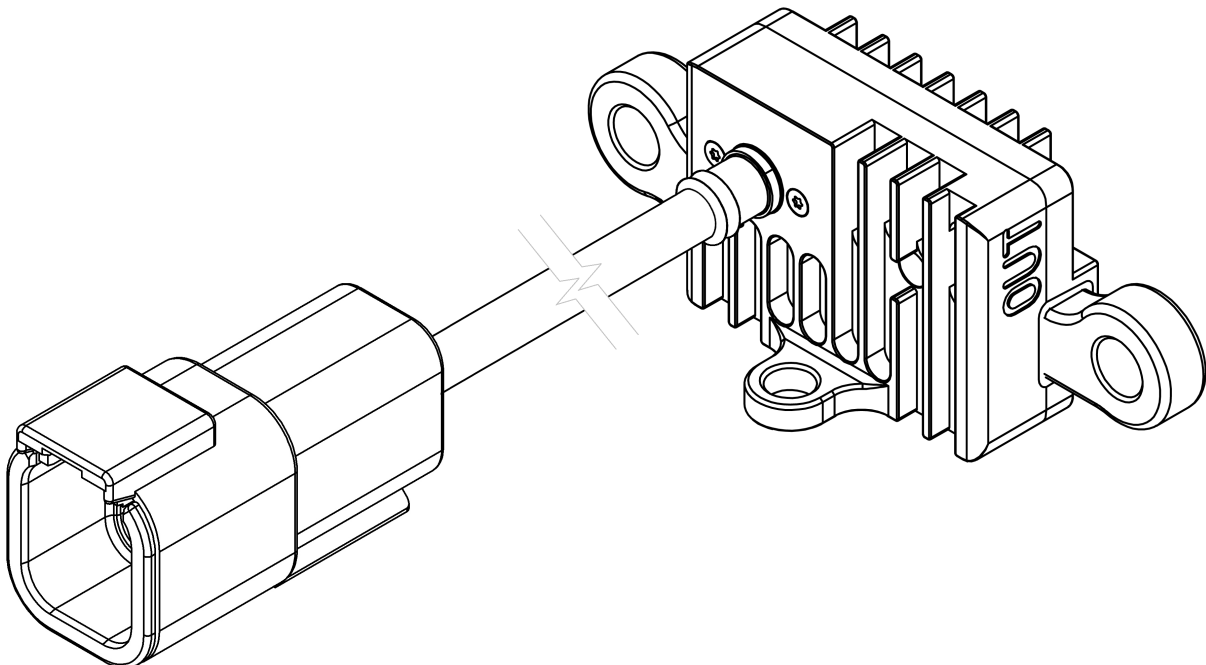
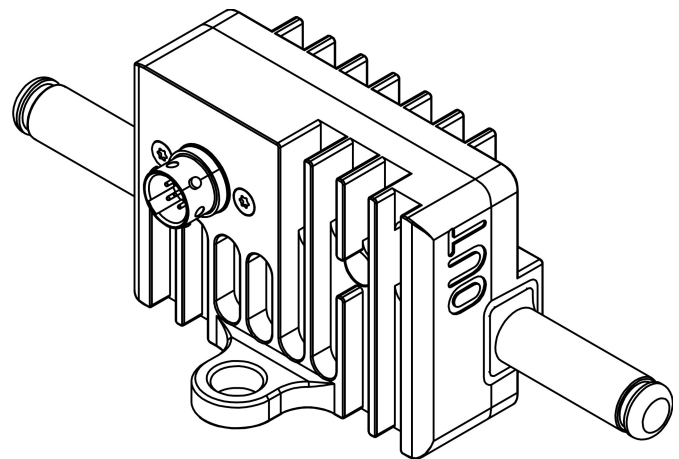
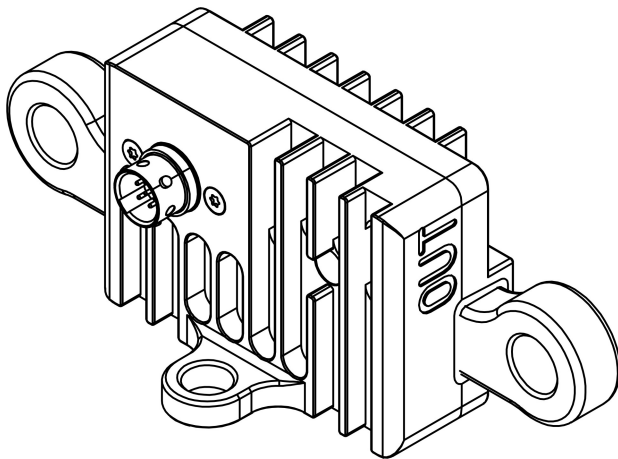


Ecumaster Battery Isolator

Manual
Revision 1.1



1 Device description

The Battery Isolator is a motorsport solid-state device which can be used for FIA compliant battery isolation and engine shutdown.

