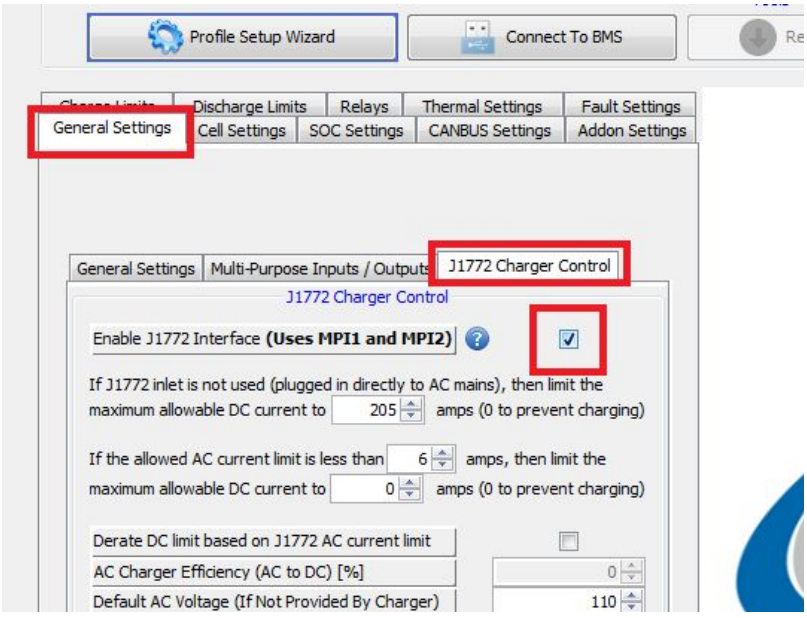
Diagnosing J1772 Charging Problems

This document serves as a guide to assist in troubleshooting the most common issues encountered relating to the SAE J1772 charging protocol when used with the Orion 2 BMS product line. Please see below for suggested diagnostic steps for frequently reported problems.

Problem: The Orion 2 BMS will not engage the J1772 EVSE station

1) **Verify that the J1772 functionality is enabled in software: By default, the Orion 2 BMS will not have the J1772 functionality switched on in the software settings and therefore must be manually enabled.** To enable J1772 functionality, open the Orion 2 BMS utility and navigate to the “General Settings” tab in the profile settings section. Next, navigate to the “J1772 Charger Control” settings on this sub-tab to bring up the J1772 related settings. Finally, **ensure that the “Enable J1772 Interface” option is CHECKED** (enabled).



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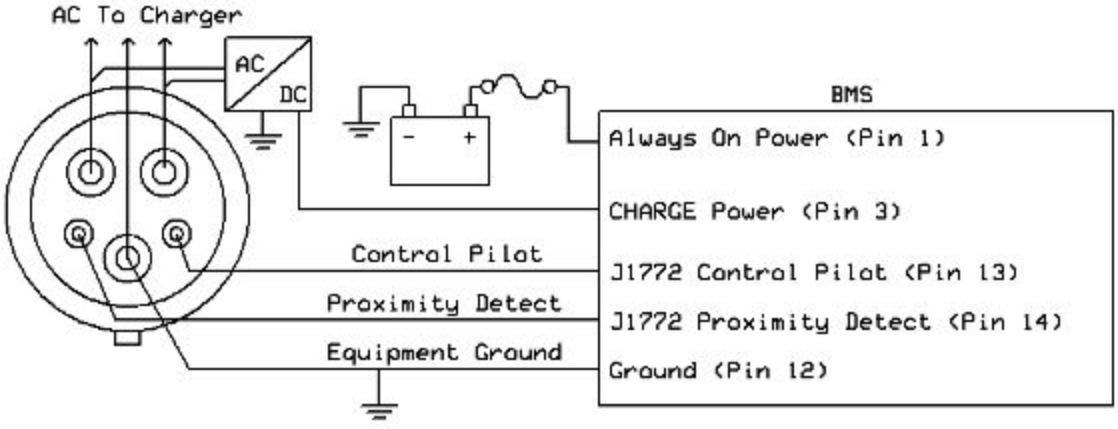
Phone: (630) 868-3173

2) **Verify that the Orion 2 BMS is powered:** In order to activate the J1772 EVSE charging station, the Orion 2 BMS requires at least one of the three power sources (Charge Power, Ready Power or Always On power) to be energized in order to activate the EVSE. Typically, the Always On power source (Main I/O pin 1, big green wire) is always energized in applications utilizing SAE J1772 charging. The BMS will wake up from low power sleep when a J1772 plug is inserted, so Ready Power and Charge Power are not necessary at this stage as long as Always On power is used. **If Always On power is not energized, either Charge Power or Ready Power will need to be present in order for the BMS to activate the J1772 EVSE.** The EVSE negotiation process requires the main electronics on the BMS to be powered before the station can be activated.

