EVS Product Manual

EVS-BMS EVS-MCU EVS-VCU

Additional hardware required is required for CAN configuration software:

- **EVS-CAT CAN Adapter Tool** - required.
- **Torque Pro CAN Adapter** – optional. Required if communication with Torque Pro app is needed.
- All EVS products include connectors with terminals.

Introduction

In order to successfully install and operate the Engovis EVS products, knowledge of battery systems, automotive wiring and general computer systems is required. As the purchaser and installer of these products, the responsibility for correct installation and implementation lies with you.

User acknowledgement: I/we understand that EVS products are not intended to be plug-and-play systems, user system design, configuration and wiring are required.

Included in the manual is a comprehensive set of information and configuration data aimed at assisting you in becoming familiar with the configuration processes and supporting your successful implementation.

If anything is unclear in the manual or if you have any other feedback please contact us at sales@engovis.com

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Product Overview

The idea behind the EVS products is to enable the repurposing of OEM electric vehicle and hybrid components. The EVS products will not prevent you from harming yourself, your battery or other components if you do not set it up properly or ignore the limits it sends out.

Use Cases

- Running Outlander RDU (Rear Drive Unit) and inverter.
- Reusing supported OEM battery modules in electric vehicle builds.
- Reusing supported OEM battery packs or modules in stationary storage applications.

Some of the use cases are shown at a high level in EVS Example Installations

High Level Features

- Controlling 12 V contactors, economised or un-economised
- Two configurable CAN busses
- OBD2 interface - compatibility with apps including Torque Pro
- Configuration over CAN bus using dedicated adapter and software
- Safety/HVIL loop monitoring
- Temperature controlled output

Supported OEM Batteries

The EVS-VCU and EVS-BMS are fully compatible, including balancing, with the following OEM batteries. Details on limitations due to OEM firmware limits will be published in the user manual.

1. VW E-Golf
2. VW GTE
3. VW ID3 and ID4 (MEB) 12S and 8S modules
4. BMW Hybrid - gen 1 (9 kWh) and gen 2 (12 kWh)
5. BMW i3
6. Mitsubishi Outlander
7. Chevy Volt - gen 1
8. Tesla Model S/X (*Requires the EVS-VCU or EVS-BMS with Tesla Serial Option*)

EVS Product Functional Overview

Table of basic functions highlighting the differences between the three products.

Functions	VCU	MCU	BMS
Controlling Outlander PHEV Rear Drive Unit	Yes	Yes	No
Controlling Outlander PHEV Charger/DCDC	Yes*	No	Yes*
Controlling CAN bus chargers	Yes**	No	Yes**
Controlling contactors	Yes	Yes	Yes
Controlling Drivetrain Cooling Relay	Yes	Yes	No
Controlling Battery Cooling Relay	No	No	Yes
HVIL Monitoring	Yes	Yes	Yes
Monitoring CAN bus BMS Slaves	Yes	No	Yes
Monitoring third party BMS on CAN bus	Yes	Yes	No
Monitor CAN bus current/voltage sensor	Yes	No	Yes
Monitoring analog current sensor	No	No	No
Controlling brake lights, pedal and regen	Yes	Yes	No
ODB2 Communication	Yes	Yes	Yes
CAN Configurable	Yes	Yes	Yes
Controlling HV cabin HVAC	No	No	No

* Requires EVS-CPI
** May require EVS-CPI

See chapter on interfacing to a charge port for details

Getting Started

In order to get the most out of your EVS product read this manual thoroughly and follow its recommendations. The best starting point is to work out which devices are connected together and then use this manual to determine the impact on the wiring and parameter settings.

Before starting to wire it is best to draw up a wiring overview to refer to when doing the wiring, this will greatly simplify troubleshooting and tech support.

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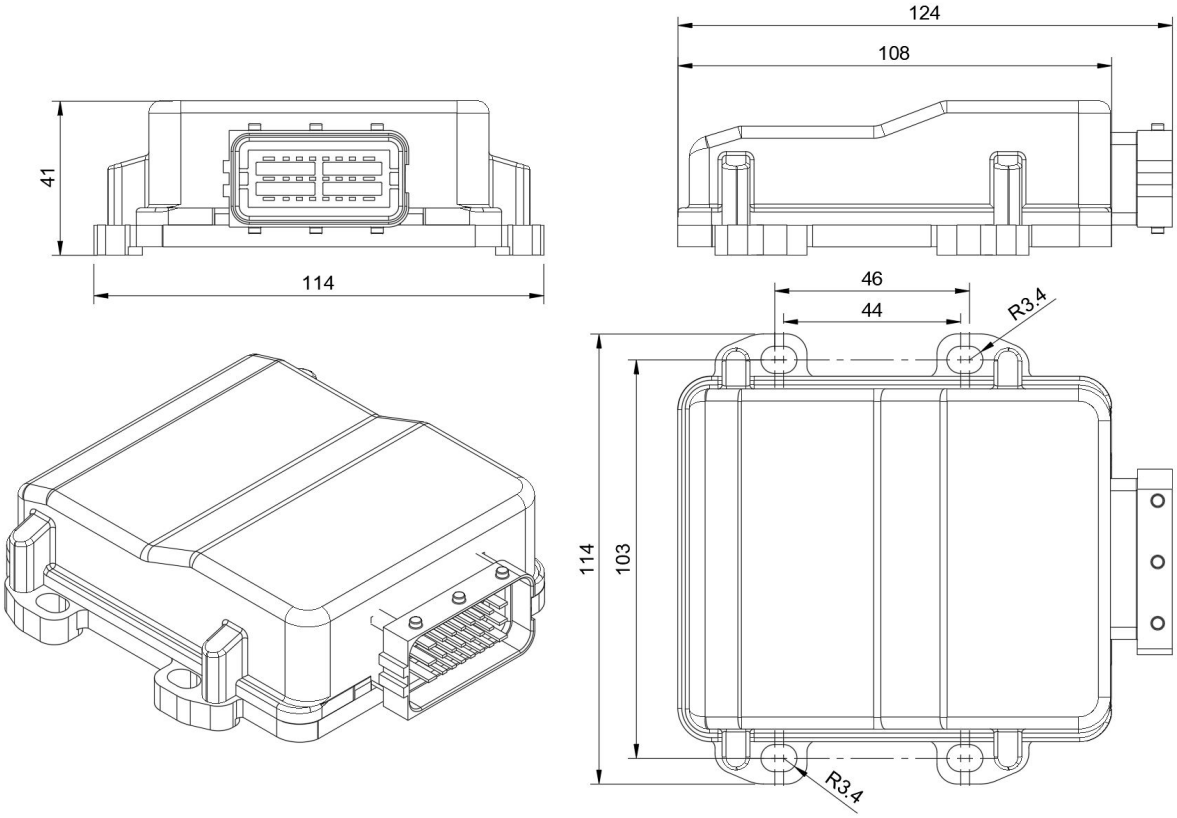
Mechanical Installation Information

The EVS products are in an aluminium enclosure rated at IP66 when the connector is installed and populated. This means that the EVS products can be mounted in the “engine bay” or underside of vehicles. With the one limitation of not intended to be submerged for any period of time.
Ensure the ambient temperature does not exceed 65C near the ecu as this can cause over temperature shutdowns and intermittent behaviour.

Mounting

The EVS products can be mounted in any orientation. It is recommended to use 4x M6 fasteners to secure the enclosure.



Opening the Enclosure

Opening the ECU is not recommended practice, it may be necessary to achieve the following:

- Fitting or removing CAN bus termination jumpers
- Updating Firmware
- Fitting Option boards
- Troubleshooting
- Direct Serial Menu interface

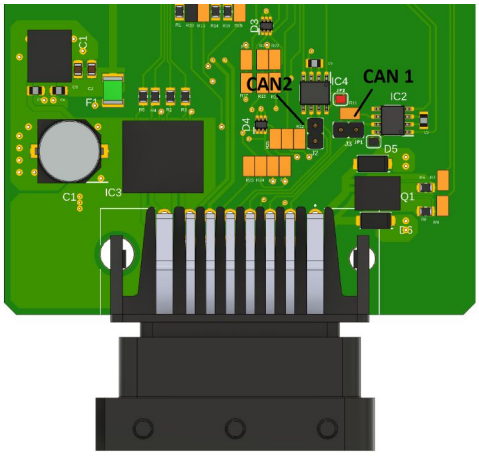
Opening Procedure:

1. Remove the ECU from the vehicle, disconnect connector and remove fixings
2. The ECU can be opened by removing the 4 fixings holding on the top half of the enclosure. The PCB and connector stay with the top half.
3. Remove the white seal that sits in the grove and across the connector, care must be taken not to damage it.
4. Carefully lift the connector upward to raise the PCB out the top half, making sure the PCB lifts up at the back two locating posts.
5. Remove PCB fully from the enclosure.

Note: when removed from enclosure the PCB is fragile and should be treated with care. Take care not to short out any pins on the bottom or top of the PCB this can cause irreversible damage.

To install back into the enclosure follow the steps in reverse. Take care not to force or place excessive force on the PCB.

Can Termination Jumpers



Jumper terminals for CAN bus, left is CAN2 jumper for terminator and right is CAN1.

Use Case Guidance

The EVS products can be used in a variety of ways, this section covers possibilities and advice on how to set up your EVS product and system.

Vehicle Versus Stationary Application

The key differences are driven by whether there is a drive system involved, EVS-VCU, EVS-MCU or 3rd party. If so these setups usually fall under the “Vehicle” application, key differences between a “Vehicle” application vs “Stationary” application:

- Driving and Charger Control do not happen at the same time
- Driving is not allowed when Charging

In order to meet these requirements the EVS-VCU and EVS-MCU require a charge port signal, parameter ChargePortType, this can be a simple 12 V inhibit/plug present signal or a CAN bus based inhibit from a dedicated charge port controller (EVS products coming soon).

The situation where charging and discharging can happen at the same time by an external system the “Stationary” application usually is the better approach. By setting the parameter ChargePortType to unused the EVS-BMS or EVS-VCU will operate in one state that allows charging and discharging.

If there is a third party high level controller involved that controls the vehicle motion/drivetrain then running in the “Stationary” application is also recommended.

Integration with other devices

The EVS-Products have been designed to be highly integrated with other devices utilising the CAN bus connections, see chapter on can bus devices. There are situations where a lower level integration is required the options for these are listed below:

EVS-VCU / EVS-MCU

Charge Port - 12 V input to inhibit drive
HV Awake - 12 V output to enable other HV supplied devices
Motor Cooling Request - 12 V output to control a coolant fan

EVS-BMS

HV wake up/Enable - 12 V input to request closing of contactors
Discharge Ok - 12 V output to allow drawing power from the battery
Charge Ok - 12 V output to allow charging of the battery
Battery Cooling Request - 12 V output to control a coolant fan

Interfacing to a Charge Port Type 2 or Type 1

There are many options when it comes to connecting the EVS-MCU or EVS-BMS or EVS-VCU to a charge port.

