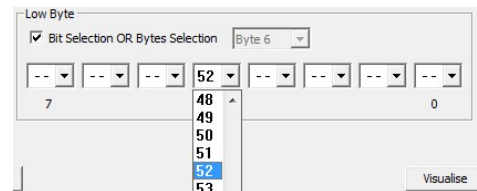
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14.5.1   Standard CAN Protocol – Receive switch status from PCM2

The green LED's can be controlled either by the MSP by pressing a switch having selected "Local" in the MSP switch configuration or by a confirmation received from the powerbox that the related output is switched on. This is done by selecting "Leg RX".

NOTE:
To activate this feature in the membrane controller, you have to add the constant decimal value of "10" (or "0A" in hex) in byte 0 in the identifier transmitting the switch status from the powerbox.
The green LEDs are controlled by bit values in bytes 3, 2 and 1.
MSP will turn ON a LED if the received value is "1" and OFF if the received value is "0".

In PCM2 use the CAN Export to configure transmission of the output switch status to the membrane panel:

- Name the package.
- Select CAN bus on which the MSP is communicating.
- Set destination address (this must correspond with the receive address specified in MSP software).
  NOTE: Maximum value is 7FF for an 11 bit identifier.
- Select 11 or 29 bit identifier used.
- Select update interval in milliseconds.
- Click in byte 0 and select Constant Value, select "10".
- Click on byte 3 and select "Output On/Off" as byte format.
- For each bit select the output to monitor on MSP.
- Continue this configuration on byte 2 and 1.

To control the green LED's, the output switch status, transmitted from an external system, must be configured this way:

- Green LED on switch #1 receives on byte 3, bit 0.
- Green LED on switch #2 receives on byte 3, bit 1.
- Green LED on switch #3 receives on byte 3, bit 2.
- Green LED on switch #4 receives on byte 3, bit 3.
- Green LED on switch #5 receives on byte 3, bit 4.
- Green LED on switch #6 receives on byte 3, bit 5.
- Green LED on switch #7 receives on byte 3, bit 6.
- Green LED on switch #8 receives on byte 3, bit 7.

- Green LED on switch #9 receives on byte 2, bit 0.
- Green LED on switch #10 receives on byte 2, bit 1.
- Green LED on switch #11 receives on byte 2, bit 2.
- Green LED on switch #12 receives on byte 2, bit 3.
- Green LED on switch #13 receives on byte 2, bit 4.
- Green LED on switch #14 receives on byte 2, bit 5.
- Green LED on switch #15 receives on byte 2, bit 6.
- Green LED on switch #16 receives on byte 2, bit 7.

- Green LED on switch #17 receives on byte 1, bit 0.
- Green LED on switch #18 receives on byte 1, bit 1.
- Green LED on switch #19 receives on byte 1, bit 2.
- Green LED on switch #20 receives on byte 1, bit 3.

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14.5.2   Standard CAN Protocol – Receive fault status from PCM2

The red LED's are intended to be controlled by an error status received from the powerbox.
This is done by selecting "Leg RX".

NOTE:
To activate this feature in the membrane controller, you have to add the constant decimal value of "10" (or "0A" in hex) in byte 0 in the identifier transmitting the switch status from the powerbox.
The red LEDs are controlled by bit values in bytes 7, 6 and 5.
MSP will turn ON a LED if the received value is "1" and OFF if the received value is "0".

To detect a failed PCM2 output an event for each output must be configured.
In PCM2 define an event this way:
*   Select Event Type as Input Follow.
*   Name the event, for example Fault LP01.
*   Select the input as the Fault for the actual output, for example called Fault LP01.
*   Set the threshold for detecting an error to "**>1**".
*   Set the threshold for detecting no fault to "**<2**".
*   Click Save.

