



## PowerBox PBX 180

### Installation and Users Guide

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# 1 Introduction

The Bosch PowerBox PBX 180 takes the whole Power Control Module concept much further than existing modules. 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.

Bosch PowerBox PBX 180 is a compact and light weight module, measuring 191 x 176 x 36 mm (excluding the Autosport connectors).

Bosch PowerBox PBX 180 has a maximum of 48 power channels, arranged as:

- 26 normal power channels, each 8 A continuous power supply.
- 2 normal and wiper motor power channels, each 8 A continuous power supply.
- 4 low power channels with PWM, each 8 A continuous power supply.
- 12 high power channels, each 20 A continuous power supply.
- 2 high power channels with PWM, each 20 A continuous power supply.
- 2 very high power channels, each 20 A continuous power supply.

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.
- 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 to 12 V sensor inputs with 16 bit resolution.
- 64 individually programmable CAN inputs, 11 or 29 bit identifiers, with bit operator.
- 4 individually programmable CAN busses.

Bosch PowerBox PBX 180 is also equipped with 4 tri-state outputs. A tri-state output is only for use as an ECU trigger. Do not connect any of these four channels to any output load.

In addition to the 4 CAN bus, Bosch PowerBox PBX 180 is also equipped with a LIN bus. Bosch PowerBox PBX 180 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.

Instead of using a conventional control program, Bosch PowerBox PBX 180 benefits from a multi-tasking operating system, allowing simultaneous executions of operations.

Furthermore, Bosch PowerBox PBX 180 is equipped with a real time clock and also has a built-in data recording facility with a memory capacity of minimum 2 GB. Data is downloaded via the Ethernet connection.

Please note that the maximum recommended current draw per channel is limited by the connector contacts - not by Bosch PowerBox PBX 180s driver stages. We have rated the individual channel's current draw in relation to the connector manufacturer's specifications.

Bosch PowerBox PBX 180 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.

For normal running conditions, the user can set limits for inrush current level and time; the fused thresholds for continuous current draw plus the number of retries and retry time intervals for each output channel.

A manual reset function of all overloaded channels is also available.

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

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.

Bosch Motorsport 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.

## 2 Hardware

The Bosch PowerBox PBX 180 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 S 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 AS6 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 AS6 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 AS6 16-35 PN.

## 3 Software Installation

The software can be installed either from a software CD, provided with the Bosch PowerBox PBX 180 or downloaded from our web site – [www.bosch-motorsport.com](http://www.bosch-motorsport.com)

### 3.1 Software Installation from a CD

Place the CD in your PC's CD drive. The installation starts automatically. Follow the instructions given on-screen to complete the installation.

A manual installation is possible by exploring the installation CD and double clicking on the file called SETUP Bosch PowerBox PBX 180 vX\_YZ.EXE where X\_YZ refers to the software release version.

### 3.2 Software Installation from web-download

It is possible to download the Bosch PowerBox PBX 180 software from our web site. Go to [www.bosch-motorsport.com](http://www.bosch-motorsport.com) and select the Software tab.

When you have downloaded the Bosch PowerBox PBX 180 software, open the folder where you saved the file and double click on the installation file. This file is called SETUP Bosch PowerBox PBX 180 vX\_YZ.EXE where X\_YZ refers to the software release version.

### 3.3 PC Software and Firmware Releases

Each new release of Bosch PowerBox PBX 180 firmware requires an updated, specific PC tool release.

Each new release of the PC tool is backwards compatible, meaning that it will support earlier Bosch PowerBox PBX 180 firmware releases.

### 3.4 Connection to System

Communication between the PC tool and a Bosch PowerBox PBX 180 is established via any of the 4 available CAN connections, using a USB CAN interface. Connection is automatic; no user commands are normally required.

Three different versions of interfaces can be used:

- CAN USB Adapter (Lawicel)
- Peak CAN Adapter (Peak Systems, recommended)
- EFI Technology CAN Adapter

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

## 3.5 Wiring Harness

Bosch Motorsport 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.



## 4 Main Menu



The PC tool has five main menu sections:

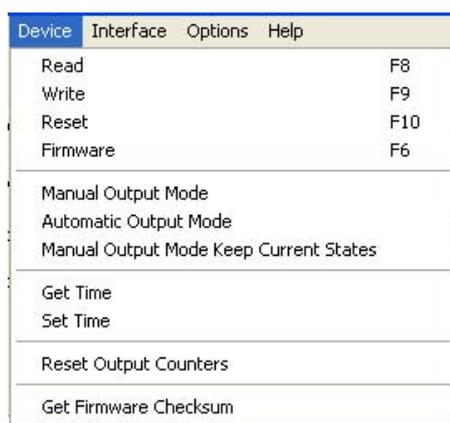
- File
- Device
- Interface
- Options
- Help

### 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. 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, 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. Admin is a Bosch PowerBox PBX 180 section only. Click on EXIT to close the Bosch PowerBox PBX 180 tool. Use F7 as a hot key to close the program.

### 4.2 Device



#### 4.2.1 Read

You can read the Bosch PowerBox PBX 180 configuration file by clicking on READ in the menu DEVICE.

Use F8 as a hot key to read the configuration from Bosch PowerBox PBX 180.

## 4.2.2 Write

You can upload a new configuration from the PC tool to Bosch PowerBox PBX 180 by clicking on WRITE.

Use F9 as a hot key to write a new configuration file to Bosch PowerBox PBX 180. Once the new configuration file has been transmitted to the Bosch PowerBox PBX 180, the module is re-booted automatically.

Note that a configuration file can only be uploaded if the battery supply voltage is above 10 V.

It is not possible to send a configuration file to Bosch PowerBox PBX 180 if more than one event controls a single output. Please see section 5.3.

## 4.2.3 Reset

Use F10 as a hot key to re-boot the Bosch PowerBox PBX 180, reading the new settings.

Bosch PowerBox PBX 180 is automatically reset after a firmware update or after uploading a new configuration.

## 4.2.4 Firmware

Click on FIRMWARE to update the Bosch PowerBox PBX 180 firmware. Once the firmware has been transmitted, Bosch PowerBox PBX 180 performs an automatic re-boot. A new firmware includes new Bosch PowerBox PBX 180 features and it is essential that you also update your PC tool, too. The latest PC tool released is always backwards compatible. Use F6 as a hot key to update firmware.

## 4.2.5 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 Bosch PowerBox PBX 180 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.

## 4.2.6 Automatic Output Mode

By clicking Automatic Output Mode Bosch PowerBox PBX 180 is switched back into automatic mode. Automatic mode is also re-established if the PC tool is disconnected from the Bosch PowerBox PBX 180.

## 4.2.7 Manual Output Mode, Keep Current States

When this option is selected, Bosch PowerBox PBX 180 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.

## 4.2.8 Get Time

Click Get Time to read date and time from Bosch PowerBox PBX 180's real time clock.

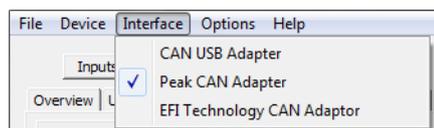
## 4.2.9 Set Time

Click Set Time to update Bosch PowerBox PBX 180's real time clock with the date and time from the PC connected. Ensure that your PC clock has the required time.

## 4.2.10 Reset Output Counters

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

## 4.3 Interface



Click Interface and then select the USB-CAN interface in use. Once the right interface is selected, communication will be established between Bosch PowerBox PBX 180 and the PC tool. No other action is required.

These interfaces are currently supported:

- CAN USB Adapter (Lawicel)
- Peak CAN Adapter (Peak Systems, recommended)
- EFI Technology CAN Adapter

Status of Bosch PowerBox PBX 180 communication is displayed in the tool by a colored LED in the upper right hand corner:

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

## 4.4 Options



### Reset Display on Disconnect

Tick this option to retain display information on display screens when disconnecting from Bosch PowerBox PBX 180. This can be a help, for example, in detecting and understanding a possible malfunction.

### Sync Time Automatically

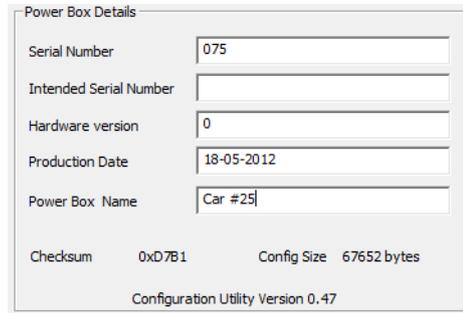
Tick this option to synchronize the time and date between Bosch PowerBox PBX 180 and the PC.

## 4.5 Help

Click HELP to open the Bosch PowerBox PBX 180 help file. Use F1 as a hot key to open the help file. (Feature not implemented in this release).

## 5 Functions

The Bosch PowerBox PBX 180 PC tool is divided into sub sections. When the program opens, it displays the Overview section by default.



### 5.1 Overview

This section displays the following Bosch PowerBox PBX 180 information:

#### Serial Number

Bosch PowerBox PBX 180 production serial number

#### Intended Serial Number

The actual configuration can only be used with a Bosch PowerBox PBX 180 having this serial number.

#### Hardware version

Bosch PowerBox PBX 180 hardware release version

#### Power Box Name

Reference name for actual PowerBox. Maximum 15 characters can be used. The PC tool release version is also displayed 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".