3) **Verify that the BMS ground is bonded to the J1772 inlet ground:** In order for the J1772 signaling to operate properly, the J1772 inlet (and the EVSE itself conductively) must share a common ground. Otherwise, the signals cannot be interpreted in the proper context. To accomplish this, the Ground wire on the BMS power input (Main I/O pin 12, big white wire) **MUST** be bonded to the J1772 inlet communication ground line. This wire can vary by size and color depending on which J1772 inlet is being used so consult with the documentation provided with the inlet for details. **If the BMS ground is not connected to the J1772 inlet ground the J1772 functionality will not operate.**

4) **Verify that both the J1772 related wires are properly connected:** The J1772 negotiation process occurs over two wires: The control pilot (Main I/O pin 13, **ORANGE / WHITE** stranded) and the proximity detect (Main I/O pin 14, **BROWN / WHITE** stranded). These wires must be connected to their respective cables on the J1772 inlet. If the wires are connected incorrectly the system will not operate properly, so it is very important to verify that these two wires go to the correct locations on the J1772 inlet.



J1772 connections to the BMS (AC wiring is simplified, fuses may be required)

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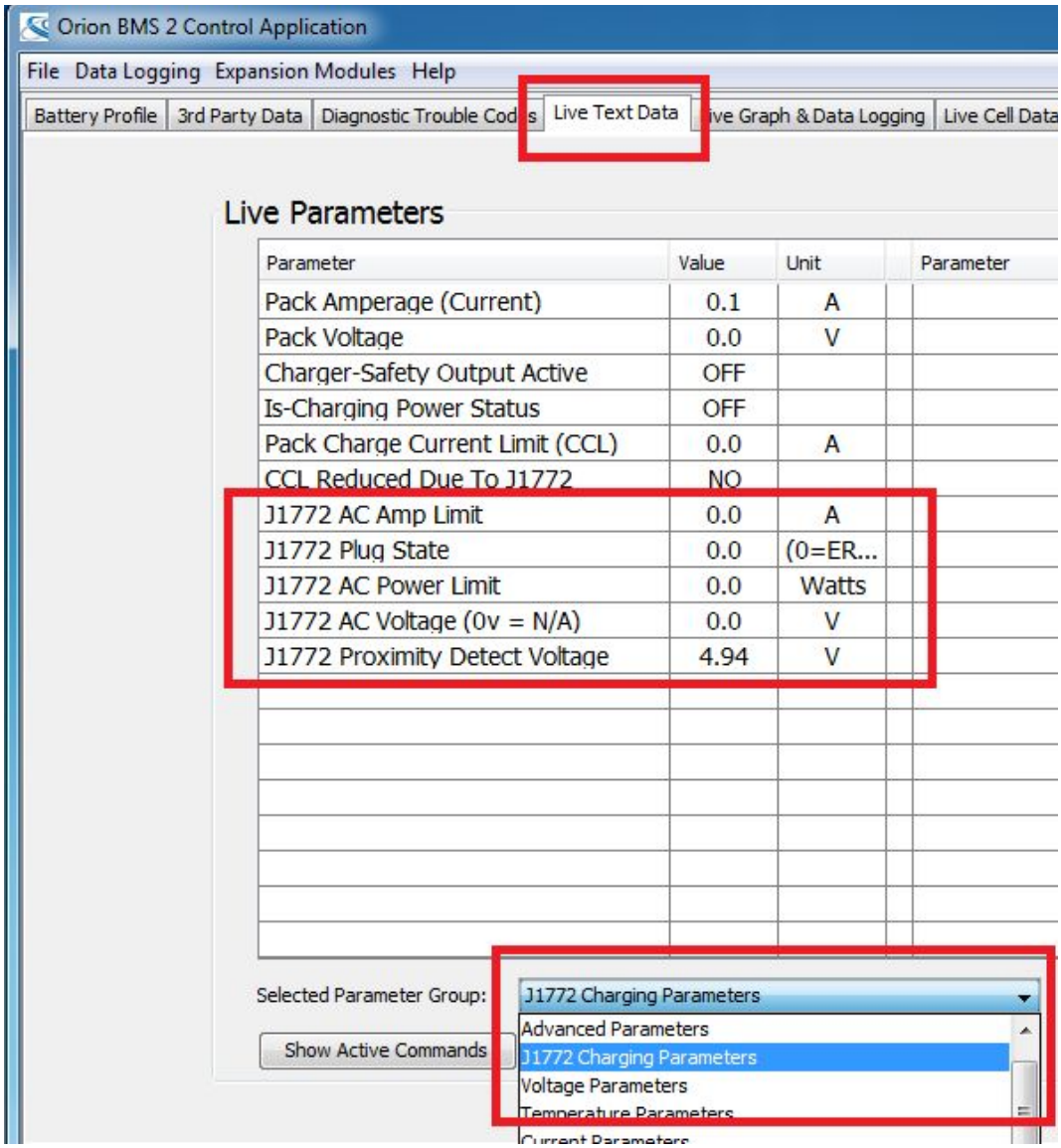
5) **Verify that the EVSE is powered and functional:** If possible, try connecting a different vehicle or source to the EVSE to confirm that it is operating properly. An incorrectly functioning EVSE poses an obvious issue.