It is the most lightweight solution possible. The device is designed for harsh motorsport environments and weighs only 83g. The lack of mechanical components ensures long life and high reliability.

The device has built-in alternator load dump protection without the need for external components. This means there is no risk of damage to expensive electronic equipment during an emergency shutdown. It is controlled by two external switches and can be shut down with a CAN bus message. The message can be sent from an Ecumaster PMU16 unit in case of high impact or another event.

The device is configurable through CAN bus and the Light Client software. It also transmits diagnostic information which can be used by other equipment and is invaluable during device setup and diagnosis.

The state of the device is transmitted over CAN bus and is also indicated by a multi-colour LED light.

It is fully protected from overheating and overcurrent.

2 Specification

- Weight: 83g
- Dimensions: 50mm x 100mm x 38.5mm
- Voltage range: 6V - 19V, 28V transient (12V automotive installations only)
- Current capability: 300A continuous, peak up to 1000A
- Current measurement resolution: 4A
- Current measurement range: -1000A to 1000A
- Current measurement accuracy: $\pm 10\%$
- Inductive load switching capability: 600mJ
- Enclosure: Anodized billet aluminium, IP67 rated
- High current terminals: M8 nickel-plated terminals or Radlok™ connectors
- Signal connector: Deutsch ASX202-06PN (mating connector ASX602-06SN included) or Deutsch DTM04-6P (mating connector DTM06-6S included)
- Power save state current consumption: <1mA
- ON state current consumption: ~20mA
- Engine kill output: 1.5 A, High (VBat), Low (GND) or Hi-Z¹

¹* Hi-Z high impedance output not connected to 12V or ground.

3 Installation

- To avoid damage, it is advised to disconnect any electrical equipment during welding on the car.
- **Pay attention to correctly connecting power terminals. Any attempt to crank the engine with a reverse terminal connection will most likely damage the device. Polarity is clearly engraved on the case.**
- **Always disconnect the battery (BATT +12V) before disconnecting the signal connector. Disconnecting the signal connector when the device is running may damage the device.**




3.1 Mounting

The device automatically shuts down at an internal temperature of 90°C. The temperature warning for the device is set at 80°C. It is advised to install the device in a cool, well ventilated location on a flat metal area of the chassis.

The device will provide the specified continuous current when firmly installed on a flat metal area of the chassis at an ambient temperature of 30°C. Device performance will vary depending on how much heat dissipation is provided.

After installation, you should verify that during normal operation the device has enough temperature headroom not to fail during racing conditions.

3.2 Battery Isolator types

Type	Pinout												
Battery Isolator 'AS' Radlok connectors  A black, rectangular battery isolator with a heat sink. It has two long, silver-colored metal pins extending from the top and bottom. A red terminal is visible on the left side.	<table><tr><td>1</td><td>Power save switch input</td></tr><tr><td>2</td><td>Emergency kill switch input</td></tr><tr><td>3</td><td>Engine kill output</td></tr><tr><td>4</td><td>CAN L</td></tr><tr><td>5</td><td>CAN H</td></tr><tr><td>6</td><td>Ground</td></tr></table>	1	Power save switch input	2	Emergency kill switch input	3	Engine kill output	4	CAN L	5	CAN H	6	Ground
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Battery Isolator 'AS' Plated terminals  A black, rectangular battery isolator with a heat sink. It has two large, silver-colored metal ring terminals on the left and right sides. A red terminal is visible on the left side.	<table><tr><td>1</td><td>Power save switch input</td></tr><tr><td>2</td><td>Emergency kill switch input</td></tr><tr><td>3</td><td>Engine kill output</td></tr><tr><td>4</td><td>CAN L</td></tr><tr><td>5</td><td>CAN H</td></tr><tr><td>6</td><td>Ground</td></tr></table>	1	Power save switch input	2	Emergency kill switch input	3	Engine kill output	4	CAN L	5	CAN H	6	Ground
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Battery Isolator 'CLUB' Plated terminals  A black, rectangular battery isolator with a heat sink. It has a blue cable with a connector on the left side and a large, silver-colored metal ring terminal on the right side. A red terminal is visible on the left side.	<table><tr><td>1</td><td>Power save switch input</td></tr><tr><td>2</td><td>Emergency kill switch input</td></tr><tr><td>3</td><td>Engine kill output</td></tr><tr><td>4</td><td>CAN L</td></tr><tr><td>5</td><td>CAN H</td></tr><tr><td>6</td><td>Ground</td></tr></table>	1	Power save switch input	2	Emergency kill switch input	3	Engine kill output	4	CAN L	5	CAN H	6	Ground
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3.3 Electrical connection

The device is connected between the battery positive (+) terminal and the rest of the vehicle installation.