In PCM2 use the CAN Export to configure transmission of the output switch status to the membrane panel:

*   Name the package.
*   Select CAN bus on which the MSP is communicating.
*   Set destination address (this must correspond with the receive address specified in MSP software).
    NOTE: Maximum value is 7FF for an 11 bit identifier.
*   Select 11 or 29 bit identifier used.
*   Select update interval in milliseconds.
*   Click in byte 0 and select Constant Value, select "10".
*   Click on byte 7 and select "Events 0 - 255" as byte format.
*   For each bit select the fault event to monitor on MSP.
*   Continue this configuration on byte 6 and 5

To control the red LED's, the output error status, transmitted from an external system, must be configured this way:

*   Red LED on switch #1 receives on byte 7, bit 0.
*   Red LED on switch #2 receives on byte 7, bit 1.
*   Red LED on switch #3 receives on byte 7, bit 2.
*   Red LED on switch #4 receives on byte 7, bit 3.
*   Red LED on switch #5 receives on byte 7, bit 4.
*   Red LED on switch #6 receives on byte 7, bit 5.
*   Red LED on switch #7 receives on byte 7, bit 6.
*   Red LED on switch #8 receives on byte 7, bit 7.

*   Red LED on switch #9 receives on byte 6, bit 0.
*   Red LED on switch #10 receives on byte 6, bit 1.
*   Red LED on switch #11 receives on byte 6, bit 2.

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- Red LED on switch #12 receives on byte 6, bit 3.
- Red LED on switch #13 receives on byte 6, bit 4.
- Red LED on switch #14 receives on byte 6, bit 5.
- Red LED on switch #15 receives on byte 6, bit 6.
- Red LED on switch #16 receives on byte 6, bit 7.

- Red LED on switch #17 receives on byte 5, bit 0.
- Red LED on switch #18 receives on byte 5, bit 1.
- Red LED on switch #19 receives on byte 5, bit 2.
- Red LED on switch #20 receives on byte 5, bit 3.

14.5.3 Speed / Termination / PCM Select

Set the CAN bus baud rate to suit the installation. The speed can be set to values between 10 kbps and 1 Mbps.

Tick the box "Terminated" to terminate the MSP CAN bus. This will enable a 120 Ohm resistor between CAN High and CAN Low.
Remember, the CAN bus must be terminated at its two extremities by a 120 Ohm resistor each.

It is extremely important to terminate the CAN bus with the correct number of resistors!

Tick the box "Use with old PCM" to switch to enable the standard CAN mode in parallel with the advanced mode.
Please see section 11.5 for a description of the two strategies.

14.5.4 Panel Transmit

Use this section to define the addresses in which the panel sends commands to external systems.
MSP can control two PCM's independently.
MSP uses the advanced protocol #1 for communication with the PC tool, but this can be shared with a PCM2.
A second option is to use "ID2" to transmit data from MSP.

ID1 is used for communication with the tool and a primary PCM2 in advanced CAN mode.
ID2 is used for communication with a secondary PCM2 in advanced CAN mode.

If the box "Use with old PCM" is ticked, MSP will transmit data using the standard protocol, too.

Leg ID1 is used for communication with a primary PCM2 in standard CAN mode.
Leg ID2 is used for communication with a secondary PCM2 in standard CAN mode.

Data addresses have to be entered in HEX. Please note that the lower address number, the higher the transmission priority. Maximum value is 7FF when using an 11 bit identifier.
Addresses can be selected having either 11 or 29 bit identifiers.

14.5.5 Panel Receive

Use this section to define the addresses in which the panel receives commands from external systems to control the green and red LED's.
MSP uses the advanced protocol #1 for communication with the PC tool, but this can be shared with a PCM2.

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A second option is to use "ID2" to receive data from external systems.
ID1 is used for communication with the tool and a primary PCM2 in advanced CAN mode.
ID2 is used for communication with a secondary PCM2 in advanced CAN mode.

If the box "Use with old PCM" is ticked, MSP will transmit data using the standard protocol, too.

Leg ID1 is used for communication with a primary PCM2 in standard CAN mode.
Leg ID2 is used for communication with a secondary PCM2 in standard CAN mode.

Data addresses have to be entered in HEX. Please note that the lower address number, the higher the transmission priority. Maximum value is 7FF when using an 11 bit identifier.
Addresses can be selected having either 11 or 29 bit identifiers.

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14.6   CAN Bus Export

This section is used for configuring the extended CAN bus export, selected in section XTRA on the "Switches" tab.

It is also used to export data from the 3 analogue inputs and the panel battery voltage.

It is possible to assign up to 8 individually selectable CAN identifiers for this export.
Maximum value is 7FF when using an 11 bit identifier.
Enter the identifier in hex, for example 0x500.

Tick the box "29 bit" ONLY if a 29 bit identifier is required.
Leave the box empty if the system uses a conventional 11 bit identifier.

