

## ‘Dash-board’

Integrating electric conversion requirements and functionality in an existing vehicle can be a challenge. This ‘dash-board’ makes it easier by supporting the following functions:

- Transforming starting 12V pulse into a 12V started and active low (grounded) signals
- OK to Drive (e.g. from charge controller) as prerequisite to start and to remain in ‘started’. This can be an active low or an active high signal (different input connection!)
- Push brake pedal as a requirement to start (on top of ‘OK to drive’)
- Onboard door buzzer for signal when a door is being opened while the car is started
- Discharge enable signal (active low) when on suitable to drive a relay<sup>1</sup>.
- 12V BMS-on output when ignition on or external “ON” request
- Test plug for powering BMS and/or triggering charge or discharge enable
- Simple CAN-HUB (1x IN, 2x OUT via Molex 1x OUT via DB9) with optional termination
- DB9 for RS232 or second CAN-BUS
- Optional: Connection for external buzzer
- Optional: disable onboard buzzer
- Optional: Output 12V started back to ‘starting signal’
- Optional: Only sound door open buzzer when Forward or Reverse selected on supported switch (available as well)

## Extension: 12V battery guard

This extension is intended to turn the car on when the 12V battery voltage drops below 11,9V and allow the 12V battery to be charged from the high voltage battery for 10 minutes using the DC/DC converter. Some key points to make this work:

- Ensure the DC/DC is enabled and working when the BMS is woken up and “Discharge enable” is triggered
- Ensure the BMS safeguards the high voltage battery by ignoring the “Discharge enable” signal below a certain state of charge (SOC) to protect the high voltage battery from being drained by the DC/DC
- At initial power on the undervoltage monitor triggers even if the voltage is above 11,9V. But after that (after 10 minutes) it operates as described under the condition that it remains powered.

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<sup>1</sup> Due to the nature of the signal it might not work as an active low signal for an analog input since it remains low when signal is removed due to the absence of a pull-up resistor.

### How it works?

- Triggers when the 12V battery voltage drops below 11,9V
- Wakes up the BMS and triggers "Discharge enable signal (active low) when on"
- Minimum trigger duration is 10 minutes and after that is extended if needed if the 12V battery voltage still isn't above 12,5V

Only works when using "Discharge enable signal (active low) when on" for requesting the BMS to close contactors and not when you use 'started' for closing the HV contactors.

There also is a "12V guarded" output which is being powered as long as the 12V battery is sufficiently charged (>11,9V) but is being switched off when the guard kicks in. With this output (max 3A) you can typically power devices that potentially drain the 12V battery (for example internet connectivity devices).

### What if the battery guard kicks in and the user wants to drive or charge?

The guard is a 'parallel' "ON" condition so is comparable with turning the ignition on. So one can still also turn the ignition on and (of there is no charge plug present) start and drive off. For being able to charge when the guard has kicked in it is important that the 'charge enable' signal had a higher priority in the BMS than the 'discharge enable' signal. In that case the car will switch from discharge enable to charge enable.

Note: this "Discharge enable" still only is about waking up the BMS and closing the HV contactors and should not be used to enable the inverter. That should only be done when the car has successfully "started".

## Inputs

### Main input

Main input connector is a 14-way Molex Mini Fit Jr.

|    |    |    |    |    |   |   |
|----|----|----|----|----|---|---|
| 14 | 13 | 12 | 11 | 10 | 9 | 8 |
| 7  | 6  | 5  | 4  | 3  | 2 | 1 |



1. RS232 Ground
2. RS232 Rx or CAN 2 High
3. RS232 Tx or CAN 2 Low
4. Door open (active low)
5. OK to Drive (active low)
6. 12V forward selected
7. 12V reverse selected
8. Chassis ground
9. OK to Drive (active high 12V)
10. 12V always on
11. Ignition (12V)
12. External BMS-on and discharge enable request
13. Starting (12V)
14. Brake light (12V)

### Car CAN-BUS 1

The three two way Molex Mini Fit Jr. connectors at the side are for CAN-BUS. Either one can be used as the input connection

|   |       |
|---|-------|
| 2 | CAN H |
| 1 | CAN L |

## Test

For testing purposes there is a six way onboard Molex Minifir Jr. connector.

|   |   |   |
|---|---|---|
| 6 | 5 | 4 |
| 3 | 2 | 1 |



By bridging the pins you can turn the BMS on and optionally trigger discharge or charge enable.

|   |   |   |
|---|---|---|
| 6 | 4 | 4 |
| 3 | 2 | 1 |

BMS on

|   |   |   |
|---|---|---|
| 6 | 5 | 4 |
| 3 | 2 | 1 |

BMS on and discharge enable

|   |   |   |
|---|---|---|
| 6 | 5 | 4 |
| 3 | 2 | 1 |

BMS on and charge enable



This of course assumes you use the outputs 'BMS on', discharge enable and charge enable accordingly.

