Systems Control Module 2 (SCM²)

---Manual---

HAWKEYE INNOVATIONS LLC

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Safety First!

This list is not all inclusive. Use common sense and be responsible when working with high voltage and high voltage components. High voltage components are dangerous and can cause injury or death if not correctly or safely handled. ***If leaving the vehicle/system unused for an extended period of time (a few weeks or more, especially in the cold), it is important to disconnect the high voltage traction pack and 12V battery to avoid parasitic drains - especially if your DC/DC converter is powered constantly. A DC/DC converter with undervoltage protection can still fail and/or drain the batteries very low.***

Always wear safety equipment such as high voltage rated shoes, gloves, and safety glasses. Be sure to remove all metal jewelry or any metal objects prior to working with any high voltage. Use insulated tools or insulate any tools that may be coming in contact with high voltage points.

Always check over the high voltage wiring and connections several times. Always use precautions when working with high voltage and/or series connected batteries. Be sure that the vehicle is off of the ground, and the wheels will not make contact with anything. It is good practice to have more than one support mechanism that supports the vehicle for extra safety.

Always refer to the component manufacturers' manuals for the most up to date information on their specific products. Please be sure to always use correct high voltage fusing and high voltage disconnect devices that are fully operational.

If you ever feel uncomfortable or uncertain in any way, STOP and seek advice from a knowledgeable person immediately.

DISCLAIMER:

SCM manuals and schematics can change and be updated at any time without notice. Except for Hawkeye Innovations, LLC's express warranties, if any, set forth in the manual regarding the Systems Control Module (SCM) located at https://www.hawkeyeinnovationsllc.com/store/p18/Systems-control-module.html , Hawkeye Innovations, LLC, makes no representations or warranties whatsoever with respect to the SCM, including but not limited to any warranty of merchantability, warranty of fitness for a particular purpose, or warranty against infringement of intellectual property rights, whether express or implied by law, course of dealing, course of performance, usage of trade, or otherwise. Hawkeye Innovations, LLC, has no control of third-party installation or use of the SCM. Accordingly, Hawkeye Innovations, LLC, assumes no liability for vehicle functionality or safety during or after third-party installation of the SCM. Additionally, Hawkeye Innovations, LLC, assumes no liability for any damage caused to the vehicle or the SCM as a result of installation of the SCM. Hawkeye Innovations, LLC, assumes no responsibility for this product in any use. SCM documentation can be updated at any time, without notice.

Wiring Schematic

The most up to date schematic is available for direct download from the link on our website SCM web page and QR code below (scroll toward the bottom of the web page, next to the manual download).

https://www.hawkeyeinnovationsllc.com/store/p18/Systems-control-module.html

SCM Specifications

Fusing:

- Please review the wiring schematic for fusing instructions based on the installed features of your SCM. (Fusing and wiring key is at the bottom of the schematic)

Current output:

- Coolant pump output: up to 5A
- Cooling fan output: up to 10A

Miscellaneous specifications:

- SCM initialization time: 3 seconds (when main power connector is plugged in with 12v present)
- 12v battery watchdog circuit trigger voltage: 12.7v (can be customized upon request, but for almost all cases with a lead acid starting battery, we recommend **not** changing this unless you have a Lithium 12v battery)
- SCM standby current draw: about 10mA @ 13.2V.
- SCM and Orion BMS (36 cell unit) idle current draw: 160 mA @ 13.2V.
- SCM enclosure dimensions: Approximately 10 by 6 inches and 3 inches tall.

Product Overview

--- Hawkeye Innovations LLC ---

General Overview: The SCM is a centralized control module designed to save countless hours of time and effort while providing a clean factory look. It controls almost all aspects of your electric vehicle's (EV) 12V system, and the way it interfaces with various high voltage (HV) components. The SCM is a great solution that simplifies the overall wiring of the vehicle.