Select whether to change CAN data only when pressing a switch or to send periodic updates.
A combination of both can also be selected.

**It is recommended to use only "Send Periodically"
when any of the analogue channels are assigned for export.**

In Format it is possible to define the type of CAN export, using one or two bytes:
- Switch value LSB
  Select to send switch data having values between 0 and 255.
- Switch value MSB
  Select to send switch data having values between 256 and 65535
- In Value select which switch to assign to this export.

Note:
If it is required to send switch values at any value between 0 and 65,535 bits arrange the export so that the lower byte is the MSB and the higher number is LSB (for example as bytes (0,1) = (Switch MSB,Switch LSB) – this is the Motorola format.
If the data is required in the Intel format then arrange the export as for example bytes (0,1) – (Switch LSB,Switch MSB).

- Group value LSB
  Select to send group data having values between 0 and 255.
- Group value MSB
  Select to send group data having values between 256 and 65535
- In Value select which group to assign to this export.

Note:
If it is required to send group values at any value between 0 and 65,535 bits arrange the export so that the lower byte is the MSB and the higher number is LSB (for example as bytes (0,1) = (Group MSB,Group LSB) – this is the Motorola format.
If the data is required in the Intel format then arrange the export as for example bytes (0,1) – (Group LSB,Group MSB).

- Constant value
  Select any value 0..255 from the drop down menu in Value.

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- Analogue Inputs

The 3 available analogue channels all have a 10 bit resolution. This means that the data resolution splits the 0...5,000 mV sensor range into 1024 steps and requires 2 bytes (a word) to send this data.

If data space has to be as compact as possible, then select to export the data with an 8 bit resolution. This means that the data resolution splits the 0...5,000 mV sensor range into 256 steps and requires 1 byte to send this data.

- Analogue value 8 bits
   Select to send 0..5.0 V sensor data having values between 0 and 255 bits.
- Analogue value LSB
   Select to send 0..255 bits of the 1024 bits representing 5,000 mV sensor data
- Analogue value MSB
   Select to send 256..1023 bits of the 1024 bits representing 5,000 mV sensor data
- In Value select which analogue sensor input to assign to this export, being sensor 1,2, 3 or battery voltage.

Note:

If it is required to send analogue values at any value between 0 and 1,023 bits arrange the export so that the lower byte is the MSB and the higher number is LSB (for example as bytes (0,1) = (Analogue MSB,Analogue LSB) – this is the Motorola format.

If the data is required in the Intel format then arrange the export as for example bytes (0,1) – (Analogue LSB,Analogue MSB).

Exporting the MSP battery voltage on CAN, please use this scaling:

- Exporting battery voltage as single byte value please scale using 29.4 as a multiplier and then divide by 256.

- Exporting battery voltage as a word (2 bytes) value please scale using 29.4 as a multiplier and then divide by 1024.

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14.7   Miscellaneous Functions

This tool support software for both hardware version of the CAN controller.
MSP1 covers hardware version 1.
MSP2 covers hardware version 2.
The MSP panel is backlit by an electro luminescent layer.
It is possible to adjust the brightness of the EL layer and of the LED's

individually in 8 steps for MSP1, but in 255 steps for MSP2.

MSP1

Selecting number 7 sets the brightest levels while selecting 0 turns the backlight off and dims the LED's to their minimum intensity.

MSP2

With the current CAN controller the brightness of EL and the LEDs are adjustable in up to 255 steps.

For both MPS1 and MPS2 it is possible to assign an alternative intensity level to be selected automatically when pressing one of the membrane switches – typically the light switch. This way the brightness will be dimmed when lights are turned on for night driving.