## Outputs

### Main output

The main output is a six way Molex Minifit Jr. connector.

|   |   |   |
|---|---|---|
| 6 | 5 | 4 |
| 3 | 2 | 1 |



1. Charge enable (active low)
2. 12V Guarded
3. Discharge enable (active low)
4. 12V when started (max 750 mA)
5. Started (active low)
6. 12V BMS-on

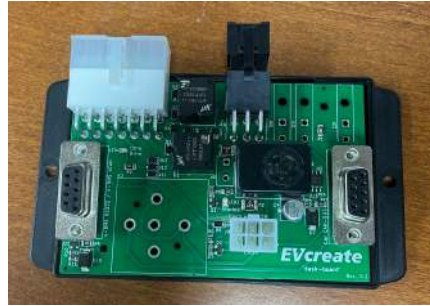
The "Charge enable (active low)" is only being triggered by the test plug. The regular 'charge enable' signal is expected to come from a charge controller.

The 'Discharge enable (active low)' signal might not work as an active low signal for an analog input since it may remain low when signal is removed due to the absence of a pull-up resistor. If the device you are connecting it to does not have a sufficient pull-up either, use it signal from the dash-board to drive a relay for a firm active low or float.

## DB9 connectors

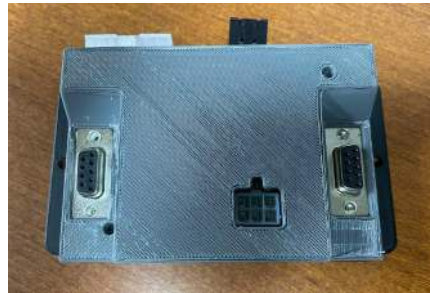
**Left**

5  
9  
4  
8  
3  
7  
2  
6  
1



**Right**

5  
9  
4  
8  
3  
7  
2  
6  
1



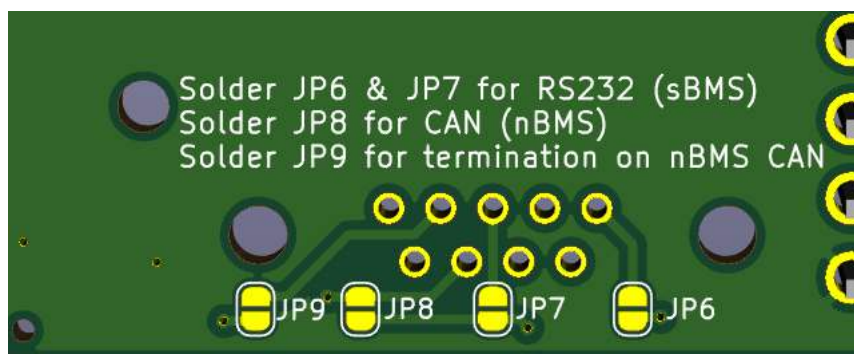
Right hand DB9 connector is for the CAN1 connection plus a power supply (12V+ and GND) for for example a CAN logging device such as the CANedge.

2 = CAN-L  
6 = GND  
7 = CAN-H  
9 = 12V+

The left hand side DB9 connector is a bit less straightforward and requires 'configuration' on the back side of the board.

It can be used either for RS232 communication (typically for Lithium Balance sBMS) or CAN-BUS 2 (typically Lithium Balance nBMS).

Furthermore you can optionally enable a termination resistor for CAN2 (only Rev 0.3 and higher).



