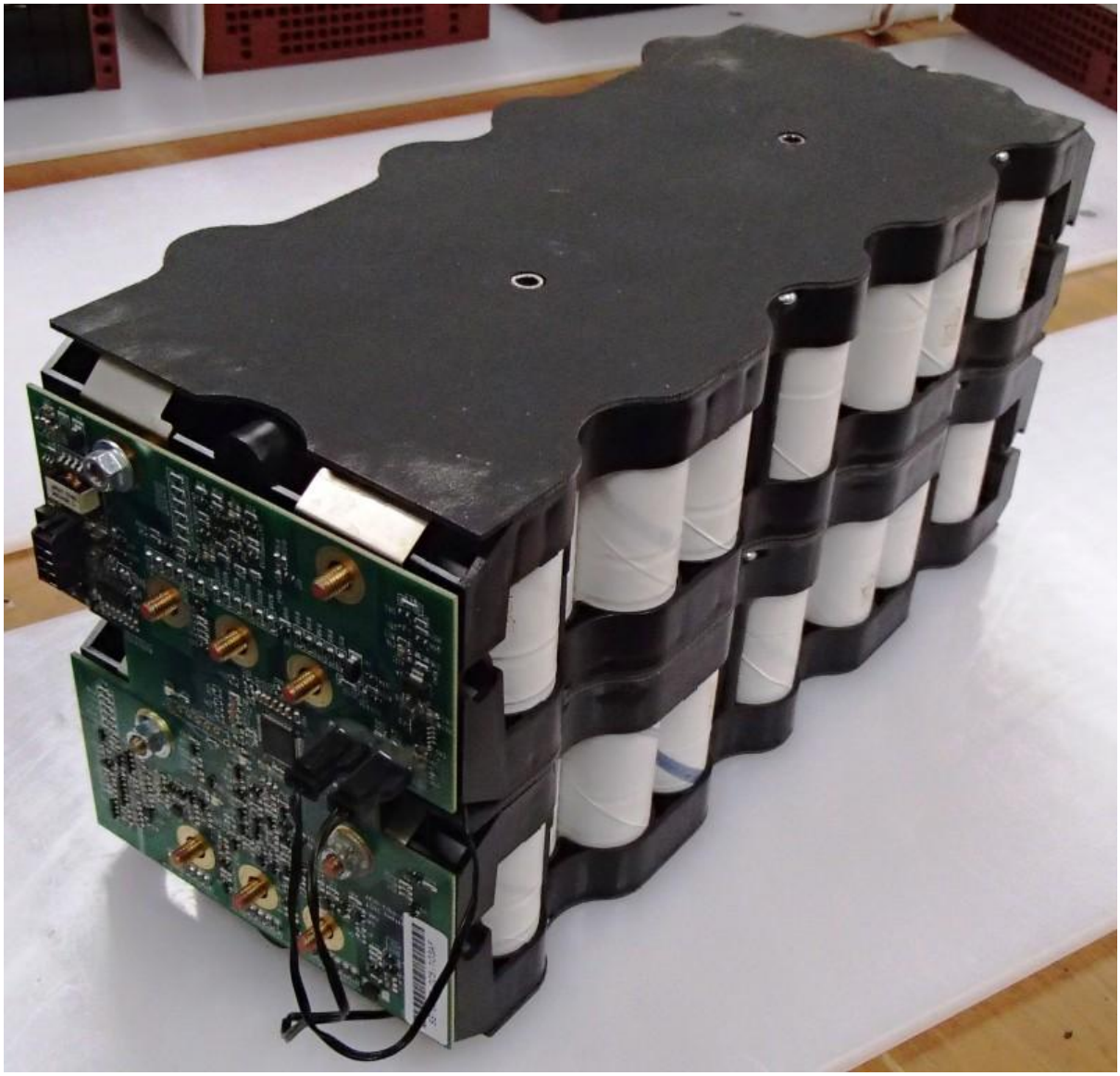
