ABSTRACT

The purpose of this memo is to present the process and ideas behind the redundant temperature safety system. Due to a change in our requirements, our team did not construct an ESS controller board meaning the current design was not implemented by us, but should be used in future designs. A voltage regulator, temperature sensing chip, capacitor, and an optocoupler, will be added to each OBPP board. The connection of the OBPP boards runs through a comparator and triggers a switch of the safety loop on the Master Slave Board. This system is designed to shut down the system when there are temperatures that exceed 65°C Celsius (45°C above the ambient temperature) on any of the OBPP boards. This is 5°C higher than the requirement in the Statement of Work stating a maximum temperature of 40°C above ambient (60°C). There is a 2°C setpoint accuracy for the temperature sensing chip and our chips and circuits on the OBPP all have the ability to run at 60°C. We have raised the temperature for the safety trigger activation to 65°C in order to provide a buffer of 2 - 3°C and limit any false positives.

TECHNICAL FINDINGS

The value of the $R_{SET}$ resistor determines the temperature at which the AD22105 chip becomes active. From the data sheet, this resistance can be determined by the equation $R_{SET} = \frac{39 \Omega \cdot ^{\circ}C}{T_{SET}(^\circ C) + 281.6^\circ C} - 90.3 \, k\Omega$. The $R_{SET}$ value which allows an activation temperature of 65.3°C is 22.1 kΩ.

RECOMMENDATIONS AND DECISIONS

The 12 Volt DC supply on the OBPP will run through an LM2936 Voltage Regulator providing the AD22105 Resistor Programmable Thermostatic Switch with a source voltage of 5 Volts. As shown in the attached diagram, a capacitor should run in parallel to the AD22105 in order to lower the noise on the signal. The $R_{SET}$ value should be 22.1kΩ to allow an activation temperature of 65°C. The OUT pin is connected to the $R_{PULL-UP}$ pin, passed through a 6N135 Optocoupler and tied to the output from the temperature sensing system on each of the OBPP boards. If the signal from any of the OBPP boards is below a certain threshold voltage (meaning an activated temperature sensor), then the connection between all the OBPP boards will be driven low. This wire passes through another 6N136 Optocoupler and a comparator and in the case of temperature sensor activation, closes a switch to trigger the safety loop. This Redundant Temperature Safety System is designed for
multiple packs and a connection to the ESS controller board. This system is not designed for a stand-alone battery pack and must be connected to the ESS controller board.

ATTACHED DOCUMENTS

The document “Redundant Temperature Safety System Schematic.pdf” can be opened with Adobe Acrobat Pro and shows the general outline of the system, including connections between OBPP boards and the connection to the Safety Relay.
REDUNDANT TEMPERATURE SAFETY SYSTEM

**OBPP #1**

- **AD22105**
- **6N135 Optocoupler**
- **LM2936 Voltage Regulator**
- **DC 12 Volts**
- **Vs (+5V)**

**OBPP #2**

- **AD22105**
- **6N135 Optocoupler**
- **LM2936 Voltage Regulator**
- **DC 12 Volts**
- **Vs (+5V)**

**MORE PACKS**