Detailed information on EVS-CPC (Charge Port Control) and EVS–CPI (Charge Port Interface): EVS Products - Charging Control

The EVS-MCU only requires a 12V signal to inhibit from going into drive when something is plugged in. This can easily be achieved with an EVS-CPI, charge port interface.

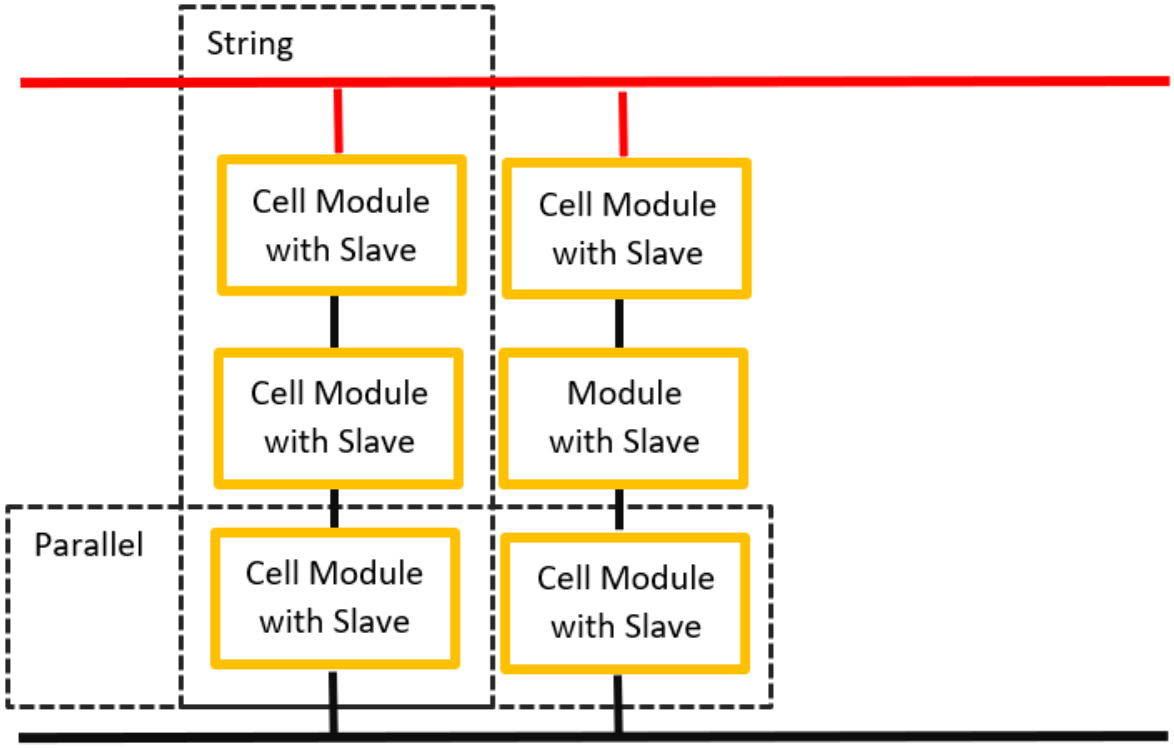
When the EVS-BMS or EVS-VCU needs to control the charger based on the charge port control pilot signal it is required to utilise the EVS-CPC, charge port controller.

Background information

Battery Physical Configuration

When reusing existing vehicle battery modules might not be possible to parallel them at cell level.
The approach that thus can be taken is to wire all the modules in series and then parallel the strings to create the complete pack. Each string of modules needs to be fused separately.
Values to determine for your setup:

- Battery Capacity – Capacity of parallel cells monitored by each BMS Slave
- Strings in parallel – How many battery strings are connected in parallel
- Cells in Series – total amount of cells that are in series in a string



Cell Balancing

This only applies to EVS-VCU or EVS-BMS, all supported batteries have passive balancing capabilities. The goal is to reduce the cell voltage gap, between the highest and lowest, this is done above the balanceVoltage until the cell voltage gap is below the set balanceHyst.

Wiring Information

Before starting on wiring your EVS product you need to get an understanding of the major components in your setup.

Ask yourself the following questions:

1. Which EVS product do I need
2. Will the EVS products control the Contactors
3. What other inputs and outputs are going to be used
4. What devices are to be connected to the CAN bus network
5. Which test do I need to run before connecting the High Voltage/High Current connections

Wiring up Chargers

- EVS-VCU and EVS-BMS can control chargers over CAN bus on bus 2.
- EVS-BMS can also control a charger with simple on/off control with a 12 V signal
- The EVS-VCU and EVS-BMS need to close the contactors or not be in control of the contactors for them to allow control of the charger.
- It is recommended chargers are not directly connected to the battery modules.

Please refer to the charger documentation when wiring them up to the EVS products.

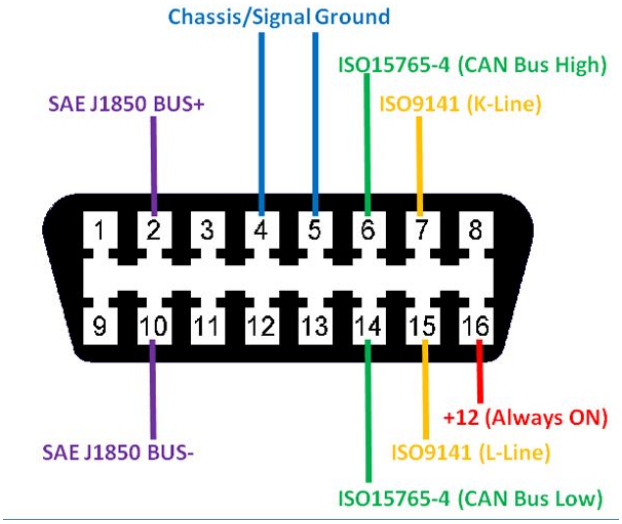
CAN Bus

- The EVS products can communicate on two separate CAN buses. In order for the CAN bus networks to work properly each bus needs its own pair of termination resistors.
- The EVS products provide an internal jumper to enable the bus termination resistor.
- The wires used for the CAN bus need to be twisted together to ensure signal integrity.
- For further details on compatible CAN bus devices see the rest of the information in this document.

OBD2 port and adapter wiring

In order to utilise an OBD2 port adapter you will need to wire the OBD2 port as follows

Signal	Pin OBD2	EVS connection
12 V supply	16	None
Ground	4 and 5	None
CAN Low	14	A5
CAN High	6	A4



Outputs and Inputs

Inputs

The EVS products are designed to operate in a 12 V automotive environment. All inputs have reverse voltage and overvoltage protection, these are meant to protect the device however should not be relied on in normal operation.
The digital inputs are rated for 12 V
The analogue inputs are rated for 0 to 5V, use the provided 5V supply on the connector.

Outputs

5 V supply is limited to 500 mA, it is meant to be used to supply the cell monitoring circuits or pedal position sensors.

12 V outputs are current limited to 1.5 A continuous, 10 A inrush. These inputs are self resetting and have a floating output detection. This means they will measure high when not connected to a load, when testing use a 12 V bulb to verify output state, LEDs will glow dimly due to this so are not very reliable.

Low side outputs have a flyback diode incorporated to allow PWM control of a coil, more information provided in the following chapter about contactors.

Power Supply

The EVS products are designed to operate in a 12 V automotive environment, it can take a voltage surge on its power input, this however should not be relied on for continuous operation. The nominal supply voltage should be 12V.

The EVS products are designed to work on an ignition feed, they do not automatically go into a low powerstate so should be switched off when the system is not in use.
The input should be fused at 10 A, depending on connected outputs the fuse rating may need to be increased to 15 A.

Contactors

Wiring contactors into EVS-BMS or Not
Depending on your setup you can decide to have the contactors controlled by the EVS-BMS or by the Inverter/Drive unit.

Keep in mind:

1. Tripping contactors with rotating motors has a high possibility of damaging the inverter
2. The EVS-BMS is meant to protect the batteries and not other items
3. Wiring items directly to the battery can cause drain that can irreversibly damage the batteries.

It is recommended that your motor controller/inverter controls the contactors. The EVS-BMS should be used to enable and disable the inverter based on the battery parameters and errors.

Control

It is possible to use both contactors with built in economizers or without.
The main positive and negative contactor can be controlled in the following ways:

1. On/Off , used with contactors with built in economizers
2. PWM, used with contactors without built in economizers
3. Not used, if the EVS products does not control the contactors

Selecting the type of contactor used is done with the parameter ContHold.

The configuration for PWM control are to be done based on information from the manufacturer and fine tuned if required.

PullTime - Ms of time the contactor gets driven “On” before PWM starts, default value is 2000ms.

ContHold- PWM percentage of “On” for holding contactor closed, a recommended starting value is 50 if no information can be obtained about the contactor used.

Precharging

Precharging is controlled by the EVS product by switching the contactors in the following sequence:

1. Main Negative contactor on
2. Precharge contactor on
3. Main Positive contactor on
4. Precharge contactor off

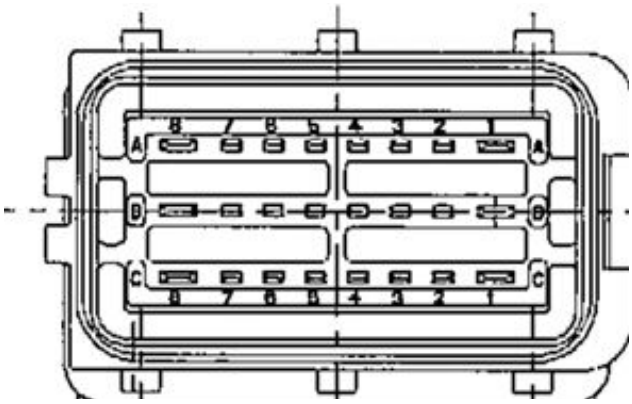
Note the naming of the contactors does not have to denote their position in the circuit. The key takeaway is that the precharge contactor is to be used across the main positive contactor.

Precharging can be controlled in the following ways:

1. Time based with a 5 second delay
2. Time and Current based with a 5 second delay and the measure current needs to be below a configurable threshold, parameter PreCurrent
3. Voltage measurements based, using the measured voltage to track precharging

Selecting the type of precharge is done via parameters ContType.