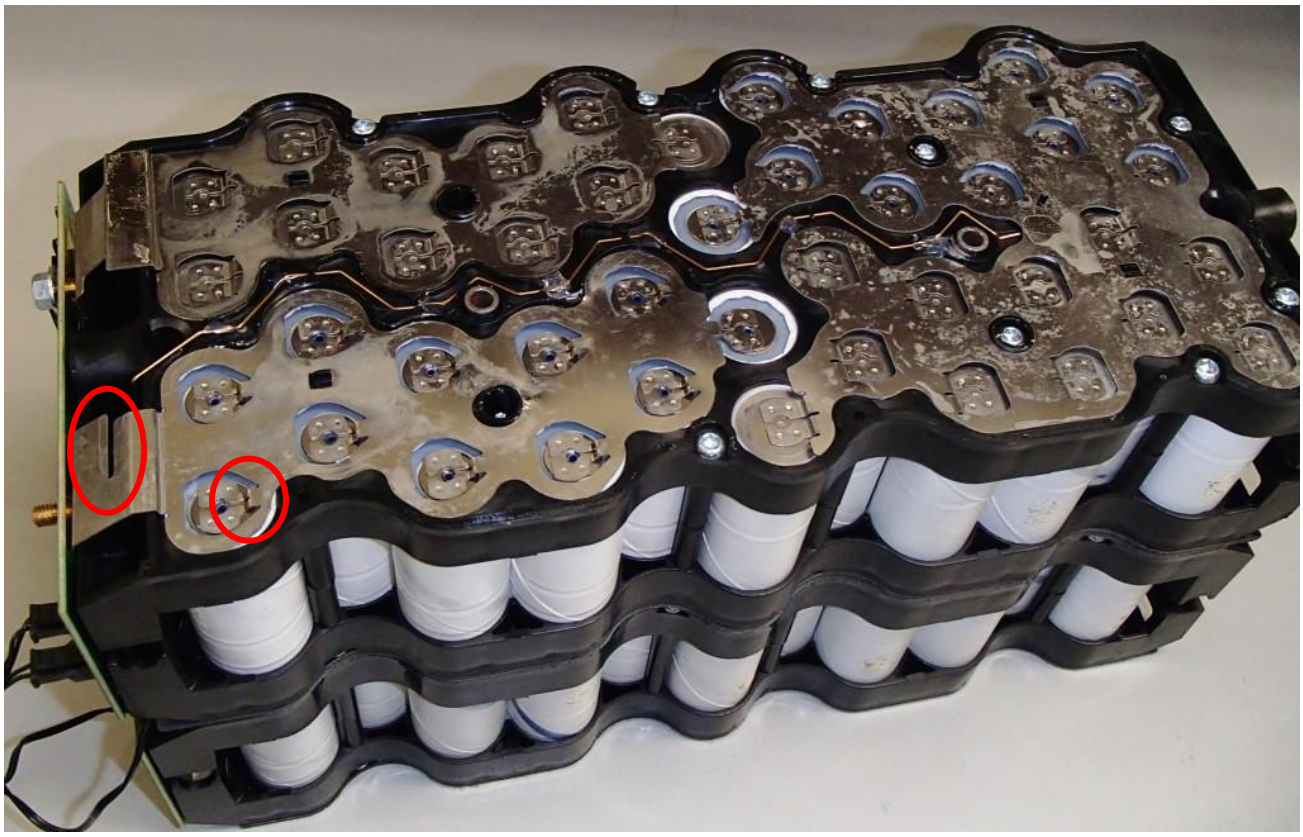
Guide to A123 Hymotion Battery Modules