Compatibility: The SCM is designed to be used with the popular EV conversion setup employing the HyPer 9 AC drive system by NetGain Motors, Orion BMS 2 by Ewert Energy Systems, TC/ElCon Battery Charger, TC/ElCon DC/DC, Hawkeye 6.6kW + 1.2kW Charger/DCDC Combo. All of these products are systems we sell and are available. For more information on compatibility and options, please contact us.

Base model features:

- DC/DC Converter control
- CAN Bus Hub
- 12V Battery Watchdog Circuit
- Controller Enable Logic Control
- Hawk-IoT Telematics Compatible
- Controller Ignition Relay
- Intelligent coolant pump control
- Coolant pump PWM control
- Intelligent cooling fan control
- Power brake/Power steering Signal Control
- Deceleration Light Output

Optional add-on modules:

- Preheater/Cabin Heater module (2024).
- A/C Kit (for cabin cooling and battery chilling) with smart speed control (2024).

Feature Details

DC/DC Converter Control – Fully compatible with TC/ElCon DC/DC converters and Hawkeye 6.6kW + 1.2kW Charger/DCDC Combo. The SCM powers-up the DC/DC converter in three different states. (1) Ignition is on (driving mode). (2) Ignition is off and the vehicle is in charging mode. This is so the 12V battery will stay charged under the 'charging' state loads of the coolant pump and coolant fan. (3) 12V Battery Watchdog circuit is active (12V battery fell below the threshold voltage).

CAN Bus Hub – One CAN bus pair that goes to the Orion BMS, and 6 CAN bus pairs that can be wired up to any CAN device you want to add to your network.

12V Battery Watchdog – All EV conversions have parasitic draws on the 12V system that, unaddressed, will discharge the 12V battery. At the very least, it can leave your BMS with no power, preventing the car from being started. Over time, repeated over-discharge abuses will eventually kill the battery (battricide!). The SCM's Watchdog circuit monitors the state of charge (SOC) of the 12V battery, and at 12.7V automatically powers-up the EV's DC/DC converter to recharge the 12V battery. This system is superior to leaving your DC/DC converter on to constantly charge your 12V battery, which harms the battery and creates a significant parasitic draw on the HV system. NOTE: The Watchdog circuit will not work when SOC is < 25%.

Controller Enable Logic Control – Controls the K1-4 and K1-7 enables on the HyPer Controller to ensure the BMS can shut down any discharge and charge into the battery pack.

Hawk-IoT Telematics Compatible – Can send some data parameters to the Hawk-IoT WiFi module.

Control Ignition Relay – Integrated HV relay to handle the ignition signal to K1-24.

Intelligent coolant pump control – The coolant pump is activated during ignition-on driving mode, but also needs to be on during charging without backfeeding to the ignition system, so the SCM controls the coolant pump in two ways. (1) 'Ignition on' state (driving mode). (2) 'Ignition off' state (charging mode), and does so without backfeeding to the ignition-controlled circuits.

Coolant Pump PWM Control – The SCM will also speed control the coolant pump through the Pump PWM output, at a default speed control of 60%. This speed control value can be changed prior to shipping out your unit.

Intelligent cooling fan control – As with the coolant pump, the cooling fan will automatically turn on and off via the set temperature in the Orion BMS settings, in both driving and charging modes.

Power brake/Power Steering Signal Control – Controls an external relay (customer supplied) used to power-on most electric brake vacuum kits, and will output +12V signal, up to 0.5A max.

Deceleration Light Output – We have found that the deceleration light output on the HyPer Controller is very erratic, and can incorrectly enable this output. There is also no regen threshold to enable this output. The SCM output runs off of the current measured by the BMS, and triggers when ignition is on, and is -35A or larger regen current. This value can be customized prior to shipping your unit.

