

NanoPower BP4

Datasheet

High Capacity battery pack for nano-satellites featuring four Li-Ion cells

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2 Changelog

Changes from version 1.3 to 2.0

- Batteries are placed on top of PCB
- Possibility of stack through
- Power switch connector is changed
- Heaters design changed from to a non-wound type
- Added ground-cut-off connector
- Heater and power switch are powered from the stack connector

Date	Revision	Author	Description
08-03-2011	1.0	MB	Initial revision
11-10-2011	1.1	MB	Updates to heater information
19-03-2014	1.2	MB	Updated to BP4-2.0. See change description above.
20-01-2016	2.1	KLK	New layout, text, drawing and photo update, minor text corrections
28-04-2016	2.2	KLK	New front page picture
22-06-2016	2.3	MB	Fixed spelling mistake and wrong heater resistance
28-03-2016	2.4	KLK	Chapter 3.3

3 System Overview

NanoPower BP4 (BP4) is a battery pack tailored to fit in CubeSat satellites together with the GomSpace NanoPower EPS. It employs four lithium-ion cells and features a power switch, which can be used for control of high power consuming elements like antenna separation. It further features a ISS approved ground breaker.

3.1 Highlighted Features

NanoPower BP4:

- Lithium-Ion battery pack for space applications
- Utilizes four 18650 series cells
- Available in two different voltage range configurations:
 - 6.0 – 8.4 V
 - 12.0 – 16.8 V
- Temperature sensors w. digital interface
- Heater
- Operational temperature: Depends on chosen battery cell
- Fits standard PC104
- Weight: 270 g
- PCB material: Glass/polyimide ESA ECSS-Q-ST-70-11-C
- IPC-A-610 Class 3 assembly

3.2 General Description

The BP4 comes in two different configurations:

Configurations	Number of cells	2600 mAh cell (Nominal)
2P-2S	4	38.5 Wh 6 - 8.4 V 5.2 Ah
1P-4S	4	38.5 Wh 12 - 16.8 V 2.6 Ah

For information on battery specifications (temperatures, charge and discharge current etc), please see the GomSpace battery datasheet (gs-ds-battery).

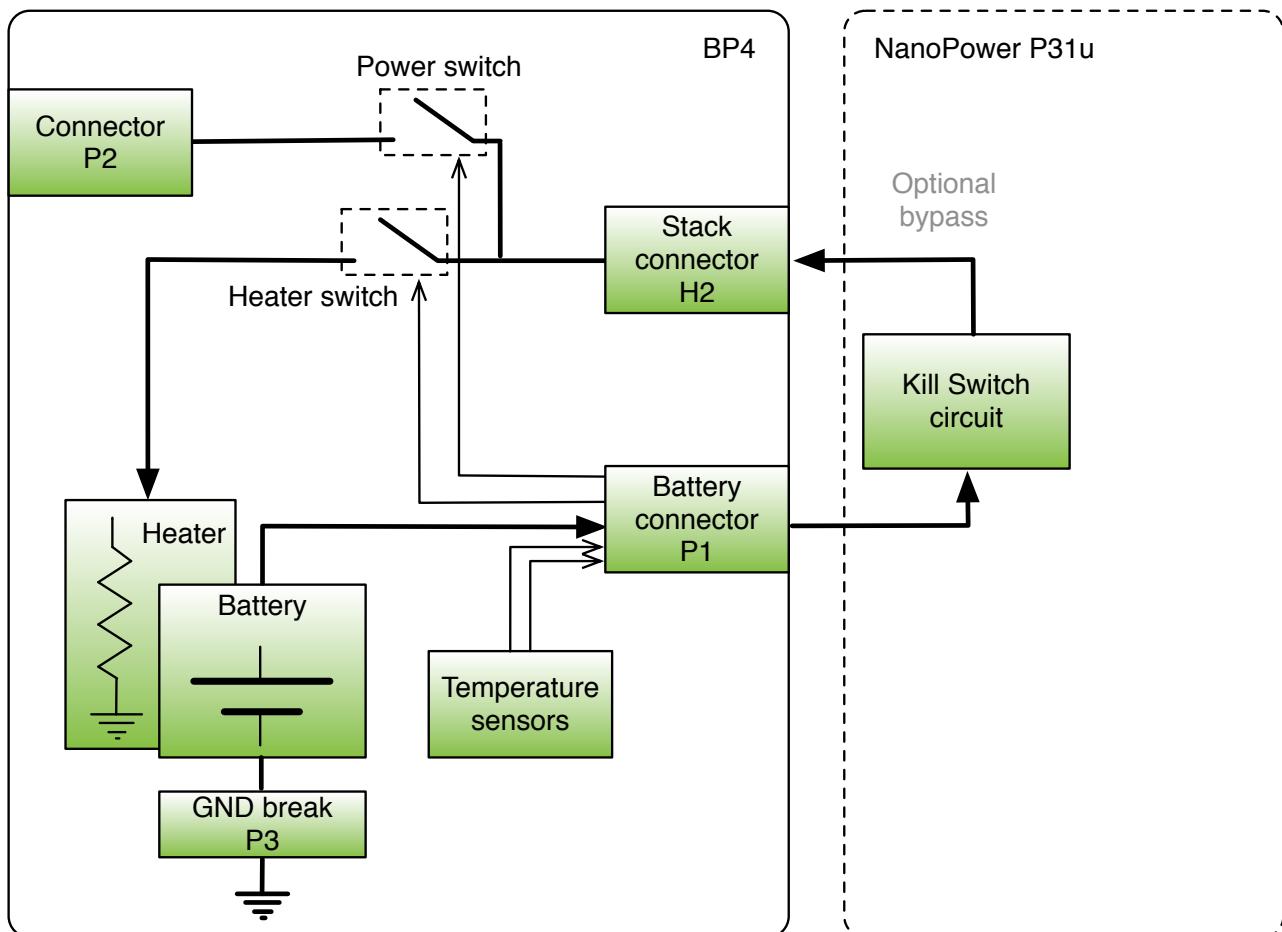
The batteries are attached to a PCB following the CubeSat Kit standard (modified PC-104 plus) and are re-packed with Kapton insulation and fitted to the board with Scotch-Weld 2216 epoxy. In addition, aluminum brackets are glued to the batteries and screwed to the PCB for added mechanical and thermal stability. The inter-cell connections are made with strips spot-welded to the cell terminals.

