Headboard: SEVT Battery Management System

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What is the Headboard?

The headboard is the main board in the battery management system for the MIT Solar Electric Vehicle. It contains all the high voltage and low voltage components used in battery management. This board has been refined over many years, and has recently undergone changes to move the car over from single occupancy to multi occupancy. With this new vehicle class comes new requirements for the car, including EV charging and a much larger battery. The board is composed of 5 schematics: high voltage, power, at90can, IO, and horn components; which are all brought together on the top level diagram below.

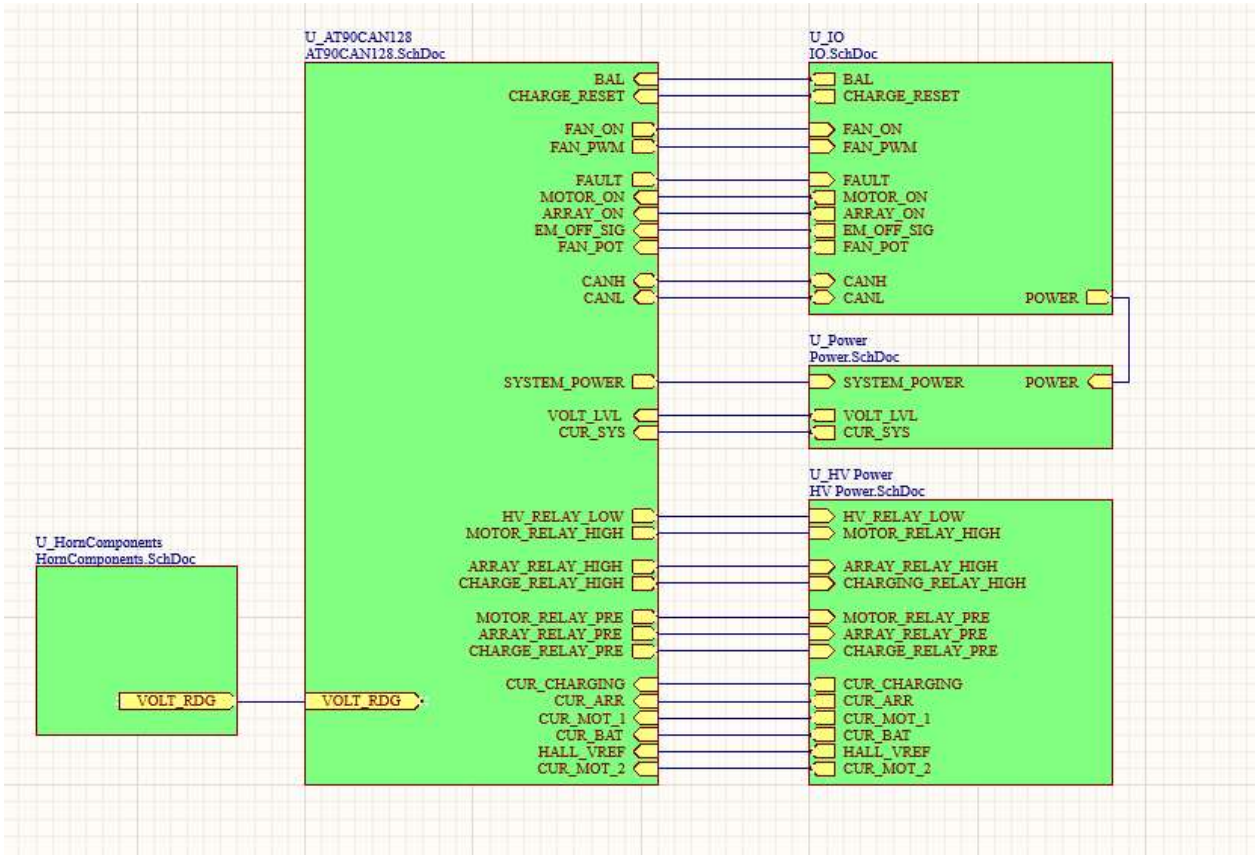

Figure 1: Top Level Diagram

The top level diagram allows for the large board to be brought together, without it being a cluttered and crowded schematic.

Changes for Multi Occupancy

For the new car, Gemini, we will have 2 motors, where we used to have only one. Because of these new motors, there will be a fairly large current draw. We originally planned to have this current connected on the board, and then for it to split with off-board wires. An issue with this was partially due to supplies, as research failed to turn up a PCB mount hall effect sensor that could process 80A. Rather than working with an off board sensor, we decided instead to split the current earlier while still on the board, using one contactor (K3) still, but two hall sensors (U12, U16) and two connectors (J6, J15).