Pinout Information



Font of Enclosure Connector View

Pin	Pin	EVS-VCU	EVS-MCU	EVS-BMS
1	A1	Low side HV Positive Contactor*	Low side HV Positive Contactor*	Low side HV Positive Contactor*
2	A2	Can H 1	Can H 1	Can H 1
3	A3	Can L 1	Can L 1	Can L 1
4	A4	Can H 2	Can H 2	Can H 2
5	A5	Can L 2	Can L 2	Can L 2
6	A6	Tesla BMS TX	Unused	Tesla BMS TX
7	A7	HV Alive signal / Drive Ready 12 V Out	HV Alive signal / Drive Ready 12 V Out	HV Alive signal / Discharge OK 12 V Out
8	A8	Motor Cooling Output 12 V	Motor Cooling Output 12 V	Battery Cooling Output 12 V
9	B1	Low side HV Positive Contactor*	Low side HV Positive Contactor*	Low side HV Positive Contactor*
10	B2	Start Switch input 12 V	Start Switch input 12 V	Enable Input 12 V
11	B3	Safety Loop in/HVIL 12 V In	Safety Loop in/HVIL 12 V In	Safety Loop in/HVIL 12 V In
12	B4	Drive Mode Input 12 V	Drive Mode Input 12 V	Unused
13	B5	Drive Inhibit Input 12 V	Drive Inhibit Input 12 V	Unused
14	B6	Tesla BMS RX	Unused	Tesla BMS RX
15	B7	Brake Light Output 12 V	Brake Light Output 12 V	HV Alive signal / Charge Ok 12 V
16	B8	High side Precharge Contactor	High side Precharge Contactor	High side Precharge Contactor
17	C1	12 V System Ground	12 V System Ground	12 V System Ground
18	C2	Forward Switch input 12 V	Forward Switch input 12 V	Unused
19	C3	Reverse Switch input 12 V	Reverse Switch input 12 V	Unused
20	C4	5V Throttle Signal 1	5V Throttle Signal 1	Unused
21	C5	5V Throttle Signal 2	5V Throttle Signal 2	Unused
22	C6	5V Brake input OR 12 V brake switch in	5V Brake input OR 12 V brake switch in	Unused
23	C7	BMS Slave Supply & Throttle & Brake	Throttle Signal and Brake	BMS Slave Supply
24	C8	Fused 12 V Input	Fused 12 V Input	Fused 12 V Input

A1-Low side HV Positive Contactor

Output that pulls to ground to control a contactor, see chapter on Contactors for details

B1-Low side HV Positive Contactor

Output that pulls to ground to control a contactor, see chapter on Contactors for details

B8-High side Precharge Contactor

Output the provide 12 V for controlling the precharge contactor, see chapter on Contactors for details

A2-Can H 1 & A3-Can L 1

CAN bus pair, high and low, for CAN bus 1 primary battery CAN bus, see chapter CAN Bus Devices for more information.

A4-Can H 2 & A5-Can L 2

CAN bus pair, high and low, for CAN bus 2, see chapter Can Bus Devices for more information.

A6-Tesla BMS TX & B6-Tesla BMS RX (Optional)

Option configurable pins, if fitted with the Tesla Serial option used for communication with the Tesla S/X slave modules, see chapter for wiring Tesla Model S and X Slaves

A7-HV alive signal / Drive Ready /Discharge Ok

12 V Output that goes high when contactors have successfully closed.
EVS-BMS : Used to control battery discharging
EVS-VCU and EVS-MCU : to indicate ready to start drive and HV discharge allowed

A8-Motor Cooling / Battery Cooling

12 V Output that goes high when temperatures exceed set parameter
EVS-BMS : Looks at battery modules temperature
EVS-VCU and EVS-MCU : looks at inverter and motor temperature

B2- Start Switch/Enable

12 V Input
EVS-BMS : If configured used to request enabling of contactors
EVS-VCU and EVS-MCU : Enable throttle control of drive only accepted after HV contactors have closed

B3-Safety Loop in/HVIL 12 V In

12 V Input, if configured 12 V is always required to be present for the system to function, if this goes away the system will shutdown. Designed to be used as HVIL monitoring and/or crash sensor input.

B4-Drive Mode Input 12 V

12 V Input, high level input selects second set of drive torque parameters
EVS-VCU and EVS-MCU Only

B5-Drive Inhibit/Plug present

12 V Input, high level input enters the device into charging mode and disables drive

B7-Brake Light Output/Charging Ok

12 V Output
EVS-BMS : Outputs 12 V when Charging of the battery is allowed
EVS-VCU and EVS-MCU : Outputs 12 V when brake pedal is pressed and when regen threshold is exceeded for turn on, see parameter BrkOnTrq. Use this to control a relay to drive the brake lights

C1-12 V System Ground

12 V ground, this is the ground point to which all measured signals are references, ensure this is a clean ground. Size appropriately to be able to carry the Contactor control currents, wire size of at least 1.0mm2 recommended.

C2-Forward Switch input

12 V Input, high level input will put drive into forward state only when drive has been started
EVS-VCU and EVS-MCU Only

C3-Reverse Switch input

12 V Input, high level input will put drive into forward state only when drive has been started
EVS-VCU and EVS-MCU Only

C4-5V Throttle Signal 1 & C5-5V Throttle Signal 2

0-5V Input, to be connected to a two signal throttle. Signals can be the same, scaled or inverted. Checks are carried out to ensure no mismatch occurs.
EVS-VCU and EVS-MCU Only

C6-5 V Brake input OR 12 V brake switch in

0-5 V input is currently not implemented
12 V input, Needs to be 12 V high when brake pedal is depressed. This is used to control regen

and the brake light activation.
EVS-VCU and EVS-MCU Only

C7-5 V Supply BMS Slave Supply AND Throttle and Brake

5 V Supply limited to 500 mA, designed to supply the throttle sensor and to provide power to the isolated side of certain BMS cell monitoring circuits/slaves.

C8-Fused 12 V Input

12 V Power Input to the ECU, input to be fused at 10-15 A and wire to be at least 1.0 mm^2. This only needs to be supplied with 12V when the system should function. In a vehicle application this should be “ignition” and charging power.

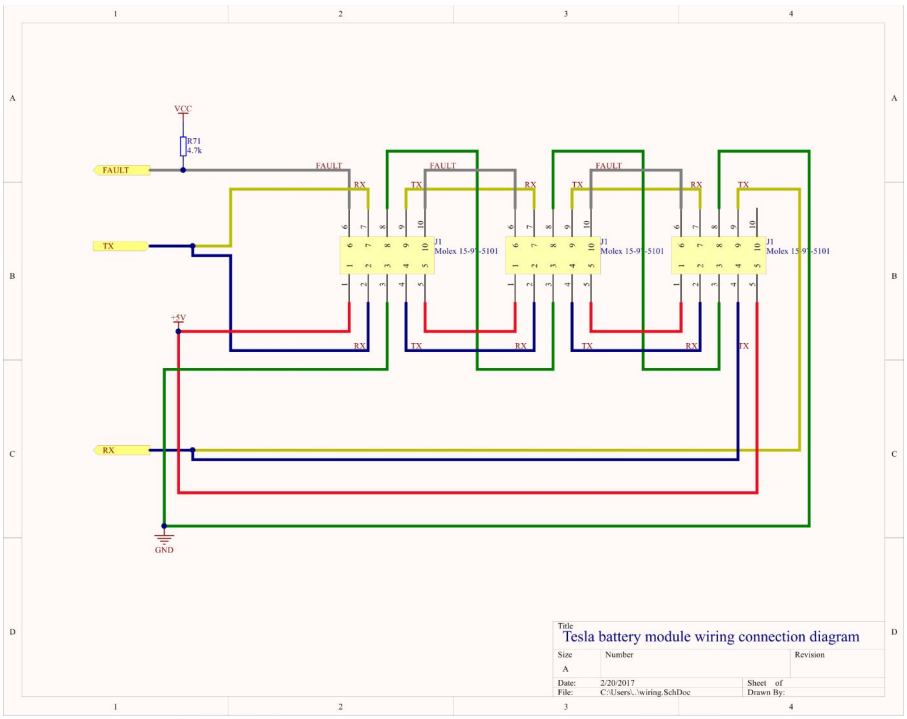
Tesla Model S and X slave modules

Supply: 5 V+
Communication Pins: TX and RX Serial

In order to use the Tesla Model S and X slaves with the EVS-VCU or EVS-BMS the Tesla Serial option must be fitted to the product.

The wiring style utilised is a daisy chain approach, where the EVS-VCU or EVS-BMS TX connects to the first modules RX, the first module has its TX connected to the second modules RX and the second modules TX is connected to the following modules RX and so on. The final modules RX is connected back to the EVS-VCU or EVS-BMS

The Fault signal is unused as the faults are monitored over the serial bus.



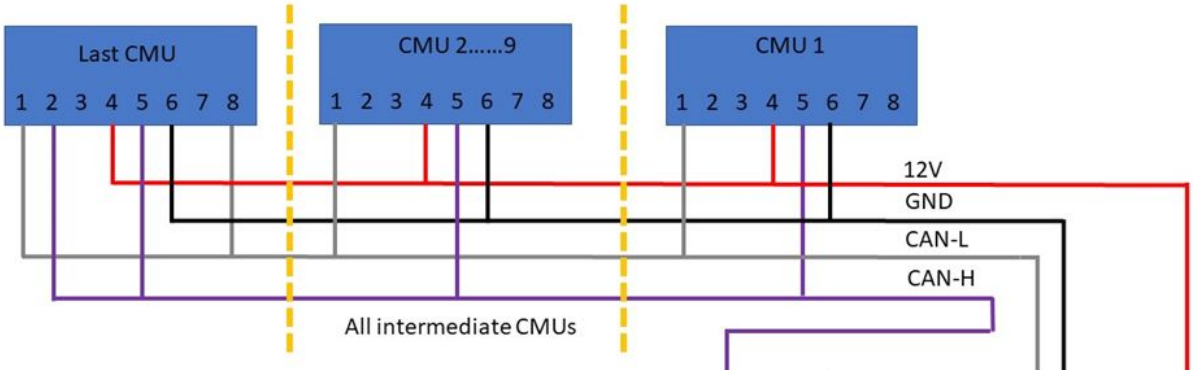
Source: https://hackaday.io/project/10098-model-s-bms-hacking

Signal	EVS connector	Slave Connection
Supply +5V	C7	Pin 1 First Module, Pin 5 Last Module
Ground	C1	Pin 3 First Module, Pin 8 Last Module
ECU TX	A6	Pin 2 or 7 First Module
ECU RX	B6	Pin 4 or 9 First Module

Mitsubishi Outlander CMUs

Supply: 12 V+
Communication Pins: CAN Bus

The EVS-VCU or EVS-BMS replaces the OEM battery master. The wiring for the slaves is of a branched method, all the slaves are wired the same branched off from the wiring from the EVS-VCU or EVS-BMS



Signal	Pin CMU	EVS connection
12 V supply	4	
Ground	10	C1
Can Low	1	Bus 1 A3 Bus 2 A5
CAN High	5	Bus 1 A2 Bus 2 A4
CAN Bus Termination Resistor	2	

The Firmware in the CMUs limits the use of only one pack worth of CMUs to be able to work on one CAN bus. You must also ensure that no CMUs with the same CAN bus ids are used on one network. The easiest way to achieve this is to use all the modules out of one functioning battery pack.

BMW i3 CSC modules

Supply: 5V+
Communication Pins: CAN Bus
Designed to be Daisy chained from one module to the next, each signal has two pins on the CSC connector. Remember to close the end CAN bus by having a 120 ohm resistor between canH and canL.