I am happy to announce that Sybesma's Electronics in Holland MI, a service partner of A123 Systems, will soon be making available a sizable inventory of ANR26650-M1-based batteries, starting with modules from the old Hymotion program. The Hymotion L5 Plug-in Conversion Module (PCM) was A123's first venture into the automotive world, and was an aftermarket add-on for the Gen I and II Toyota Prius that converted the Prius into a PHEV with greatly augmented electric assist. The Hymotion-modified Prius was the world's first crash-test-certified PHEV. At the heart of the L5 are 7 battery modules, wired in series. It is the modules that will be made available and are described here.



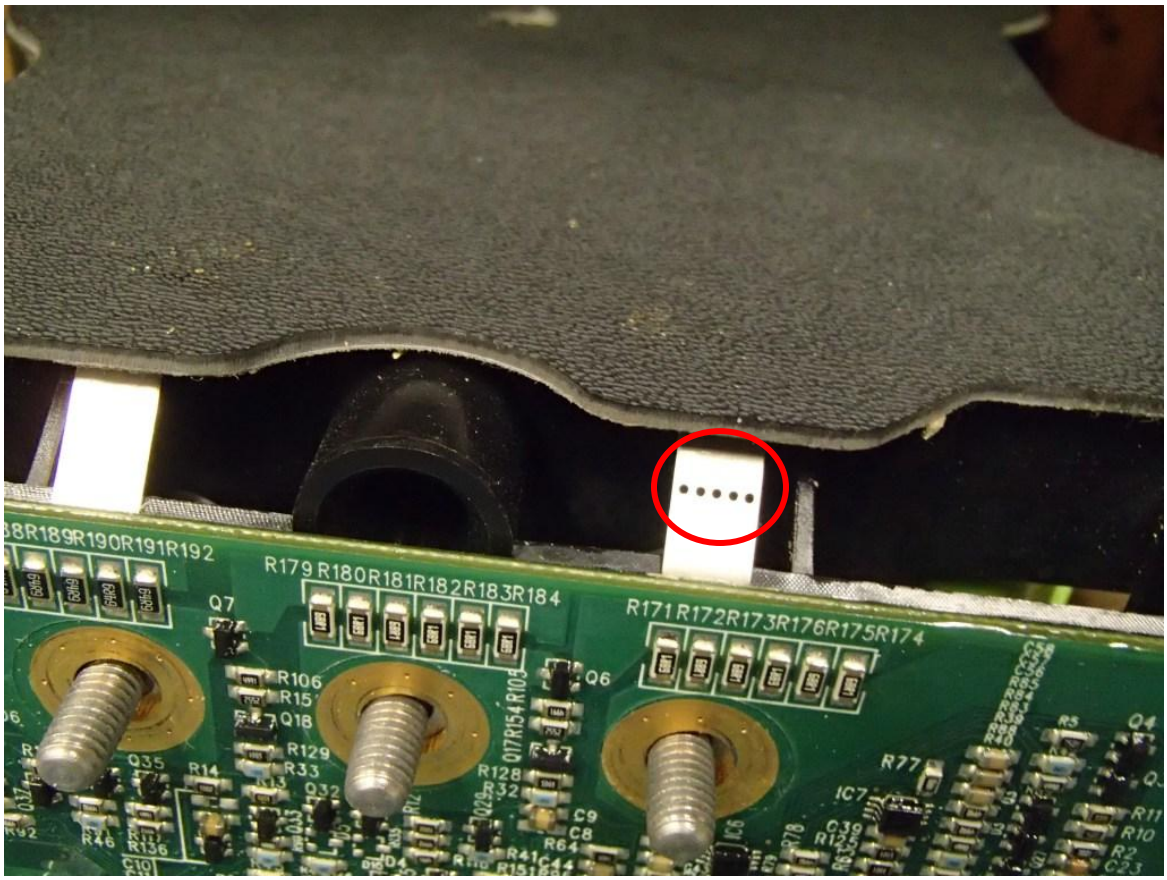
Shown above is a single Hymotion battery module, with its Monitor and Balance Board (MBB) still attached. Sybesma's plans to provide the modules without the electronics (they're not very useful without the outboard BMS), but I wanted to show how the original connections to the balance circuitry were accomplished. Note the two holes in the top cover. These have metal sleeves that go all the way through the module and are intended for use with bolts for holding the modules down firmly inside a watertight enclosure.