6) **Verify J1772 related parameters in the BMS utility:** To assist with diagnosing problems, many of the live J1772 related parameters and values are available to be viewed through the BMS utility software. To view this information, open the Orion 2 BMS utility and connect to the BMS as normal. Next, click the “Live Text Data” tab at the top. Then click the “Selected Parameter Group” drop-down menu item near the bottom of the screen and select “J1772 Charging Parameters”. This will then bring up the J1772 charging related fields.



In the above example, this data indicates that the J1772 interface is enabled in software

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but neither the Control Pilot nor the Proximity Detect wires are connected to the J1772 inlet. Because of this, the BMS is reporting an “Error” state for the plug and it is therefore not activating the EVSE charging station. A value at or near 5.0v for the Proximity Detect voltage typically means this line is not actively connected to anything (the wire may have been forgotten or cut).

If the problem still persists, please contact technical support for further assistance providing as much details and background data as possible. Additional information from the BMS may be requested during this process.

NOTE: For safety reasons, the Orion 2 BMS is unable to “force” the J1772 charging station output on, even for diagnostic purposes. There are intentionally no provisions for bypassing the normal safety checks that are part of the J1772 document.

Problem: The Proximity Detect input is registering an invalid voltage

The BMS uses the Proximity Detect input to determine whether a plug is inserted into the inlet. The J1772 standard uses different resistance values (applied by different states of the plug) to convey this information to the BMS (this means the BMS can determine the plug state before the EVSE activates and even when the EVSE itself is unpowered or malfunctioning). The BMS determines the resistance by measuring the voltage of the Proximity Detect input.

The following table indicates what the various voltage ranges mean for the Proximity Detect Voltage parameter:

Voltage Range	**Mode State**
4.6v to 5.0v	Error (Invalid State)
4.0v to 4.6v	Plug Disconnected (valid, but unplugged)
3.5v to 4.0v	Error (Invalid State)
2.2v to 3.5v	Plug Button Depressed (plug inserted but release button is held down). Station will not activate.
1.75v to 2.2v	Error (Invalid State)
0.75v to 1.75v	Plug Ready (plug inserted and button not depressed, ready to activate station)

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0v to 0.75v	Error (Invalid State)

If the voltage measured for the Proximity Detect line is within the Error / Invalid State ranges this could be due to a number of reasons:

1) The BMS Proximity Detect wire may not be wired to the correct pin on the J1772 inlet.
2) The BMS ground may not be bonded to the J1772 inlet ground per the requirements outlined in the Orion 2 BMS wiring manual (**the BMS ground MUST be bonded to the J1772 inlet ground for proper operation**).
3) The Proximity Detect wire may be pinched or shorted resulting in intermittent or unreliable connectivity, or if insufficient gauge cabling was used to extend the wire. The recommended cable gauge is 22 awg stranded copper wire.
4) The J1772 functionality may not not be enabled in the BMS software (the J1772 functionality **MUST** be enabled for the BMS [General Settings -> J1772 Charger Control] to properly interpret voltages on this input).