3.3 ISS acceptance test

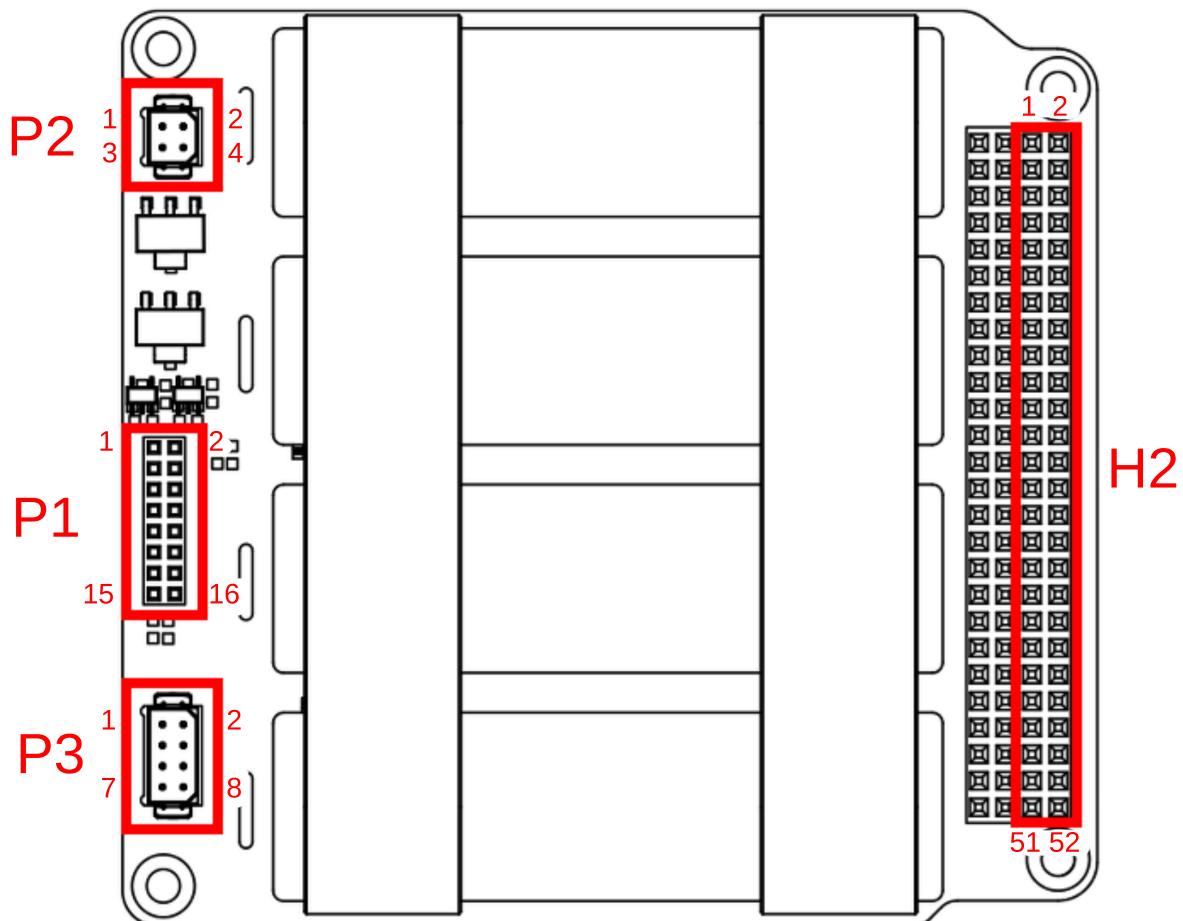
GomSpace offers an option to perform an ISS acceptance test to meet NASA and NanoRacks safety requirements for ISS launch. This includes: vibration test, vacuum test, battery testing and a test report.