So depending on how you solder the back end jumpers the DB9 pinout is:

### **As RS232 (sBMS)**

2 = RS232 TX  
3 = RS232 RX  
5 = RS232 Gnd

### **As CAN2 (nBMS)**

2 = CAN-L  
7 = CAN-H



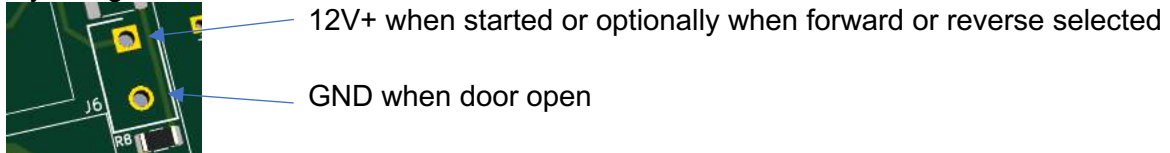
## LEDs on PCB

On the PCB there are two LEDs, one if it is 'OK to Drive' and another one for 'started'.



## External buzzer

Furthermore there is a provision for an external 12V buzzer. It is J6 and has room for a two way straight Molex connector.



It is an optional feature and thus not populated nor supplied.

## Configuration options

### JP1: Use supported gear selector as extra door buzzer requirement

By default the onboard 'started' signal is used to determine if the door buzzer should be enabled or not. However, in The Netherlands the requirement of the RDW is that an alarm should sound if a door is opened while a car would drive off if you hit the throttle.

But this is only the case if actually a forward or reverse gear is selected. If this is done electronically using the supported gear selector, the gear position can be used as an extra condition for sounding the buzzer.

If you use this selector and want to enable that option, cut JP1 on the back with a box cutter.



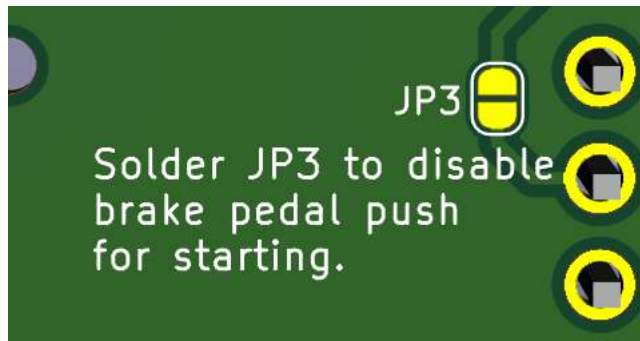
### JP2: CAN1 120 Ohm termination resistor

If the 'dash board' is the last device in the loop, solder JP2 to add a termination resistor.



### **JP3: Disable brake pedal push requirement for starting**

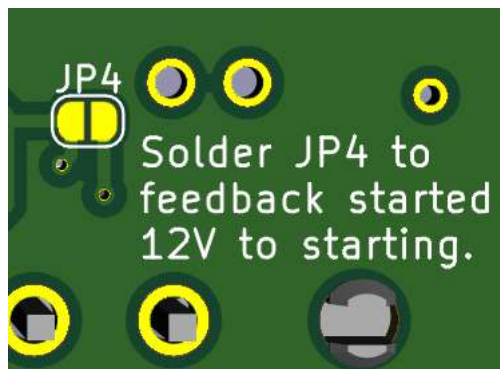
If you do not want the requirement for someone to push the brake to be able to start the car you can disable that feature by soldering JP3. In that case you also do not need to wire Main input 14 (brake light).



### **JP4: Feedback started to starting**

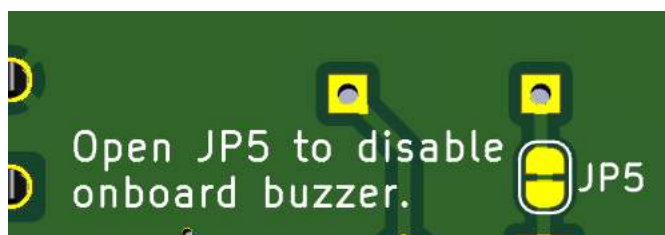
By default the 'starting' pulse often from the ignition is just a momentary pulse and the car does not require it to remain powered when the key is released.

If this is the case, you can solder JP4. Then the 'dash-board' will power Main input 13 (starting) with 12V as long as the car has started (so OK to Drive is in place).



### **JP5: Disabling the onboard buzzer**

If you do not want to use the onboard buzzer you can disable it by cutting JP5 with a bx cutter.



### **JP6 -9: Configure left hand side DB9, see above**