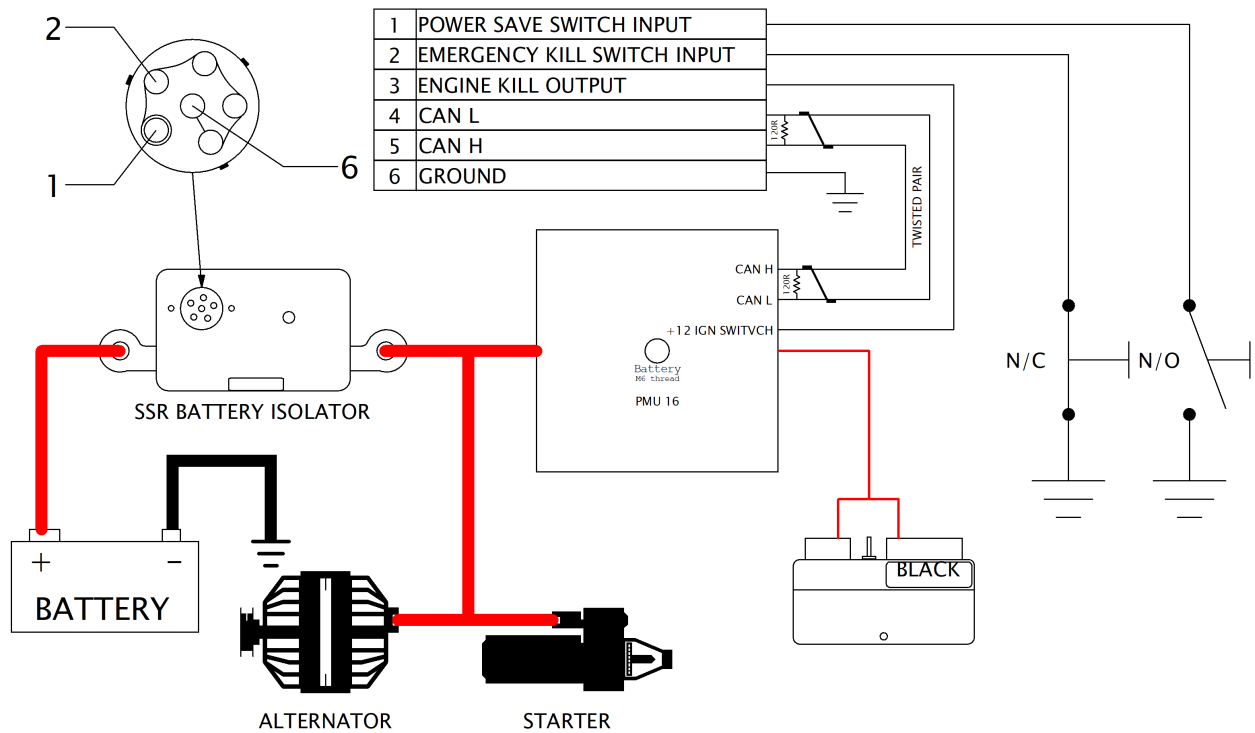
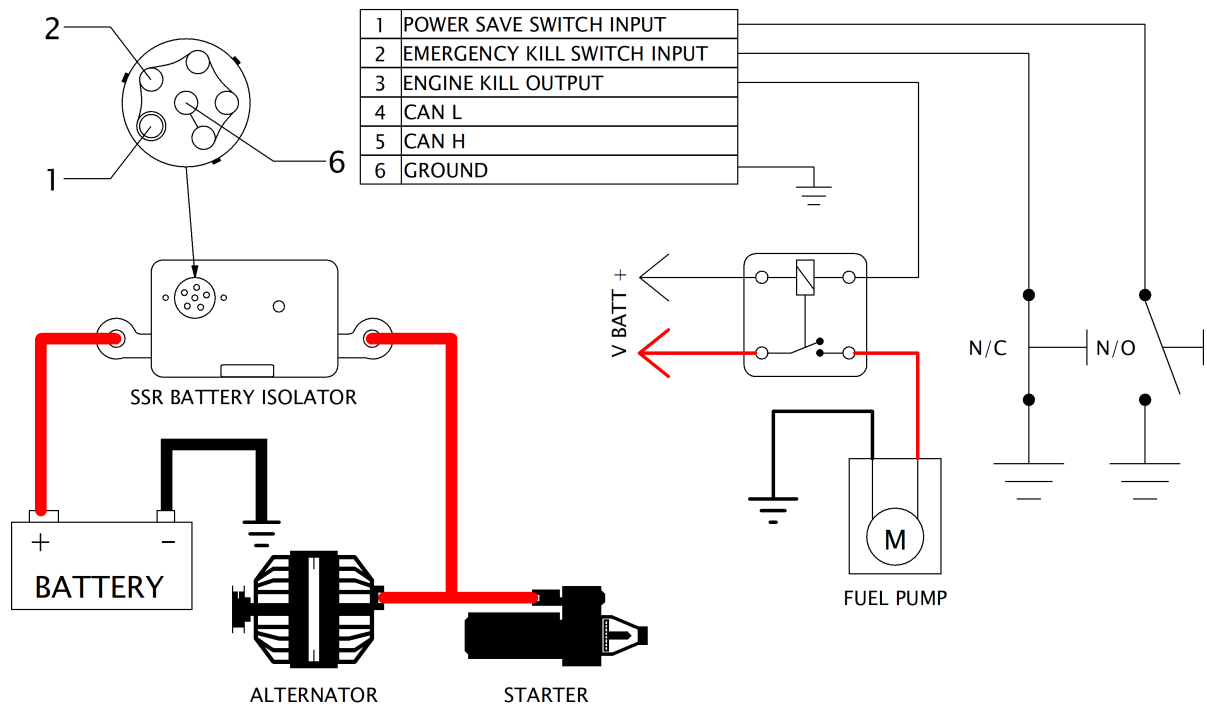
The device has two switch inputs:

