#### Discharge characteristics of Li ion Battery pack with 4S 40A BMS

This experiment is conducted to obtain the discharge characteristics of the Li-ion battery pack and plot the characteristics against various load current.

Components used:-

Li-ion battery pack( 4S 4P), 4s 40A BMS, current sensor (INA 169) , multimeter , BLDC motor with ESC,

RC transmitter,connecting wires.

Experimental setup:-

The BLDC motor connected with a propeller acts as a load. The motor is connected to an ESC which takes the PWM signals from the receiver to control the speed of the motor. By controlling the throttle , the speed of the motor is varied and hence the load current also varies.

Current sensor is connected between the battery pack and the load, the three leads of the sensor are connected to an arduino board which continuously samples the adc value from the input pins.These adc values are converted to the measured current values by dividing the reading with the sensitivity of the current sensor. A multimeter is also connected in series to measure the current readings.

Table 1.1 :

|  |  |  |
| --- | --- | --- |
| Battery voltage :15.83 V | | |
| Sensitivity considered: 73.2mv/A | | |
| S no | Voltage Measured (V) | Multimeter reading (A) | | Measured Value(A) | Error | Error % |
|  |  |  | |  |  |  |
| 1 | 15.73 | 0.05 | | 0.00 | -0.05 | 100% |
| 2 | 15.12 | 0.60 | | 0.47 | -0.13 | 22% |
| 3 | 14.58 | 1.02 | | 1.00 | -0.02 | 2% |
| 4 | 14.04 | 1.52 | | 1.60 | 0.08 | 5% |
| 5 | 13.58 | 1.99 | | 2.20 | 0.21 | 11% |
| 6 | 13.05 | 2.48 | | 2.87 | 0.39 | 16% |
| 7 | 12.51 | 2.98 | | 3.47 | 0.49 | 16% |
|  |  |  | |  |  |  |

Observations:-

* The above readings were taken with interval of 0.5A of current, further as the current was increased the voltage level dropped below the overdischarge voltage level which is around 11.2V and the load was prevented to draw further current.
* It can be inferred that when the voltage goes below the set point, the BMS cuts off the supply to the load and waits for the voltage to rise above the set discharge voltage level.
* The above readings were measured through a 10-bit ADC of arduino, hence the resolution is very less. It is advisable to use a resolution of 12-bit or more for better accuracy.

Observations:-

* While the limitation in current drawn from the battery can be attributed to the undervoltage , the same setup when measured current without using the multimeter, the current drawn exceeded to a maximum of 25A (tentative since measured through sensor) the voltage was about 11.8V
* It can be inferred that either the balance voltage levels must be below the overdischarge voltage level or Li ion battery has reached the max discharge current limits.
* Li-ion can be discharged to 1.5C ie., 3.25\*1.5=4.875A /cell since 4P is used max discharge can be 4.875\*4=19.5A continuous current. Further increase in current will result in drastically reduced voltage levels.

Detailed tabulation of readings are available in excel document :mod\_load\_test 1.1