In addition, with MSP2 it is also possible to adjust the brightness via CAN.
The command sent to MSP2 must be using the ID specified under CAN Bus for Legacy Receive.
Byte 0 must be the constant value of 52 (or 34 in hex) to enable the adjustment in MSP2.
The value in byte 1 can vary between 0..255 to adjust the brightness of the LEDs.
The value in byte 2 can vary between 0..255 to adjust the brightness of the EL panel.
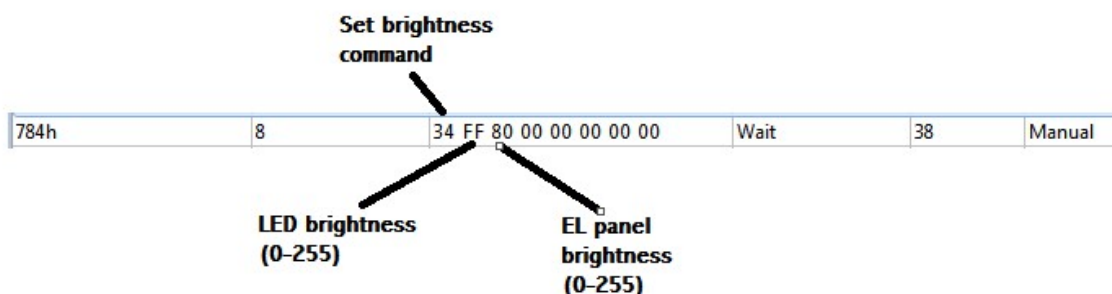
The four windows in this section shows the sensor value for each of the 3 analogue inputs and battery voltage. All inputs are 0..5 Volts with a 10 bit resolution, the values are displayed as 0..1023 bits.
The battery voltage scaling uses a multiplier of 29.4 and a divisor of 1024.

Tick the box "Send Update on Switch Change" to send a CAN message as soon as a switch is activated.
Tick the box "Send Periodic Update" to send CAN packages at a selected time interval.
Enter the time interval in milliseconds.

14.8   CAN Bus Monitor

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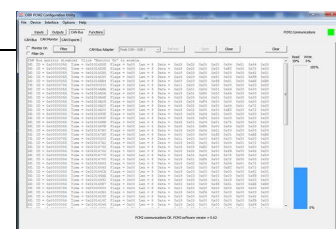
A CAN bus analysing tool is included in the PC tool.

By default the monitor displays the load on the actual CAN bus.
The monitor is only active once the "Monitor On" box is ticked.

Tick the box "Monitor On" to display the data detected on the bus.
The analyser displays all traffic on the bus it is connected to.

It is possible to filter the messages so that only selected CAN messages are shown. To activate this feature tick the "Filter On" box.
Next click the button "Filter" and type the required CAN identifiers in hex. The CAN monitor will now only display messages having the selected identifiers.

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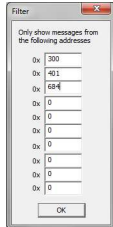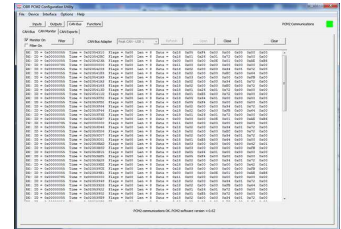
15   Steering Wheel Controller

The steering wheel controller is a very compact controller, converting digital and analogue inputs to CAN. It is small enough to fit inside a steering wheel, measuring just 55 mm in diameter and only requires a 4-wire connection to include it in the car wiring, considerably simplifying wiring of the steering wheel.

The SWC has inputs for up to 20 switches and 3 analogue inputs (5 in the extended version) and 24 LED drivers. Communication, programming and terminating is done via the CAN link and it can be programmed to communicate on any address.

It is fitted to the steering wheel by 2 x M3 screws and has a total thickness of 13 mm.

The steering wheel controller shares software with the membrane switch controller.
Please refer to section 13 for general software description.

Specifications:
- 4 x 5 input matrix for up to 20 switches.
- 3 analogue inputs, 0..5 Volts and 10 bit resolution.
- 1 CAN port with software selectable termination resistor.
- 24 LED outputs, max 30 mA each and software controlled brightness.
   This is for 24 mono colour LED's, use of RGB diodes are planned for the future
- VREF supply for LED's and analogue sensors; 5.0 Volts, max 350 mA.
- Power supply 7..30 Volts.
- Board diameter 55 mm.
- 1 mm diameter holes for soldering connections, 3 mm pitch.
- Board thickness 13 mm.