Problem: The J1772 plug state goes to “Ready” but the EVSE does not engage (the state does not change to “Charging”)

The final step before engaging the EVSE charging station is validating the Control Pilot signal. The J1772 EVSE applies a variable PWM pulse to this signal wire in order to tell the BMS how much AC current is available (and ultimately how much power the onboard charger can safely draw without tripping any breakers).

Once the BMS switches to the “Ready to charge” mode, it will begin evaluating the Control Pilot signal for valid input. If the BMS detects an irregular pattern or behavior it will prevent the EVSE from activating until the signal stabilizes.

There are a number of possible causes for why the BMS may reject the Control Pilot signal:

1) The Control Pilot signal wire may not be connected, or the wire may be damaged or shorted.
2) The Control Pilot signal wire may be connected to the wrong pin on the J1772 inlet (perhaps if it is switched with the Proximity Detect).
3) The Orion 2 BMS ground wire may not be bonded to the J1772 inlet ground (**the Orion 2 BMS ground MUST be bonded to the J1772 inlet ground or the Control Pilot signal will not operate**).
4) The EVSE may be providing an incorrect or invalid PWM signal range OR the EVSE may not be fully compliant with the J1772 standard. Try plugging in a different vehicle if possible to validate the charging station.

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If the problem still persists, please contact technical support for further assistance providing as much details and background data as possible. Additional information from the BMS may be requested during this process.

Problem: The J1772 EVSE activates but the BMS is restricting the maximum power output too much (charger not charging fast enough)

The Orion 2 BMS negotiates with the J1772 EVSE to determine what the maximum amount of current the onboard charger is allowed to draw from the station as part of the J1772 standard. Because the BMS is calculating a maximum charge current limit on the DC side there are some additional steps it must take to convert the data provided by the EVSE into a workable limit.

This is the general logic flow that the BMS will perform to arrive at the DC current limit:

1) The BMS receives the AC current limit published by the J1772 EVSE charging station.
2) The BMS either receives the AC voltage from the onboard vehicle charger itself by CANBUS, or if the charger does not support transmitting the AC voltage then the BMS will use a default value for the AC voltage (by default this value is 110vAC). **The J1772 protocol does NOT transmit data or information about the AC voltage. It only transmits the AC current limit.** Because of this, the BMS itself is not aware of the AC voltage unless the charger tells it (or it uses a default value).
3) If configured, the BMS will compute the maximum AC power available (by multiplying the AC voltage by the published AC current limit) and use this value to determine roughly what the maximum DC current limit would be based on this. **This feature requires that the BMS be programmed with the rough AC to DC efficiency to operate properly.** For example, if the published AC current limit is 12A and the AC voltage is 110vAC, the maximum AC power limit would be 1320 watts. If our battery pack is 200vDC and our charger has an AC to DC efficiency of 90%, that would mean the maximum DC current limit would be approximately 6A DC (1320 watts * 0.90 efficiency = 1188 watts usable, 1188 watts / 200vDC = ~6A DC). **If the AC voltage is incorrect, or the AC to DC charger efficiency is wrong, this may negatively impact the maximum DC current limit published by the BMS.**
4) The BMS may be reducing the current limit for entirely unrelated reasons (EG: the pack may be nearing full, or the temperature may be elevated, or the charger itself may not be able to handle the higher current limit that the EVSE is allowing for). Please see the Orion 2 BMS Operation Manual for details on how the charge current limit itself is calculated and what factors may restrict it.

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NOTE: It is possible to configure the BMS to ignore the AC current limit all together (and therefore not reduce the DC current limit due to the received AC current data at all). This is a checkbox option on the “J1772 Charger Control” settings tab.

To summarize, the following common causes may be resulting in the BMS reducing the Charge Current Limit due to J1772:

1) The AC voltage may be incorrect (ie: it is not being received from the charger OR the charger may not support transmitting AC voltage) or is defaulting to an incorrect value. This commonly shows up as the current limit being exactly half what it should be for US based installs where 110vAC level 1 charging is used (versus 220vAC for level 2 charging). The BMS publishes what it believes the AC voltage is on the Live Text Data screen described earlier in this document.

2) The BMS itself may be reducing the current limit for other unrelated reasons (meaning, the J1772 functionality is not the root cause for the lower limit).

3) If the EVSE is not providing a high enough current limit to activate (typically 6A AC) this may prevent the BMS from permitting any charge at all. Depending on how the BMS is configured on the “J1772 Charger Control” tab, this limit may be higher. Please see the J1772 settings screen for a complete listing of all the configured logic.

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