SLB-BAT4C-DOC-v0.2

# Battery Module 4C Documentation

*Battery Module 4C Documentation*
*SpaceLab, Universidade Federal de Santa Catarina, Florianópolis - Brazil*

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**Project Chief:**
Eduardo Augusto Bezerra

**Authors:**
Amanda Batista Medeiros
André Martins Pio de Mattos
Gabriel Mariano Marcelino
Yan Castro de Azeredo

**Contributing Authors:**
Leonardo Kessler Slongo
Sara Vega Martinez
Bruno Vale Barbosa Eiterer
Túlio Gomes Pereira

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| 0.1 | G. M. Marcelino | Document creation | 2020/11/07 |
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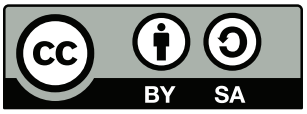

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# CHAPTER 1

## Introduction

The Battery Module 4C (BAT4C) is a separate board from the EPS2 [1] in order to accommodate 4 lithium-ion cells. Besides the cells, the board has connectors for interfacing signals and power lines with the EPS2 module, 2 power resistors to operate as heaters to maintain the cells temperature during eclipse periods, and 4 temperature sensors. The batteries used are the **ICR18650-30B** lithium-ion cells, which are connected in series and parallel to supply the required voltage and current. Each cell is fixed with **18650** metal holders and between the pairs there are the power resistors attached with a thermal element in the middle. A mechanical mount is placed over the batteries and screwed to the board, providing better stress resistance. Also, there are PC104 through hole pads present on the board for a connector that could be used for making mechanical integration with the EPS, or with future improvements a interface for power, data or control signals.

The board is a direct improvement from the first battery board used in the FloripaSat-1 mission [2]. All the project, source and documentation files are available freely on a GitHub repository [3] under its repectives licenses.

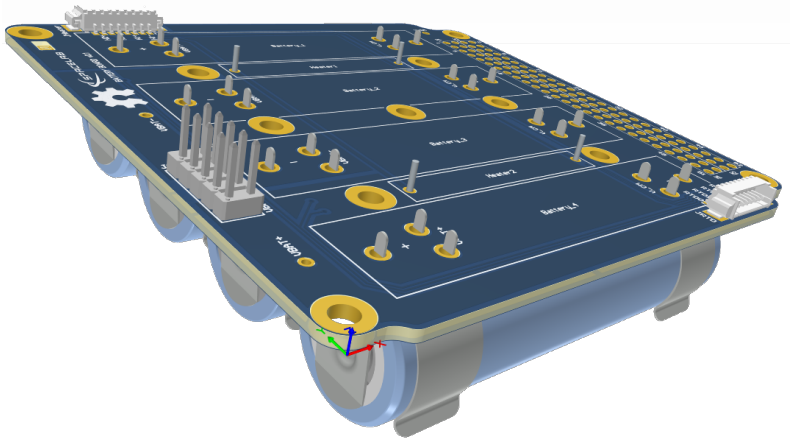

Figure 1.1: 3D view of the Battery Module 4C PCB.

# CHAPTER 2

## System Overview

The board is a 2 layer 1.6mm thick PCB with FR-4 dieletric. The board has PC104 through hole pads for a connector, however for the v0.1 of the project the interface is not used for any signals, power or mechanical fitting. The power from the batteries are conducted by a pin header making a board-to-board connection to the EPS2 module. The power for the heaters actuation and the temperature sensors (RTD) measurements are brought through PicoBlade connectors via external cables to the EPS2. The Figure 2.1 presents the simple block diagram of the module.