“Common problems” the SCM solves

- ***Effortless and seamless integration of accessories (i.e. Air conditioning, heater, display, and more).***

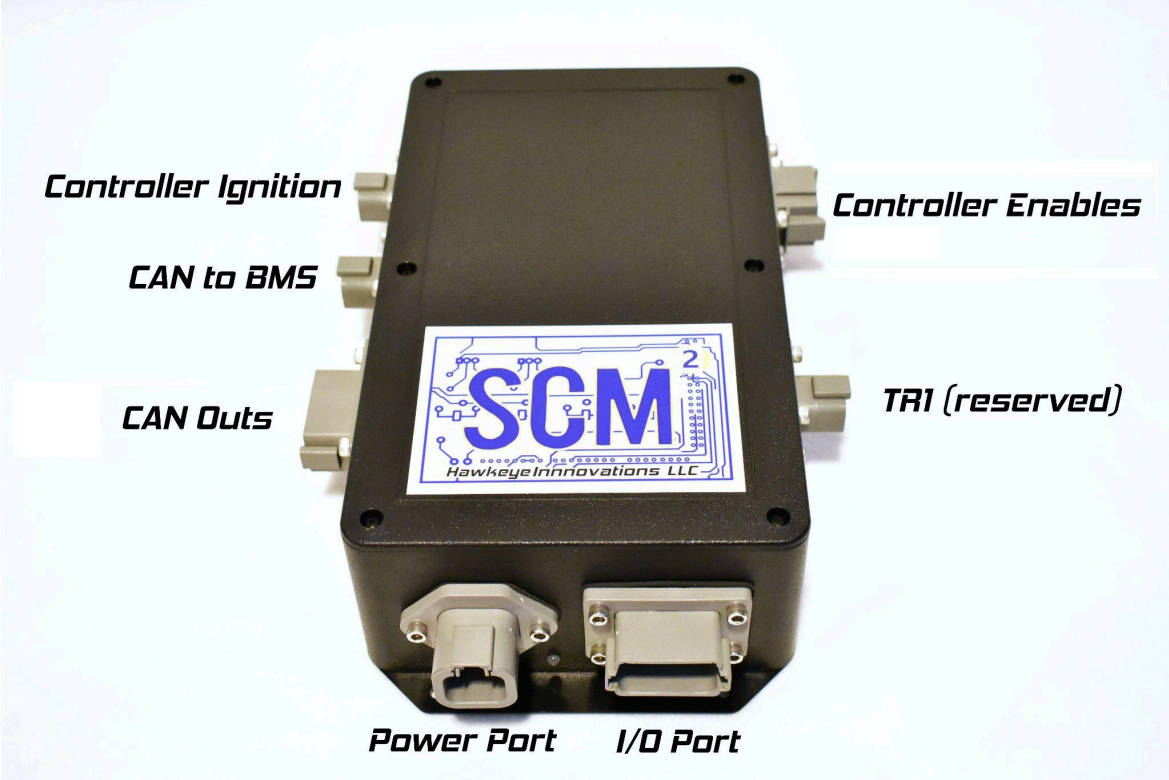
- The coolant pump must be on when the car powers up (ignition on), as it cools down the components during discharge. The challenge arises when the vehicle needs the coolant pump to also be on during charging as well. If the pump is wired to your ignition system, that will not function correctly. When you try to charge the car, it will back-feed into your ignition system and turn the car on – which is a problem. Typically, this is resolved by adding at least two separate relays and some tricky logic – which increases the complexity of your conversion. Since the SCM maintains control over the coolant pump in the vehicle, this common problem is easily solved.

- The 12V Battery Watchdog feature of the SCM will protect the 12V battery from the parasitic draws of the car or EV components like the BMS, which tends to be a common problem in some old and new conversions.

- With the Orion BMS, it only sends out CAN bus data when the ignition is on, or when the car is charging. If you are using the Hawk-IoT WiFi module, this could potentially be an issue. Here at Hawkeye Innovations, we enjoy being able to check up on the battery pack any time of day, and our customers like this feature too. The solution to this is to keep the Orion BMS in the “awake” state all of the time, which keeps CAN bus data flowing to the WiFi module. Unfortunately, this also enables the Orion fan output, which on a hot day, may leave your cooling fan running continuously even though the car is off. The SCM also has an integrated cooling fan control that will provide additional checks to see if the BMS is requesting the fan, but will only allow it if the car is actually on or charging, fixing this common problem.

