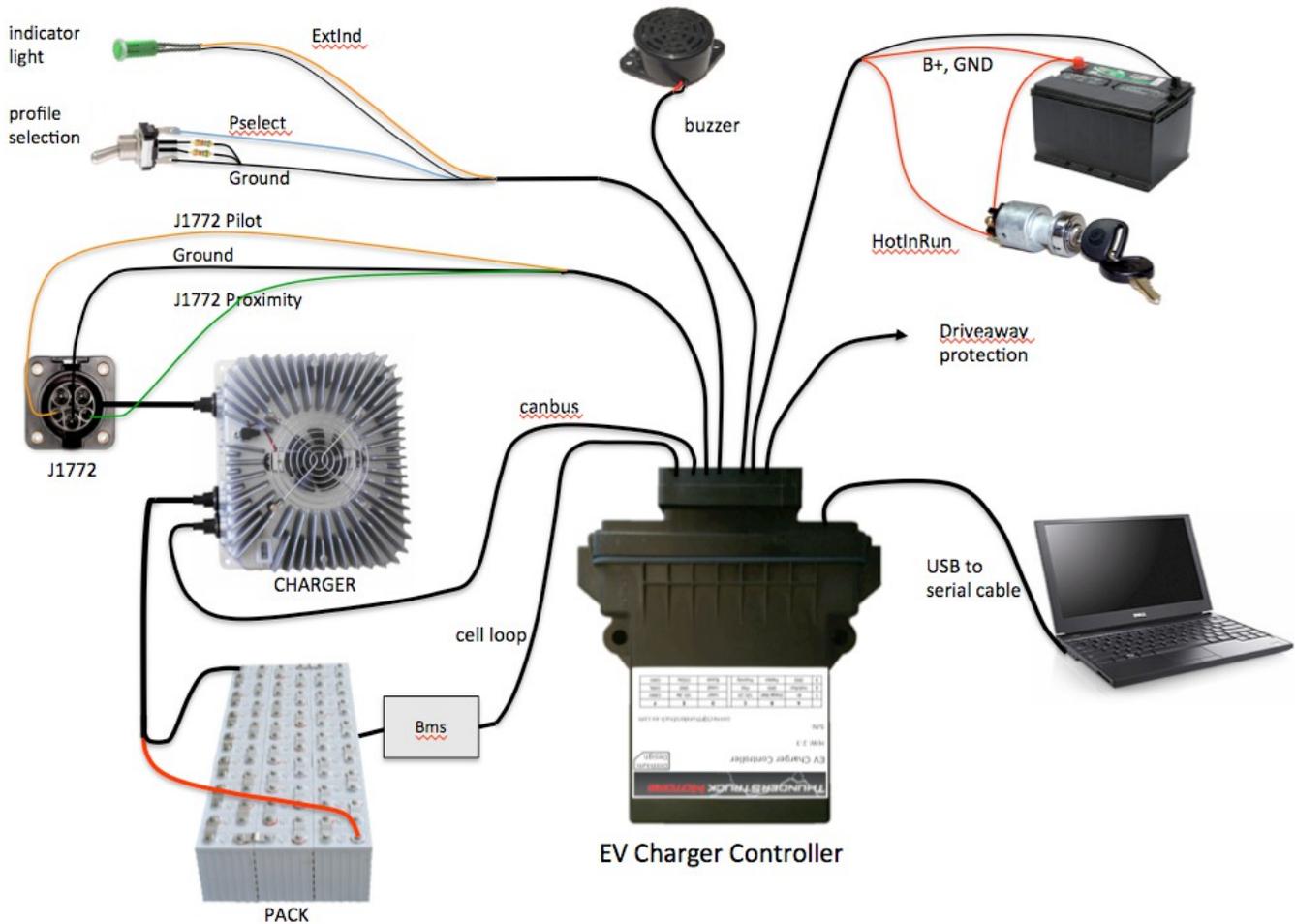


## Overview

The Electric Vehicle Charger Controller (EVCC) integrates charger CANBUS control and J1772 functions in a simple to use, cost effective, and environmentally robust enclosure. Charge parameters such as maximum voltage, maximum current, and total charge time are configured, saved in nonvolatile memory, and used when charging to control a CAN enabled charger. The EVCC connects to analog “cell loop” Battery Management Systems (BMSs) as well as CAN enabled BMSs.



**Figure 1 – EVCC System Diagram**

The EVCC draws approximately 3mA of current when “off”. The EVCC senses the presence of the J1772 plug and will automatically turn itself “on” to start charging. Current draw when “on” is around 35ma. The EVCC turns itself off when charging is complete.