## 2.1 Block Diagram

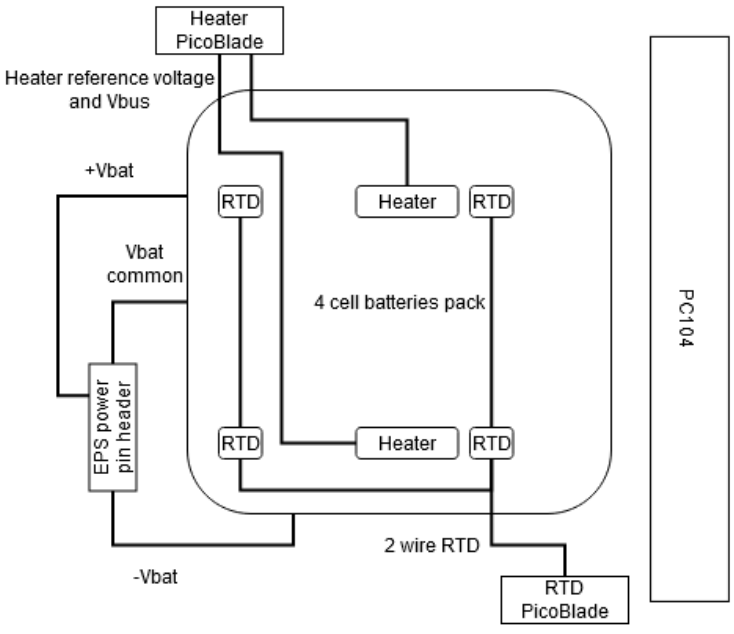


Figure 2.1: Battery Module 4C Block Diagram.

# CHAPTER 3

# Hardware

This chapter describes the hardware of BAT4C in detail. As mentioned beforehand the board is to be used alongside the EPS2 module, both PCBs are complementary forming the full energy power system of a CubeSat.

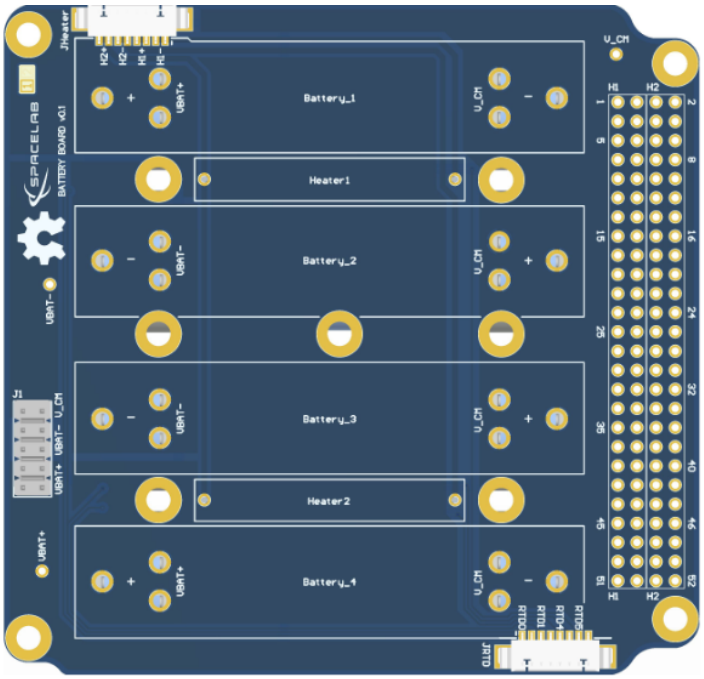


Figure 3.1: Top side of the PCB.

## 3.1 External Connectors

The external interfaces are connected to the EPS with board to board and cable to cable connectors. The following topics describes these interfaces and present their pinout.

### 3.1.1 JRTD - RTD PicoBlade

The RTDs on the board are connected to the EPS2 with the labeled "JRTD" 8 pin right angle PicoBlade (**53261-0871**), its pinout is showed on Table 3.1. The connector can be seen in Figure 3.4.

