Selecting The Right Current Sensor

The Orion BMS and Orion JR both use current sensors to significantly improve the accuracy of the State of Charge calculation (using a technique called Coulomb Counting) as well as to track the performance and efficiency of the battery pack as a whole. Because this sensor is such a vital part of how the BMS operates it is very important to select the correct one for the application. If the incorrect sensor is selected that can lead to either reduced State of Charge accuracy or fault codes being generated.

There are two different types of current sensors used by our products: Hall Effect and Shunt sensors. Hall effect sensors work by measuring the magnetic field generated by current as it travels through the power cables and are fully passive (they go around the power cables and thus are non-invasive). Shunt sensors are technically large resistors that intentionally cause a predictable voltage drop across them when current is run through, allowing the BMS to determine the overall amount of current flowing through based on how much voltage drop is present after the sensor. Please check with the purchasing guide and support documentation for the product being considered to make sure that the correct type of current sensor is purchased.

Each current sensor, regardless of type, has a maximum current rating (expressed in amps) that determines the total amount of current that it can sense in either direction (both current going into the battery pack and current going out of the battery pack). This rating is usually included in the name or description of the current sensor and is the single most important factor to consider when sizing a current sensor for an application.

- **The general rule to follow is to select the smallest possible current sensor with a maximum amperage rating of at least 10% larger than the maximum peak current draw the application will see.** This allows for some overhead in the event of momentary spikes in current (eg: when a motor starts or a contactor engages this can often cause abnormally high current draw for very brief moments) without going with too large of a sensor. If the sensor selected is significantly oversized for the application (eg: using a 500A sensor when the maximum application current is likely to be around 60A) this can reduce the accuracy of several calculations made by the BMS. Current sensors

with a lower maximum current rating will have a higher resolution (accuracy factor) than sensors with a higher maximum current rating.

- **If the current draw from the application ever exceeds the maximum current rating for the sensor, the BMS will set a fault code because it does not know whether the sensor itself is damaged (shorted) or whether the current draw is more than it can handle.** There is some hysteresis in the BMS to allow several brief moments of high current events without setting a fault but this should not be relied on to regularly avoid faults being set.

- **For Shunt style current sensors it is very important not to regularly draw more current than 80% of the maximum rating for the sensor itself.** Because Shunt sensors are resistive they can end up generating a reasonable amount of heat at these levels which can impact the accuracy of the sensor long term. On Hall Effect style current sensors it will not damage the sensor if the current rating is exceeded, even if exceeded for long periods of time (it simply will max out the reported current and the BMS will set a fault code).

Real Application Examples

- For an application that has a maximum theoretical peak current draw of 120 amps and a typical current draw of 80 amps: A 200A sensor would be recommended as it is the smallest sensor that still is large enough to measure the full peak current range. Technically a 500A sensor could be used as well but the accuracy would be greater on the 200A sensor which is why it would be recommended instead.

- For an application that has a maximum theoretical peak current draw of 230 amps and a typical current draw of 150 amps: A 500A sensor would be recommended in this case because the peak current exceeds the maximum ratings of the 200A sensor.