Signal	Colour	BMW i3 Pin	EVS connection

5 V supply	Grey/Red	1	C7
Ground	Black/Purple	6	C1
CAN Low	White Yellow	4	Bus 1 A3 Bus 2 A5
CAN High	Light Blue/Yellow	5	Bus 1 A2 Bus 2 A4

If using more then one module the daisychain connection is as follows:

Function	**First BMW i3 Pin**	**Next BMW i3**
5V supply	7	1
Ground	12	6
CAN Low	10	4
CAN High	11	5

If you use the full pack you can interface to the “Master” connector

Signal	Master plug pin	Colour	EVS Connection
5 V supply	5 + 11	Red/White	C7
Ground	6 + 12	White/Brown	C1
CAN low	8	Yellow/Brown	Bus 1 A3 Bus 2 A5
CAN high	7	Yellow/Red	Bus 1 A2 Bus 2 A4
Resistor 120 Ω	1 + 2	Yellow/Brown and Yellow/Red	120 Resistor between

	BMW i3 CSC Connector					
Function	5V Power		?	CanL	CanH	GND
Wire	Red/White	NC	Blue	Yellow/Brown	Yellow/Red	White/Brown
Pin	1	2	3	4	5	6
Pin	7	8	9	10	11	12
Wire	Red/White	NC	Blue	Yellow/Brown	Yellow/Red	White/Brown
Function	5 V Power		?	CanL	CanH	GND

The Firmware in the CSCs limits the use of only one pack worth of CSCs to be able to work on one CAN bus. You must also ensure that no CSCs with the same CAN bus ids are used on one network. The easiest way to achieve this is to use all the modules out of one functioning battery pack.

BMW Phev Gen1/Gen2

Supply: 5V+
Communication Pins: CAN Bus

Gen 1 is designed to be Daisy chained from one module to the next, each signal has two pins on the CSC connector. Remember to close the end CAN bus by having a 120 ohm resistor between canH and canL.

Gen 2 only has the CAN bus connection to the master CSC

Signal	BMW CSC Pin	EVS connection
5V supply	1	C7
Ground	6	C1
Can Low	4	Bus 1 A3 Bus 2 A5
Can High	5	Bus 1 A2 Bus 2 A4

If using more then one module the daisychain connection is as follows:

Function	First BMW CSC Pin	Next BMW CSC
5V supply	7	1
Ground	12	6
CAN Low	10	4
CAN High	11	5

If you use the full pack you can interface to the “Master” connector

Signal	Master plug pin	Colour	EVS connection
5 V supply	5 + 11	Red/white	C7
Ground	6 + 12	White/Brown	C1
CAN low	7 + 1	Yellow/Brown	Bus 1 A3 Bus 2 A5
CAN high	8 + 2	Yellow/Red	Bus 1 A2 Bus 2 A4

The Firmware in the CSCs limits the use of only one pack worth of CSCs to be able to work on one CAN bus. You must also ensure that no CSCs with the same CAN bus ids are used on one

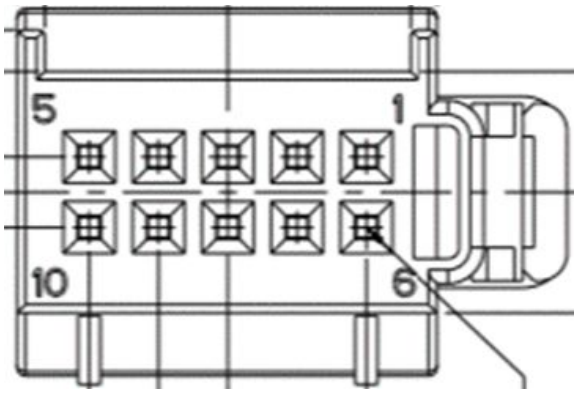
network. The easiest way to achieve this is to use all the modules out of one functioning battery pack.

VW GTE or Egolf

Supply: 12 V+
Communication Pins: CAN Bus

Designed to be Daisy chained from one module to the next, each signal has two pins on the CSC connector. Remember to close the end CAN bus by having a 120 ohm resistor between canH and canL.

Signal	VW CSC Pin	EVS connection
12 V supply	5	C8
12 V Enable	3	C8
Ground	1	C1
CAN Low	6	Bus 1 A3 Bus 2 A5
CAN High	7	Bus 1 A2 Bus 2 A4



If using more then one module the daisychain connection is as follows:

Signal	First CSC Pin	Next CSC Pin
12 V Supply	10	5
12 V Enable	4	3
Ground	2	1
CAN Low	9	6
CAN High	8	7

The Firmware in the CSCs limits the use of only one pack worth of CSCs to be able to work on one CAN bus. You must also ensure that no CSCs with the same CAN bus ids are used on one network. The easiest way to achieve this is to use all the modules out of one functioning battery pack.

VW MEB (ID.3/ID.4)

- Supply: 12 V+
- Communication Pins: CAN Bus

Designed to be Daisy chained from one module to the next, each signal has two pins on the CSC connector. Remember to close the end CAN bus by having a 120 ohm resistor between canH and canL. Connectors cannot be obtained so must be salvaged from the battery pack.

Signal	VW CSC Pin	EVS connection
12 V supply	11	C8
Ground	1	C1
CAN Low	9	Bus 1 A3 Bus 2 A5
CAN High	7	Bus 1 A2 Bus 2 A4

If using more then one module the daisychain connection is as follows:

Signal	First CSC Pin	Next CSC Pin
12 V supply	12	11
Ground	2	1
CAN Low	10	9
CAN High	8	7

Each slave also has a termination resistor that can be enable by connecting pin 4 to pin 6 on the same connector.

The Firmware in the CSCs limits the use of only one pack worth of CSCs to be able to work on one CAN bus. You must also ensure that no CSCs with the same CAN bus ids are used on one network. The easiest way to achieve this is to use all the modules out of one functioning battery pack.

Chevy Volt Gen1 Slaves

Supply: 5V+
Communication Pins: CAN Bus

The EVS-VCU or EVS-BMS replaces the OEM battery master, located in front of the Chevy Volt Gen 1 pack is connected to the internal network with the slaves.

Connector looks as below:

Signal	Pin Master Connector	Colour	EVS connection
5V supply	9	Grey/Red	C7
Ground	10	Black/Purple	C1
CAN Low	11	White Yellow	Bus 1 A3 Bus 2 A5
CAN High	12	Light Blue/Yellow	Bus 1 A2 Bus 2 A4

The Firmware in the CMUs limits the use of only one pack worth of CMUs to be able to work on one CAN bus. You must also ensure that no CMUs with the same CAN bus ids are used on one network. The easiest way to achieve this is to use all the modules out of one functioning battery pack.

CAN bus Current Sensors

Lem CAB300/CAB500

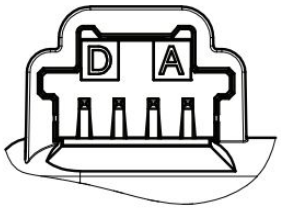
CAB300/CAB500 pinout

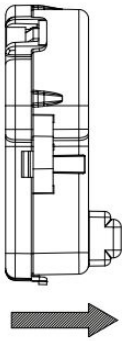
Mounting recommendation

- Connector type Tyco-AMP P/N: 1 473672-1

Connection

Pin Out	
A	CAN-L
B	CAN-H
C	GND
D	U_C





I_p (positive primary current direction)

Datasheets

https://www.lem.com/sites/default/files/products_datasheets/cab_300-c_sp3.pdf
https://www.lem.com/sites/default/files/products_datasheets/cab_500-c_sp5_public_datasheet.pdf

Application notes

The EVS products look for the following CAN bus IDs for CAB300/CAB500 sensors:
0x3C0
0x3C1
0x3C2

ISA IVT-S

You can use the version with or without Voltage measurement

IVT-S Pinout

6.2. Pin configuration / Power Supply and CANbus

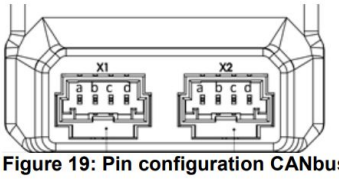


Figure 19: Pin configuration CANbus and power supply

Connector	Function	Pin	Description	Mating Plug
X1 and X2*	Power IN CANbus	a	Vcc	PIN 4
		b	CAN L	PIN 3
		c	CAN H	PIN 2
		d	GND	PIN 1

Note:

- There is no short circuit protection of the GND Line. In case of wrong wiring the sensor can possibly be destroyed!
- X2 a duplicate from X1. Only use for connect through a second sensor

6.3. Pin configuration / Voltage measurement

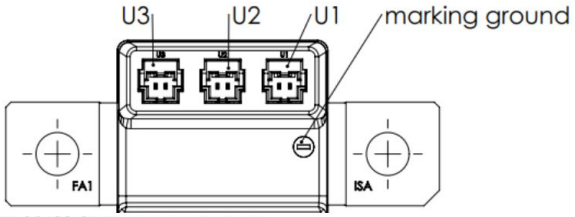


Figure 20: Voltage measurement

Connector	Function	Pin	Description
U1	Voltage Measurement 1	Both	U1 module (Both pins internally shorted)
U2	Voltage Measurement 2	Both	U2 module (Both pins internally shorted)
U3	Voltage Measurement 3	Both	U3 module (Both pins internally shorted)

Note: The high voltage pin reference to module ground

Datasheet

https://www.isabellenhuetteusa.com/wp-content/uploads/2022/07/Datasheet-IVT-S-V1.03.pdf

Application notes

The EVS products look for the standard configuration of CAN bus IDs:
0x521 - Current
0x522 - Pack Voltage
0x523 - HV Bus Voltage

Victron Lynx CAN Shunt

Fixed at 250kbps CAN bus speed.

Datasheets

https://www.victronenergy.com/dc-distribution-systems/lynx-shunt-ve-can

BMW Hybrid S-Box

Only recommended for use with BMW Hybrid packs and required modifications that are not part of this document. If you want to reuse a BMW Hybrid pack S-Box please get in touch to discuss your project.

CAN Bus Devices

OEM Battery Modules

All the OEM battery modules that communicate over CAN bus are limited by the following in their OEM firmware:

1. Fixed CAN bus speed - all devices on the bus need to be the same speed
2. Fixed CAN bus Ids - cannot have more than a full pack on one bus and needs to be unique per connected device

The EVS-BMS allows the use of two buses to monitor batteries, this means you can have upto two full packs connected. The EVS-BMS will then be able to communicate with the EVS-MCU as a 3rd party BMS. Currently not all CAN bus protocols have been compared to determine if there will be any issues running certain modules with certain chargers/inverters on the same CAN bus.

The EVS-VCU only allows battery modules connected to bus 1

The EVS-MCU does not work with any battery modules and requires a dedicated BMS

Battery Modules	CAN Bus Speed	CAN Bus Used**
VW E-Golf	500	1 (2)
VW GTE	500	1 (2)
VW ID3/ID4 (MEB)	500	1 (2)
BMW Hybrid (gen1 &2)	500	1 (2)
BMW i3	500	1 (2)
Mitsubishi Outlander	500	1 (2)
Chevy Volt Gen 1	125	1 (2)

Current and Voltage Sensors

In order to properly utilise all functionality of the EVS-BMS and EVS-VCU a current sensor is required on the CAN bus.