Num	Unit Text
01	°C
02	RPM
03	%
04	bar
05	mm
06	kph
07	ms
08	ltr
09	mB
10	mA
11	

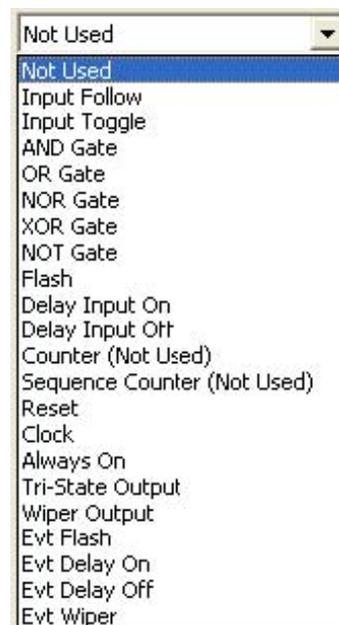
## 5.3 Events

Bosch PowerBox PBX 180 is controlled by configurable events. Events are used to create conditions, simple as well as complex logic conditions. For example, an output can be controlled by a single event or by a complex string of events. 512 individual events are available and each can be defined as a specific type:

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.

### 5.3.1 Event Type

Select between the following types of control strategies.



#### 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.

#### 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.

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

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

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

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

### NOT gate

The NOT gate inverts a single input event. Select the output to trigger. Select NONE if this is a conditional event only.

### 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.

### Delay input ON

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

### Delay input OFF

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

### Counter

This event is currently not activated.

### Sequence counter

This event is currently not activated.

## 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. Bosch PowerBox PBX 180 has a dedicated output for a fault warning light. Pin 42 in connector #4 provides a 5 V signal out in case one of the output channels goes into a fault mode. It is recommended to use a LED with a 1 kOhm resistor in-line as a warning light. Our normal reset function is based on grounding this warning light signal when ON.

We can supply a combined switch and a 5 V LED warning light.

Creating a Reset event, proceed this way:

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

Refer to section Output Diagnostics for fault message codes.

## Clock

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

## Always ON

Use this event to switch the event to true once power is applied to the Bosch PowerBox PBX 180, for example when the master switch is ON.

## Tri-state output

The tri-state outputs are used as triggers for external systems. Their value can change between 0 V, 2.5 V and 5.0 V. Do not expose these outputs to any load, they are trigger channels only. Please note that if both selectable trigger events (A and B) are true, the output will be 5 V.



**Event Configuration**

Event Type: Tri-State Output

Event Name: Ev\_tri\_state

Source Input: [Empty]

Turn On When Input Is: Not Used | 0

Turn Off When Input Is: Not Used | 0

Event 1: Event A | 2.5V

Event 2: Event B | 5V

Event 3: None

Event 4: None

Event 5: None

Time (ms): On 0 | Off 0

Lost CAN Action: Do Nothing

CAN Lost timer: 0

Start State: Off

Output: Tri-State 01

Multiplier: 0 | Assist

Counter: None

Clock: On 00:00:00 | Off 00:00:00

Save | Visualise

## 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.

## Event Flash

Use this function if an event is required to trigger the flash function.

## Event Delay On

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

## Event Delay Off

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

## Event Wiper

The wiper function can also be controlled by an event instead of a direct input as before. 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 event for easy identification.

The screenshot shows the 'Event Configuration' dialog box. The 'Event Type' is set to 'Wiper Output'. The 'Event Name' is 'WIPER'. The 'Source Input' is 'Wiper'. The 'Turn On When Input Is' and 'Turn Off When Input Is' are both set to '=' and '4'. The 'Event 1' is 'Wiper Stop' with a 'Stop' button. Events 2 through 5 are set to 'None'. The 'Time (ms)' section has 'On' and 'Off' both set to '0'. The 'Lost CAN Action' is 'Do Nothing'. The 'CAN Lost timer' is '1000'. The 'Start State' is 'On'. The 'Output' is 'Wiper Fast'. The 'Multiplier' is '0' with an 'Assist' button. The 'Counter' is 'None'. The 'Clock' section has 'On' and 'Off' both set to '00:00:00'. A 'Save' button is at the bottom.

### 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 bus) – (CAN bus 1+2 only implemented in this version)
- Counters
- Temperature

#### 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 event:

- Do nothing (keep current status)

- Turn Off (switch the output channel off)
- Turn On (switch the output on)

### 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 recognize 2 messages, confirming the CAN bus is functioning.

## 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 Output

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,

## 5.4 Miscellaneous

Use this section to set:

- Bosch PowerBox PBX 180 minimum voltage (recommended set to 6,000 mV)

The battery voltage level has to drop below the low threshold for 10 seconds before outputs are switched off. The voltage level has to rise above the minimum voltage level plus 0.5 V for mini-mum 10 seconds before outputs are turned on again.

- Bosch PowerBox PBX 180 maximum voltage (set to 24,000 mV)

## 5.5 Special Functions

It is possible to assign outputs to switch ON or to switch OFF when specific events are selected. For example, to maximize engine cranking speed and to preserve battery power Bosch PowerBox PBX 180 can be configured to disable other outputs whilst the starter motor is activated. Create an event for activating the

starter solenoid. Select this event as for example EVENT 01 in section SPECIAL OFF. Open the output map and select which outputs to switch OFF (if ON) when the starter is activated.

Click on Set Output Map to open the configuration tables. Each output can be linked to 8 condition-ing 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.

## 5.6 Counters

This function is not yet implemented.

## 5.7 Status

This section displays the general Bosch PowerBox PBX 180 status:

- Status for digital switches are shown as Open, Low or High
- Analogue channels displays sensor input voltage
- Bosch PowerBox PBX 180 on-board temperature measurement in °C on signal and power boards
- Tri-state output voltages
- Real time current draws for low, high and very high outputs
- Status of the three analogue sensor reference voltage supply (VREF)
- Warning light status
- CAN channels displays decimal channel values.
- Counters are not yet implemented.

### 5.7.1 Warning Light Status

The warning light will flash error codes, making it easy to trace an eventual fault:

#### 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

### 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 Bosch PowerBox PBX 180 events.

Green resembles a TRUE event.

Blue resembles a FALSE event.

## 5.9 Output Diagnostics

This section displays the Bosch PowerBox PBX 180 system diagnostic:

Low Power Outputs	Current	Peak	OCL	OCH	OCS	Tha	Stat
LP 01	0 NC	0 NC	0	0	0	0	0
LP 02	0 NC	0 NC	0	0	0	0	0
LP 03	0 NC	0 NC	0	0	0	0	0
LP 04	0 NC	0 NC	0	0	0	0	0
LP 05	0 NC	0 NC	0	0	0	0	0
LP 06	0 NC	0 NC	0	0	0	0	0
LP 07	0 NC	0 NC	0	0	0	0	0
LP 08	0 NC	0 NC	0	0	0	0	0
LP 09	0 NC	0 NC	0	0	0	0	0
LP 10	0 NC	0 NC	0	0	0	0	0
LP 11	0 NC	0 NC	0	0	0	0	0
LP 12	0 NC	0 NC	0	0	0	0	0
LP 13	0 NC	0 NC	0	0	0	0	0
LP 14	0 NC	0 NC	0	0	0	0	0
LP 15	0 NC	0 NC	0	0	0	0	0
LP 16	0 NC	0 NC	0	0	0	0	0
LP 17	0 NC	0 NC	0	0	0	0	0
LP 18	0 NC	0 NC	0	0	0	0	0
LP 19	0 NC	0 NC	0	0	0	0	0
LP 20	0 NC	0 NC	0	0	0	0	0
LP 21	0 NC	0 NC	0	0	0	0	0
LP 22	0 NC	0 NC	0	0	0	0	0
LP 23	0 NC	0 NC	0	0	0	0	0
LP 24	0 NC	0 NC	0	0	0	0	0
LP 25	0 NC	0 NC	0	0	0	0	0
LP 26	0 NC	0 NC	0	0	0	0	0

LP PWM Outputs	Current	Peak	OCL	OCH	OCS	Tha	Stat
LP PWM 01	0 NC	0 NC	0	0	0	0	0
LP PWM 02	0 NC	0 NC	0	0	0	0	0
LP PWM 03	0 NC	0 NC	0	0	0	0	0
LP PWM 04	0 NC	0 NC	0	0	0	0	0

High Power Outputs	Current	Peak	OCL	OCH	OCS	Tha	Stat
HP 01	0 NC	0 NC	0	0	0	0	0
HP 02	0 NC	0 NC	0	0	0	0	0
HP 03	0 NC	0 NC	0	0	0	0	0
HP 04	0 NC	0 NC	0	0	0	0	0
HP 05	0 NC	0 NC	0	0	0	0	0
HP 06	0 NC	0 NC	0	0	0	0	0
HP 07	0 NC	0 NC	0	0	0	0	0
HP 08	0 NC	0 NC	0	0	0	0	0
HP 09	0 NC	0 NC	0	0	0	0	0
HP 10	0 NC	0 NC	0	0	0	0	0
HP 11	0 NC	0 NC	0	0	0	0	0
HP 12	0 NC	0 NC	0	0	0	0	0

Very High Power Outputs	Current	Peak	OCL	OCH	OCS	Tha	Stat
Very HP 01	0 NC	0 NC	0	0	0	0	0
Very HP 02	0 NC	0 NC	0	0	0	0	0

High Power PWM Outputs	Current	Peak	OCL	OCH	OCS	Tha	Stat
HP PWM 01	0 NC	0 NC	0	0	0	0	0
HP PWM 02	0 NC	0 NC	0	0	0	0	0

Wiper Output	Current	Peak	OCL	OCH	OCS	Tha	Stat
Wiper 01	0 NC	0 NC	0	0	0	0	0
Wiper 02	0 NC	0 NC	0	0	0	0	0

The columns illustrate:

### Current

Actual real time current draw, updates when the tool is connected and the current draw changes, measured in steps of 100 mA.