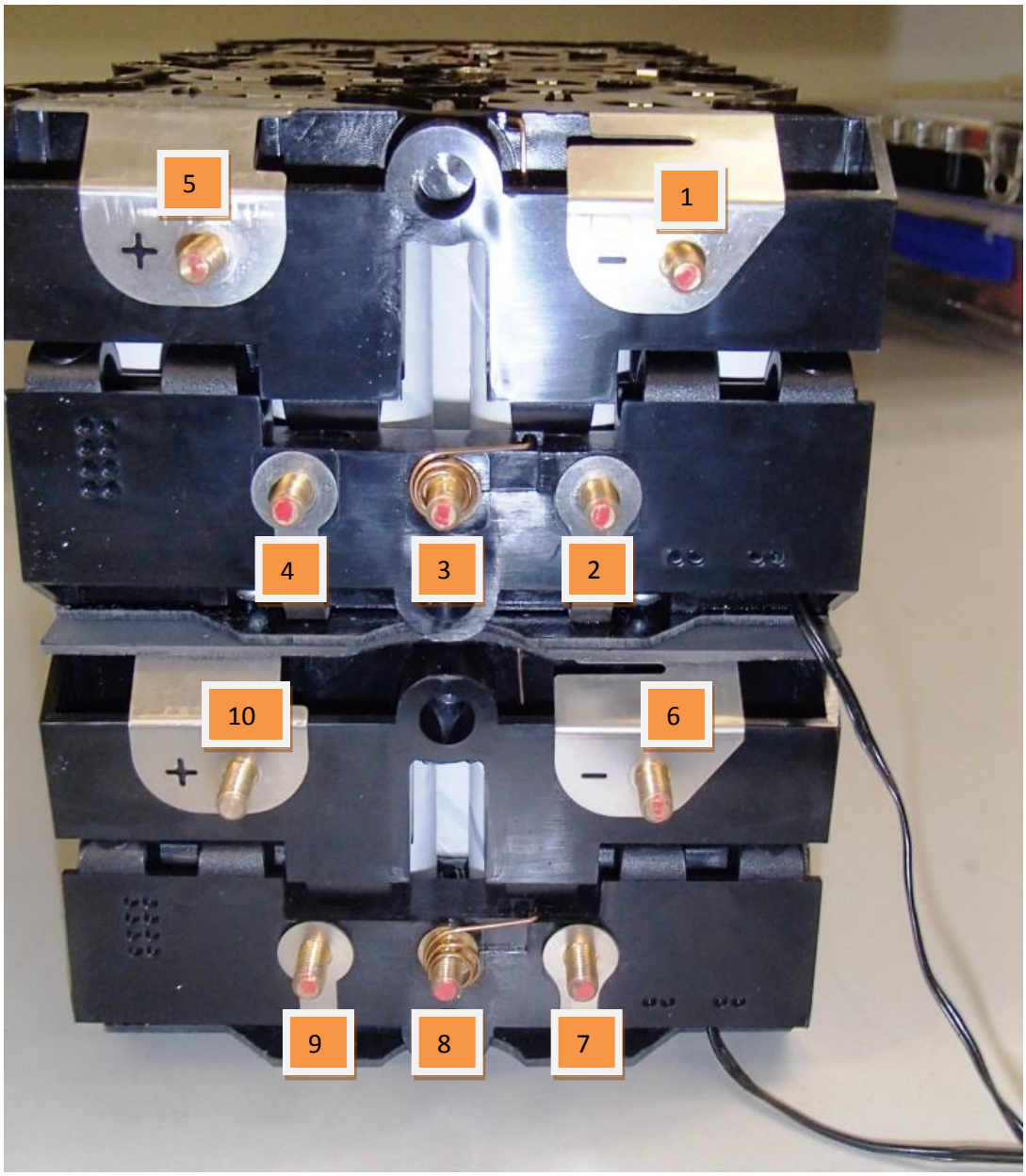
Here we see a module with its adhesive-backed cover removed, revealing the weld strap configuration and overall architecture. The modules consist of two stacked halves, each containing 44 cells in 4S11P. In its original environment, nominal voltage is 26.4V for the module, and stated nominal capacity is 25.3 Ah. However, these modules can be configured in other ways as well. Much of the inventory is unused but a few years old, so there has been some capacity fade in storage, but unused modules sampled so far have tested over 24 Ah. There are also used modules available. More on testing later.

The weld straps are solid nickel and are resistance-welded to the cells which are firmly held in place by plastic endcaps. There are multiple layers of fusing. Every cell has a neck-down fuse at its negative terminal (right hand circle above) and the notch cut into the main negative terminal (left hand circle above) is the fuse for the half-module. More fusing can be added outside the module and is strongly recommended. It's difficult to fix a weld strap after its