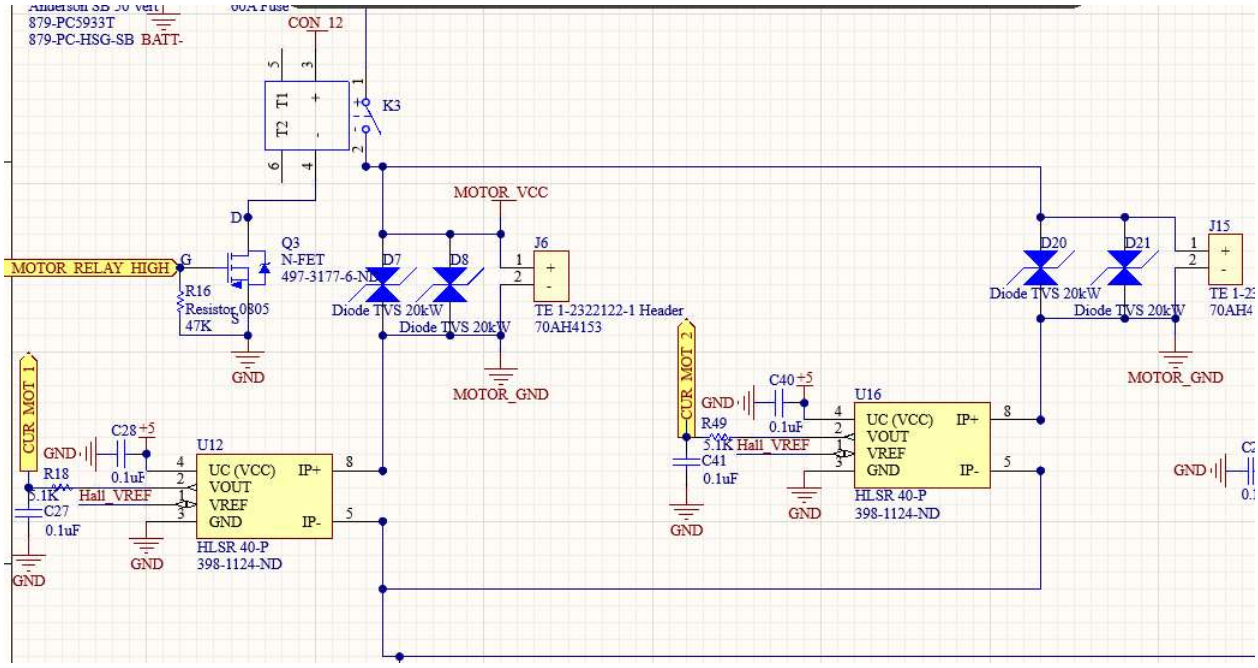

Figure 2: Motor Sensors

The other big change on the high voltage schematic was the addition of EV charging. Where we previously relied only on solar power, we now also use power from the wall. To add this, we essentially duplicated what had already been done on the high voltage schematic, while

changing the labeling. Some changes crossed over to other schematics, and we followed through the schematics accordingly.

The other important change for this car was the regulation that all battery modules, including supplemental batteries, must be housed in no more than two enclosures. This meant that the supplemental battery which supplies power to our car horn must be in the battery boxes along with our larger car battery. To accommodate this, we also moved the PCB components that are used for the horn onto the headboard, as opposed to the control board where they previously lived.

