

**Conversion Document  
For Adapting The Toyota Rav4 EV  
For Use With  
AC Propulsion's Long Ranger, Range Extending Trailer.**

# Preliminary

**Warning:**

This conversion requires modifications inside the vehicles battery pack as well as the PCU (Powertrain Control Unit). The voltages in these systems can be Lethal.

Extra care must be taken when working with dc voltages because of the tendency to continue to arc once an arc has started. A high power dc source such as a vehicle battery can cause electrical explosions.

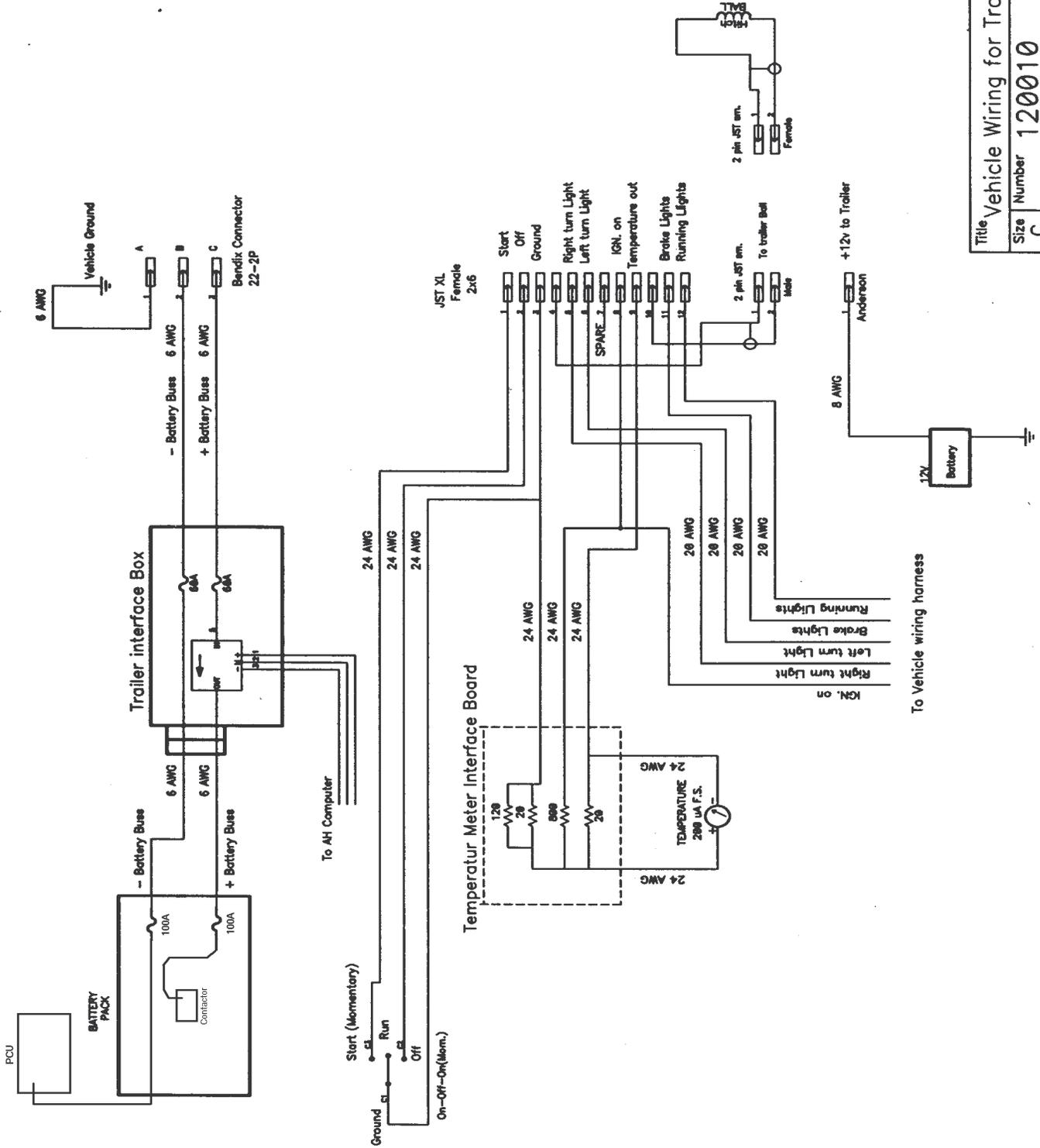
Do not attempt this conversion unless you are fully versed in related safety practices. This document does not cover safety practices.