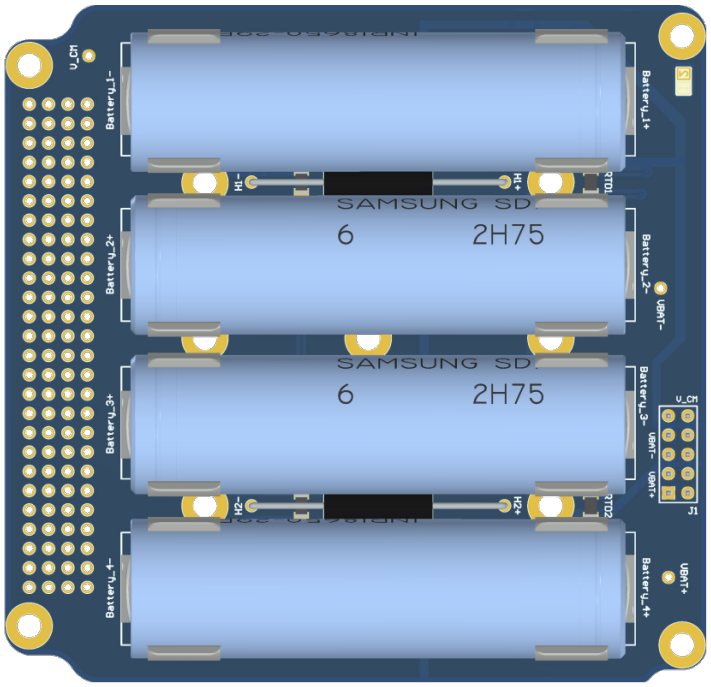


Figure 3.2: Bottom side of the PCB.

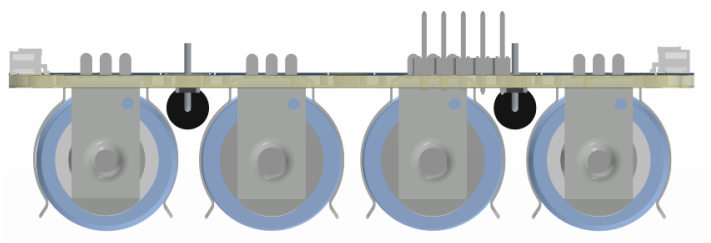

Figure 3.3: Front side of the PCB.

| *Pin* | *Row* |
|---|---|
| 1 | RTD0 |
| 2 | RTD_Common |
| 3 | RTD1 |
| 4 | RTD_Common |
| 5 | RTD4 |
| 6 | RTD_Common |
| 7 | RTD5 |
| 8 | RTD_Common |

Table 3.1: RTD PicoBlade pinout.

### 3.1.2 JHeater - PicoBlade

The heaters controled supply is done with another 8 pin right angle PicoBlade labeled "JHeater", its pinout showed on Table 3.2. The Vbus pins brings the direct power from the main power bus from the EPS2 module, thought PMW it controls mosfets gates closing the

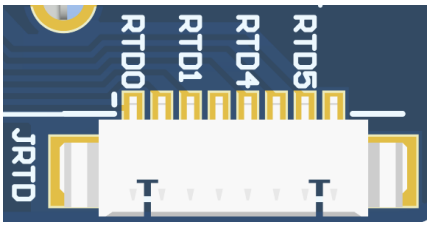


Figure 3.4: RTD PicoBlade connector.

circuit allowing current flow across the heaters. The connector can be seen in Figure 3.5.

| *Pin* | *Row* |
|---|---|
| 1 | –Heater1_Voltage |
| 2 | –Heater1_Voltage |
| 3 | VBus |
| 4 | VBus |
| 5 | –Heater2_Voltage |
| 6 | –Heater2_Voltage |
| 7 | VBus |
| 8 | VBus |

Table 3.2: Heater PicoBlade pinout.

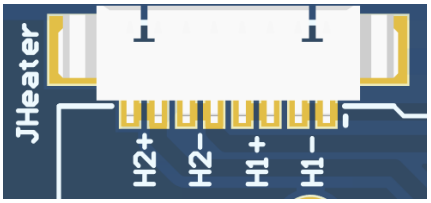


Figure 3.5: Heater PicoBlade connector.

### 3.1.3 J1 - Battery Voltage Pin Header

A pin header connector (**67996-110HLF**) labeled "J1" connects to the EPS2 module in a board to board style. These pins brings the voltage from the 4 cell batteries and a common reference voltage to be used for the battery monitor IC present on the EPS2. Its pinout can be seen on Table 3.3 and connector view on Figure 3.6.

### 3.1.4 PC104

On revision v0.1 of the project, the BAT4C does not use the PC104 for any purpose, been mechanical or electrical.

| *Pin* | *Row* |
|---|---|
| 1 | +Vbat |
| 2 | +Vbat |
| 3 | +Vbat |
| 4 | +Vbat |
| 5 | −Vbat |
| 6 | −Vbat |
| 7 | −Vbat |
| 8 | −Vbat |
| 9 | Vbat_Common |
| 10 | Vbat_Common |

Table 3.3: Battery voltage pin header pinout.

