**3.2.2 Error Handling Software**

The error handling code determines when the batteries are overloaded, overheated, or improperly charged, and takes corrective action to restore the system. The error handler ensures that the four measurements - temperature, input current, output current, and voltage - are within acceptable limits.

To reduce instability due to noise, the system makes multiple measurements before reacting. This is managed with an **error counter** for each variable. Every time a measurement is within the respective **error condition**, the error counter is incremented. Otherwise, the error counter is decremented until it reaches zero. When the error counter reaches an **error threshold** value (determined by frequency of measurement), the error flag is set and corrective action is taken.

To prevent rapid oscillation when values are close to the limit, the system uses **hysteresis** by requiring a stricter **recovery condition** to terminate the error. For the voltage and temperature errors only, a **recovery counter** is used in the same manner as the error counter to avoid spontaneous recovery due to noise.

For the current errors, a different approach is necessary because a current error will disconnect the path of the current, rendering future measurement impossible. To remedy this situation, the error handler will continually increment its recovery counter after the error has occurred. Once this counter reaches the **partial recovery threshold**, the system reconnects the current path, and the recovery counter continues to increment. Future cycles will measure the current, and if the value does not satisfy the recovery condition, the system will reset the counter and disconnect the circuit *immediately*. Otherwise, the cycle repeats until the counter reaches the **full recovery threshold**, which indicates that the recovery condition has been satisfied for a specified number of cycles. The error flag and recovery counter are then reset and operation continues as usual.

The following errors are recognized:

|  |  |  |  |
| --- | --- | --- | --- |
| **Error** | **Error Condition** | **Recovery Condition** | **Action** |
| High Temperature | T > 50°C | T < 45°C | Electrically isolate battery |
| High Voltage | V > 43.5 V | V < 43.0 V | Stop charging |
| Low Voltage | V < 36.0 V | V > 36.5 V | Stop discharging |
| High Current In | I > 6.6 A | I < 6.1 A | Stop charging |
| High Current Out | I > 6.6 A | I < 6.1 A | Stop discharging |

Table n

In addition, there is an undercurrent input warning, where I < 1.0 A. This warning does not require a counter or a recovery value for hysteresis, since the warning takes no action except for displaying a warning on the screen. (Requires rationale for undercurrent input warning, trickle charging bad?)