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# Vehicle wiring overview

8/1/2000



Title		Vehicle Wiring for Trailer III	
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## Modifying the Main Battery Pack

### Overview:

The trailer's 6 AWG high voltage wires attach to battery pack on the vehicle side of the main contactor, this allows the vehicle's main contactor to continue to prevent any high voltage from leaving the pack if the contactor is turned off. We also place two 100A DC rated fuses inside the main pack to protect against shorts in the trailer's cables between the pack and the HIB. The trailer's positive high voltage wire connects inside the battery pack on the positive output terminal of the main contactor, the trailer's negative high voltage wire goes through the pack, through the battery cable to the PCU then it connects inside the PCU after the current sensor, in other words the PCU side of the current sensor. The placement of the negative wire on PCU side of the current sensor allows the vehicle's state of charge meter to account for any contribution made by the hybrid.

### Pack removal:

- Put the vehicle on a hydraulic lift.
- Disconnect 12v accessory battery.
- Make sure ignition key is out.
- From under front of vehicle, disconnect the pack's two multi-pin connectors, see figure 1, this will also prevent the main contactor from engaging during the next step.
- Open up the PCU and confirm that no voltage is present on main battery cables before proceeding. Disconnect main battery cables and wrap ends with electrical tape.
- From under PCU disconnect main battery cable and pull free from PCU, make sure electrical tape is covering battery cable ends.
- Place movable cart or hydraulic table under vehicle to support main Pack and lower vehicle, or raise table to support main pack.
- Loosen all bolts then remove all bolts supporting main pack while confirming table is supporting it properly.
- Lower pack, or raise vehicle, slowly while watch for anything snagging or catching.

Two holes need to be drilled in the rear of the pack to pass the hybrid trailer's 6 AWG wires through, see figure 2. Drill the holes large enough to fit rubber grommets in them so that the 6 AWG wire does not rub directly on the fiberglass. The 100A fuse holder, see figure 2, will either have to be fabricated or acquired through AC Propulsion.

Wrought the 6 AWG wires through pack as shown in figure 2, 3 and 4, cover as much of the 6 AWG wire with split-loom to prevent wire chaffing. Use zip ties to secure 6 AWG wire in multiple locations along its path through the pack. The main battery cable bundle will have to be unwrapped so that the negative wire can be included in the bundle, and then it must be rewrapped. Judging by the picture you should leave about 2 feet of wire past the end of the main battery cable bundle so that the negative 6 AWG wire will have enough to reach its connection inside the PCU. The 6 AWG wire length from the pack to the HIB depends on your mounting location and orientation of the HIB.

We recommend that you fabricate a cover for the 100A fuses, we made one using a piece of PVC tubing, see figure 5.

After the pack wiring is complete, seal up and re-install the battery pack into the vehicle. Once reinstalled the negative trailer wire can be cut to length and connected inside the PCU, see figure 6 and 7. Then seal up PCU and start on low voltage wiring.