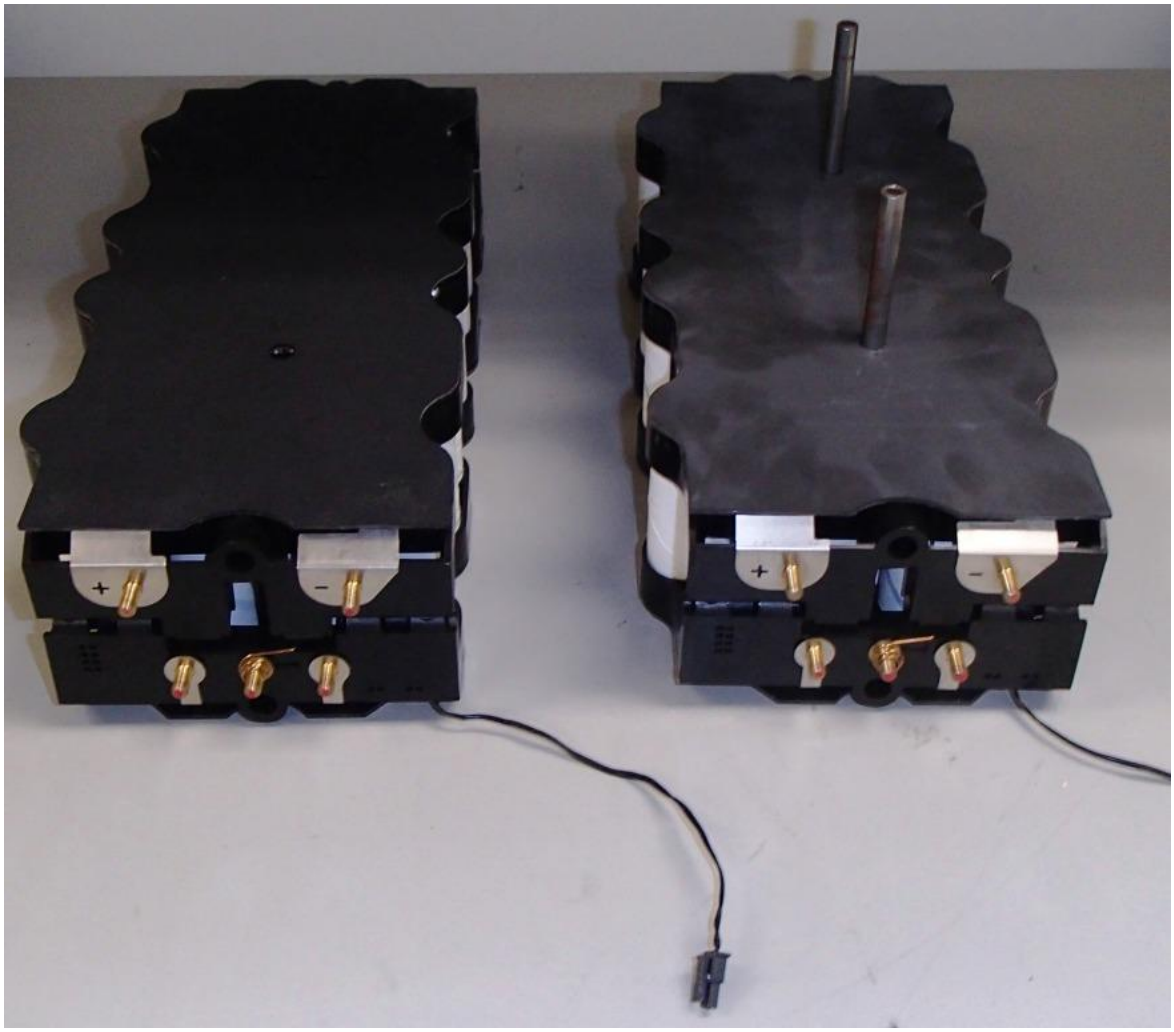
fusible links are blown. The thin copper wire running up the middle is a V sense line, and cannot support big load current—BALANCE CURRENT ONLY HERE.



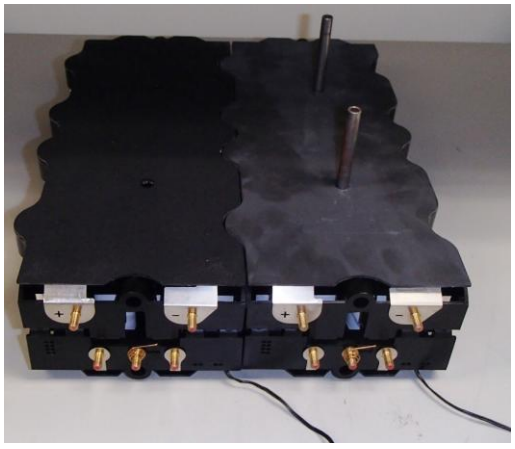
Some of the later production modules also have zipper fuses punched into some V-sense lines, but this is not a feature seen on all pieces. These conductors are also not intended to carry heavy current. Balance current on the original MBB's was ~300mA, but up to an Amp or two should be just fine for the sense lines.