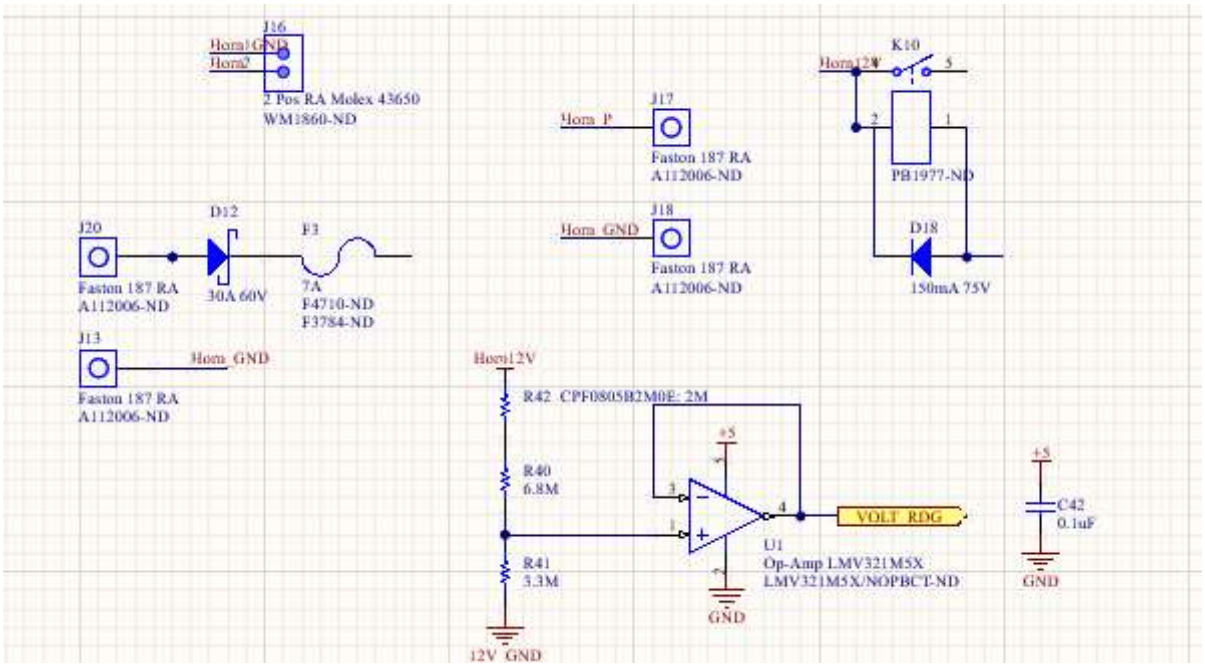

Figure 3: Horn Schematic (I am going to combine R40 and R42 I promise)

We use at90can chips on our boards. Admittedly, we do not love this, and we want to change this for our next car. But as we are working with time constraints, we decided not to change our infrastructure just yet. For the headboard, though, we seem to be running low on pins, specifically analog to digital conversion pins, on this chip, so we had to add some analog to digital converters (B1, B2) to allow us to use other pins.