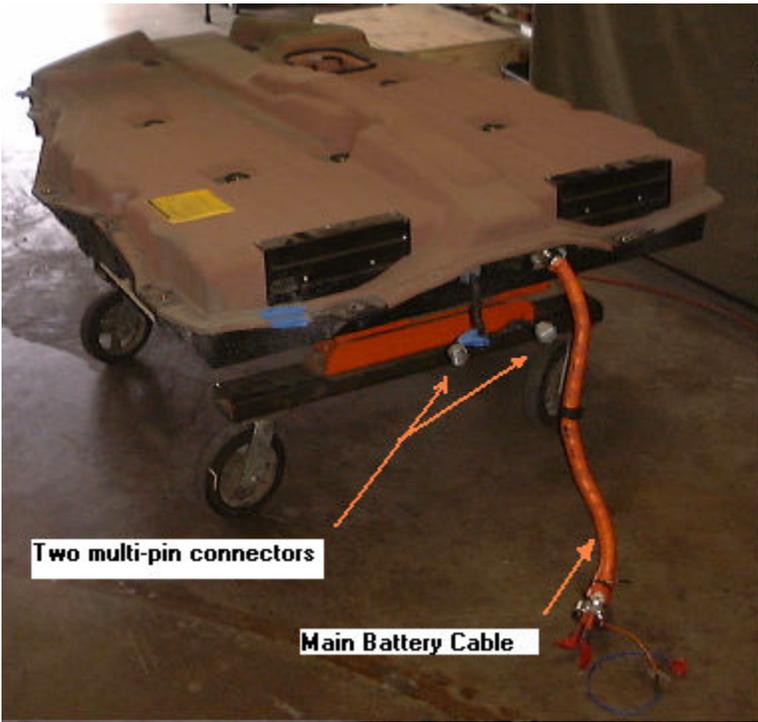


Figure 1

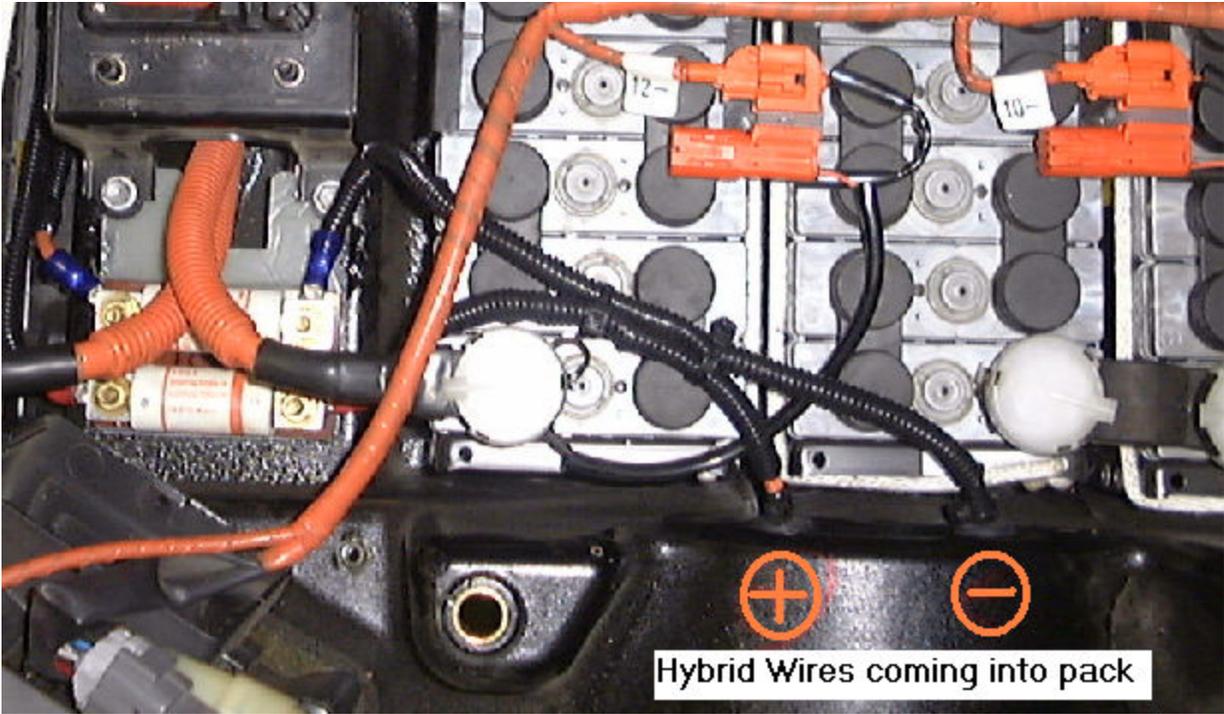


Figure 2 (Hybrid wire routing and Fuse placement)