Layout:
Digital inputs are arranged in a 4 x 5 matrix:
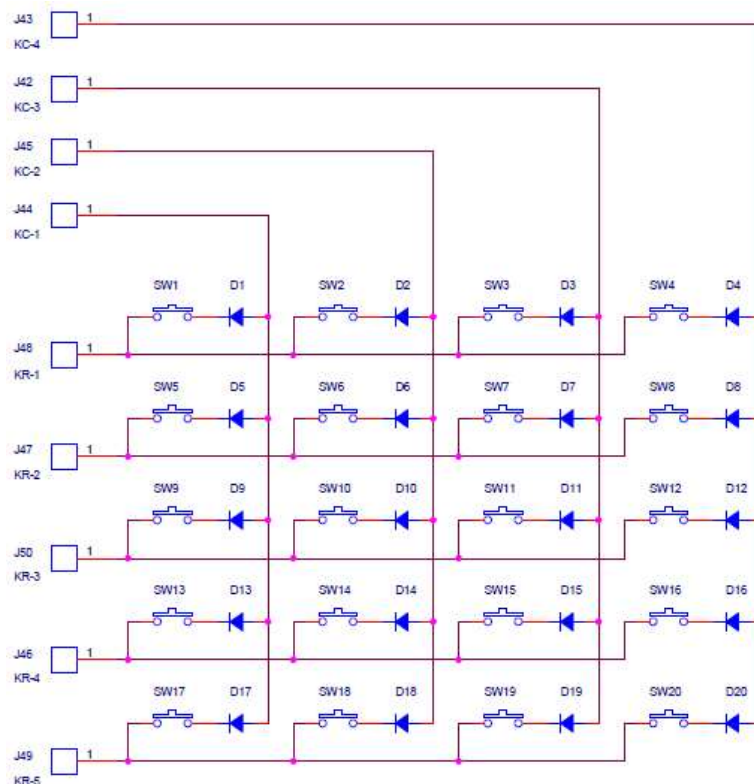
All switch inputs can be configured as latching or momentary in the software.
This means that using momentary acting switches it is possible to control the switching in two different ways:

- Set as momentary, the SWC registers the signal ON as long as the switch is pressed.
- Set as latching, press the switch once to turn ON, press the switch again to turn OFF.

Using this setup the diodes shown in the diagram are not required.

Some installations are done by using conventional toggle switches. These switches will provide a constant trigger signal. To avoid any unintended switching the diodes shown in the diagram must be used.
Using these toggle switches all iSWC inputs must be set to be momentary inputs.

The SWC shares the software with our MSP.

Connections:
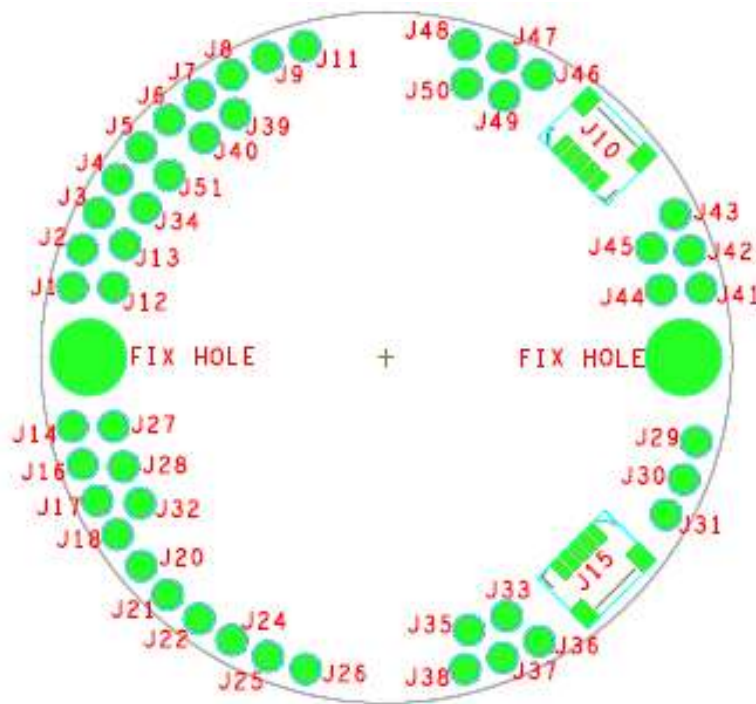
Pin	Name	Description
J1	LED -2	SWITCH 2 LED
J2	LED - 3	SWITCH 3 LED
J3	LED - 5	SWITCH 5 LED
J4	LED - 7	SWITCH 7 LED
J5	LED - 9	SWITCH 9 LED
J6	LED - 10	SWITCH 10 LED
J7	LED - 12	SWITCH 12 LED
J8	LED - 14	SWITCH 14 LED
J9	LED – 15	SWITCH 15 LED