The EVCC is configured using a simple serial interface. This interface is used for configuration and debugging, but is not required for normal operation. Diagnostic commands are supported to verify proper wiring, to trace CANBUS messages, and to retrieve charging history.

The EVCC supports the SAE J1772 standard. J1772 defines the physical connector and protocols used between the charging station (known as the “Electric Vehicle Service Equipment”), and the Electric Vehicle. The J1772 Proximity signal is used to determine if the charger plug is present. The J1772 Pilot signal is used to start and stop charging (by

enabling and disabling the contactor in the EVSE). The J1772 Pilot duty cycle is measured and can be used to limit charging current. “Driveaway protection” is supported so that the EV cannot be driven if the charge cable is still plugged in.

The EVCC supports several CAN enabled chargers, including the Thunderstruck TSM2500 charger. Charge voltage, charge current and overall charge time are controlled completely by the EVCC over the CAN interface to the charger. A constant current/constant voltage charge curve is supported for Lithium Batteries; and a three phase charge cycle is supported for Lead Acid Batteries.

The EVCC supports up to four parallel chargers for faster charging. When multiple chargers are configured, they are individually CAN addressed. Work is divided evenly between the chargers and statistics are gathered and recorded on each charger individually.

The EVCC will stop charging if the J1772 plug becomes unplugged, a cell overvoltage error occurs, there is loss of communication between the EVCC and Charger, or the maximum configured charge time is reached. Charging also stops at the end of a normal charge cycle, which, for Lithium batteries, occurs when the charging current drops below the minimum configured charge current.

Determining cell overvoltage errors and cell undervoltage error detection is the function of an EV Battery Management System (BMS). The EVCC can be configured to interface with a BMS either by a cell loop or by CAN messages. When a CAN BMS is used, the EVCC can also be configured to handle “balance cutoff”, which lowers the charging current when a cell exceeds a “balancing threshold”.

Charging history is provided for the last sixteen charge cycles and includes: the reason that charging stopped, total charge time, maximum voltage, maximum current, final current, and watt hours delivered.

When driving, the EVCC is started by the keyswitch, and can be used as a simple “BMS Master” - it can sound a buzzer when a cell undervoltage error is detected.

EVCC installation may be customized per customer requirements. EVCC features work largely independently and it is not necessary to wire up or use all features.

The EVCC is housed in a 4.55” x 5.13” x 1.67” automotive grade water-resistant enclosure. Connections are made with a single 18 pin connector. The EVCC is shipped with a pre-wired harness and with a USB to serial port cable.

## Bringup Checklist and Troubleshooting Hints

### EV Installation

- 1) Connect 12V, GND, Ignition
- 2) Connect Proximity, Pilot, GND
- 3) Connect P\_Select to a selector switch (and resistor array), if used

### Verify Analog Inputs

- 1) Type “**measure**” with no parameters to get the expected readings for each analog input. Note that if there is not a good ground connection between J1772 ground and EV chassis ground that the J1772 readings will be erratic.
- 2) Verify Cell Loop, using “**measure loop**”
  - a. Disconnect J1772 plug if connected
  - b. Verify readings with cell loop open and closed.
- 3) Verify Proximity, using “**measure proximity**”
  - a. Disconnect cell loop, if connected
  - b. Verify readings with charger plug disconnected, connected, and unlocked.
- 4) Verify Cutback, if used, using “**measure pselect**”.
  - a. Verify readings with different pselect switch settings.

### Verify J1772

- 1) Connect Cell Loop to CellLoop1 and CellLoop2.

- 2) Plug in J1772 Plug
- 3) The EVCC should attempt to start charging (LED blinks once per second).
- 4) Assuming the CAN bus is not connected to the charger yet, the charge cycle should stop after 10-15 seconds.
- 5) Remove 12V from Ignition, unplug the J1772.
- 6) Verify the “autostart” by plugging in the J1772 plug. The EVCC should power up and go into the Charge state.
- 7) For debugging, use “**trace state**” to verify that the EVCC attempts to start charging if the J1772 plug is in and the user powers up the EVCC.

#### **Verify Charger and CAN**

- 1) Connect Charger to J1772, connect CAN between Charger and EVCC.
- 2) Verify proper installation of the CAN termination resistors. Measure between CANH and CANL to verify that the resistance of 60ohms. Remember that if the internal EVCC termination resistor is used, that it must be powered up in order to make this measurement.
- 3) Now verify that when a charge cycle is started, that messages are exchanged between EVCC and Charger. (Use “**trace charger**” or “**trace can**” to log the messages).
- 4) If the pack is not yet connected to the Charger, the charge cycle will stop after a minute.

#### **Systems Test**

- 1) Verify all systems functions.