Getting familiar with your SCM

Figure 1



Looking at **Figure 1**, these are the functions of each port listed below:

I/O Port – Signal input and outputs.

Power Port – 12V power input, Pump + output, Fan + output.

CAN Outs – Integrated CAN Hub, these 6 pairs of CAN pairs can be wired to any of your CAN devices on your network.

CAN to BMS – This CAN pair should be wired to the Orion BMS CAN1 line.

Controller Ignition – CAUTION! This connector is wired to HV+ and will switch High Voltage, be careful! (only X1 Controllers). This will switch HV+ to the K1-24 ignition circuit.

Controller Enables – Inputs to control some X1 controller functions.

TR1 – Reserved.

Harness/Pinout Overview

Orion BMS I/O Harness

Your SCM2 kit will include a custom Orion BMS 2 I/O harness as shown in **Figure 2**. This harness is identical to the original Orion harness, but has been skimmed of everything unnecessary in most projects.

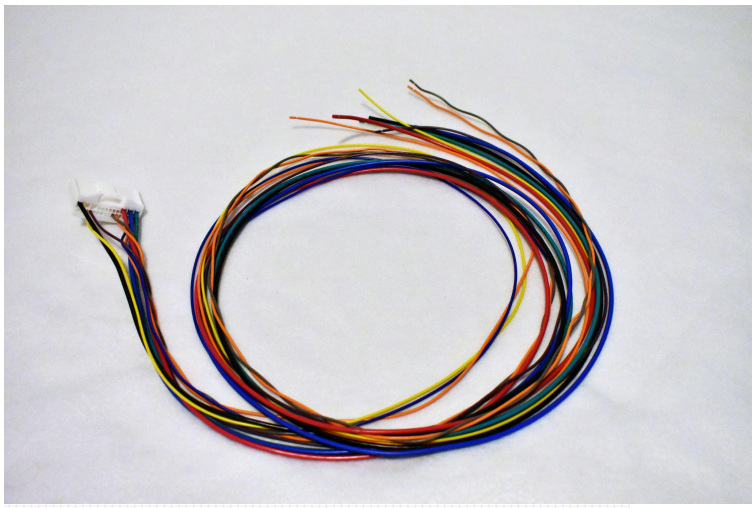
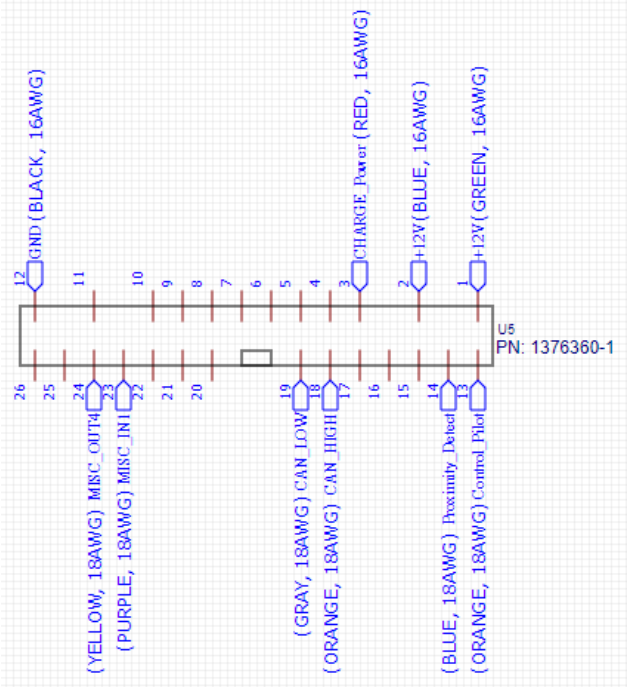


Figure 2



Follow the Orion BMS instructions to connect power and the proper fusing on the power input (pins 1, 2 , and 3). The CAN orange and gray twisted pair of this BMS I/O harness is on the CAN1 of the BMS, which has an integrated CAN termination resistor. Be sure to add one more resistor somewhere on your CAN bus for proper termination. The CAN of this harness should be connected to the 'CAN to BMS' port of the SCM (harness in **Figure 4**). Proximity detect and control pilot are for your J1772 port. The Misc_Out4 and MiscIn1 are not used in most applications, but in the harness if you need them.