Current Sensor	CAN Bus Speed	CAN Bus Used**
BMW Hybrid S-Box	500	1 or 2
CAB300/CAB500	500	1 or 2
ISA IVT-S	125/250/500	1 or 2
Victron Lynx CAN Shunt	250	1 or 2

EV Onboard Chargers

The following chargers can be controlled utilising an EVS-BMS or EVS-VCU. The configuration of the CAN bus on the chargers needs to be stock. The EVS-BMS and EVS-VCU only support outputting a command for one charger at a time.

EV Onboard Chargers	**CAN Bus Speed**	**CAN Bus Used****
Elcon/TC Charger	250/500	2
Outlander PHEV	500	2
Eltek	500	2
Brusa NLG5	500	2
Chevy Volt Charger	500	2
Coda Charger	500	2

Protocols for Storage applications

The following protocols are supported by the EVS-BMS and EVS-VCU.
The Victron GX format is utilised as a standard battery information broadcast by default, this format is supported by many low voltage (<48 V) equipment.

Stationary Storage systems	**CAN Bus Speed**	**CAN Bus Used****
GoodWe HV	250	2
Victron GX*	250/500	2
Simulation Battery Protocol		
PylonTech***	Configurable	2

*** *functionality to be verified*

Adapters

In order to configure or display information on another device the following two devices are supported. For detailed information see the chapters on OBD2 communication and Configuration Software.

Other Devices	**CAN Bus Speed**	**CAN Bus Used****
OBD2 Connection	250/500	2
EVS-CAT	250/500	2

EVS Charge Ports

In order to provide more integration between the various EVS products the following charge port ECUs are supported.

Charge Ports	CAN Bus Speed	CAN Bus Used**
EVS-ChargePortController	250/500	2
EVS-CCS CCU	250/500	2

3rd Part BMS

Any BMS that can have its CAN bus structure configured to the Victron protocol is supported by the EVS-MCU on CAN bus 1 at any speed.

CAN Bus DBC Files

CAN bus files can be provided to interface to the EVS products, please contact us for more information.

No DBC files will be provided for any of the items the EVS products interface to.

First Time Setup and Testing

Recommendation prior to the start of testing:

- All 12 V wiring should be complete,
- Verify all pinouts as correct before providing applicable EVS product(s) with power.

Which functions should be tested and order of testing will depend on the EVS product(s) you are commissioning and your system layout.

Further recommendations:

- Test one function at a time, achieving the correct functionality before moving to the next function.
- Verification should be done via the EVS-CAT CAN Adapter Tool.
  (This is also possible via the Direct Serial menus but not recommended).
- The contactors must be disconnected from the HV bus until certain steps are completed.
- The contactors must be disconnected from the ECU until certain steps are completed.

First Power On

1. Power on ECU and establish connection - Applies to all EVS products. This can be completed in the following ways:
    a. Connect via CAN bus with the EVS-CAT
    b. Open enclosure and check LED on microcontroller blinks
    c. Connect via Direct Serial USB

If this fails check wiring of 12 V and ground, when using CAN bus also verify CAN bus wiring and termination.

HVIL/Safety Loop

2. If the Safety/ HVIL Loop is to be used verify this works - Applies to all EVS products
    a. Close the loop, can be verified by measure pinput to VCU to check it has 12 V present
    b. Clear faults from ECU
    c. Open the loop
    d. Check the relevant fault gets displayed by the ECU

Check the parameter, HvilLoop, is set correctly. Verify the wiring.

Battery Module Comms

3. Battery cell monitoring communication - Applies to EVS-BMS and EVS-VCU
    a. Verify the configuration of relevant battery settings
        i. Battery Settings: Scells, Pstrings, BmsChkCnt

        ii. Canbus Settings, Can1Speed, Can2Speed, CanBatteryType, CSCvariant
    b. If any settings have been changed clear faults and power cycle the ECU
    c. Monitor the reported faults for any battery related issues
        i. Check Errors, Faults and Warnings chapter for diagnoses

During this you can also see cell voltages and temperatures utilising the OBD2 adapter or Direct Serial menus.

Current Sensor

4. Verify working of CAN bus current sensor - Applies to EVS-BMS and EVS-VCU if utilised
    a. Verify no errors are present for the CAN bus current sensor

If there are errors present review configuration of the current sensor parameters and wiring.

Contactors

5. Verify contactor Functioning - Applies to all EVS products, if contactors are connected
    a. Verify contactors are not connected to the batteries
    b. Verify that no errors are present that do not allow contactor closing
    c. Verify settings for contactor control are correctly set
        i. Review Chapter on contactors within wiring information
        ii. If using the Voltage sense precharge please change this to time based for the duration of this test and set PreCurrent to 0 to disable.
    d. Power off the ECU and connect the contactor control wiring
    e. Monitor the contactors with a multimeter and power on the ECU
        i. Verify the correct contactor closes first, the one that does not have the precharge across it.
        ii. Verify the next contactor to close is the one to be used for precharge.
        iii. Verify that the last contactor also closes
        iv. Verify the precharge contactor drops out after the last contactor closes.
    f. Depending on the desired precharge functioning the following can be tested
        i. If only using time based precharge and no end current monitoring
            1. you are done testing the contactors
        ii. Using end current for precharge
            1. Configure PreCurrent
            2. Power off system
            3. Connect up HV battery and HV output to the contactors
            4. Power on system and check if the contactor sequences completes successfully.

If this does not complete, it is due to the end precharge current not being met. Verify no current is flowing during the precharge phase beyond the precharge current. No system HV current draw allowed. Verify that no error is present for the current sensor.

Voltage Monitoring

iii. Using Voltage Monitoring

1. Configure ContType to Voltage Sense and configure the CanVoltageSource to the correct device
2. Power off system
3. Connect up HV battery and HV output to the contactors
4. Power on system and check if the contactor sequences completes successfully.

If this does not complete, it is due to the reported HV voltage not meeting the expected behaviour. Verify that no error is present for the current sensor, as these devices also can report voltage. Please check which error gets flagged and review the error.

CAN Bus Devices

6. Verifying functioning of other CAN bus devices - Applies to all EVS products, that have other devices connected to the CAN busses.
    a. Verify the configuration of CAN communication is correct
    b. Verify connected devices recognize the EVS product if applicable

If there are issues seeing the EVS product on the CAN bus devices please verify the wiring and all CAN bus settings on all devices on the bus.

Throttle Calibration

7. Calibrating and verifying throttle - Applies to EVS-MCU and EVS-VCU
    a. Power on VCU
    b. Enter Throttle calibration, using Can Configurator or Direct Serial menus
    c. Complete calibration
        i. Power Cycle required to properly clear errors after calibration
    d. Verify the reported combined throttle goes from 0-100% and does not drop out between or causes Errors to be registered.

If there are errors after calibration repeat the calibration and power cycle, if the errors remain check that the values for the throttle signal 1 and signal 2 in the parameters appear correct. Verify wiring and voltages of the throttle signals when going through a sweep. Possibility throttle is faulty or has an unsupported throttle curve, get in touch with your reseller to discuss this.

First Wheel Spin

For the following testing the vehicle needs its wheels off the floor and be restricted from moving.

8. Verifying start and direction switches and motor rotation - Applies to EVS-MCU and EVS-VCU
    a. Power on VCU and connect to it with the Can Configurator or Direct Serial menus
    b. Verify all Drivetrain parameters before continuing, these need to be correct for the connected drivetrain if not this will create dangerous situations.

c. Verify the HV system comes online without any errors being raised
    i. Clear any errors that are raised before trying to continue
d. Confirm the VCU state is shown as “HV on”
e. Ensure the direction switches are in a “off” state
f. Press down on the brake pedal, the brake light output should go high.

if this does not happen and no other errors are thrown, verify the wiring.

g. Press the Start switch this should now put the VCU into the “Drive” State, the Drive Status should now be “Ready”

If this does not happen and no other errors are thrown, verify the wiring.

h. Turn on the Forward switch, the Drive Status should now read “Forward”
i. Turn off the Forward switch and turn on the Reverse switch, the Drive Status should now read “Reverse”

If this does not happen and no other errors are thrown, verify the wiring.

j. Turn off Reverse and turn on Forward again, apply a small amount of throttle.
k. The motor should not start to spin in a direction, confirm if this is the correct rotation direction
    i. If the direction is reverse change parameter DirSwap

If the motor does not spin verify all wiring to the inverter and between the inverter and motor. If any errors are thrown while trying to spin the motor these need to be resolved.

Parameter Guide

The different products use the same set of parameters, note which parameters apply to which product as indicated.

The parameters can be set via the CAN Configuration Tool or Direct Serial Menus.

The parameters are divided into 5 categories to make finding them easier.

Category 1: Battery Parameters

*Not used by **EVS-MCU***

Category	**Index**	**Name**
1	101	Pstrings
Description		
Amount of Parallel Strings, see section on Battery Physical Configuration		
Values		
1-255 Strings in parallel		
Category	**Index**	**Name**
1	102	Scells
Description		

Series amount of cells in one string		
Values		
1-255 Cells in series in a String		
Category	**Index**	**Name**
1	103	CAP
Description		
Capacity per string		
Values		
1> Ah		
Category	**Index**	**Name**
1	104	CellGap
Description		
Maximum allowed gap between cells		
Values		
0.0-5.0 V		
Category	**Index**	**Name**
1	105	IgnoreTemp
Description		
Module Temperature Sensors to use		
Values		
0 - use both sensors 1 or 2 only use that sensor		
Category	**Index**	**Name**
1	106	IgnoreVolt
Description		
Cell voltage under which cell positions are ignored		
Values		
0.0-5.0 V		
Category	**Index**	**Name**
1	107	balanceVoltage
Description		
If the highest cell voltage is above this threshold balancing is allowed		
Values		
0.0-5.0 V		
Category	**Index**	**Name**
1	108	balanceHyst
Description		
Balancing occurs until the highest and lowest cell difference is below this threshold		
Values		
0.0-5.0 V		
Category	**Index**	**Name**
1	109	TempOff
Description		

Modification to the temperature reading from modules		
Values		
-100-100 °C		
Category	**Index**	**Name**
1	10A	chargecurrentmax
Description		
Maximum allow charging current		
Values		
>0 A		
Category	**Index**	**Name**
1	10B	chargecurrentend
Description		
End of charge current allowed		
Values		
>0 A		
Category	**Index**	**Name**
1	10C	discurrentmax
Description		
Maximum allowed discharge current		
Values		
>0 A		
Category	**Index**	**Name**
1	10D	OverVSetpoint
Description		
Highest allowed cell voltage before Error triggered		
Values		
0.0-5.0 V		
Category	**Index**	**Name**
1	10E	UnderVSetpoint
Description		
Lowest allowed cell voltage before Error triggered		
Values		
0.0-5.0 V		
Category	**Index**	**Name**
1	10F	ChargeVsetpoint
Description		
End of charge cell voltage target		
Values		
0.0-5.0 V		
Category	**Index**	**Name**
1	110	DischVsetpoint
Description		
Stop Discharge below this cell voltage		