- **Power save switch input.** When this input **is connected to ground** the device shuts down the engine and turns off to a very low current consumption level of <1mA. It is also required to reset the device after a fault condition occurs. The input has an internal pull-up resistor and is **not active when disconnected**. The switch connected to this input must be latching and have two stable positions.
- **Emergency switch input.** When this input **is disconnected from ground** the device shuts down the engine and turns off the car power supply but it is still powered on itself. Normally closed emergency switches should be connected to this input in series. The input has an internal pull-up resistor and is **active when disconnected**. The switch for this input must be momentary with normally closed configuration.

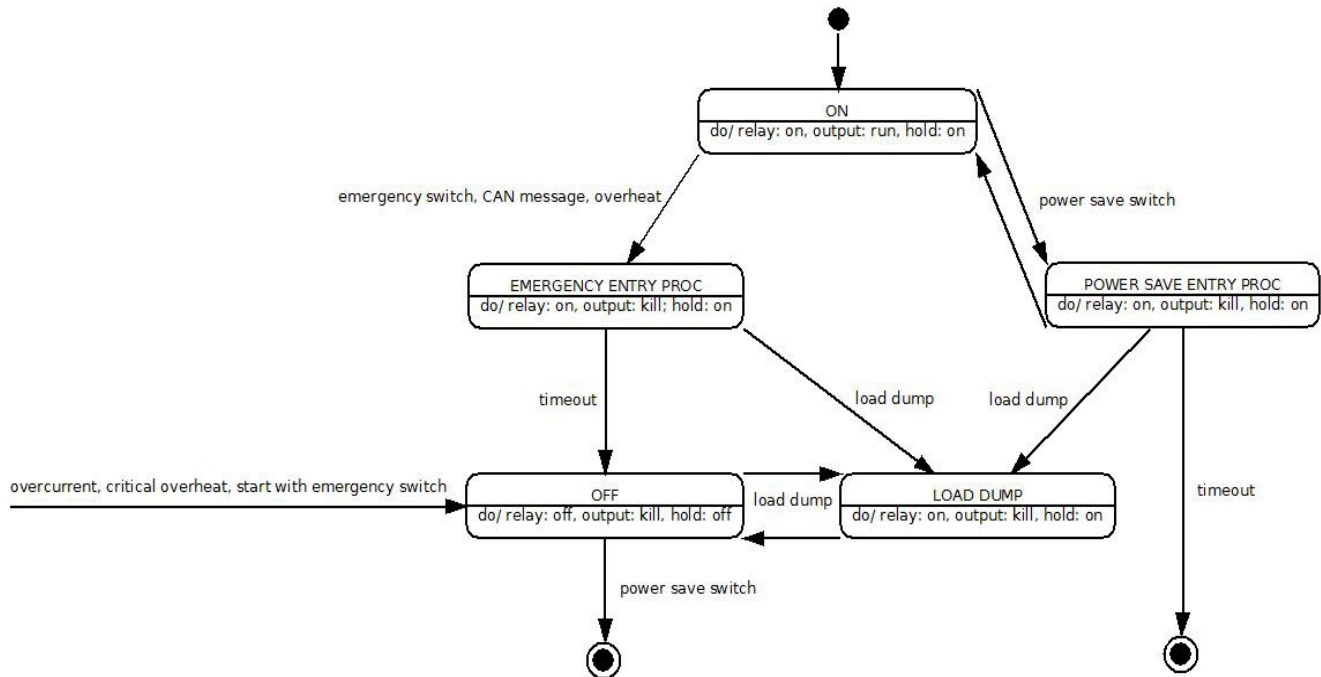
The device has one output used to kill the engine in case of emergency. This output is fully programmable and can have VBat, GND or High-Z independently when active and inactive. For the system to work, the engine must shut down when the engine kill output is active. If the engine keeps running, the alternator will continue to supply power to the car installation. If current is drawn from the kill output, GND - High-Z combination is preferred for best performance on a drained battery.

