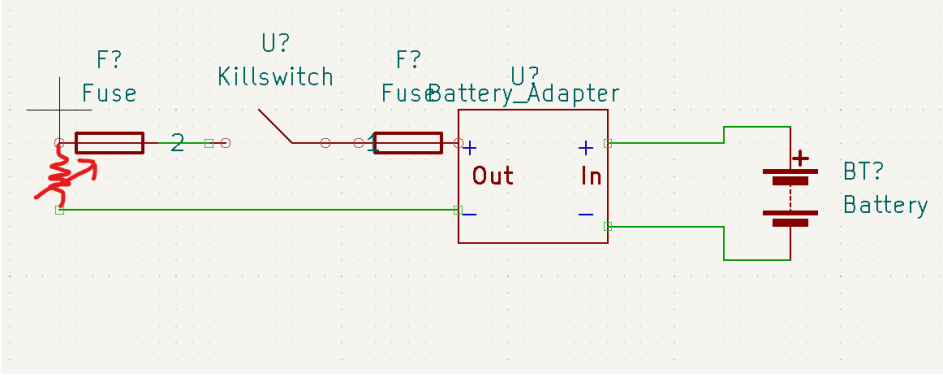
Signoff Request - 4/18

Monday, April 18, 2022 7:48 AM

Battery Adapter Subsystem Specifications

The battery adapter subsystem will provide a nominal voltage of 20 V and a maximum current of 10 amps for distribution via the 12 gauge wires.

Analysis
A variable resistor and digital multimeter will be used the verify that current and nominal voltages are being met. Readings of voltage will be taken across various resistance values to determine the nominal voltage of the battery/adapter system. The correct operation of the kill switch will be determined with the resistance and multimeter as well. Then using two 1 ohm resistors in series the fuse operation will be verified to ensure that system will break the circuit if currents reach unsafe levels. The figure below shows a buildable schematic of this analysis