**Peak**

Highest recorded peak current.

**OCL**

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

**OCH**

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

**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:

<b>Fault Status</b>	<b>Hex Value</b>	<b>Decimal Value</b>
STATUS_OUTPUT_OFF_OK	0x0000	0
STATUS_OUPTUT_ON_OK	0x0001	1
STATUS_OUTPUT_SHUTDOWN_OVER_VOLTAGE	0x0002	2
STATUS_OUTPUT_SHUTDOWN_UNDER_VOLTAGE	0x0004	4
STATUS_OUTPUT_SHUTDOWN_OPEN_LOAD	0x0008	8
STATUS_OUTPUT_SHUTDOWN_OVER_CURRENT_LOW	0x00010	16
STATUS_OUTPUT_SHUTDOWN_OVER_CURRENT_HIGH	0x00020	32
STATUS_OUTPUT_SHUTDOWN_OVER_THERMAL	0x00040	64
STATUS_OUTPUT_SHUTDOWN_OVER_SOFT_CURRENT	0x00080	128
STATUS_OUTPUT_SHUTDOWN_OVER_SOFT_CURRENT_RE- TRY	0x00100	256

Channels not supported are:

- Low power 29, 30, 31 and 32.
- All PWM channels
- All tri-state outputs
- All VREF sensor supplies

<b>Value</b>	<b>Description</b>
0	Channel switched off.
1	Channel switched on.
8	Channel switched off and has no load connected to it.

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

<b>Value</b>	<b>Description</b>
17	Bosch PowerBox PBX 180 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.
33	Bosch PowerBox PBX 180 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.
129	Bosch PowerBox PBX 180 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.

Only channels which have failed will be reset.

In general, switching a channel OFF then ON will attempt a restart, even if the channel has failed earlier.

To clear diagnostic, look in the tools main menu in "Device". Clicking on "Reset Output Counters" will reset diagnostics.

## 6 Inputs

Bosch PowerBox PBX 180 has 14 digital and 16 analogue inputs. These inputs can be used with sensors or switches. Furthermore, Bosch PowerBox PBX 180 has 4 individual CAN lines with a maximum of 64 CAN channels and unlimited assigning of identifiers. Bosch PowerBox PBX 180 is fitted with 2 internal temperature sensors for system monitoring.

### 6.1 Digital Inputs

14 digital inputs are available as switch inputs, but can also be assigned as wheel speed sensor inputs, for example.

The intention with the Bosch PowerBox PBX 180 is to simplify the wiring installation as much as possible. If you use the digital inputs for external toggle switches, you have to connect up to 14 signal wires to the module. But if you choose to control Bosch PowerBox PBX 180 via CAN, you can control all functions via a 2-wire data bus for each CAN bus.

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

Configuration of switch condition is set within the event handling.

Defining whether an input is considered latching or momentary is also done within the event handling. Set the minimum debounce time required for the system to acknowledge a switch signal. If a digital input is used with a speed sensor, the sensor must be a Hall effect sensor. Channel status is displayed.

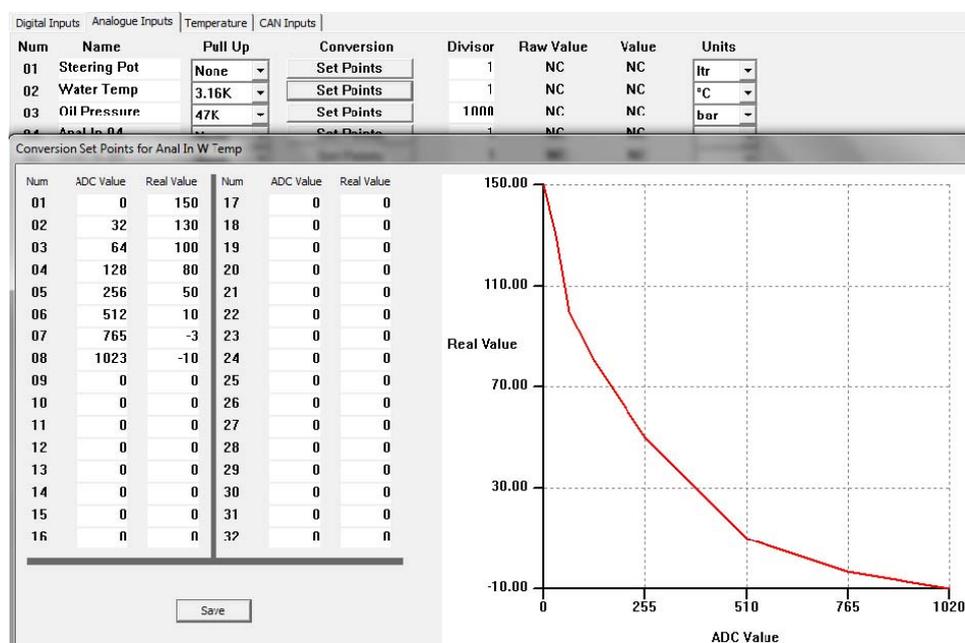
Pin Configuration Digital Inputs:

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



## 6.2 Analogue Inputs

Bosch PowerBox PBX 180 has 16 analogue 0 to 12 V sensor inputs with a 16 bit resolution. Furthermore, these inputs can be grouped to create 8 differential inputs (not implemented yet). Input names can be up to 15 characters long.



Analogue inputs can be assigned having different characteristics:

- Pull-up to VREF through a 3,16 kOhm resistor (for use with NTC temperature sensors)
- Pull-up to VREF through a 47 kOhm resistor
- Floating input

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 mV.

Sensor scaling is normally entered in for example mbar, ml, mA etc. Use the column Divisor to scale mbar to bar etc.

Sensor channel values are displayed in real time in both raw and scaled sensor values.

Please note that the analogue inputs are disabled in the instant when power to the Bosch PowerBox PBX 180 is switched off.

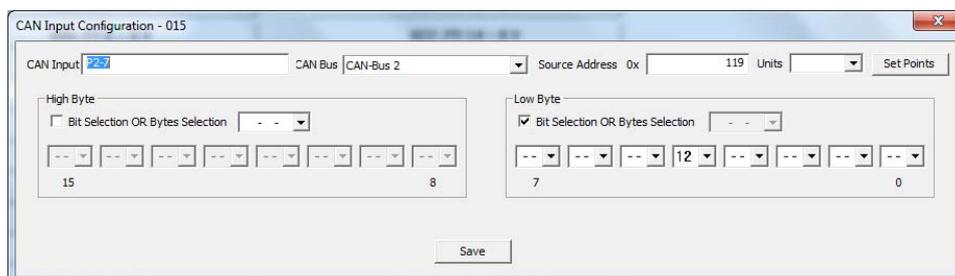
Pin Configuration Analogue Inputs:

Analogue Input	Connector 4	Pin
1	AS2 16-35 SN	48
2	AS2 16-35 SN	49
3	AS2 16-35 SN	53

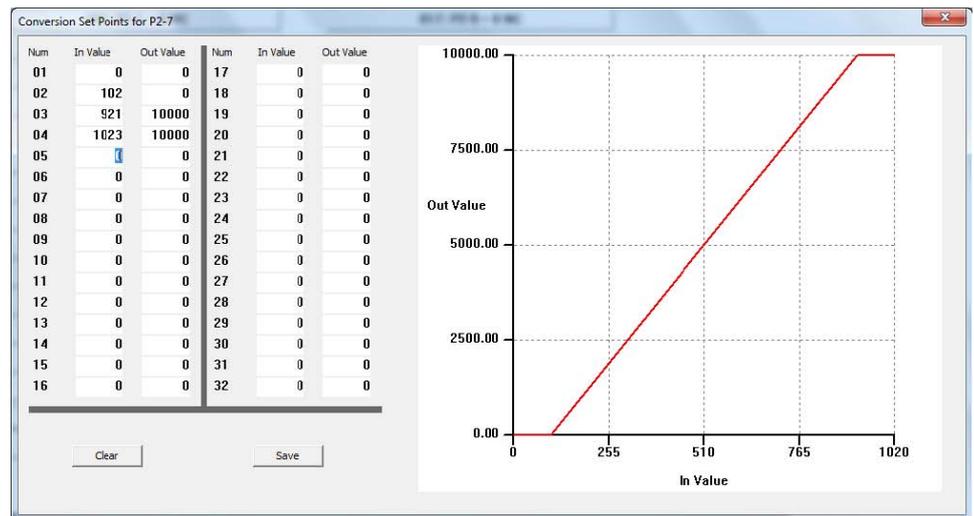
4	AS2 16-35 SN	43
5	AS2 16-35 SN	54
6	AS2 16-35 SN	50
7	AS2 16-35 SN	55
8	AS2 16-35 SN	44
9	AS2 16-35 SN	51
10	AS2 16-35 SN	45
11	AS2 16-35 SN	52
12	AS2 16-35 SN	37
13	AS2 16-35 SN	46
14	AS2 16-35 SN	38
15	AS2 16-35 SN	39
16	AS2 16-35 SN	31

## 6.3 CAN Inputs

Bosch PowerBox PBX 180 has 4 individual CAN busses. Each CAN bus can be defined as 11 or 29 bit identifier. Additionally, each of these 4 CAN bus can be individually terminated and the baud rate for each is selectable.