Values		
0.0-5.0 V		
Category	**Index**	**Name**
1	111	ChargeHys
Description		
Required highest cell voltage drop before allowed to charge again		
Values		
0.0-5.0 V		
Category	**Index**	**Name**
1	112	DisVtaper
Description		
Offset from settings.DischVsetpoint at which discharge current tapers to Zero Amps at settings.DischVsetpoint		
Values		
0.0-5.0 V		
Category	**Index**	**Name**
1	113	OverTSetpoint
Description		
Above this temperature Charge and Discharge is inhibited		
Values		

Category	**Index**	**Name**
1	114	UnderTSetpoint
Description		
Under this temperature charging is inhibited		
Values		
Value in °C		
Category	**Index**	**Name**
1	115	ChargeTSetpoint
Description		
Temperature below which charging current gets reduced		
Values		
Value in °C		
Category	**Index**	**Name**
1	116	DisTSetpoint
Description		
Temperature above which discharge gets reduced		
Values		
Value in °C		
Category	**Index**	**Name**
1	117	WarnVOff
Description		
Cell voltage offset to raise a warning		

Values		
0.0-5.0 V		
Category	**Index**	**Name**
1	118	WarnTOff
Description		
Temperature offset to raise a warning		
Values		
>0 °C		
Category	**Index**	**Name**
1	119	VTripTime
Description		
Delay before counting over or undervoltage in ms		
Values		
>0 ms		
Category	**Index**	**Name**
1	11A	SocVolt[0]
Description		
SOC Cell Voltage Reference point 1		
Values		
0.0-5.0 V		
Category	**Index**	**Name**
1	11B	SocVolt[1]
Description		
SOC % Reference point 1		
Values		
0-100 %		
Category	**Index**	**Name**
1	11C	SocVolt[2]
Description		
SOC Cell Voltage Reference point 2		
Values		
0.0-5.0 V		
Category	**Index**	**Name**
1	11D	SocVolt[3]
Description		
SOC % Reference point 2		
Values		
0-100 %		
Category	**Index**	**Name**
1	11E	VoltOnlySOC
Description		
Use Cell voltage derived SOC		
Values		

0- Unused 1- Used		
Category	**Index**	**Name**
1	11F	TempConv
Description		
Temperature conversion factor, only used on Outlander		
Values		
Multiplier		
Category	**Index**	**Name**
1	120	BmsChkCnt
Description		
Start Delay before BMS checks, time allowed to establish module connection		
Values		
1-10 s		

Category 2: Connections, Contactors and Charging Parameters

Category	**Index**	**Name**
2	201	ContType
Description		
Precharge Control Method, check Contactor Chapter		
Values		
0- Unused 1-Time based 2-Voltage Based		
Category	**Index**	**Name**
2	202	PullTime
Description		
Pull in time for PWM, check Contactor Chapter		
Values		
ms of pull in time for Low side Driver		
Category	**Index**	**Name**
2	203	ContHold
Description		
Selection of PWM Control Contactor holding PWM Level		
Values		
0-ON/OFF control no pwm 1-256 for holding pwm		
Category	**Index**	**Name**

2	204	PreCurrent
Description		
Precharge End Current, to end precharge current needs to be under threshold if Time Based control		
Values		
0-Ignore 1-20 Current in Amps		
Category	**Index**	**Name**
2	205	HvilLoop
Description		
HVIL and/or Crash signal input		
Values		
0- Input Not Used 1- Input Used		
Category	**Index**	**Name**
2	206	AutoStart
Description		
Contactor enable control		
Values		
0- Do Not Start 1- Apply HV on Power Up 2- HV On with input 3-HV On with CAN Command		
Category	**Index**	**Name**
2	207	ChargePortType
Description		
Charge Port and drive inhibit control.		
Values		
0- Not Used 1-4-Unavailable 5-Digital Input 6-CAN bus Input		
Category	**Index**	**Name**
2	208	CanVoltageSource
Description		
Precharge voltage controlled, selected voltage measurement source		

Values		
0- Not Used 1-BMWSbox 2-IVTS 3-Outlander Rear Inverter		
Category	**Index**	**Name**
2	209	ChargerACVolt
Description		
Voltage expected at the AC input of the charger		
Values		
0-Ignores this variable and ChargerEff 0-255 AC Input Voltage		
Category	**Index**	**Name**
2	20A	ChargerEff
Description		
Estimated Charger Efficiency		
Values		
0-99 Charger Efficiency		
Category	**Index**	**Name**
2	20B	ChargerFixAc
Description		
Fixed Max AC Current from the wall. Overrides any other AC current limtis.		
Values		
0-100 AC Amps		

Category 3: Drivetrain Parameters

*Not used by **EVS-BMS***

Category	**Index**	**Name**
3	301	MaxThrot1
Description		
Calibration value, throttle signal 1 fully depressed		
Values		
0-1024		
Category	**Index**	**Name**
3	302	MinThrot1
Description		
Calibration value, throttle signal 1 fully released		
Values		
0-1024		

Category	Index	Name
3	303	MaxThrot2
Description		
Calibration value, throttle signal 2 fully depressed		
Values		
0-1024		
Category	**Index**	**Name**
3	304	MinThrot2
Description		
Calibration value, throttle signal 2 fully released		
Values		
0-1024		
Category	**Index**	**Name**
3	305	ThrotType
Description		
Throttle type selection		
Values		
0- Two signal only check top and bottom 1- Not implement yet		
Category	**Index**	**Name**
3	306	MaxReq
Description		
Max torque in forward Mode 1		
Values		
0-500 Nm		
Category	**Index**	**Name**
3	307	MaxReq2
Description		
Max torque in forward Mode 2		
Values		
0-500 Nm		
Category	**Index**	**Name**
3	308	MaxReqRev
Description		
Max torque in reverse Same in Both Modes		
Values		
0-500 Nm		
Category	**Index**	**Name**
3	309	MinReq
Description		
Max regen in either direction, also overrides max brake request when higher Mode 1		
Values		
-500-0 Nm		

Category	Index	Name
3	30A	MinReq2
Description		
Max regen in either direction, also overrides max brake request when higher Mode 2		
Values		
-500-0 Nm		
Category	**Index**	**Name**
3	30B	BrakeReq
Description		
Max brake request torque in both forward and reverse Mode 1		
Values		
-500-0 Nm		
Category	**Index**	**Name**
3	30C	BrakeReq2
Description		
Max brake request torque in both forward and reverse Mode 2		
Values		
-500-0 Nm		
Category	**Index**	**Name**
3	30D	RegTaper
Description		
Motor Speed at which regen starts to taper to 0 at 0 rpm for Mode 1		
Values		
>0 rpm		
Category	**Index**	**Name**
3	30E	RegTaper2
Description		
Motor Speed at which regen starts to taper to 0 at 0 rpm for Mode 2		
Values		
>0 rpm		
Category	**Index**	**Name**
3	30F	changespeed
Description		
Vehicle speed under which direction can be changed		
Values		
>0 mi/h or km/h		
Category	**Index**	**Name**
3	310	RevSpeed
Description		
Max Vehicle Speed in reverse		
Values		
>0 mi/h or km/h		
Category	**Index**	**Name**

3	311	DirSwap
Description		
Motor rotation to vehicle direction		
Values		
0-Normal rotation 1-Reversed rotation		
Category	**Index**	**Name**
3	312	roadspeedgain
Description		
Translation of motor rpm into vehicle speeds		
Values		
(mi/h or km/h)/1000 rpm		
Category	**Index**	**Name**
3	313	BrkOnTrq
Description		
Amount of Regen that turns on the brake light output		
Values		
-500-0 Nm		

Category 4: Thermal Parameters

Category	**Index**	**Name**
4	401	MotFanTemp
Description		
Inverter and Motor Temp at which to turn on Fan Output		
Values		
>0 °C		
Category	**Index**	**Name**
4	402	BatFanTemp
Description		
Battery Module Temp at which to turn on Fan Output		
Values		
>0 °C		
Category	**Index**	**Name**
4	403	ChargerLoop
Description		
If the Outlander Charger is used in which coolant loop does it live. Will be expanded with other chargers.		
Values		

0-Unused Not watercooled 1-InMotor Charger in loop with inverter and motor 2-InBattery Charger in loop with Battery

Category 5: Communication Parameters

Category	Index	Name
5	501	Can1Speed
Description		
CAN bus 1 Baud Rate		
Values		
0-1000 kbps		
Category	**Index**	**Name**
5	502	Can2Speed
Description		
CAN bus 2 Baud Rate		
Values		
0-1000 kbps		
Category	**Index**	**Name**
5	503	Can3Speed
Description		
CAN bus 3 Baud Rate		
Values		
0-1000 kbps		
Category	**Index**	**Name**
5	505	CanDriveType
Description		
To be controlled Powertrain		
Values		
0- Unused 1-Outlander Rear Motor and Inverter		
Category	**Index**	**Name**
5	506	CanBatteryType
Description		
Battery modules or BMS connected		
Values		
0-UnUsed 1-CanType1, third party can bus based 2-BMW, further specify with CSCvariant 3-VWMEBGTE 4-Outlander 5-Chevy Volt 6-Tesla Model S/X		

Category	Index	Name
5	507	CanVehicleType
Description		
Vehicle CAN bus profile, Victron format broadcast when no conflicts with selected devices		
Values		
0- Default		
Category	**Index**	**Name**
5	508	CanChargerType
Description		
0- Do Not Start 1- Apply HV on Power Up 2- HV On with input 3- HV On with CAN Command		
Values		
0-NoCharger 1-BrusaNLG5 2-ChevyVolt 3-Eltek 4-Elcon 5-Victron 6-Coda 7-PylonTech 8-GoodWEHV		
Category	**Index**	**Name**
5	509	ChargerSpd
Description		
Period of charger control messages in ms		
Values		
>100mS		
Category	**Index**	**Name**
5	50A	SecPack
Description		
ONLY for EVS-BMS Additional modules on canbus 2		
Values		
0-Unused 1-Not used 2-Second Pack On canbus 2		
Category	**Index**	**Name**
5	50B	CurSens
Description		
CAN bus current sensor connected		
Values		

0-No current Sensor 1-S-BOx 2-IVT-s 3-CAB300/500		
Category	**Index**	**Name**
5	50C	InvertCur
Description		
Reverse Reported Current from sensor		
Values		
0-Not Reverse 1-Current Readings Reversed		
Category	**Index**	**Name**
5	50D	CSCvariant
Description		
BMW CAN bus CSC variant used		
Values		
0-UnUsed 1-PHEV 2-i3 3-MiniE		
Category	**Index**	**Name**
5	50E	CurSensBus
Description		
CAN bus where the current sensor is located		
Values		
0-Unused 1-Canbus 1 2-Canbus 2		

Category 15: Services

These are for reference only and are non-configurable parameters.