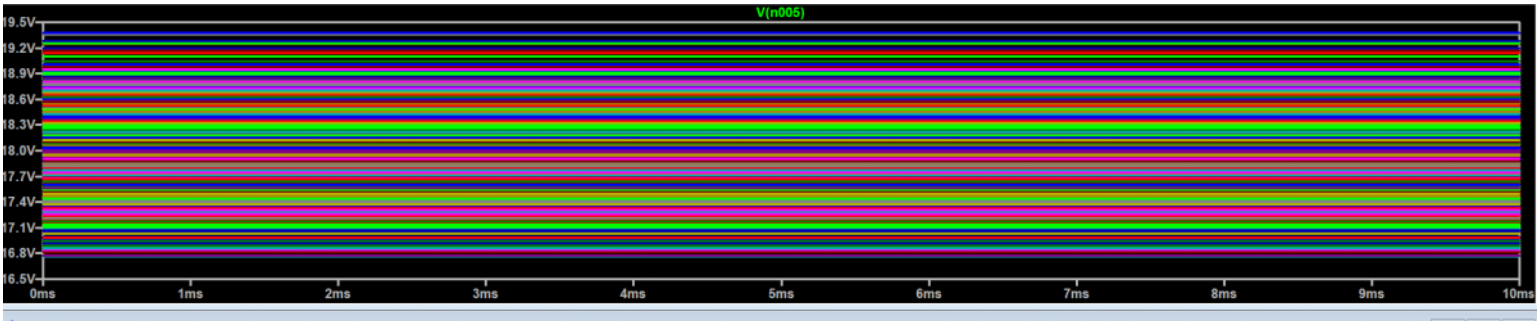


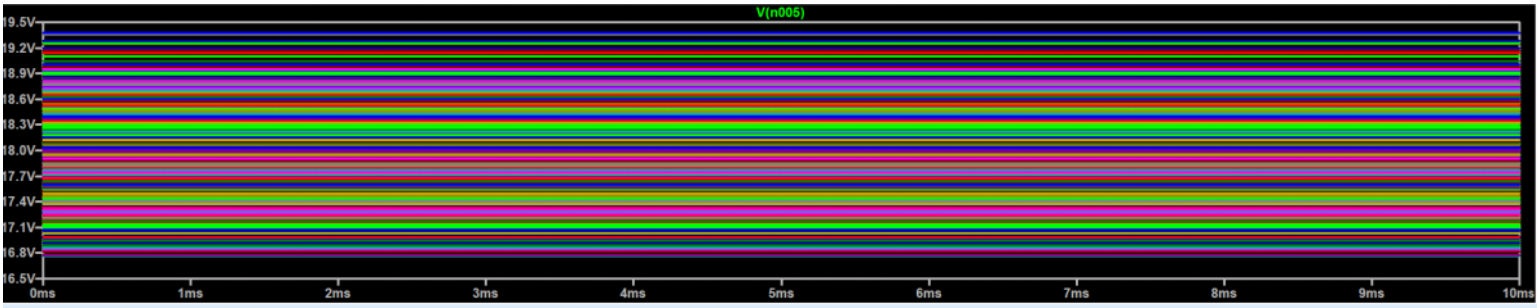
Battery Adapter Subsystem Expectations

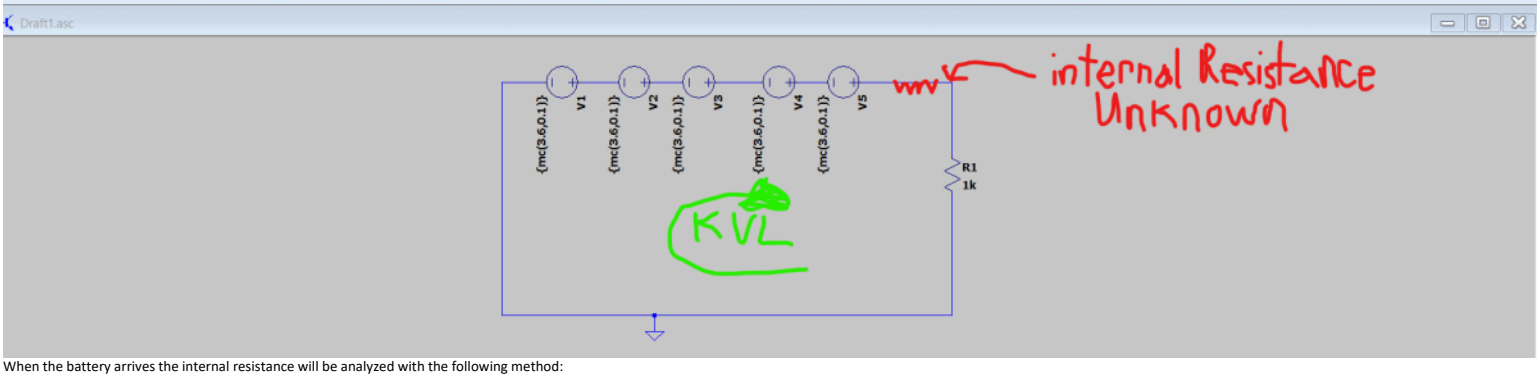
The purpose of the battery adapter subsystem is to provide a safe connection from the battery terminals to the wires. There are four elements to this subsystem. The first element is the battery itself. The battery will provide current and voltage to the second element, the adapter. The adapter will be placed on the chassis attached with a shim. The adapter has a kill switch and fuses to protect the last element of the subsystem, the wires. The wires will be used to connect the rest of the power system together.

Battery - 20 V(max) 5.0 Ah
https://www.amazon.com/DEWALT-DCB205-2-Lithium-Battery-2-Pack/dp/B00KQU1ENG/ref=sr_1_2?crid=3P6O3PDJOF29X&keywords=dewalt%2BDCB180&qid=1650294183&sprefix=dewalt%2Bdcb180%2Caps%2C136&sr=8-2&th=1

Analysis - The battery is modelled in LTSPICE as 5 battery cells in series with a "nominal voltage" of 3.6 V each. The tolerance was estimated to be 10% each. A monte-carlo simulation was executed with a simple resistive load to show some possible values :







When the battery arrives the internal resistance will be analyzed with the following method:

- [ ] The No Load Voltage will be determined at full charge by connecting a multimeter across the battery terminals. The Voltage will be recorded as the No-Load Voltage.
- [ ] Once the No-Load Voltage is determined the external resistor's resistance will be measured and recorded with a multi meter. The resistor will be connected to the battery. The voltage will be measured across the resistor quickly to avoid damaging the battery.
- [ ] Once the Voltage Across the external 1k resistor is known the Current will be determined by I = V/R
- [ ] Once the current is known a KVL will be performed to determine the internal resistance :
- [ ] (no_load_voltage) = (current*internal_resistance) + measured_external_voltage
- [ ] internal_resistance = no_load_voltage - measured_external_voltage / current

The internal resistance will be recorded and used to monitor battery health by repeating the experiment during trouble shooting if necessary.