- Each of the 64 available CAN inputs can be named as required.
- Select on which of the four CAN bus the actual channel is found.
- Set the identifier in which the actual channel is included. This value must be in hex, for example 0x119.
- Select the unit of the channel, for example RPM, bar, deg etc,
- 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.
- 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).



- For each individual CAN bus there is no limitation to the numbers of CAN identifiers selected. Each of the 64 available CAN inputs can use a unique identifier. Identifiers do not have to be arranged in special groups.
- CAN channels can contain a switch status, 8 bit data channels or 16 bit data channels.
- A typical switch status uses the individual 8 bits within a single byte.
- An 8 bit data channel reads data in the range between 0 and 255 and uses 1 byte.
- A 16 bit data channel reads data in the range between 0 and 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 is available.

Each byte contains 8 bits which are numbered this way:

- Byte 0 = 0 to 7 bits
- Byte 1 = 8 to 15 bits
- Byte 2 = 16 to 23 bits
- Byte 3 = 24 to 31 bits
- Byte 4 = 32 to 39 bits
- Byte 5 = 40 to 47 bits
- Byte 6 = 48 to 55 bits
- Byte 7 = 56 to 63 bits

Using 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:

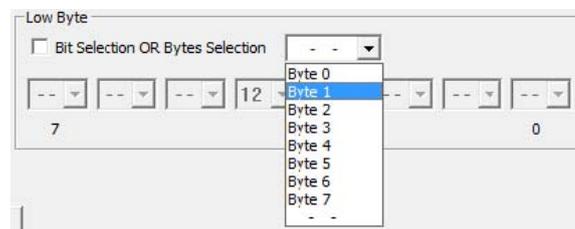
- Bit 0 = 1

- Bit 1 = 2
- Bit 2 = 4
- Bit 3 = 8
- Bit 4 = 16
- Bit 5 = 32
- Bit 6 = 64
- Bit 7 = 128

Example:

To read the data from bit 4 in byte 1 of a given identifier proceed this way:

1. In section Low Byte un-tick "Bit Selection OR Byte Selection"
2. Click on the arrow down and select the byte containing the data information, for example byte 1



3. Tick "Bit Selection OR Byte Selection"
4. 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.
5. An easy way to proceed is to click once on one of the bit windows, then press END (now the se-lection "- -" is displayed). Using the TAB key jump to the next bit, press END, then the TAB key again etc.
6. Leave bit 4 on the value of 12.

Bosch PowerBox PBX 180 will detect and report an eventual short circuit of a CAN bus. After a short circuit the CAN bus will reset.

Pin Configuration for CAN Communication:

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

## 7 Outputs

Bosch PowerBox PBX 180 has 48 power channels with current measurement plus 4 analogue trigger outputs. All power outputs are designed for use in harsh environments and include self-recovery features. 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) (frequency controlled duty cycle)
- High power outputs (ON/OFF switches)
- High power outputs with pulse width modulation (PWM) (frequency controlled duty cycle)
- 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.

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.

### 7.1 Tri-State Outputs

Tri-state outputs **cannot** be used as 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. They are controlled by the event handling and the output signals can have these values:

- 0 V
- 2.5 V
- 5.0 V

Please read also the description from tri-state event in Events section.

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

### 7.2 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 8 A each channel. Please observe that our recommended current rating each channel is given in accordance with Deutsch's current limit for the size AWG20 contacts in the Autosport 20-39 connector.

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

Num	Name	Fuse	Init ms	Norm mA	Retry	Retry ms	Status mA	Manual	Pin	Trigger
01	LP 01	10A 150us	10	100	3	10	0	On	Off	3-e
02	LP 02	7.5A 150us	10	100	3	10	0	On	Off	3-N
03	LP 03	7.5A 1.2ms	10	100	3	10	0	On	Off	3-f
04	LP 04	7.5A 10ms	10	100	3	10	0	On	Off	3-P
05	LP 05	7.5A 155ms	10	100	3	10	0	On	Off	3-q
06	LP 06	10A 1.2ms	10	100	3	10	0	On	Off	3-H
07	LP 07	10A 10ms	10	100	3	10	0	On	Off	3-g
08	LP 08	10A 155ms	10	100	3	10	0	On	Off	3-S
09	LP 09	12.5A 150us	10	100	3	10	0	On	Off	3-h
10	LP 10	12.5A 1.2ms	10	100	3	10	0	On	Off	3-T
11	LP 11	12.5A 10ms	10	100	3	10	0	On	Off	3-i
12	LP 12	12.5A 155ms	10	100	3	10	0	On	Off	3-U
13	LP 13	7.5A 150us	10	100	3	10	0	On	Off	3-d
14	LP 14	7.5A 150us	10	100	3	10	0	On	Off	3-K
15	LP 15	7.5A 150us	10	100	3	10	0	On	Off	3-n
16	LP 16	7.5A 150us	10	100	3	10	0	On	Off	3-L
17	LP 17	7.5A 150us	10	100	3	10	0	On	Off	3-p
18	LP 18	7.5A 150us	10	100	3	10	0	On	Off	3-M
19	LP 19	7.5A 150us	10	100	3	10	0	On	Off	3-c
20	LP 20	7.5A 150us	10	100	3	10	0	On	Off	3-J
21	LP 21	7.5A 150us	10	100	3	10	0	On	Off	3-G
22	LP 22	7.5A 150us	10	100	3	10	0	On	Off	3-H
23	LP 23	7.5A 150us	10	100	3	10	0	On	Off	3-F
24	LP 24	7.5A 150us	10	100	3	10	0	On	Off	3-b
25	LP 25	7.5A 150us	10	100	3	10	0	On	Off	3-D
26	LP 26	7.5A 150us	10	100	3	10	0	On	Off	3-E

Click on the trigger to open the event

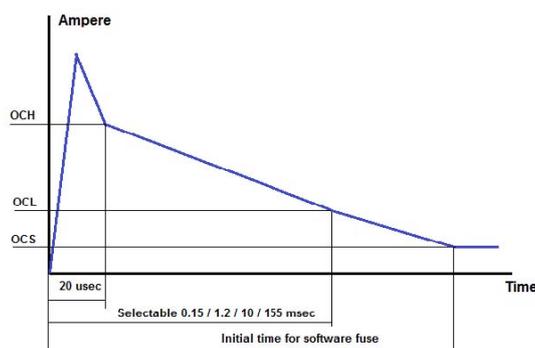
The driver stages can deliver significantly more current, but it is important to avoid overloading the wiring and contacts in the connector.

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. This level is selectable between 7.5 A to 12.5 A.
- OCS is the software selected current threshold.



1. Switching an output ON, an inrush current up to and in excess of 75 A is allowed for a 20 usec time interval.
2. After these 20 usec the current level must be below OCH which is 75 A.
3. 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 A, 10 A, 12.5 A.
4. 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.
5. 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.
6. 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.
7. If the current draw on an output exceeds the NORM fuse setting, the output will switch off.
8. In Retry set the maximum number of automatic re-activation of an output channel after it 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.
9. In Retry ms set the time interval between retries in milliseconds.
10. The status window will show the real time current draw of the output in mA.
11. Use the Manual option to test the output connection. When Manual is active, Bosch PowerBox PBX 180's event handling has been deactivated and all channels are OFF by default.
12. Click the ON button for each individual channel to switch the output ON.
13. Click the ON button again to switch the output OFF.
14. Clicking on Trigger will open the main event controlling this output. A warning may appear if several events are used to control it.

LP OUT	Max current, A	Connector 3	Pin
1	8	AS2 20-39 SA	e
2	8	AS2 20-39 SA	N
3	8	AS2 20-39 SA	f

4	8	AS2 20-39 SA	P
5	8	AS2 20-39 SA	q
6	8	AS2 20-39 SA	R
7	8	AS2 20-39 SA	g
8	8	AS2 20-39 SA	S
9	8	AS2 20-39 SA	h
10	8	AS2 20-39 SA	T
11	8	AS2 20-39 SA	i
12	8	AS2 20-39 SA	U
13	8	AS2 20-39 SA	d
14	8	AS2 20-39 SA	K
15	8	AS2 20-39 SA	n
16	8	AS2 20-39 SA	L
17	8	AS2 20-39 SA	p
18	8	AS2 20-39 SA	M
19	8	AS2 20-39 SA	c
20	8	AS2 20-39 SA	J
21	8	AS2 20-39 SA	G
22	8	AS2 20-39 SA	H
23	8 (high resolution current measurement)	AS2 20-39 SA	F
24	8 (high resolution current measurement)	AS2 20-39 SA	b
25	8 (high resolution current measurement)	AS2 20-39 SA	D
26	8 (high resolution current measurement)	AS2 20-39 SA	E

## 7.3 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 8 A each channel. Please observe that our recommended maximum current rating for each of these four channels is given 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 PWM output channels in parallel.**

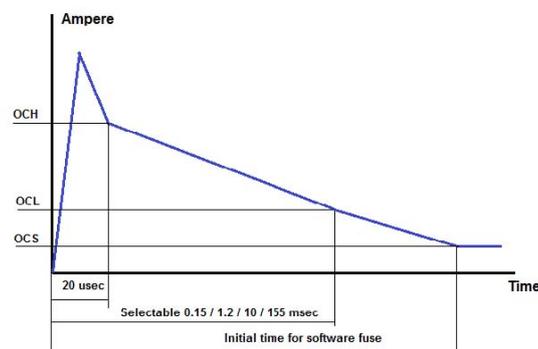
Current draw can be measured on all outputs and displays the maximum current draw, neglecting the OFF periods.