Category	**Index**	**Name**
F	F02	BatteryID
Description		
Battery Identification number. A placeholder currently not implemented.		
Values		
0-default		
Category	**Index**	**Name**
F	F03	VCULockedError
Description		
Parameter to show configuration not yet completed and ECU is locked.		
Values		

0-No Error
1-Not Setup

Category	Index	Name
F	F04	ThrotCal
Description		
Throttle calibration ongoing		
Values		

Category	Index	Name
F	F05	FirmwareNo
Description		
Firmware version identifier		
Values		

Category	Index	Name
F	F06	SerialNo
Description		
Serial Number Identifier		
Values		

Category	Index	Name
F	F07	LoopStates
Description		
See Chapter Software States		
Values		

Category	Index	Name
F	FFD	ErrorMatrixHis
Description		
See Chapter Errors, Faults and Warnings		
Values		

Category	Index	Name
F	FFE	ErrorMatrixCur
Description		
See Chapter Errors, Faults and Warnings		
Values		

Category	Index	Name
F	FFF	Save To Flash
Description		
Command to save all parameters to flash		
Values		

CAN Configuration Software

Dedicated software to configure EVS products over CAN bus. In order to utilise the software with the EVS products the EVS-CAT is required, other CAN adapters will not work with the software.

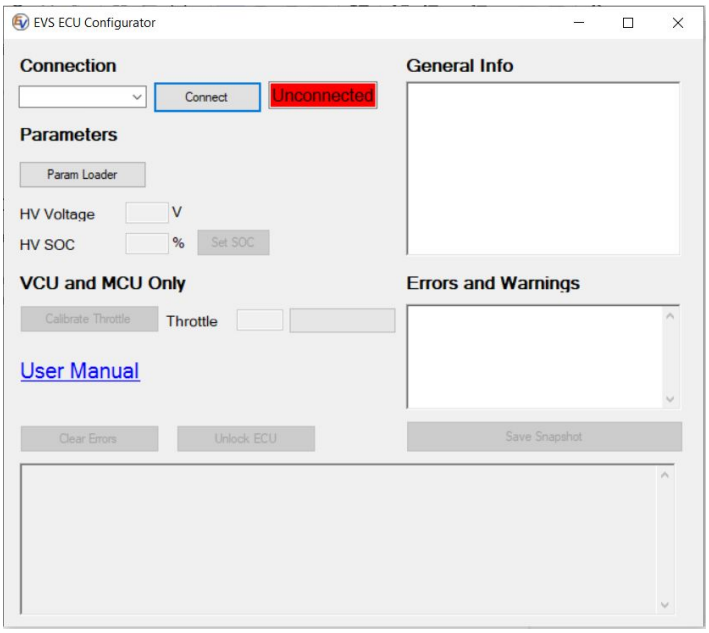
Functions currently supported by the CAN configuration software:

- Obtain hardware serial number
- Observe software loop states
- Rear out errors
- Calibrate throttle
- Read parameter configuration from ECU
- Write parameter configuration to ECU
- Save and load parameter configuration
- Save diagnostic snapshots
- Windows support only

Download and installation

1. Please download the files and unzip them : EVS Can Config Zip
2. Run the Setup.exe
3. Follow the setup instructions
4. On completion the program will launch.

Start up window

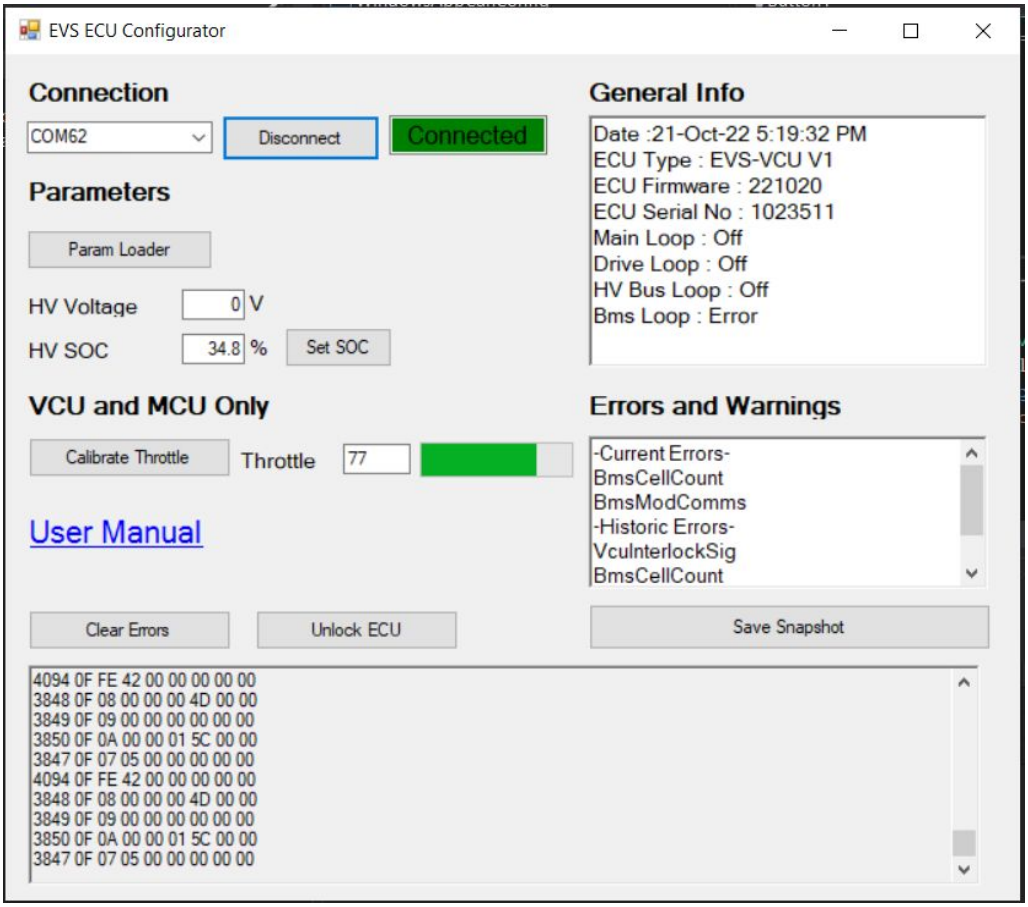


Making connection to the ECU

Have the EVS-CAT connected to the computer before starting the program.
Ensure the EVS-CAT is connected to CAN bus 2 of the EVS product. The EVS product needs to be powered to establish communication.

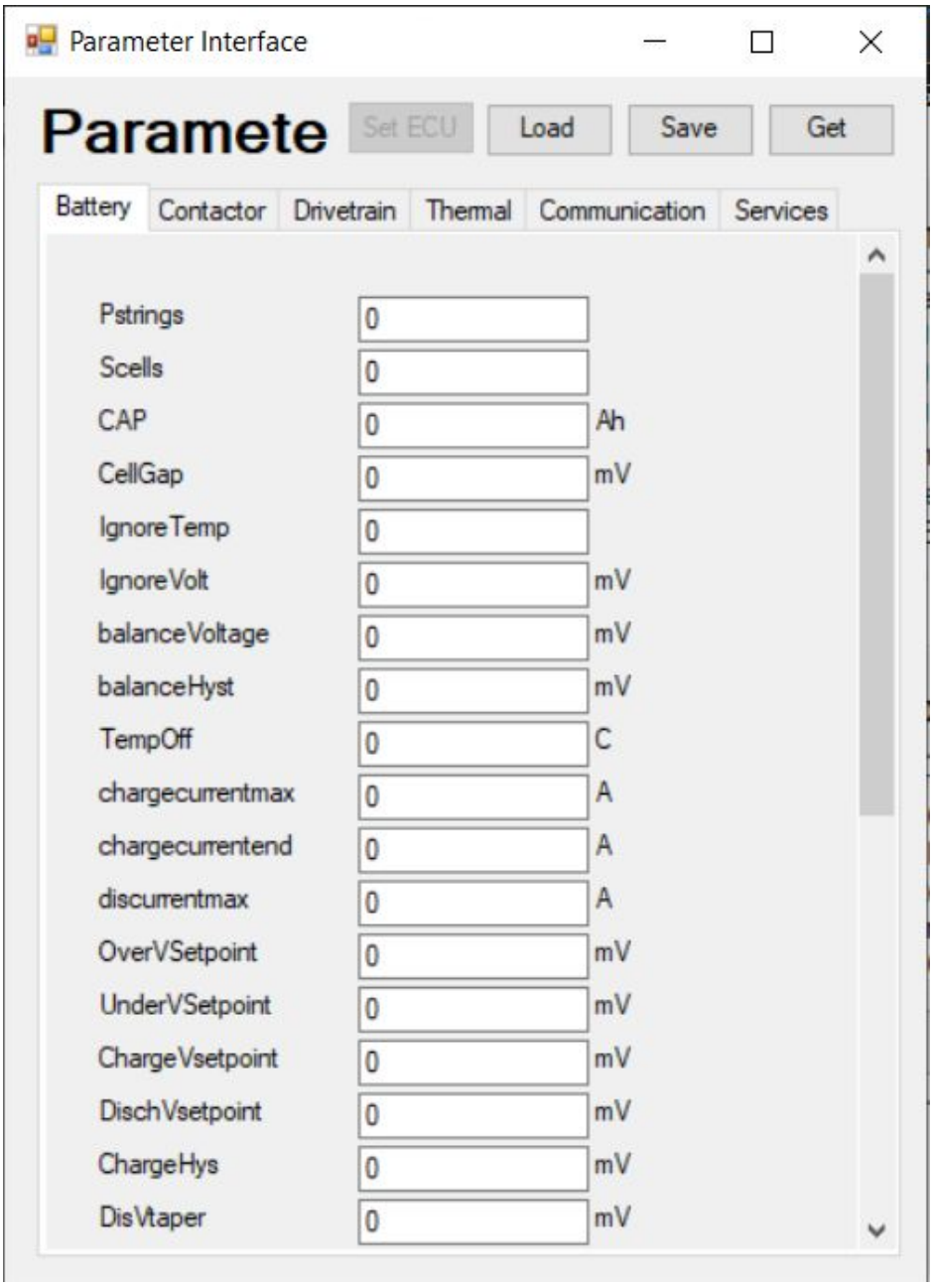
Once the program is started, all the available com ports are shown in the Connection drop down. Select the one related to the EVS-CAT, if you are uncertain, disconnect all other devices or use the Windows Device Manager to determine which com port “USB-Serial CH340” is. *Note: Windows should detect the device automatically and assign the correct drivers, if this does not happen please unplug the EVS-CAT and plug it back in.*

When communication is established with the EVS ecu the General Info field gets populated, the Errors and Warnings get populated, and all the relevant buttons become selectable.



Obtain Parameters from ECU

Once the connection is established, open the Parameter interface by clicking on the button “Param Loader”.



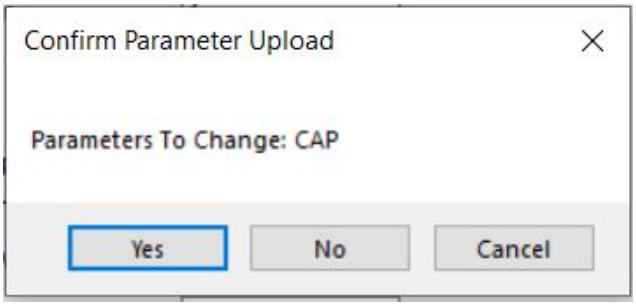
To obtain the parameter configuration click the “Get” button, a progress bar will appear covering all the parameters. Once loaded the parameters will be populated in the fields. Any changes to the parameters will show in yellow. Click the “Check” button to set the parameters as reference for changes made later.