Wire - (if not available in lab) https://www.amazon.com/dp/B08R34NG4P/ref=twister_B08XVR3YYD?th=1

12	0.0808	2.05232	3.31	1.588Ω IDOO	5.20864	9.3 A	4150 Hz

Analysis: 12 gauge wire rated for a maximum of 9.3 A with about 1.5 ohm resistance every 1000 ft.

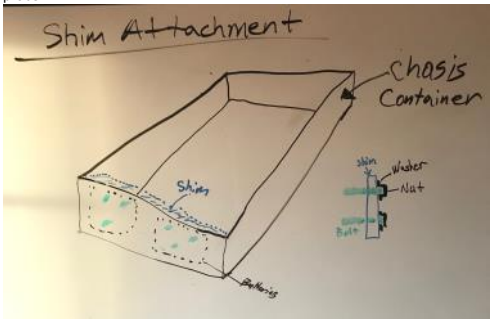
Inline Fuse - waterproof will use 2 in series ATC/ATO standard blade fuse 12 Gauge wire
https://www.amazon.com/dp/B07RY8Y2QV/ref=sspa_dk_detail_4?psc=1&pd_rd_i=B07RY8Y2QV&pd_rd_w=DGnXI&pf_rd_p=57cbdc41-b731-4e3d-aca7-49078b13a07b&pd_rd_wg=sJdMn&pf_rd_r=JJNQ1EXJB2H4VJCT9V0X&pd_rd_r=297cbe3d-abb2-40b8-adab-61fd0432ce41&s=automotive&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUExQjVFT0ZRQ1hCUTFWJmVuY3J5cHRlZElkPUEwNjg4NzA1MTFLSFAzOEhJVEtZNSZlbmNyeXB0ZWRBZElkPUEwNDg5MzUzMU9aTTFGNVo4UVE0OSZ3aWRnZXROYW1lPXNwX2RldGFpbF90aGVtYXRpYyZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU=

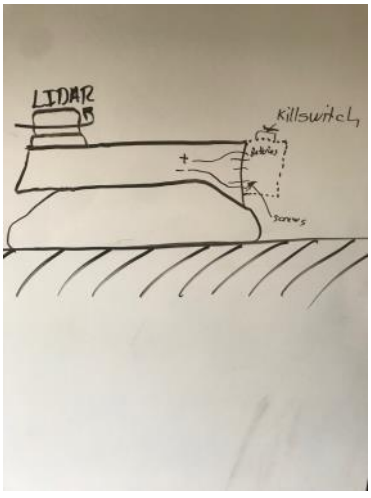
Analysis - The 12 gauge wire in line fuse of 10 A will break circuit if unsafe levels of current for wire are detected.

Battery Adapter - Integrated Kill Switch and Inline Fuse
https://www.amazon.com/dp/B09HTB57MC/ref=sspa_dk_detail_2?pd_rd_i=B09HTB57MC&pd_rd_w=gvGwJ&pf_rd_p=57cbdc41-b731-4e3d-aca7-49078b13a07b&pd_rd_wg=M6jxF&pf_rd_r=FS2P46KRTK7V9HGDTG6Q&pd_rd_r=631da457-1592-4152-aefd-8435b6130dc9&s=electronics&spLa=ZW5jcnlwdGVkUXVhbGlmaWVyPUEzVlg1WEJYRzRCWDFPJmVuY3J5cHRlZElkPUEwNjI4MzgzM0gxMURROFlNQlZVMSZlbmNyeXB0ZWRBZElkPUEwNzQ2MzU5MklKNlczNUZERE1WNiZ3aWRnZXROYW1lPXNwX2RldGFpbF90aGVtYXRpYyZhY3Rpb249Y2xpY2tSZWRpcmVjdCZkb05vdExvZ0NsaWNrPXRydWU&th=1

Analysis - 12 gauge wire with a 10 A fuse to break circuit if current gets too high

Attachment- The following figures illustrate the proposed method for adapter attachment to robot chassis. Care was taken to place batteries in a position that does not interfere with LIDAR or moisture probe.





Battery Charger - (if not available in lab)

https://www.amazon.com/DEWALT-DCB118-FLEXVOLT-Fast-Charger/dp/B01HD4E0LK?th=1

Analysis - No analysis for this component it may not be necessary if a charger can be found