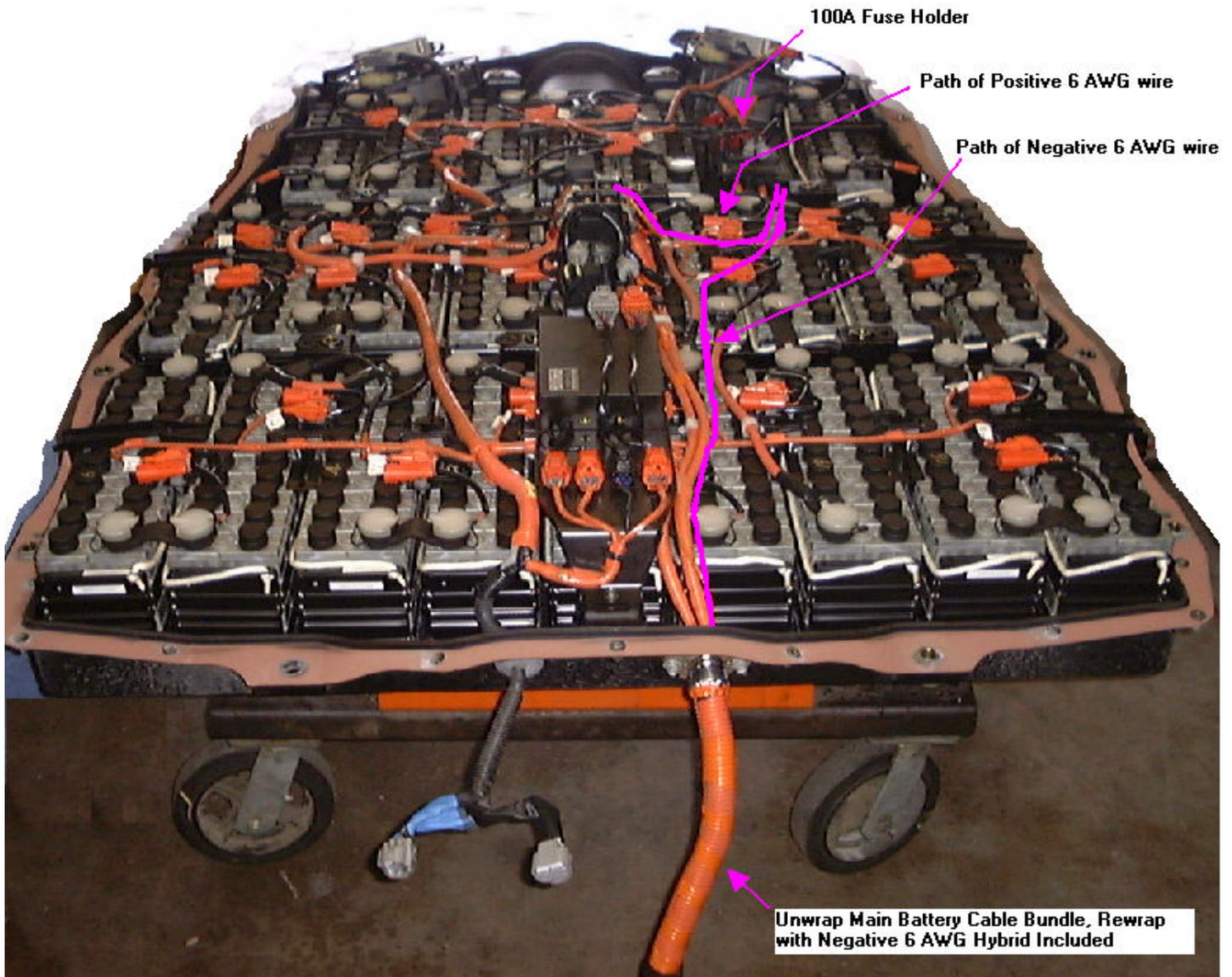


Figure 3 (Path of Hybrid Trailer's High Voltage Wires Inside Main Pack)