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Pin	Name	Description
J10		
J11	LED - 16	SWITCH 16 LED
J12	LED -1	SWITCH 1 LED
J13	LED – 4	SWITCH 4 LED
J14	LED - 17	SWITCH 17 LED
J15	PRG	MCU Programming Header
J16	LED - 19	SWITCH 19 LED
J17		
J18		
J19		
J20		
J21	GND	Ground connection for SWC Power/All connections
J22	Vbatt	Positive connection for SWC Power
J23		
J24	Vbatt	Positive connection for SWC Power
J25	+5V	5V Reference and LED indicators
J26	+5V	5V Reference and LED indicators
J27	LED - 18	SWITCH 18 LED
J28	LED - 20	SWITCH 20 LED
J29	CAN-H	CAN Bus High signal
J30	CAN-L	CAN Bus Low signal
J31	GND	Ground connection for SWC Power/All connections
J32		
J33	AN-2	Analogue Input 2
J34	LED - 6	SWITCH 6 LED
J35	AN-1	Analogue Input 1
J36	AN-3	Analogue Input 3
J37		
J38		
J39	LED - 13	SWITCH 13 LED
J40	LED - 11	SWITCH 11 LED
J41	GND	Ground connection for SWC Power/All connections
J42	KC-3	Keyboard Matrix Column 3
J43	KC-4	Keyboard Matrix Column 4
J44	KC-1	Keyboard Matrix Column 1
J45	KC-2	Keyboard Matrix Column 2
J46	KR-4	Keyboard Matrix Row 4
J47	KR-2	Keyboard Matrix Row 2
J48	KR-1	Keyboard Matrix Row 1
J49	KR-5	Keyboard Matrix Row 5
J50	KR-3	Keyboard Matrix Row 3
J51	LED - 8	SWITCH 8 LED

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16   PCM2 Pin Configuration
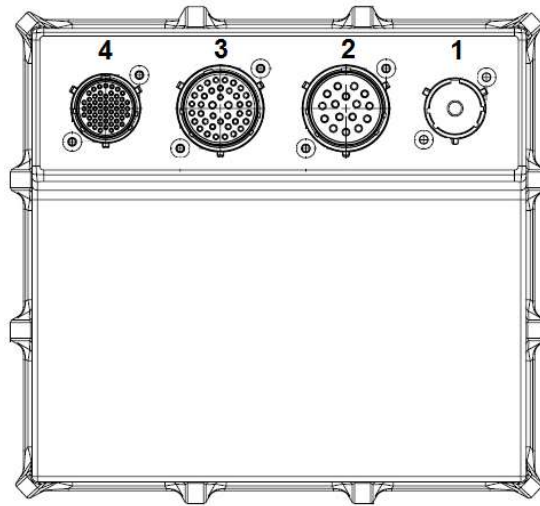
16.1   Connector 1 – Battery Power Supply

Mating connector: Deutsch ASHD6 14-1 SN C35

16.2   Connector 2 – High Power Outputs

Mating connector: Deutsch AS6 20-16 PN or Souriau 8STA62016PN

Pin	Used for	Max Recommend / Max Peak (A) *)
A	Channel 10 High Power	26 / 100
B	Channel 2 Very High Power	26 / 300
C	Channel 1 Very High Power	26 / 300
D	Channel 9 High Power	26 / 100
E	Channel 1 High Power	26 / 100
F	Channel 5 High Power	26 / 100
G	Channel 1 High Power PWM	26 / 100 (5..100% DC) **)
H	Channel 2 High Power PWM	26 / 100 (5..100% DC) **)
J	Channel 12 High Power	26 / 100
K	Channel 4 High Power	26 / 100
L	Channel 11 High Power	26 / 100
M	Channel 3 High Power	26 / 100
N	Channel 6 High Power	26 / 100
P	Channel 2 High Power	26 / 100
R	Channel 7 High Power	26 / 100
S	Channel 8 High Power	26 / 100

*) Please note that the current draw per channel is limited by the connector - not by the driver stages.

) WARNING: Do not connect PWM output channels in parallel.