Num	Name	Fuse	Init ms	Norm mA	Retry	Retry ms	Pwm Type	Status	mA	Manual	Pin	Trigger
01	LP PWM1	7.5A 150ms	500	5000	3	300	Duty intrp	Tb	0	On	Off	3-k
02	LP PWM2	7.5A 150ms	500	5000	3	300	None	Tb	0	On	Off	3-V
03	LP PWM3	10A 150ms	500	5000	0	300	None	Tb	0	On	Off	3-j
04	LP PWM4	10A 150ms	500	5000	3	300	None	Tb	0	On	Off	3-W

Note: LP PWM Output 1 and 2 MUST have the same frequency.

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. This level is selectable between 7.5 A to 12.5 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 A, 10 A, 12.5 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 13,000 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 it 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.

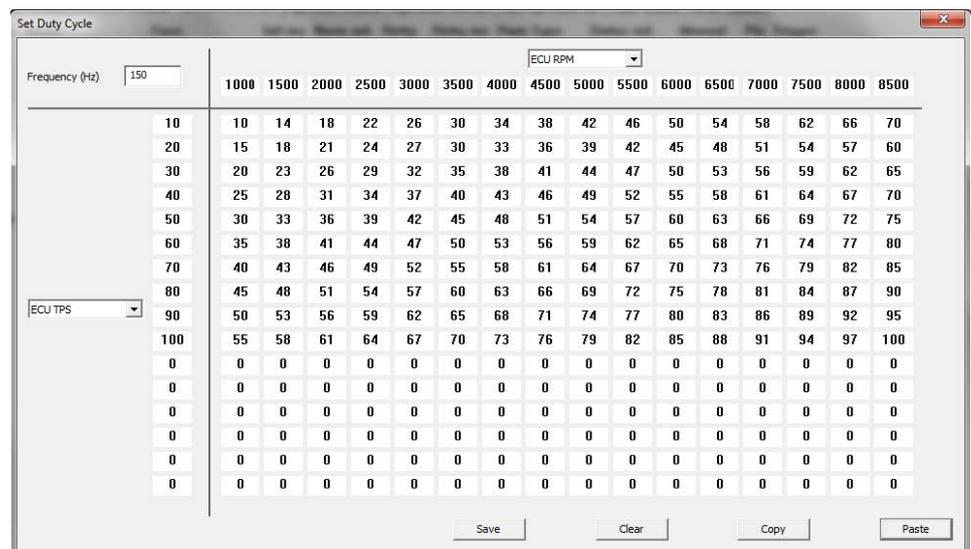
PWM Type is used to define the functionality of the PWM feature:

PWM Type	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.

### 7.3.1 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:

1. Open the duty cycle map.
2. Click "Copy".
3. Paste into Excel.
4. Modify table.
5. Mark the table and copy.
6. Return to the tool and click past.
7. 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!

## 7.3.2 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.

Duty Cycle (%)	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850
		30	50	70	90	110	130	150	170	190	210	230	250	270	290	310	330

- Use the drop down menus to select the channel used for the single axis of the table.
- The map can be imported and exported to Excel.

An easy way to create a frequency map is to follow this procedure:

1. Open the frequency map.
2. Click "Copy".
3. Paste into Excel.
4. Modify table.
5. Mark the table and copy.
6. Return to the tool and click past.
7. 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.
8. Use the Manual option to test the output connection. When Manual is active (see section 4.3), Bosch PowerBox PBX 180's event handling has been deactivated and all channels are OFF by default.
9. Click the ON button for each individual channel to switch the output ON.

10. Click the ON button again to switch the output OFF.
11. 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.
12. Use the Manual option to test the output connection. When Manual is active (see section 4.3), Bosch PowerBox PBX 180's event handling has been deactivated and all channels are OFF by default.
13. Click the ON button for each individual channel to switch the output ON.
14. Click the ON button again to switch the output OFF.
15. Clicking on Trigger will open the main event controlling this output. A warning may appear if several events are used to control it.

LP PWM OUT	Max current, A	Connector 3	Pin
1	8	AS2 20-39 SA	k
2	8	AS2 20-39 SA	V
3	8	AS2 20-39 SA	j
4	8	AS2 20-39 SA	W

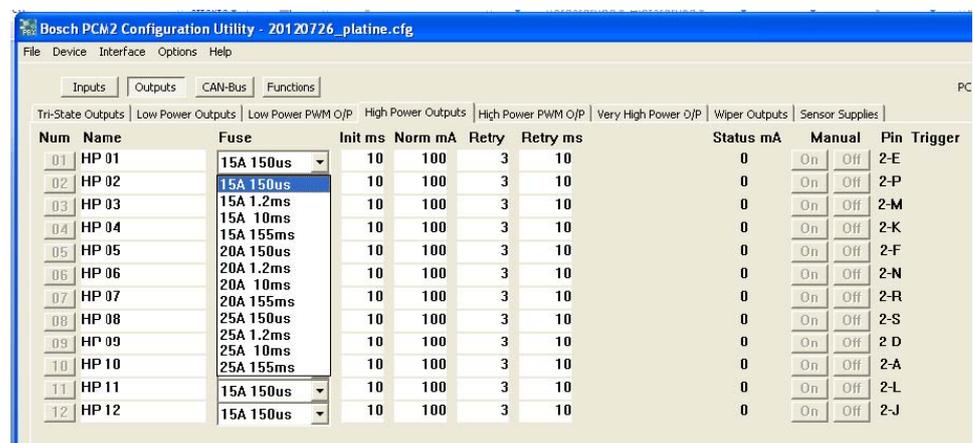
## 7.4 High Power Outputs

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 20 A each channel. Please observe that our recommended current rating each channel is given 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.



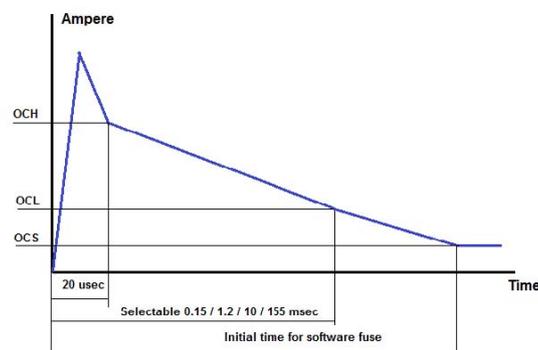
The driver stages can deliver significantly more current, but it is important to avoid overloading the wiring and contacts in the connector.

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. This level is selectable as 15 A, 20 A or 25 A.
- OCS is the software selected current threshold.



1. Switching an output ON, an inrush current up to and in excess of 100 A is allowed for a 20 usec time interval.
2. After these 20 usec the current level must be below OCH which is 100 A.
3. 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 A, 20 A, 25 A.
4. 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.
5. Maximum time is limited to 10 seconds.
6. 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.
7. 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.
8. If the current draw on an output exceeds the NORM fuse setting, the output will switch off.
9. In Retry set the maximum number of automatic re-activation of an output channel after it 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.
10. In Retry ms set the time interval between retries in milliseconds.

11. The status window will show the real time current draw of the output in mA.
12. Use the Manual option to test the output connection. When Manual is active (see section 4.3), Bosch PowerBox PBX 180's event handling has been deactivated and all channels are OFF by default.
13. Click the ON button for each individual channel to switch the output ON.
14. Click the ON button again to switch the output OFF.
15. Clicking on Trigger will open the main event controlling this output. A warning may appear if several events are used to control it.

Channel	Max current, A	Connector 4	Pin
3	20	AS2 12-16 SN	M
4	20	AS2 12-16 SN	K
5	20	AS2 12-16 SN	F
6	20	AS2 12-16 SN	N
7	20	AS2 12-16 SN	R
8	20	AS2 12-16 SN	S
9	20	AS2 12-16 SN	D
10	20	AS2 12-16 SN	A
11	20	AS2 12-16 SN	L
12	20	AS2 12-16 SN	J

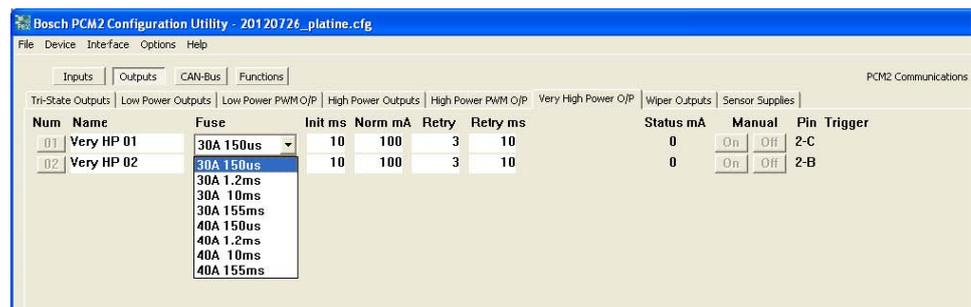
## 7.5 Very High Power

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 20 A each channel. Please observe that our recommended current rating each channel is given 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.