Changing Parameters

The parameters can be modified in the field directly, refer to the Parameters chapter for the information on the values. Obtain the parameters from the ECU before making any changes, as obtaining the parameters overwrites all the fields.

Make all required parameter changes. To verify which parameters are changed click “check” to highlight the made changes.

To upload the parameter changes to EVS ecu click the “Set ECU” button, this will prompt you to confirm the parameters you are expecting to modify. Check the listed parameters are correct, click “yes” to upload changes or press “no” or “cancel” to stop uploading.



Saving Parameters

Using the “Save” button you can save the parameters obtained from the EVS Ecu.

Load Parameters

Obtain the parameters from the EVS Ecu before loading.
Using the “Load” button you can load a saved set of parameters from the computer.

The loaded parameters will be written over the EVS Ecu parameters, any differences will be highlighted in yellow.

Direct Serial Menus

In order to access the direct serial menu, it is required to open up the enclosure and connect to the USB on the microcontroller board.

Note: care must be taken not to short out the exposed circuit board!

Connection can be made via a serial terminal, recommended ones are: Termite and the Arduino IDE built in solution.

Configuration for serial connection:

Speed: 115200kbps
Line ending: New Line AND Carriage Return

Debugging Menus

To toggle the various debugging menus the following letters can be sent, once being displayed sending the same letter stops this information being displayed:

“i” - Shows raw input and output states
“v” -Shows software “VCU” loop information relating to contactor states
“b” -Shows software “BMS” loop information relating to cell voltages and limits
“c1” -CAN bus 1 raw CAN data
“c2” -CAN bus 2 raw CAN data
“c0” -Stop all raw CAN data

Settings Menus

Sending a “s” opens the settings menu, this is used to modify the parameters described in the parameter guide. Each parameter lists its ID after the -”

In the loaded menu the following rules apply:

- Modified settings are used right away, but will not be saves unless you fully exit the settings menu using “q” and return to the scrolling debug
- Some settings require a Controller restart
    - “Z” - reboots controller without saving
    - “X” -reboots controller with saving settings
- Only unlock the controller using “U” when all settings are correctly displayed in the menus

Error codes

These will be displayed if present. They are described in the Errors, Faults and Warnings chapter.

To reset enter the settings menu and send “P” and then reboot the controller

Errors, Faults and Warnings

The errors and faults are described in an Error Matrix a 32bit value that is requested by the configuration software and is accessible over CAN bus via OBD2. There are two ways the Error Matrix is updated, there is a currently active matrix and a historical matrix that gets set once error occurs and can only be reset by the user.

EVS Error Matrix Worksheet

Each Error can be caused by one or more reasons they will be explained below. If an error is present the EVS product will limit or even inhibit functionality.

Note the names of the errors are related to the software loops and not the product names.

VCULocked

Error Id	Error Index	Name
0	0x01	VCULocked

Result
Inhibits the closing of contactors or controlling CAN bus devices. System will not work till cleared, can only be cleared by Serial Menu or Configuration Tool.

Causes

- Device not configured, in order to prevent an attempt to use an unconfigured device in a new setup.
- Major Failure of internal hardware detected, fault returns after being reset

VcuInterlockSig

Error Id	Error Index	Name
1	0x02	VcuInterlockSig

Result
Inhibits the closing of contactors or controlling CAN bus devices. System will not work till cleared and can only be cleared by power cycling the system.

Causes

- 12 V Safety/HVIL loop broken, check 12 V is present at required ECU pin

- 12 V Safety/HVIL loop parameter set when not intended to be used

VcuThrottleError

Error Id	Error Index	Name
2	0x04	VcuThrottleError

Result
Motor control is inhibited till fault is cleared. Fault clears once throttle enters operational range again.

Causes
- Throttle is giving incorrect readings, check calibration if fault remains check throttle
- Throttle is incorrectly calibrated, check calibration

VcuThrottleIgnore

Error Id	Error Index	Name
3	0x08	VcuThrottleIgnore

Result
Motor control is inhibited till fault is cleared. Fault clears once throttle Calibration has completed successfully.

Causes
- Throttle calibration is ongoing, complete calibration or power cycle system
- Throttle is incorrectly calibrated, check calibration

VcuInverterCan

Error Id	Error Index	Name
4	0x10	VcuInverterCan

Result
Motor control is inhibited till fault is cleared. Fault clears once inverter communication is resumed correctly.

Causes
- Faulty Inverter, check power to inverter and wiring
- Unstable CAN bus network, review wiring and connected devices

VcuChargePort

Error Id	Error Index	Name
5	0x20	VcuChargePort

Result
Only applies to CAN bus connected charge ports.
Motor control is inhibited till fault is cleared. Fault clears once ChargePort signals are within bounds.

Causes
- Incorrectly configured charge port parameters, check parameters
- Unstable CAN bus network, review wiring and connected devices

HvNegCont

Error Id	Error Index	Name
6	0x40	HvNegCont

Result
Will only be present with voltage based precharge control
Inhibits the closing of contactors or controlling CAN bus devices. System will not work till cleared, a power cycle is required to clear.

Causes
- Contactor Stuck On causing voltage leakage, check contactor

HvPosCont

Error Id	Error Index	Name
7	0x80	HvPosCont

Result
Will only be present with voltage based precharge control
Inhibits the closing of contactors or controlling CAN bus devices. System will not work till cleared, a power cycle is required to clear.

Causes
- Contactor Stuck On causing voltage leakage, check contactor

HvPreCont

Error Id	Error Index	Name
8	0x0100	HvPreCont

Result
Will only be present with voltage based precharge control AND current monitoring precharge
Inhibits the closing of contactors or controlling CAN bus devices. System will not work till cleared, a power cycle is required to clear.

Causes

- Precharge end current not met, Check HV devices do not draw current during precharge
- Precharge end voltage not met, Check precharge circuit electrically

HvCanOn

Error Id	Error Index	Name
9	0x0200	HvCanOn

Result
Will only be present with CAN bus HV request enabled
Inhibits the closing of contactors or controlling CAN bus devices. System will not work till cleared, clears once CAN bus communication is back within spec.

Causes

- Incorrectly configured parameter, check parameter HV enable
- Incorrect CAN bus message sent to device, review CAN bus communication
- Unstable CAN bus network, review wiring and connected devices

BmsCanCurrent

Error Id	Error Index	Name
24	0x01000000	BmsCanCurrent

Result
Will only be present with a CAN bus current sensor configured
Will Inhibits the closing of contactors if current or voltage based precharge is used. This error means that the current measurement is inaccurate and will cause SOC drift. Error is self clearing once communication is within spec again, a power cycle is required to verify it does not occur again.
Causes

- Unstable CAN bus network, review wiring and connected devices
- Faulty current sensor

BmsCellCount

Error Id	Error Index	Name
25	0x02000000	BmsCellCount

Result
Will only be present with when not using 3rd party BMS over CAN bus
Inhibits the closing of contactors or controlling CAN bus devices. System will not work till cleared, clears once all configured cells are present again and the system is power cycled. Note this fault does not occur on the first missing cell but looks at an interval.

Causes
- Incorrectly configured parameter, check parameter Pstrings and Scells
- Unstable CAN bus network, review wiring and connected devices
- Faulty Cell Monitoring Modules, verify one by one to determine devices at fault

BmsHighVoltage

Error Id	Error Index	Name
26	0x04000000	BmsHighVoltage

Result
Will only be present with when not using 3rd party BMS over CAN bus
Inhibits the closing of contactors or controlling CAN bus devices also will force a shutdown of HV system. System will not work till cleared, wil clear once cells are back in bounds. Note this fault is delayed by the time set in parameter VTripTime, this is to allow stabilisation of measurements.

Causes
- Incorrectly configured parameter, check parameters relating to overvoltage
- Faulty Cell Monitoring Modules, please verify one by one to determine devices at fault

BmsLowVoltage

Error Id	Error Index	Name
27	0x08000000	BmsLowVoltage

Result

Will only be present with when not using 3rd party BMS over CAN bus
Inhibits the closing of contactors or controlling CAN bus devices also will force a shutdown of HV system. System will not work till cleared, wil clear once cells are back in bounds. Note this fault is delayed by the time set in parameter VTripTime, this is to allow stabilization of measurements.

Causes

- Incorrectly configured parameter, check parameters for undervoltage
- Faulty Cell Monitoring Modules, please verify one by one to determine devices at fault

BmsHighTemp

Error Id	Error Index	Name
28	0x10000000	BmsHighTemp

Result
Will only be present with when not using 3rd party BMS over CAN bus
Inhibits the closing of contactors or controlling CAN bus devices also will force a shutdown of HV system. System will not work till cleared, wil clear once temperatures are back in bounds.

Causes

- Incorrectly configured parameter, check parameters for overtemperature
- Faulty Cell Monitoring Modules, please verify one by one to determine devices at fault

BmsLowTemp

Error Id	Error Index	Name
29	0x20000000	BmsLowTemp

Result
Will only be present with when not using 3rd party BMS over CAN bus
Inhibits charging and discharging of the HV system. System will not allow charge or discharge till cleared, wil clear once temperatures are back in bounds.

Causes

- Incorrectly configured parameter, check parameters for under-temperature
- Faulty Cell Monitoring Modules, please verify one by one to determine devices at fault

BmsModComms

Error Id	Error Index	Name

30	0x40000000	BmsModComms

Result
Will only be present with when not using 3rd party BMS over CAN bus
Inhibits charging and discharging of the HV system and will not allow enabling of HV system when present. System will not allow charge or discharge till cleared, wil clear once communication is functioning again and the system is power cycled. Note this fault does not occur on the first missing message but looks at an interval.

Causes
- Unstable CAN bus network, review wiring and connected devices
- Unstable Serial network, review wiring and connected devices
- Faulty Cell Monitoring Modules, please verify one by one to determine devices at fault

BmsCellGap

Error Id	Error Index	Name
31	0x80000000	BmsCellGap

Result
Will only be present with when not using 3rd party BMS over CAN bus
Inhibits enabling of HV system when present. System will not allow activation till cleared, wil clear once cells are within bounds.

Causes
- Incorrectly configured parameter, check parameters for cellgap
- Faulty Cell Monitoring Modules, please verify one by one to determine devices at fault

Torque Pro App Setup

The EVS products can communicate with the Torque Pro app via the obd2 adapter.

Information

Torque Pro wiki

Custom Sensor Input

1. Save required csv file on device: EVS PIDS
2. Open the Torque Pro app
3. Go to Settings by clicking the gear in bottom left
4. Select “Manage extra PIDs/Sensors
5. Click the three dots in top right corner and select “Import CSV file”
6. Select the downloaded csv linked above

Now the EVS specific sensors are available to be assigned to gauges and graphs.