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16.3   Connector 3 – Low Power Outputs

Mating connector: Deutsch AS6 20-39 PA or 8STA62039PA

Pin	Used for	Max Recommend / Max Peak (A) *)
A 1	Channel Wiper 2	13 / 75
B 2	Tri-State Output 2	Trigger 0 / 2.5 / 5 volt ***)
C 3	Tri-State Output 4	Trigger 0 / 2.5 / 5 volt ***)
D 4	Channel 25	13 / 75
E 5	Channel 26	13 / 75
F 6	Channel 23	13 / 75
G 7	Channel 21	13 / 75
H 8	Channel 22	13 / 75
J 9	Channel 20	13 / 75
K 10	Channel 14	13 / 75
L 11	Channel 16	13 / 75
M 12	Channel 18	13 / 75
N 13	Channel 2	13 / 75
P 14	Channel 4	13 / 75
R 15	Channel 6	13 / 75
S 16	Channel 8	13 / 75
T 17	Channel 10	13 / 75
U 18	Channel 12	13 / 75
V 19	Channel 2 PWM	13 / 25 (0..100% DC) **)
W 20	Channel 4 PWM	13 / 25 (0..100% DC) **)
X 21	Channel Wiper 1	8 / 75
Y 22	Tri-State Output 1	Trigger 0 / 2.5 / 5 volt ***)
Z 23	Tri-State Output 3	Trigger 0 / 2.5 / 5 volt ***)
a 24	Reserved	--
b 25	Channel 24	13 / 75
c 26	Channel 19	13 / 75
d 27	Channel 13	13 / 75
e 28	Channel 1	13 / 75
f 29	Channel 3	13 / 75
g 30	Channel 7	13 / 75
h 31	Channel 9	13 / 75
i 32	Channel 11	13 / 75
j 33	Channel 3 PWM	8 / 25 (0..100% DC) **)
k 34	Channel 1 PWM	8 / 25 (0..100% DC) **)
m 35	Power Ground	
n 36	Channel 15	13 / 75
p 37	Channel 17	13 / 75
q 38	Channel 5	13 / 75
r 39	Power Ground	

*) Please note that the current draw per channel is limited by the connector - not by the driver stages.

**) WARNING: Do not connect PWM output channels in parallel.

***) Tri-state outputs are trigger signals for ECU's only. DO NOT CONNECT TO LOAD!

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16.4 Connector 4 – Signal and Inputs

Mating connector: Deutsch AS6 16-35 PN or Souriau 8STA61635PN

Pin	Used for	Comments
1	Digital Input 7	Trig High / Low / Open
2	Digital Input 5	Trig High / Low / Open
3	Digital Input 3	Trig High / Low / Open
4	Digital Input 11	Trig High / Low / Open
5	Digital Input 9	Trig High / Low / Open
6	Digital Input 6	Trig High / Low / Open
7	Digital Input 2	Trig High / Low / Open
8	Digital Input 1	Trig High / Low / Open
9	CAN 3H	
10	Digital Input 13	Trig High / Low / Open
11	Digital Input 12	Trig High / Low / Open
12	Digital Input 8	Trig High / Low / Open
13	Digital Input 4	Trig High / Low / Open
14	CAN 4H	
15	CAN 2L	
16	CAN 2H	
17	RS232 TX	
18	RS232 RX	
19	Digital Input 14	Trig High / Low / Open
20	Digital Input 10	Trig High / Low / Open
21	CAN 4L	
22	CAN 3L	
23	CAN 1L	
24	CAN 1H	
25	LIN bus LIN_MST	Connect to 26 to set as MASTER
26	LIN bus LIN_BUS	
27	Ethernet TX-	Reserved for future use
28	Ethernet TX+	Reserved for future use
29	Ethernet RX+	Reserved for future use
30	Ethernet RX-	Reserved for future use
31	Analogue Input 16; 12 bit	Pull-up 0 / 3.16k / 47k
32	Sensor supply VREF1	5.0 volt @ 1.0 A
33	Analogue ground	
34	Analogue ground	
35	Analogue ground	
36	Analogue ground	
37	Analogue Input 12; 12 bit	Pull-up 0 / 3.16k / 47k
38	Analogue Input 14; 12 bit	Pull-up 0 / 3.16k / 47k
39	Analogue Input 15; 12 bit	Pull-up 0 / 3.16k / 47k
40	Sensor Supply VREF2	5.0 volt @ 1.0 A
41	Analogue ground	
42	Warning Light + Reset	5.0 volt @ 1.0 A
43	Analogue Input 4; 12 bit	Pull-up 0 / 3.16k / 47k
44	Analogue Input 8; 12 bit	Pull-up 0 / 3.16k / 47k
45	Analogue Input 10; 12 bit	Pull-up 0 / 3.16k / 47k
46	Analogue Input 13; 12 bit	Pull-up 0 / 3.16k / 47k
47	Sensor Supply VREF 3	5.0 volt @ 500 mA
48	Analogue Input 1; 12 bit	Pull-up 0 / 3.16k / 47k