PLEASE NOTE: OUTPUT IS ONLY 1.5A SO CAN'T BE USED AS A DIRECT FEED FOR IGNITION. THE CORRECT RELAY NEEDS TO BE USED IF THE ISOLATOR IS NOT USED WITH A POWER DISTRIBUTION DEVICE.

The connector used for signals is a Deutsch ASX 6 way. AWG 24 (0.2mm²) is the maximum usable wire size. Crimping the contacts requires a special tool (M22520/2-01 with K1586 positioner) for motorsport or military size 24 terminals. If you're not equipped with such a tool or suitable gauge wire, please contact your Ecumaster dealer sales department for a premade wiring loom.



4 Operation principles



The device operation can be best explained with a state machine diagram:

- Relay: state of main relay, on or off
- Output: state of ECU/PMU output: run or kill
- Hold: state of internal power supply hold. When hold is off, power save switch will turn the device off immediately.

When the device is turned on, it goes to **ON** state. From there it can be turned off by the power save switch or emergency switch. Each switch will start an entry procedure the duration of which can be set by using the Light Client software. It is used to give time for other CAN devices to shut down properly and for the engine to shut down.

If the device detects that the engine is still running it will stay in the **LOAD DUMP** state until the engine shuts down.

When the device is in the **OFF** state it can be reset only by toggling the power save switch.

The state of the device is indicated with an LED light in the following way:

Device states:

- green - relay **ON**
- red - relay **OFF**
- toggling green - **POWER SAVE ENTRY PROC** device countdown to Power Save mode
- toggling red - **EMERGENCY ENTRY PROC** device countdown to Relay **OFF** mode

Additional warnings (only in **ON** state):

- yellow – overheat (temperature > 80°C)
- short green flash – undervoltage (VBat < Battery Saver Threshold Voltage)
- short red flash – overvoltage (VBat > 19V)
- short blue flash – CAN-bus error (also when nothing is connected to the CAN-bus)

Additional warnings will add up in a sequence. For example:

Short red flash, then short blue flash, then yellow means overvoltage with overheat and CAN error.

4.1 Under Voltage Lock Out

The device has a built in Under Voltage Lock Out function to protect itself from invalid operation when the supply voltage is too low.

If the battery voltage drops below 6V the device will instantly turn off power to the car.

4.2 Battery saver

The battery saver function is used to protect the car battery from deep discharge.

If the battery voltage is below the threshold voltage for a defined time the isolator will disconnect the battery by going into **EMERGENCY ENTRY PROC**.

Keep in mind that the total time from the voltage dropping below the threshold to the isolator cutting off power is equal to the Battery saver timeout + Emergency kill timeout.

5 Configuration

The Battery Isolator is configured through the Ecumaster Light Client software. The device CAN-BUS must be accessed with a USBtoCAN interface or other compatible devices. For general Light Client usage refer to the Light Client software manual.