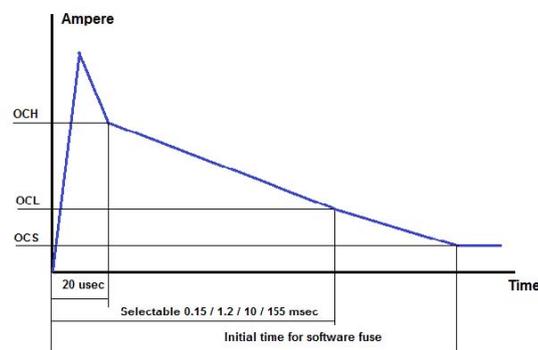
Once an output is turned on, the current draw depends on the attached load.

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 150 A.
- OCL is the user defined continuous current threshold. This level is selectable as 2 x 30 A or 2 x 40 A.
- OCS is the software selected current threshold.



1. Switching an output ON, an inrush current up to and in excess of 150 A is allowed for a 20 usec time interval.
2. After these 20 usec the current level must be below OCH which is 150 A.
3. 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 A, 40 A.
4. 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.
5. Maximum time is limited to 10 seconds.
6. 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.
7. 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.
8. If the current draw on an output exceeds the NORM fuse setting, the output will switch off.
9. In Retry set the maximum number of automatic re-activation of an output channel after it 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.
10. In Retry ms set the time interval between retries in milliseconds.

11. The status window will show the real time current draw of the output in mA.
12. Use the Manual option to test the output connection. When Manual is active (see section 4.3), Bosch PowerBox PBX 180's event handling has been deactivated and all channels are OFF by default.
13. Click the ON button for each individual channel to switch the output ON.
14. Click the ON button again to switch the output OFF.
15. Clicking on Trigger will open the main event controlling this output. A warning may appear if several events are used to control it.

Channel	Max current, A	Connector 4	Pin
VHP1	20	AS2 12-16 SN	B
VHP2	20	AS2 12-16 SN	C

## 7.6 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) – NOT YET IMPLEMENTED.
- 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 20 A each channel. Please observe that our recommended current rating each channel is given 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 PWM output channels in parallel.**

Current draw can be measured on all outputs.

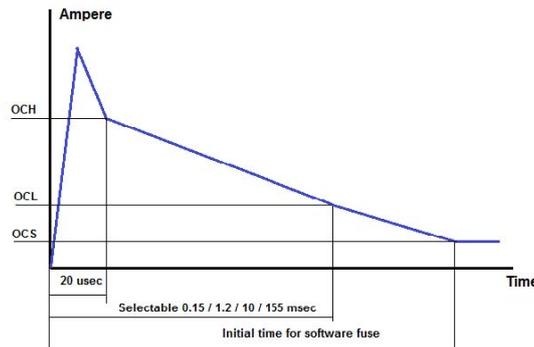


Outputs are protected by three current thresholds and three timers:

- OCH is the high current threshold of 100 A.
- OCL is the user defined continuous current threshold. This level is selectable as 7.5 A, 10 A, 12.5 A, 15 A, 20 A or 25 A.



- OCS is the software selected current threshold.



1. Switching an output ON, an inrush current up to and in excess of 100 A is allowed for a 20 usec time interval.
2. After these 20 usec the current level must be below OCH which is 100 A.
3. 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 10 A, 12.5 A, 20 A or 25 A.
4. 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.
5. Maximum time is limited to 10 seconds.
6. 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.
7. 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.
8. If the current draw on an output exceeds the NORM fuse setting, the output will switch off.
9. In Retry set the maximum number of automatic re-activation of an output channel after it 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.
10. In Retry ms set the time interval between retries in milliseconds.

PWM Type is used to define the functionality of the PWM feature:

PWM Type	PWM feature
None	Output disabled
Dig out	No PWM used, output is off or on 100% <b>DO NOT USE THIS OPTION ON Bosch PowerBox PBX 180 SERIAL &lt;076</b>
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

## 7.6.1 Duty Cycle Maps

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

Frequency (Hz)	1000	1500	2000	2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500	8000	8500
10	10	14	18	22	26	30	34	38	42	46	50	54	58	62	66	70
20	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
30	20	23	26	29	32	35	38	41	44	47	50	53	56	59	62	65
40	25	28	31	34	37	40	43	46	49	52	55	58	61	64	67	70
50	30	33	36	39	42	45	48	51	54	57	60	63	66	69	72	75
60	35	38	41	44	47	50	53	56	59	62	65	68	71	74	77	80
70	40	43	46	49	52	55	58	61	64	67	70	73	76	79	82	85
80	45	48	51	54	57	60	63	66	69	72	75	78	81	84	87	90
90	50	53	56	59	62	65	68	71	74	77	80	83	86	89	92	95
100	55	58	61	64	67	70	73	76	79	82	85	88	91	94	97	100
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

- 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:

1. Open the duty cycle map.
2. Click "Copy".
3. Paste into Excel.
4. Modify table.
5. Mark the table and copy.
6. Return to the tool and click past.
7. Set frequency in Hz; minimum applied value is 30 Hz, maximum value is 15 kHz.
8. HP PWM1 and HP PWM2 must use the same frequency. The Status window shows the real time current draw of the output in mA.
9. Use the Manual option to test the output connection. When Manual is active (see section 4.3), Bosch PowerBox PBX 180's event handling has been deactivated and all channels are OFF by default.
10. Click the ON button for each individual channel to switch the output ON.
11. Click the ON button again to switch the output OFF.
12. 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.

13. Use the Manual option to test the output connection. When Manual is active (see section 4.3), Bosch PowerBox PBX 180's event handling has been deactivated and all channels are OFF by default.
14. Click the ON button for each individual channel to switch the output ON.
15. Click the ON button again to switch the output OFF.
16. Clicking on Trigger will open the main event controlling this output. A warning may appear if several events are used to control it.

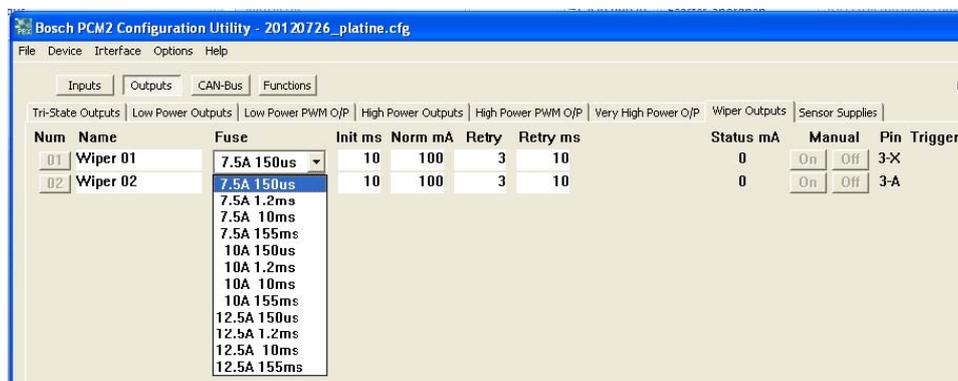
HP PWM OUT	Max current, A	Connector 3	Pin
1	20	AS2 20-16 SN	G
2	20	AS2 20-16 SN	H

## 7.7 Sensor Supplies

Bosch PowerBox PBX 180 has 3 stabilized 5.0 V sensor supplies (VREF) for use with the analogue sensor inputs. Maximum current draw from each output is 1.0 A.

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

## 7.8 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).

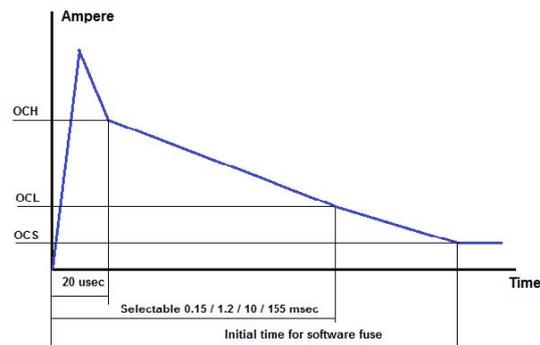
The 2 power outputs can supply a maximum continuous current of 8 A each channel. Please observe that our recommended current rating each channel is given in accordance with Deutsch's current limit for the size AWG20 contacts in the Autosport 20-39 connector. The driver stages can deliver significantly more current, but it is important to avoid overloading the wiring and contacts in the connector.

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. This level is selectable between 7.5 A to 12.5 A.
- OCS is the software selected current threshold.



1. 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.
2. 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 A, 10 A, 12.5 A.
3. 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.
4. Maximum time is limited to 10 seconds.
5. 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.
6. 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.
7. If the current draw on an output exceeds the NORM fuse setting, the output will switch off.
8. In Retry set the maximum number of automatic re-activation of an output channel after it 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.
9. In Retry ms set the time interval between retries in milliseconds.
10. The status window will show the real time current draw of the output in mA.
11. Use the Manual option to test the output connection. When Manual is active (see section 4.3), Bosch PowerBox PBX 180's event handling has been deactivated and all channels are OFF by default.