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Pin	Used for	Comments
49	Analogue Input 2; 12 bit	Pull-up 0 / 3.16k / 47k
50	Analogue Input 6; 12 bit	Pull-up 0 / 3.16k / 47k
51	Analogue Input 9; 12 bit	Pull-up 0 / 3.16k / 47k
52	Analogue Input 11; 12 bit	Pull-up 0 / 3.16k / 47k
53	Analogue Input 3; 12 bit	Pull-up 0 / 3.16k / 47k
54	Analogue Input 5; 12 bit	Pull-up 0 / 3.16k / 47k
55	Analogue Input 7; 12 bit	Pull-up 0 / 3.16k / 47k

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17   Specifications

17.1   Inputs

Number of digital input	14
Number of analogue inputs	16 (0..12 volts; 16 bit resolution)
	Can be regrouped as 8 differential inputs
Number of CAN ports	4
Number of CAN input channels	64
Number of membrane switch inputs via CAN	20

17.2   Outputs

All driver stages are thermally and reverse polarity protected.

17.2.1   Very high power channels

Number of individual outputs	2
Maximum inrush peak current each output	300 A
Maximum continuously current draw per output	100 A
Maximum recommended current draw	26 A *)

17.2.2   High power channels

Number of individual outputs	12
Maximum inrush peak current each output	150 A
Maximum continuously current draw per output	50 A
Maximum recommended current draw	26 A *)

17.2.3   High power PWM channels

Number of individual outputs	2
Maximum inrush peak current each output	150 A
Maximum continuously current draw per output	50 A
Maximum recommended current draw	26 A *)
Maximum applied frequency	25 kHz

17.2.4   Low power channels

Number of individual outputs	26
Maximum inrush peak current each output	100 A
Maximum continuously current draw per output	25 A
Maximum recommended current draw	13 A *)

17.2.5   Low power PWM channels

Number of individual outputs	4
Maximum inrush peak current each output	100 A
Maximum continuously current draw per output	25 A
Maximum recommended current draw	13 A *)
Maximum applied frequency	25 kHz

17.2.6   Wiper channels

Number of individual outputs	2
Maximum inrush peak current each output	75 A
Maximum continuously current draw per output	25 A
Maximum recommended current draw	13 A *)

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*) Current draw based on typical race car wiring quality with maximised performance of Deutsch Autosport connector specifications.

17.2.7 Sensor supplies & warning light

Number of 5 volts reference sensor supplies   4; each 1.0 A @ 5 volts

17.2.8 Tristate Supplies

Number of tri-state logic outputs   4
Voltage level of tri-state analogue outputs   0 Volts / 2.5 Volts / 5.0 volts @ 50 mA max

17.3 Maximum current rating

Maximum recommended current   < 300 A
Maximum recommended inrush current   < 1,000 A peak current

17.4 Temperatures

Maximum operating temperature   <= 85 deg C continuous internal temperature
Typical temperature rise over ambient   < 30 deg C @ 140 A; 30 minutes

17.5 Communication

PC Interface   CAN1..4

CAN ports   4, with full routing option between all ports
CAN protocol   2.0B
CAN baud rate (each CAN bus)   10 kbps to 1 Mbps, individually selectable

CAN1-CAN2 identifiers   11 bit or 29 bit identifiers
     Motorola or Intel format
     Maximum 64 individual numbers of identifiers
     Bit wise operator
     Row counts available

CAN3-CAN4 identifiers   11 bit or 29 bit identifiers
     Motorola or Intel format
     Maximum 5 individual numbers of identifiers
     Bit wise operator
     Row counts available

LIN bus   1; configurable as master or slave

Ethernet   1 @ 100 Mbit/s

Serial bus   RS232 serial link (for Supervisor).

17.6 Power Supply

Supply Voltage   6.0 to 30 Volts

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17.7   Dimensions

Length x Width x Height   197 x 183 x 38 mm excl. connectors
Weight   1,190 grams

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