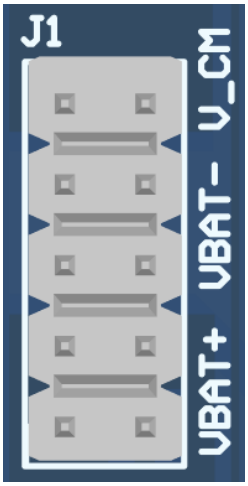


Figure 3.6: Battery pin header connector.

## 3.2 Batteries

Each 18650 size battery cell is fixed with metal holder (**54**). The pollarity for each cell is visible on the silkcreen on the board as can be seen in Figure 3.1. The metal holders are soldered on the though hole pads, the exposed square pads are a simple solution for soldering the cells to the board and keeping them in place during vibrations, see Figure 3.7. This particular solution might suffer improvements in later hardware releases.


Figure 3.7: Bottom side of the PCB.

## 3.3 Temperature Sensors

Temperature of the board is measured with four RTDs (**32207595**), two placed near the batteries contacts and the other two in the middle between the cells and below the heaters legs, as can be seen on Figure 3.8. The RTDs are Pt1000 Class B accuracy, its datasheet can be acessed here [4] for more technical spececification of the sensors.

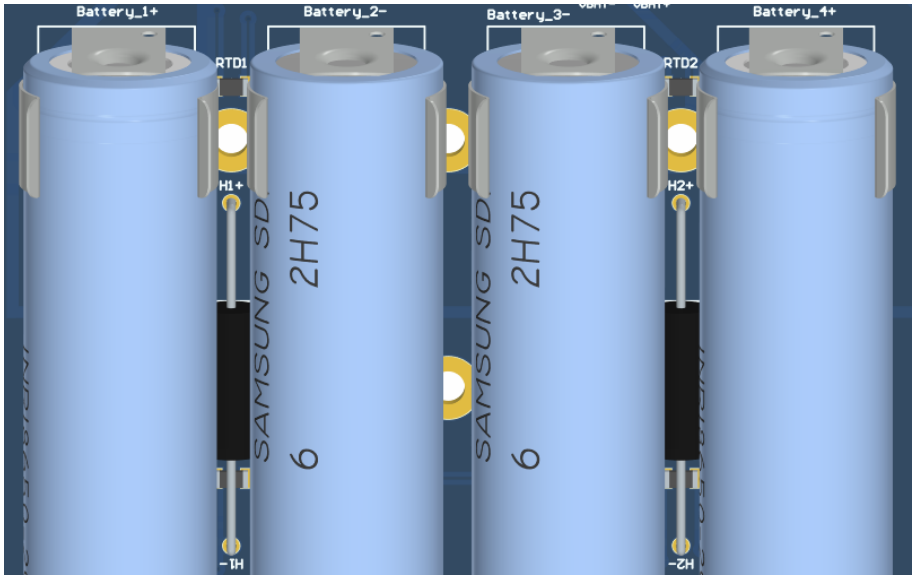


Figure 3.8: RTDs and heaters view.

## 3.4 Heaters

Wirewound resistors (**RS02B24R00FE12**) are used for the two heaters placed on the board between the cells, as previously seen in Figure 3.8. Their purpose is to maintain the cells temperature during eclipse periods, where a CubeSat can reach temperatures below −20 degrees celsius. While the resistors can deliver up to a maximum of 3 watts of power, controled PWM signals from the EPS2 regulates this energy dissipation to secure and ideal levels for the cells normal operation.

# Bibliography


[1] Energy power system 2.0 documentation, 2021. Available at <https://github.com/spacelab-ufsc/eps2>.

[2] Battery board 1 documentation, 2018. Available at <https://github.com/floripasat/eps/wiki/External-Hardware#batteries-board>.

[3] Battery module 4c documentation, 2021. Available at <https://github.com/spacelab-ufsc/battery-module-4c>.

[4] Heraeus Inc. *32207595 Datasheet*, April 2020. Available at <https://br.mouser.com/datasheet/2/619/smd_1206_v_e-1920021.pdf>.