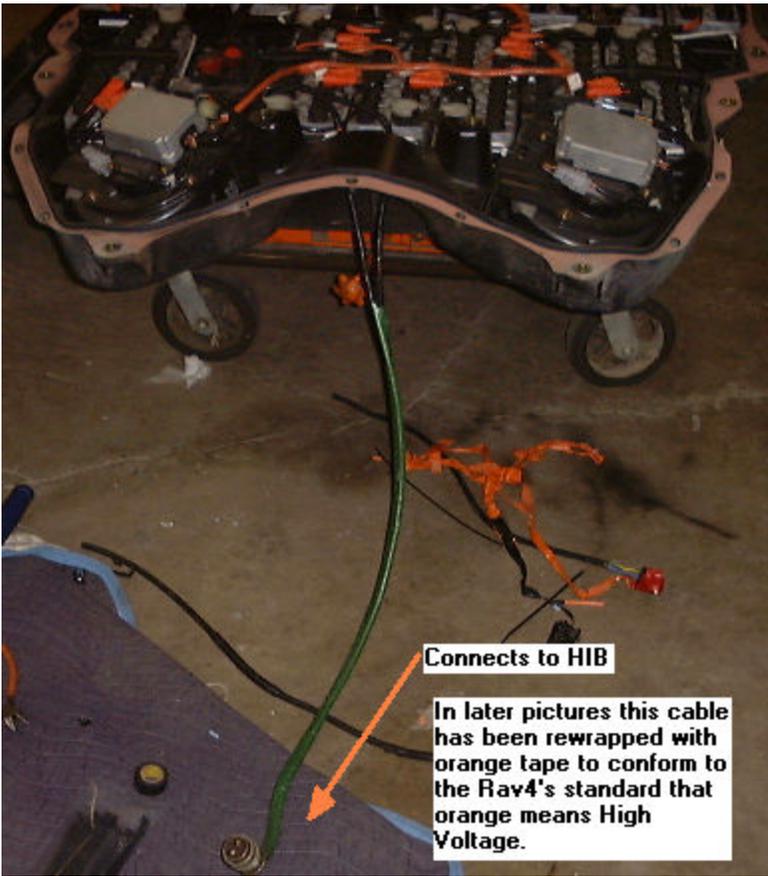


Figure 4

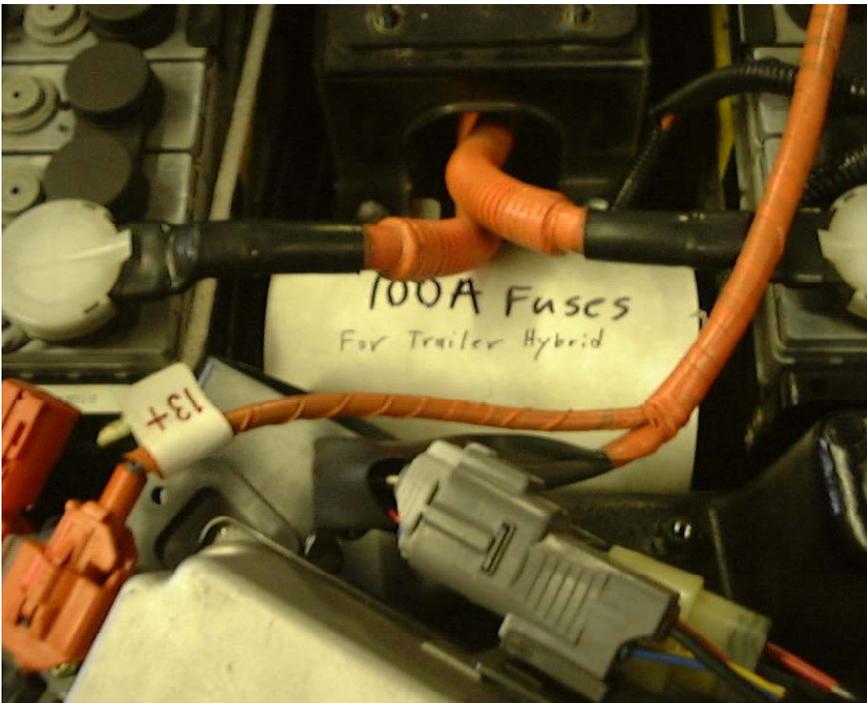


Figure 5 (Fuse Cover for 100A Fuses Inside The Main Pack)