The screenshot displays the Ecumaster Light Client software interface for configuring the 'batteryisol' device. The window title is 'Ecumaster Light Client: 1 Mbps --- batteryisol ""'. The interface is divided into several sections:

- Devices:** A table showing the device details. The 'batteryisol' device is listed with 'Rev' N/A, 'Serial num...' (empty), 'Firmware' FW 2.0, 'Comment' (empty), and 'Info' In: 0FC-0FF Out: 6A. Buttons for 'Refresh', 'Set comment', 'User manual', 'Upgrade', and 'More...' are available.
- Properties:** A section for configuring the device's CAN ID and various timeouts and limits.
 - CAN ID:** 0x06A0, Standard.
 - Timeouts:** Power save: 5.0 s, Emerg. kill: 0.2 s.
 - PMU/ECU output:** Run mode: Vbat, Kill mode: High-Z.
 - Current limit:** Current limit: 800 A.
 - CAN kill:** Emerg. kill ID: 0x0FC Standard.
 - Battery saver:** Enable: ☐, Threshold voltage: 11.5 V, Timeout: 10.0 min.
 - General options:** Dis. emerg. switch: ☐, Dis. CAN LED warn.: ☐, Ena. CAN terminator: ☐.
- Channels:** A table showing the device's status and flags.
 - Flags:** overvoltage warn: 0, undervoltage warn: 1, overheat warn: 0, overheat kill: 0, overcurrent kill: 0, emergency kill: 0, powersave kill: 0, CAN kill: 0, UVLO kill: 0, load dump occurred: 0, battery saver kill: 1.
 - device state:** OFF.
 - kill countdown:** 0.0 s.
 - heartbeat:** 219.
 - peak current:** 666 A.
- All frames:** A table showing the device's output data stream.
 - 6A0h:** 8, 00 70 00 0D 00 00 01 3F, 20.2 Hz, 20694.
 - 6A1h:** 8, 04 02 04 00 D7 02 9A 00, 20.2 Hz, 20694.
- Transmit:** A section for sending data to the device.
 - ID:** 0FFh, **DLC:** 8, **Bytes:** FC 00 00 00 00 00 00 00, **Freq:** Manual, **Count:** 0.

At the bottom, the 'Bit rate' is set to 1 Mbps and the 'Status' is OK.

5.1 Properties

- **CAN ID** - CAN-BUS first message ID for the device output data stream
- **Timeouts** - delay times for transition between device states
 - **Power save** - timeout from POWER SAVE ENTRY PROC to POWER SAVE (complete device turn off)
 - **Emerg. kill** - timeout from EMERGENCY ENTRY PROC to OFF

- **PMU/ECU output** - configuration of output used to shut down the engine
 - **Run mode** - state of output during normal device operation (12v (max 1.5 A), 0V (max 1.5 A) or High -Z)
 - **Kill mode** - state of output when engine shutdown is desired ("kill: on" on state machine diagram)
- **Current limit** – current value, that if exceeded, will turn the device to the OFF state immediately
- **Emerg. kill ID** - CAN ID for receiving emergency shutdown information from CAN-BUS
- **Battery saver** - function to disconnect the battery if voltage remains below the threshold for a predetermined time
 - **Enable** - enables battery saver functionality
 - **Threshold voltage** - voltage below which the **Timeout** starts counting. If voltage rise above the threshold voltage during timeout, the timeout timer resets.
 - **Timeout** - time duration with voltage below the Threshold voltage to activate the function.

CAN Bus shutdown function is activated when the message with the first data byte different from 0x00 is received. Other message bytes are irrelevant. If the first byte is equal to 0x00 the function is not activated. **For reliable operation, only one device on the CAN-BUS can transmit with a particular ID. To be able to be shut down by multiple devices, the Battery Isolator will listen to four message IDs starting from Emerg. kill ID.**

For example, Emerg. kill ID is 0x0FC. The device will shut down when receiving messages with IDs 0x0FC, 0x0FD, 0x0FE, 0x0FF with the first data byte set to anything from 0x01 to 0xFF.