Figure 3

Figure 4

I/O Port Harness (Figure 5)

1. **Ignition Input (Red) –** The SCM needs +12V signal on this circuit for ignition to start up the car.
2. **Preheater Input (Green) –** Switch this wire to ground to activate the preheater module.
3. **A/C Input (Orange) –** Switch this wire to ground to activate the A/C module.
4. **Battery Chiller Input (Blue) –** Switch this wire to ground to activate the battery chiller function of the A/C module.
5. **DC/DC Enable (yellow) –** Connect this wire to the DC/DC enable input of the DC/DC converter.
6. **Pump PWM output (Purple) –** Connect this to the PWM input of the Tesla Coolant Pump to control it at a lower speed. Default programmed value is 60% speed, and can be pre-programmed prior to shipment at any speed request. Note, you do not need to connect this wire to the pump. No PWM input to the pump will default at full speed.
7. **Deceleration Signal Output (Tan/Brown) –** This is a +12V 0.5A signal out that can power a relay to turn on the brake lights. This output turns on when ignition is on, and current is -35A or larger regen current.
8. **Power Steering/Power Brake Signal Output (Gray) –** This is a +12V 0.5A signal output that is turned on when ignition is on. This signal output can be used to turn on your power relay for power steering, or power relay for power brake system, or both.
9. **Heater Input (Pink) –** Switch this wire to ground to activate the heater module.

Figure 5

CAN Outs Harness (Figure 6)

The CAN Outs Harness has 6 pairs of CAN lines that can be wired up to any CAN device on your CAN network. Gray is CAN low, and orange is CAN high.

Figure 6

Controller Enables Harness (Figure 7)

This harness connects to some of the wires on your HyPer Controller K1 harness.

Pin 1 (Black) – Connects to K1-1

Pin 2 (Green) – Connects to K1-4, this is used to enable or disable the drive motor when the BMS needs to shut down discharge.

Pin 3 (Blue) – Connects to K1-7, this is used to block regen when the BMS needs to block any charging.

All other plugged circuits are reserved.

Figure 7

Controller Ignition Harness (Figure 8)

X1 Controller (non isolated logic):

CAUTION! This connector is wired to HV+ and will switch High Voltage, be careful! (only X1 Controllers). This will switch HV+ to the K1-24 ignition circuit on the X1 controller.

Pin 1 (Orange) – This is the HV+ input, which needs to be fused with a 10A fuse.

Pin 2 (Red) – This should be connected to the K1-24 wire of the X1 controller.

X144 Controller (isolated logic):

Pin 1 (Orange) – This should be connected to **+12V** constant with a 10A fuse.

Pin 2 (Red) – This should be connected to the K1-24 wire of the X1 controller.