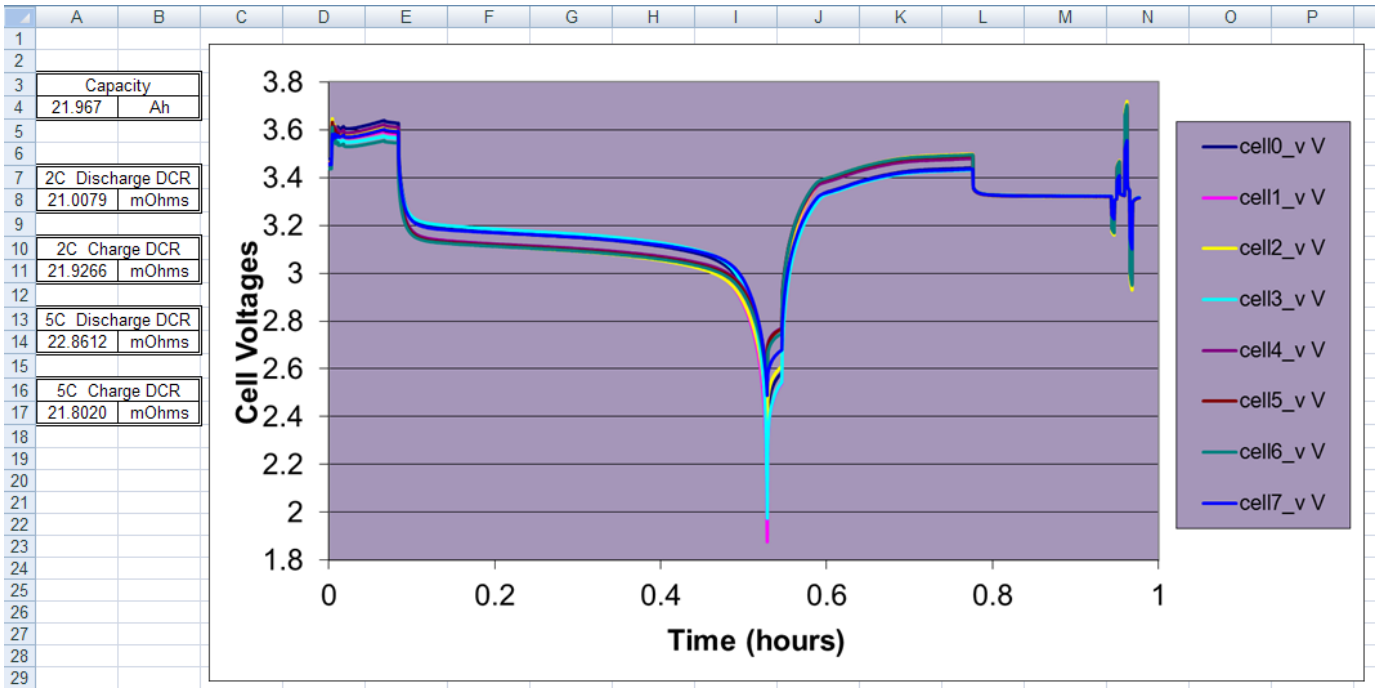
Above we see the module with the MBB removed. Nuts with built-in washers will be included on each post. Points 1, 5, 6, and 10 can support full load current. Pulses of a couple hundred Amps should be fine, but I don't know the absolute limit of the weld straps offhand. Points 2-4 and 7-9 are for BALANCE CURRENT ONLY. The copper wire that connects points 3 and 8 to their respective cell groups are particularly easy to damage with overcurrent. To make a 26V module, place a sturdy jumper between points 5/6 or 1 /10 (whatever is convenient in your installation) and use the opposite corners for output. To make a 13V module with twice the Ah capacity, jumper points 1/6 and 5/10 and use any of those four points for output. All Vsense/balance leads should be affixed to the bolts as well.



Above we see the two halves physically separated. The halves are relatively easy to take apart. The steel sleeves can be removed, or cut in half so that each half can be firmly bolted down. The original tie-downbolts from the Hymotion pack are included when you buy a module. The wires coming from each half are thermistors for monitoring cell temperature. The modules are shaped so that they snug up very nicely together, see below.



Test Results to Come With Every Module



Above are test results for a typical used Hymotion module. The module goes onto a custom battery cycler already fully charged and balanced. The cycler tops off charge again before running a 2C capacity test which ends when any cell group reaches 2.0 Volts. After a moment of rest, the cycler replaces half of the Ah it counted during the capacity test, setting the module at 50% SOC. There is then a ten minute rest, followed by charge and discharge pulses at 2C (50 A) and 5C (125 A). The module's 2C and 5C DCR values are calculated from these. To find average cell group impedance, divide these figures by 8.

Every battery Sybesma's sells will include test results like those shown above so buyers can have high confidence that they know exactly what they are getting. Pricing is still being discussed while Sybesma's develops a relationship with an independent sales team that will handle these sales. Stay tuned.

Duane Harvey
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