- **General options**
 - **Dis. emerg. switch** - disables emergency switch input
 - **Dis. CAN LED warn.** - disables the blue warning flash when CAN-BUS is not connected
 - **Ena. CAN terminator** - enables CAN-BUS internal 120Ohm terminator (available from hardware RevD)

5.2 Channels

- Voltage in - voltage on battery side
- Voltage out - voltage on car side
- Current load - current flowing through the relay. Positive values: battery to car, negative: car to battery (charging). Current load is not intended for precise current measurements but for general information on device load and charging. Keep in mind the measurement accuracy when interpreting results.
- Temperature – device internal temperature
- Flags:

FLAG	SET condition	RESET condition
Overvoltage	Battery voltage > 19V	Battery voltage <= 19V
Undervoltage	Battery voltage < battery saver threshold voltage	Battery voltage >= battery saver threshold voltage
Overheat	Temperature > 80°C	Temperature <= 80°C
Overheat kill	Temperature > 90°C	Device reset
Overcurrent kill	Current > current limit	Device reset
Emergency kill	Emergency switch activated	Device reset
Powersave kill	Power save switch activated	Power save switch deactivated
CAN kill	CAN kill message received	Device reset
UVLO kill	Battery voltage < 6V	Device reset
Load dump occurred	Alternator is still charging when isolator disconnects	Device reset
Battery saver kill	Battery saver function turned off power	Device reset
Overvoltage kill	Voltage exceeded device specification for too long	Device reset

- Device state - refer to Operation principles
- Kill countdown - time remaining to go from POWER SAVE ENTRY PROC to POWER SAVE or from EMERGENCY ENTRY PROC to OFF
- Heartbeat - counter indicating that the device is running, incremented with every CAN message sent

6 Troubleshooting

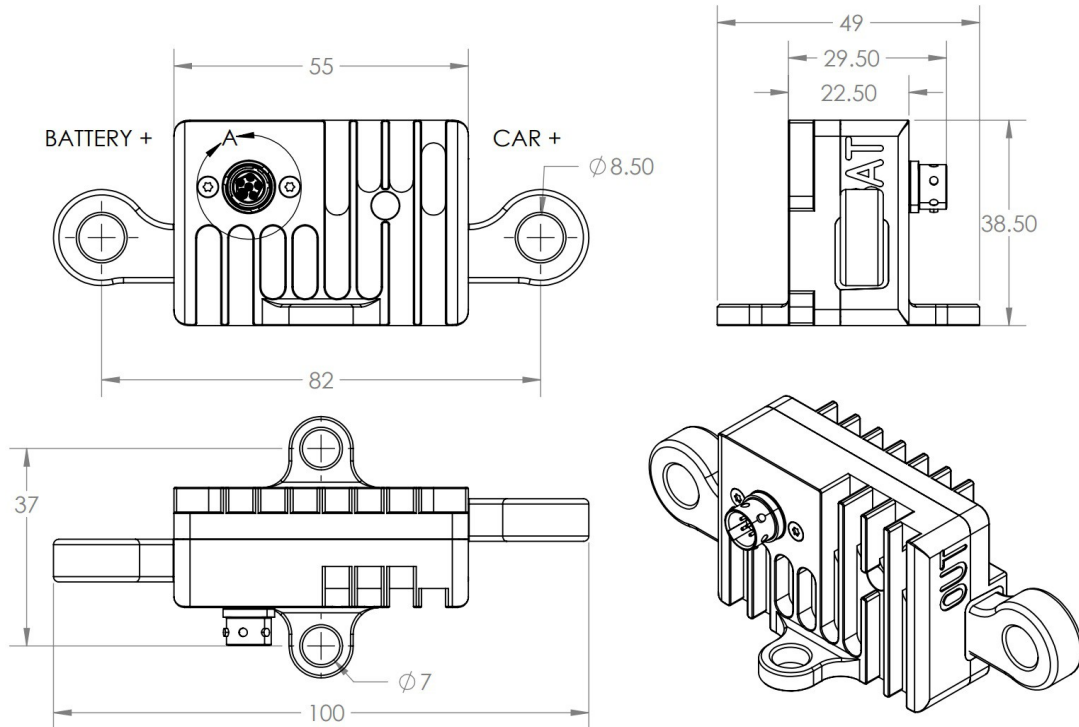
Finding the reason why the isolator disconnected the battery is mainly achieved by reading device flags. Flags can be read via the Light Client software. Possible reasons/solutions are listed below:

- Device turned off and there are no flags active.
 - Power save switch was activated.
 - Supply voltage dropped below 6V.
- **overvoltage warn** - warning only, doesn't turn off the device.
- **undervoltage warn** - warning only, doesn't turn off the device.
- **overheat warn** - warning only, doesn't turn off the device.
- **overheat kill** - internal device temperature exceeded 95°C
 - Reduce device current load.
 - Install device in colder environment.
 - Install device on chassis with thermally conductive material to spread the heat.
- **overcurrent kill** - current limit was exceeded.
 - check car wiring and devices for shorts or malfunctions
 - increase **Current limit**
- **emergency kill** - emergency switch was activated
 - If this wasn't intended, check the emergency switch circuit for continuity.
- **powersave kill** - flag is active when power save switch is active. It leads to the device turning off completely.
- **CAN kill** - device was turned off with CAN bus message
 - if this wasn't intended, check that there aren't any devices sending messages on ID set up in **Emerg. kill ID** field, or on the following 3 IDs.
- **UVLO kill** - supply voltage dropped below specification.
 - Check if the battery is sufficiently charged.