12. Click the ON button for each individual channel to switch the output ON.
13. Click the ON button again to switch the output OFF.
14. Clicking on Trigger will open the main event controlling this output. A warning may appear if several events are used to control it.

WPM OUT	Max current, A	Connector 3	Pin
WP1	8	AS2 20-39 SA	X
WP2	80	AS2 20-39 SA	A

## 7.9 Warning Lamp

Bosch PowerBox PBX 180 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 V ON, maximum current draw is 1.0 A.

### 7.10 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.

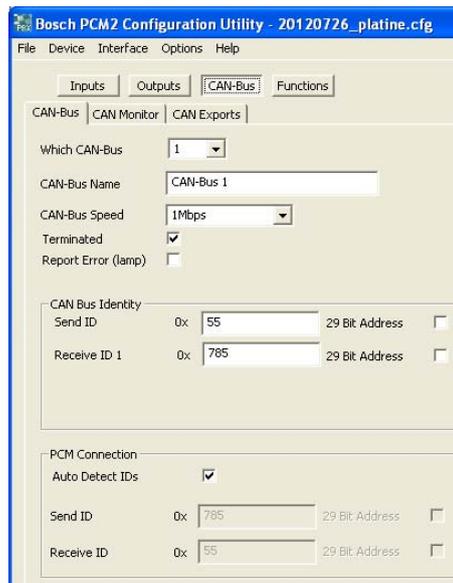
Use the event settings to define the switching conditions.

Resetting Bosch PowerBox PBX 180 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.

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

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

## 8 CAN Bus



### 8.1 Data Bus

Bosch PowerBox PBX 180 has 4 separate CAN busses, two are implemented in the current software release.

Select the CAN bus number to be edited.

If a CAN bus fails, for example after a short circuit, Bosch PowerBox PBX 180 will automatically reset the CAN stream.

#### 8.1.1 CAN Bus Name

Each CAN bus can be labeled individually to ease identification. Maximum 15 characters can be used. This can be used for each individual CAN bus.

#### 8.1.2 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

This must be set for each individual CAN bus.

### 8.1.3 Terminated

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 Bosch PowerBox PBX 180, terminating one end of the CAN string.

Each CAN bus can be individually terminated. By ticking the box, a 120 Ohm resistor within Bosch PowerBox PBX 180 is connected between CAN H and CAN L on the selected CAN bus.

Please note that a CAN connection should not exceed 16 meters (for 1 Mbits/s baud rate) and that a CAN bus MUST be terminated at each end by a 120 Ohm resistor.

CAN wires must be laid out as twisted pairs.

This must be respected for each individual CAN bus.

### 8.1.4 Report Error

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.

### 8.1.5 CAN Bus Identity

Set the base send and receive identifiers for each CAN bus.

This must be set for each individual CAN bus.

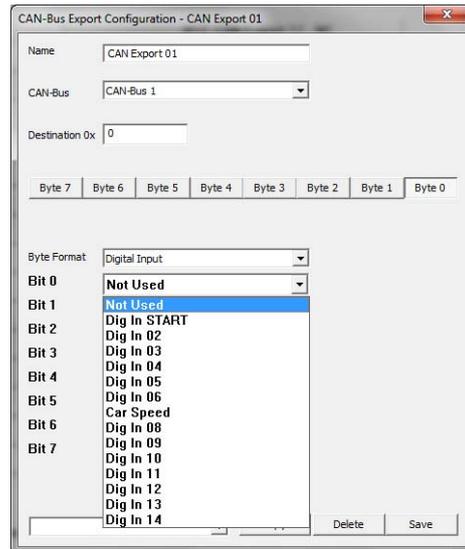
## 8.2 CAN Monitor

A CAN bus analyzing tool is included in the PC tool. It is possible to monitor each of the 4 CAN bus.

The analyzer can display all traffic on the selected bus, but it is also possible to filter the messages so that only CAN identifiers defined within Bosch PowerBox PBX 180 will be shown.

## 8.3 CAN Export

Bosch PowerBox PBX 180 can export up to 64 individual messages on any of the four CAN busses.



### 8.3.1 Name

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

### 8.3.2 CAN Bus

Select the CAN bus on which you are going to define the export.

### 8.3.3 Destination

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

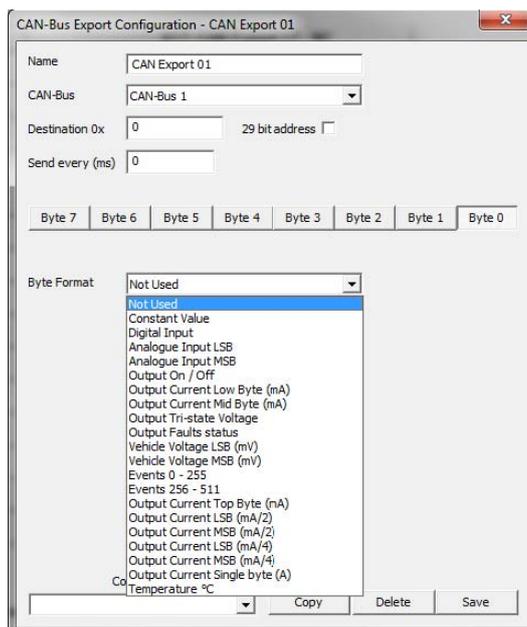
### 8.3.4 Send every (ms)

Set the identifier transmission interval in msec.

### 8.3.5 Bytes

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





## Constant Value

Use this section to define a constant value of a selected byte. This is used to define a row count.

## Digital Input

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

## Analogue Input

It is possible to export values of each of Bosch PowerBox PBX 180's 16 analogue inputs plus any of the 64 available CAN channels. This way it is also possible to route data from one CAN bus onto another CAN bus.

Analogue channels can occupy one or two bytes. This means that up to 8 analogue channels can be exported in each byte. To export channels occupying two bytes it is possible to define which of the two bytes will be MSB and which will be LSB (Motorola or Intel format).

Please note that the temperature channels listed in this section are NOT in use.

## Output On / Off

Each individual bit in the selected byte can be used to display the status of each individual output:

0 = off

1 = on

## 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.

## Output Current Mid Byte

Current draw from each of the 48 power outputs can be measured. This section uses 2 bytes, combining mid and low byte, to export current draw for any channel, measured in mA with a range up to 65,535 mA.

## 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

## Output Fault status

Select one of the 56 outputs to transmit its fault status in the selected identifier address and byte. The fault status is transmitted as a combination of:

<b>Fault Status</b>	<b>Hex value</b>	<b>Decimal value</b>
STATUS_OUTPUT_OFF_OK	0x0000	0
STATUS_OUTPUT_ON_OK	0x0001	1
STATUS_OUTPUT_SHUTDOWN_OVER_VOLTAGE	0x0002	2
STATUS_OUTPUT_SHUTDOWN_UNDER_VOLTAGE	0x0004	4
STATUS_OUTPUT_SHUTDOWN_OPEN_LOAD	0x0008	8
STATUS_OUTPUT_SHUTDOWN_OVER_CURRENT_LOW_OCL	0x0010	16
STATUS_OUTPUT_SHUTDOWN_OVER_CURRENT_HIGH_OCS	0x0020	32
STATUS_OUTPUT_SHUTDOWN_OVER_THERMAL	0x0040	64
STATUS_OUTPUT_SHUTDOWN_OVER_SOFT_CURRENT_OCS	0x0080	128
STATUS_OUTPUT_SHUTDOWN_OVER_SOFT_CURRENT_RETRY	0x0100	256

Channels not supported are:

- Low power 29, 30, 31 and 32.
- All PWM channels
- All tri-state outputs
- All VREF sensor supplies

<b>Value</b>	<b>Description</b>
0	Channel switched off
1	Channel switched on

8 Channel switched off and has no load connected to it.

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

Value	Description
17	Bosch PowerBox PBX 180 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.
33	Bosch PowerBox PBX 180 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.
129	Bosch PowerBox PBX 180 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.

Only channels which have failed will be reset.

In general, switching a channel OFF then ON will attempt a restart even if the channel has failed earlier.

To clear diagnostic, look in the tools main menu in "Device". Clicking on "Reset Output Counters" will reset diagnostics.

## Vehicle Battery Voltage

Define 2 bytes in the identifier to transmit the vehicle battery power. Status is expressed in mV, for example 13,250 mV.

## Events

The export of event status is divided into two sections, one for the first 256 events and one for the following 256 events.

Each byte in the identifier can display the status of 8 events:

0 = False

1 = True

## Output Current Top Byte

Current draw from each of the 48 power outputs can be measured.

This section uses 3 bytes, combining top, mid and low byte, to export current draw for any channel, measured in mA with a range in excess of 200,000 mA.

## Output Current LSB, MSB byte (mA/2)

Current draw from each of the 48 power outputs can be measured.

This section uses 2 bytes, combining MSB and LSB, to export current draw for any channel, scaled at 2 mA/bit with a range up to 130,000 mA.

## Output current LSB, MSB byte (mA/4)

Current draw from each of the 48 power outputs can be measured.

This section uses 2 bytes, combining MSB and LSB, to export current draw for any channel, scaled at 4 mA/bit with a range up to 260,000 mA.