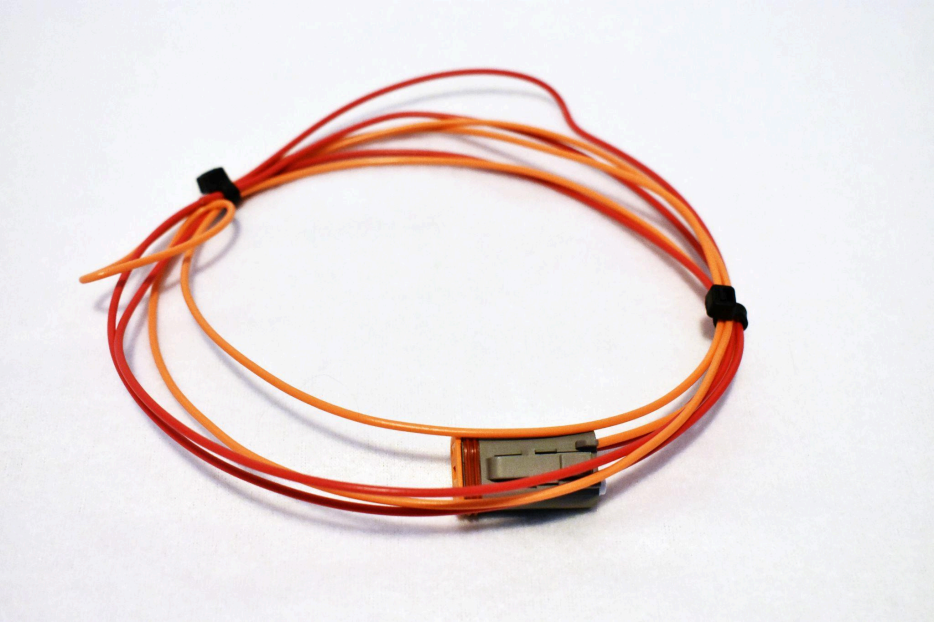


Figure 8

Power Port Harness

Pin 1 (Red, "P1") – +12V Constant, 30A fuse

Pin 2 (Black, "P2") – Ground (-12V)

Pin 3 (Brown, "P3") – Fan output + (connect to the positive of the fan, then ground the negative of the fan).

Pin 4 (Blue, "P4") – Pump output + (connect to the positive of the pump, then ground the negative of the pump).

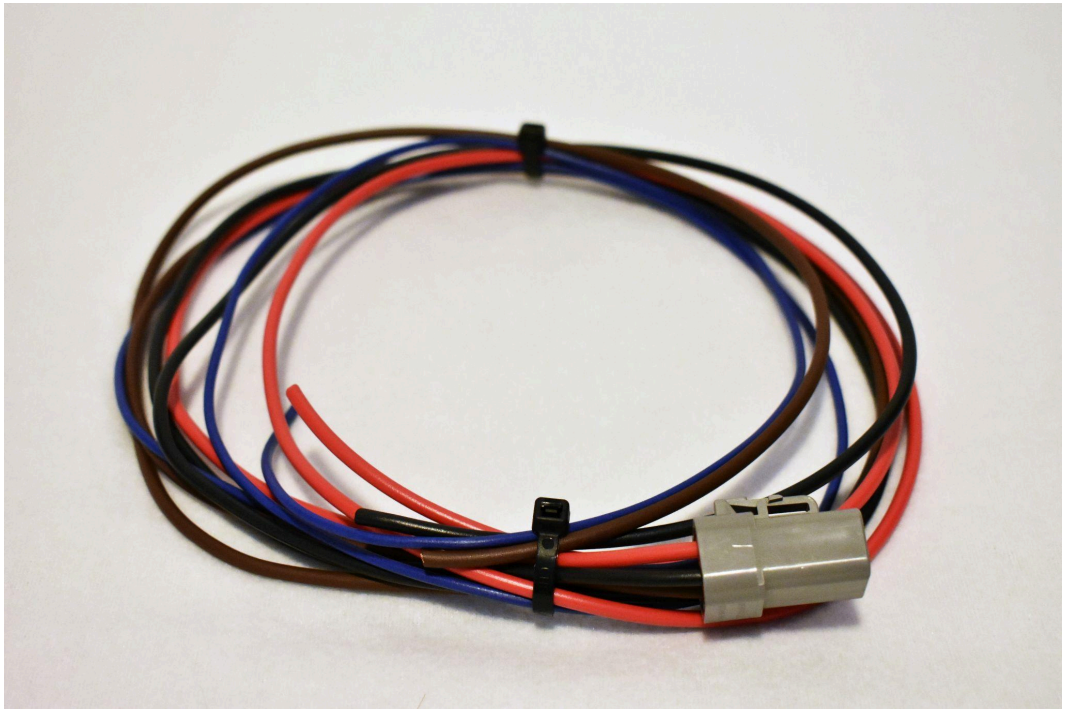


Figure 9

Connecting to your system

To connect the SCM to your system, first connect all of the wires outlined in this manual that apply to the features you need/want to use. Please follow the directions in the previous sections, and refer to the “Harness/Pinout Overview” section for pinout information, as well as pin descriptions and uses.