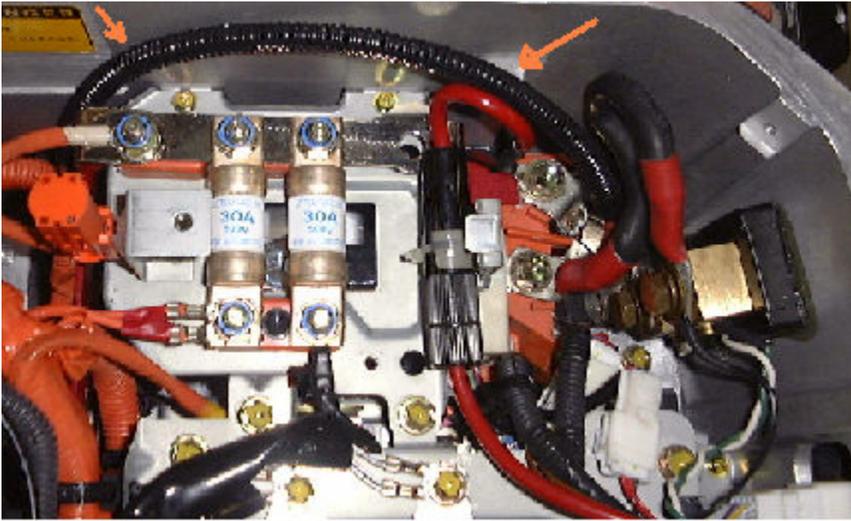


Figure 6 (Routing Inside the PCU)



Figure 7 (Connecting Inside the PCU)

## Low Voltage Wiring

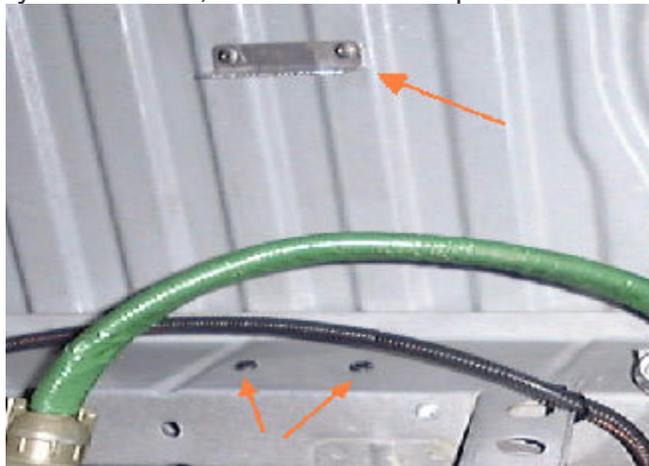
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## HIB (Hybrid Interface Box)

The hybrid, or trailer, interface box houses the two 60-70A DC rated fuses as well as the hybrid current sensor that supplies a signal to the driver's hybrid current gauge. The 2 pin female Bendix connector that was added to the main pack, plugs into the HIB. And the two 6 AWG wires that come out of the HIB go to the 3 pin Bendix connector, along with the 6 AWG chassis ground cable, that plugs into the trailer.



We mounted the HIB above the spare tire, by pop riveting on an aluminum bracket on one side of the HIB, with threaded holes added to the HIB. To the other side of the HIB we added two metal dowels that line up with two rubber grommets that we added to a cross member. This method allowed us easy removal of the HIB, only two screws, if service was required.



## Trailer Hitch

One of the key features of this hybrid trailer is its active steering. Because of the trailers overall short length it must only be used with the active steering functioning properly. Also it is critical that there is no up/down slop to the hitch ball connect and no slop of the ball to vehicle connections. For more on maintenance and adjustments see the trailer interface document.

The trailer ball height should be such that, on level ground, the trailer's horizontal frame rails are parallel to the ground

## Preliminary testing

Coming in later version of this document.