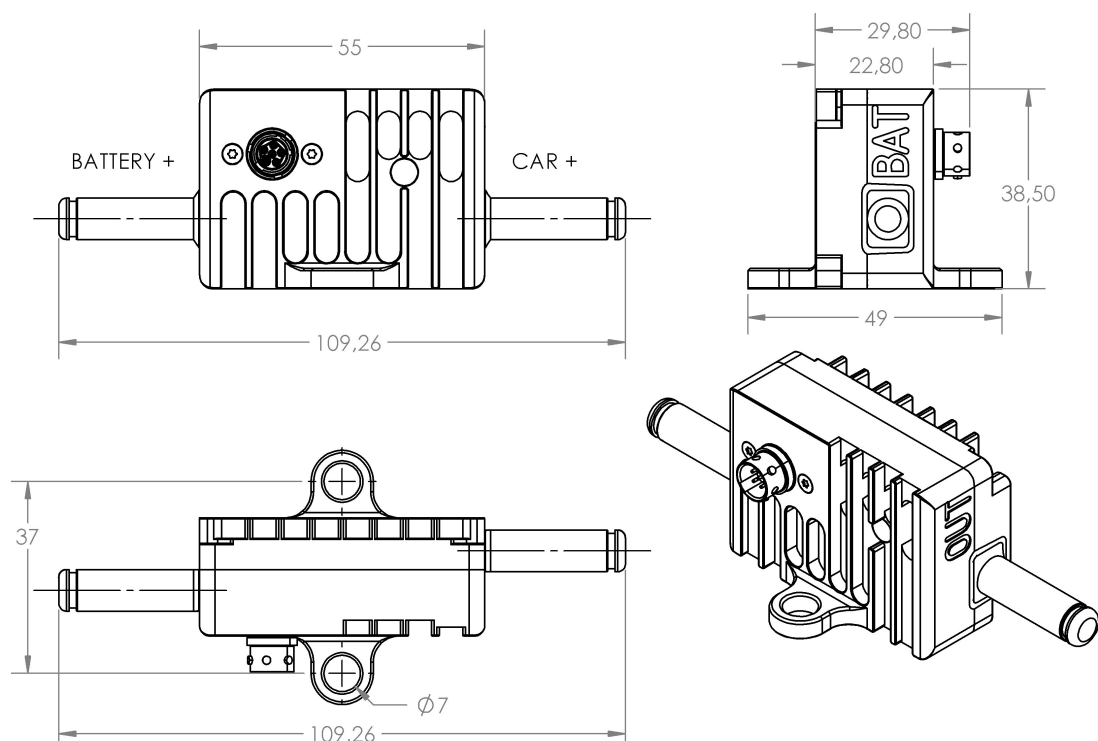
- Check if supply wires are properly fastened.
- **load dump occurred** - current was flowing to the battery, while the device was disconnecting the battery.
 - PMU/ECU output doesn't shut down the engine properly.
 - Timeouts are too short. The engine should stop before disconnecting the battery.
 - Supply voltage exceeded the device specification.
- **battery saver kill** - battery saver function was activated.
 - Check battery saver setup.
 - Check if the alternator is charging the battery when the engine is running.
- **overvoltage kill** - supply voltage exceeded the device specification.
 - Check the alternator for proper operation.
 - Check if the battery is properly connected to the chassis and the isolator.

7 Dimensions

Battery Isolator 'AS' Plated terminals



Battery Isolator 'AS' Radlok connectors



8 Revision history

Revision	Date	Changes
0.2	14.06.2019	Initial revision
0.3	17.07.2019	Battery saver and UVLO added
0.4	11.10.2019	Switch type and kill output hints added
0.5	28.11.2019	Drawing for lug and Radlok versions
0.6	12.12.2019	Text revised
0.7	16.06.2020	Troubleshooting, firmware 3.0
1.0	10.05.2022	Table with the types of Battery Isolator Note about disconnecting the signal connector Drawing for 'CLUB' version Drawing with dimensions of Battery Isolator 'AS' Radlok connectors
1.1	27.09.2022	Engine kill output current rating changed