### 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.

### Temperature °C

Temperatures are measured at the hottest points on the two Bosch PowerBox PBX 180 internal boards, signal and power.

These values can be exported in one signed byte each. Scaling is 1 deg C/bit with a range between -127 deg C to +128 deg C.

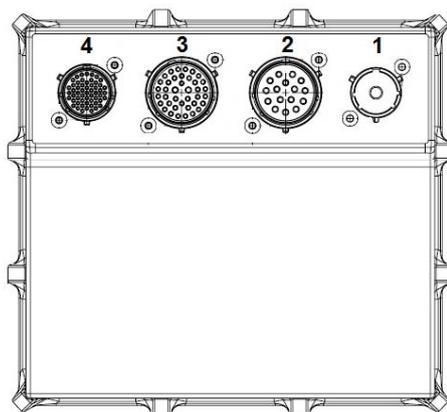
Please note that these channels are only updated with a time interval of 1.5 sec.

### 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 255 A.

## 9 Pin Configuration



### 9.1 Connector 1 - Battery Power Supply

Mating connector: Deutsch ASHD6 14-1 SN C35

### 9.2 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	20 / 100
B	Channel 2 Very High Power	20 / 150
C	Channel 1 Very High Power	20 / 150
D	Channel 9 High Power	20 / 100
E	Channel 1 High Power	20 / 100
F	Channel 5 High Power	20 / 100
G	Channel 1 High Power PWM	20 / 80 (0 to 95 % DC) **)
H	Channel 2 High Power PWM	20 / 80 (0 to 95 % DC) **)
J	Channel 12 High Power	20 / 100
K	Channel 4 High Power	20 / 100
L	Channel 11 High Power	20 / 100
M	Channel 3 High Power	20 / 100
N	Channel 6 High Power	20 / 100
P	Channel 2 High Power	20 / 100
R	Channel 7 High Power	20 / 100
S	Channel 8 High Power	20 / 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.**

## 9.3 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	8 / 75
B 2	Tri-State Output 2	Trigger 0 / 2.5 / 5 V ***)
C 3	Tri-State Output 4	Trigger 0 / 2.5 / 5 V ***)
D 4	Channel 25	8 / 75
E 5	Channel 26	8 / 75
F 6	Channel 23	8 / 75
G 7	Channel 21	8 / 75
H 8	Channel 22	8 / 75
J 9	Channel 20	8 / 75
K 10	Channel 14	8 / 75
L 11	Channel 16	8 / 75
M 12	Channel 18	8 / 75
N 13	Channel 2	8 / 75
P 14	Channel 4	8 / 75
R 15	Channel 6	8 / 75
S 16	Channel 8	8 / 75
T 17	Channel 10	8 / 75
U 18	Channel 12	8 / 75
V 19	Channel 2 PWM	8 / 30 (0 to 100 % DC) **)
W 20	Channel 4 PWM	8 / 30 (0 to 100 % DC) **)
X 21	Channel Wiper 1	8 / 75
Y 22	Tri-State Output 1	Trigger 0 / 2.5 / 5 V ***)
Z 23	Tri-State Output 3	Trigger 0 / 2.5 / 5 V ***)
a 24	Reserved	--
b 25	Channel 24	8 / 75
c 26	Channel 19	8 / 75
d 27	Channel 13	8 / 75
e 28	Channel 1	8 / 75
f 29	Channel 3	8 / 75
g 30	Channel 7	8 / 75
h 31	Channel 9	8 / 75
i 32	Channel 11	8 / 75
j 33	Channel 3 PWM	8 / 30 (0 to 100% DC) **)
k 34	Channel 1 PWM	8 / 30 (0 to 100% DC) **)

m 35	Power Ground	
n 36	Channel 15	8 / 75
p 37	Channel 17	8 / 75
q 38	Channel 5	8 / 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 ECUs only. DO NOT CONNECT TO LOAD!

## 9.4 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-	
28	Ethernet TX+	
29	Ethernet RX+	
30	Ethernet RX-	
31	Analogue Input 16; 12 bit	Pull-up 0 / 3.16k / 47k
32	Sensor supply VREF1	5.0 V at 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 V at 1.0 A
41	Analogue ground	
42	Warning Light + Reset	5.0 V at 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 V at 500 mA
48	Analogue Input 1; 12 bit	Pull-up 0 / 3.16k / 47k
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



## 10 Specifications

### 10.1 Inputs

Number of digital input	14
Number of analogue inputs	16 (0 to 12 V; 16 bit resolution), can be regrouped as 8 differential inputs
Number of CAN input channels	64

### 10.2 Outputs

All driver stages are thermally and reverse polarity protected.

#### 10.2.1 Very High Power Channels

Number of individual outputs	2
Maximum continuously current draw per output	26 A
Maximum peak current each output	150 A inrush

#### 10.2.2 High Power Channels

Number of individual outputs	12
Maximum continuously current draw per output	26 A
Maximum peak current each output	100 A inrush

#### 10.2.3 High Power PWM Channels

Number of individual outputs	2
Maximum continuously current draw per output	26 A
Maximum peak current each output	100 A inrush
Maximum applied frequency	25 kHz

#### 10.2.4 Low Power Channels

Number of individual outputs	26
Maximum continuously current draw per output	13 A
Maximum peak current each output	75 A inrush

### 10.2.5 Low Power PWM Channels

Number of individual outputs	4
Maximum continuously current draw per output*)	13 A
Maximum peak current each output	75 A inrush
Maximum applied frequency	25 kHz

### 10.2.6 Wiper Channels

Number of individual outputs	2 (with protection diodes)
Maximum continuously current draw per output	13 A
Maximum peak current each output	75 A inrush
Notes	Can be used as normal outputs

### 10.2.7 Sensor Supplies

Number of 5 V reference sensor supplies	3; each 1.0 A at 5 V
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### 10.2.8 Tristate Supplies

Number of tri-state logic outputs	4
Voltage level of tri-state analogue outputs	0 V / 2.5 V / 5.0 V at 50 mA

## 10.3 Maximum Current Rating

Maximum recommended output current	180 A continuously; > 300 A peak current
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## 10.4 Temperatures

Maximum operating temperature	85°C
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## 10.5 Communication

PC Interface	CAN 1 to 4 (only CAN 1 + 2 in current release)
CAN bus	4
CAN protocol	2.0B
CAN baud rate (each CAN bus)	10 kbps to 1 Mbps

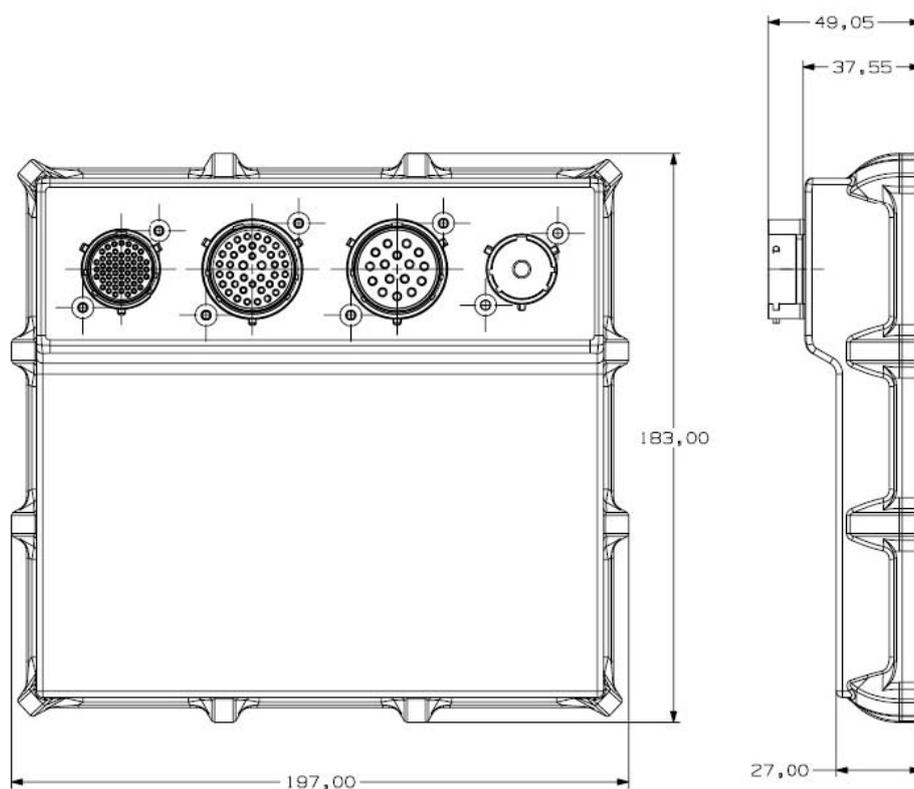
CAN identifiers	11 bit or 29 bit identifiers Motorola or Intel format Unlimited number of identifiers Bit wise operator
LIN bus	1; configurable as master or slave
Ethernet	1 at 100 Mbit/s
Serial bus	RS232 serial link (for Supervisor)

## 10.6 Power Supply

Supply Voltage	6.0 to 22 V
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## 10.7 Dimensions

Length x Width x Height	197 x 183 x 37.55 mm (w/o connectors)
Weight	1,190 g





## PowerBox PBX 180

### Installation and Users Guide