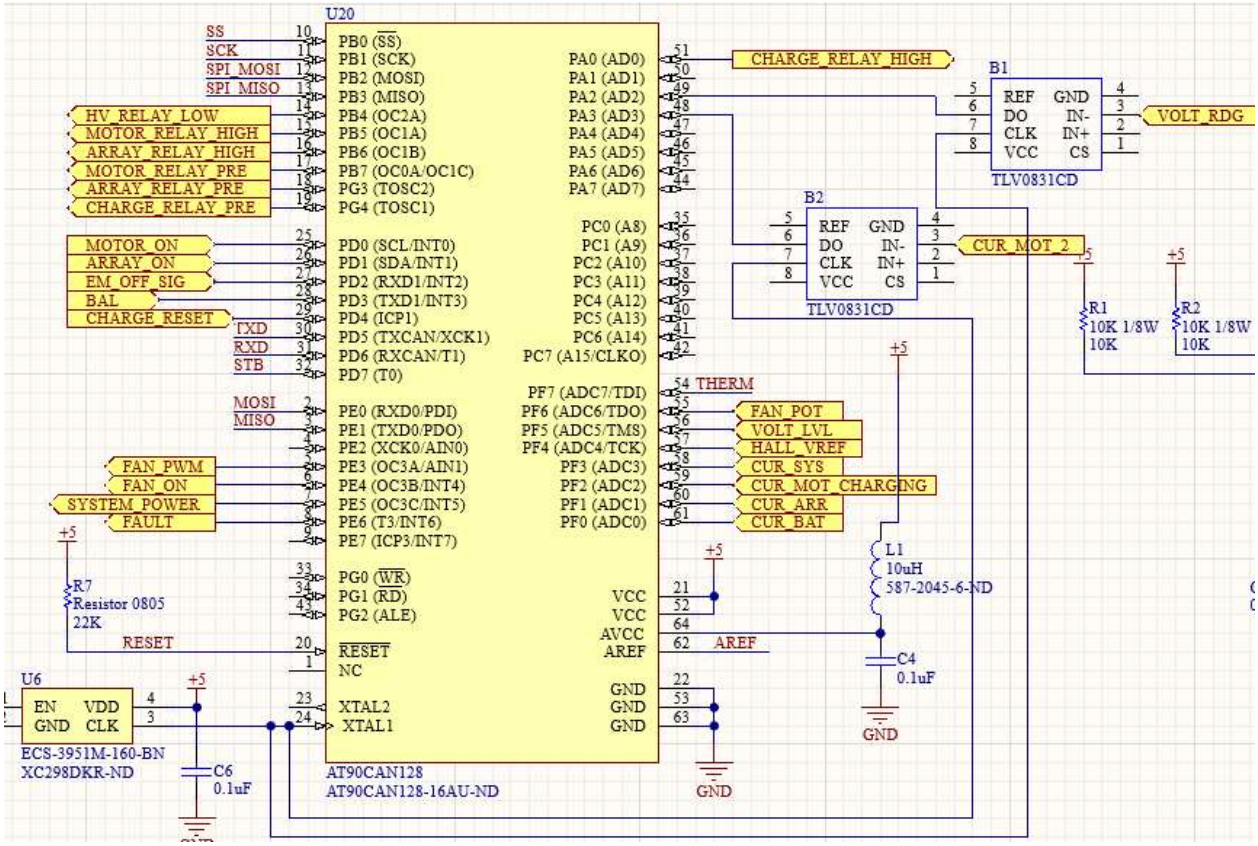

Figure 4: AT90CAN

Ongoing Issues

One major issue we have been unable to solve yet has been the solar array pre-charge. We have pinpointed this issue to R30, but have yet to calculate the correct value for it as we need to research various other values before we can complete the calculation.

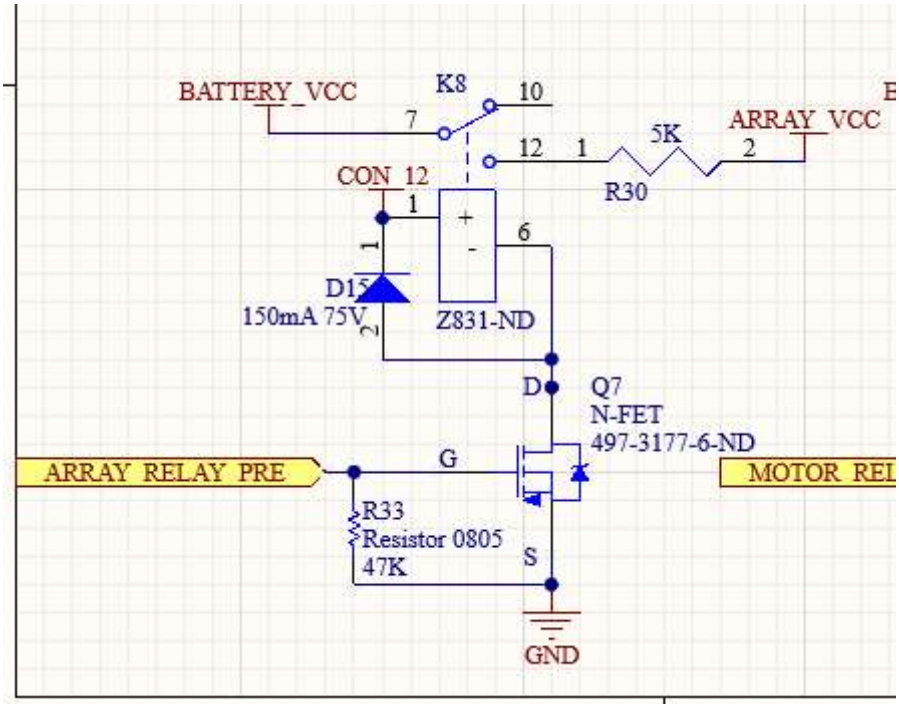

Figure 5: Array Pre-Charge

There is also the much greater issue of the layout.

The Very Scary Layout

After that heading, you are probably wondering what could possibly be so scary about a PCB layout. To that, I introduce you to the battery squad, which is the group of people designing our battery. Battery squad told us we can build the board in the dimensions 400x120mm. In terms of area this is very reasonable, but take a look at the board in layout mode.

Figure 6: Layout

It is just so ... long. But it is coming along and seems to be able to fit.

Credits:

While I have worked with this board for quite some time, I was not its original creator. It has been passed down within MIT SEVT for many generations, each one trying to make it a little better than the last. Also, I am not the only person who has worked on it recently, so credit to everyone who has ever touched this board!