A few things to note:

- The SCM uses the Hyper Controller ‘Interlock’ input when the Orion BMS needs to block discharging.
- The SCM uses the Hyper Controller K1-7 ‘Clutch Switch’ input when the Orion BMS needs to block charging and prevent any regen. This input should not just be used by the SCM, but should also be wired in parallel as your clutch switch if you are using a manual transmission and only if you have regen enabled. If you have the lower voltage HyPer system (non isolated logic), this parallel connection should connect K1-7 to K1-1 when the clutch switch is pressed (I/O Ground on controller, **NOT** chassis ground). If you have the higher voltage HyPer system with isolated logic, this parallel connection should connect K1-7 to chassis ground (-12V ground) when the clutch switch is pressed. This can get a bit confusing, so if you have any questions, please feel free to reach out to us.

1. **Please ensure that high voltage is not yet present, this will be switched on in a later step. We recommend using a HV rated disconnect switch such as the Rincon/Gigavac HV Disconnect that we sell in our conversion kits and our online store.** Wire up the HV+ through the fuse mentioned previously, to the HV+ input of the SCM with a 20 AWG wire. Then, connect the K1-24 red wire from the Controller Ignition harness, to the K1-24 on the controller.

2. Wire up the 3 wires on the Controller Enables harness to the HyPer Controller.
3. With all 12V power off and no power on the CAN bus, connect all of the CAN out pairs to your devices, CAN to the BMS, and any other signals that need to be wired up on the I/O Port for your application.

4. ***After wiring up all necessary connections for your SCM, you will need to verify and recheck all wiring of all components, and connections of the SCM prior to plugging any connectors into the SCM.*** Once you have verified the wiring, plug in all of the connectors into the SCM, except for the Power Harness.

5. ***Verify again that everything is wired correctly and verify that the polarity of the SCM Power harness wiring is correct. Due to the 12V Watchdog monitoring circuit in the SCM, the unit does not have reverse polarity protection on the power input, so please be sure your polarity is correct on SCM P1 and P2. Reversed polarity can damage your SCM! Please refer to the SCM wiring schematic for fusing instructions.*** You may now plug the SCM Power harness into the SCM Power port.

6. High voltage can now be switched on using a manual HV (High Voltage) disconnect switch, only if you have your high voltage and all other wiring of your setup safely completed and checked. ***If you ever feel uncomfortable or uncertain about any wiring or especially high voltage wiring, please stop and consult a professional and/or a knowledgeable person.***

SCM Status LED States

Green blink (right LED): The LED will blink green once every 3 seconds to show that it is idle, which is when ignition is off and the vehicle is not in charging mode. It also indicates that the SCM is communicating with the BMS over CAN bus.

Solid Green with blink (right LED): This shows that the ignition signal is present, and the SCM is in 'driving' mode. You will see the idle blink as mentioned above if the ignition signal is present, and the unit is communicating with the BMS over CAN.

Solid Green no blink (right LED): The SCM has the ignition on signal, but is not communicating with the BMS (the unit will not run).

Solid Blue (right LED): This shows that the Orion BMS is requesting charge, and the SCM is in 'charge' mode (this is when the charger safety relay is active). Note: This doesn't mean that just the J1772 is plugged in, but means that the BMS has completed its cross-checks and is requesting charge from the charger (usually over CAN bus). When charging is complete, the blue LED will disappear.

Solid Red (right LED): Ignition input is off, charge mode is off, and the SCM is not able to communicate with the BMS over CAN.

Solid Orange (left LED): 12V Battery Watchdog protection circuit is active.

Left LED off: Idle state.

The SCM should now be fully operational and set up with your system. If you have any questions, please feel free to contact us!

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