3.4 Block Diagram

The BP4 connects to the NanoPower P31u through a dedicated battery connector as well as through the stack connector.



4 Connector Pinout



4.1 H2 – Stack Connector

Connector H2 is the stack connector.

Pin	Name	Dir.	Description
H2-29	GND	O	Power ground
H2-30	GND	O	Power ground
H2-32	GND	O	Power ground
H2-45	V_BAT	O	Battery voltage
H2-46	V_BAT	O	Battery voltage

4.2 P1 – Battery Connector

The battery cells are connected to a 16-pin dual row 2 mm pitch female header. This connector fits with the female external battery connector of the GomSpace NanoPower P31 with a Samtec TW-08-07-G-D-375-188 in between.

Pin	Name	Description	Pin	Name	Description
1	Vbat	Battery voltage connection	2	Vbat	Battery voltage connection
3	Vbat	Battery voltage connection	4	Vbat	Battery voltage connection
5	GND	Ground	6	GND	Ground
7	GND	Ground	8	GND	Ground
9	MISO	SPI MISO	10	MOSI	SPI MOSI
11	VCC	Supply voltage for temperature sensors	12	SCK	SPI SCK
13	CS1	Chip select for temperature sensor 1	14	SC2	Chip select for temperature sensor 2
15	PS	Active high power switch control (optional)	16	HS	Active high heater control

4.3 P2 - Power-switch Output

Harwin M80-8670405.

Pin	Name	Description
1	Vout	Power switch out
2	GND	Ground
3	Vout	Power switch out
4	GND	Ground

4.4 P3 - Ground-break Connector

Harwin M80-8670805.

Pin	Name	Description
1	GND	Ground
2	Bat GND	Battery negative terminal
3	GND	Ground
4	Bat GND	Battery negative terminal
5	GND	Ground
6	Bat GND	Battery negative terminal
7	GND	Ground
8	Bat GND	Battery negative terminal

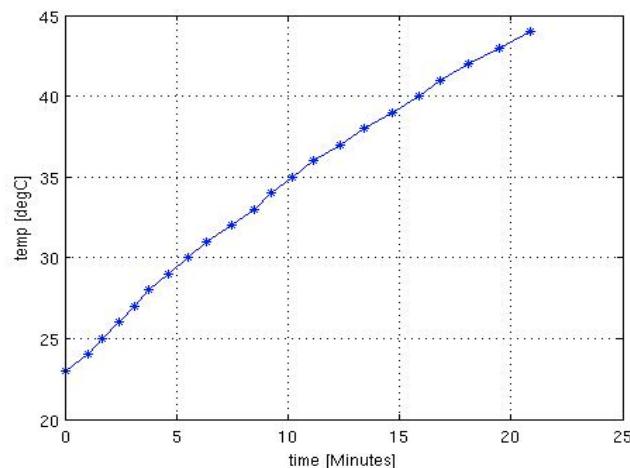
5 Heater and power switch

The power switch and the heater are implemented as high side switches with drivers (with active high inputs) and are powered from the stack connector. Optionally they can be powered directly from the battery.

Parameter	Condition	Min.	Typ.	Max.	Unit
Heater Element					
Control voltage	Active high	1.5		6	V
Heater resistance	Total, 2P-2S		11		Ω
	Total, 1P-4S		41		Ω
Heater power	2P-2S	3.5		7	W
	1P-4S	3.5		7	W
Power Switch					
Control voltage	Active high	1.5		6	V
Current	Continues		1	3.9	A

For details on heater control please see the NanoPower P31 datasheet/manual.

The graph below shows a test of the heater system of the standard BP4 connected to a NanoPower P31u. Operation is in vacuum with only a small thermal coupling to vacuum chamber. Ambient temperature of vacuum chamber is 23 °C. Battery voltage is 7.4 V and total heater resistance is 22 Ω .



6 Temperature Sensors

Two temperature sensors with SPI interface are mounted just under each battery-set to provide battery temperatures for housekeeping purposes. A complete thermal control system can be implemented using the two optional heater elements.

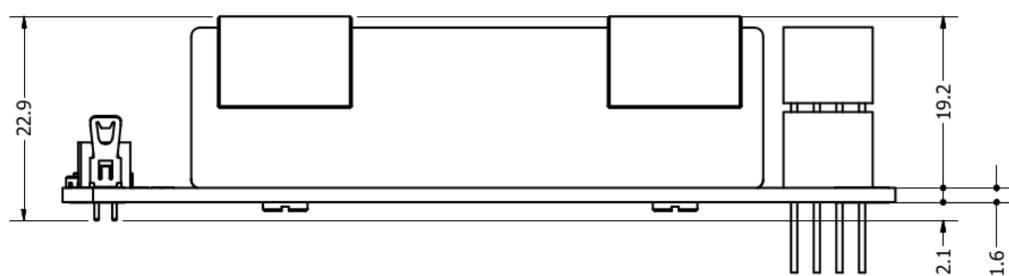
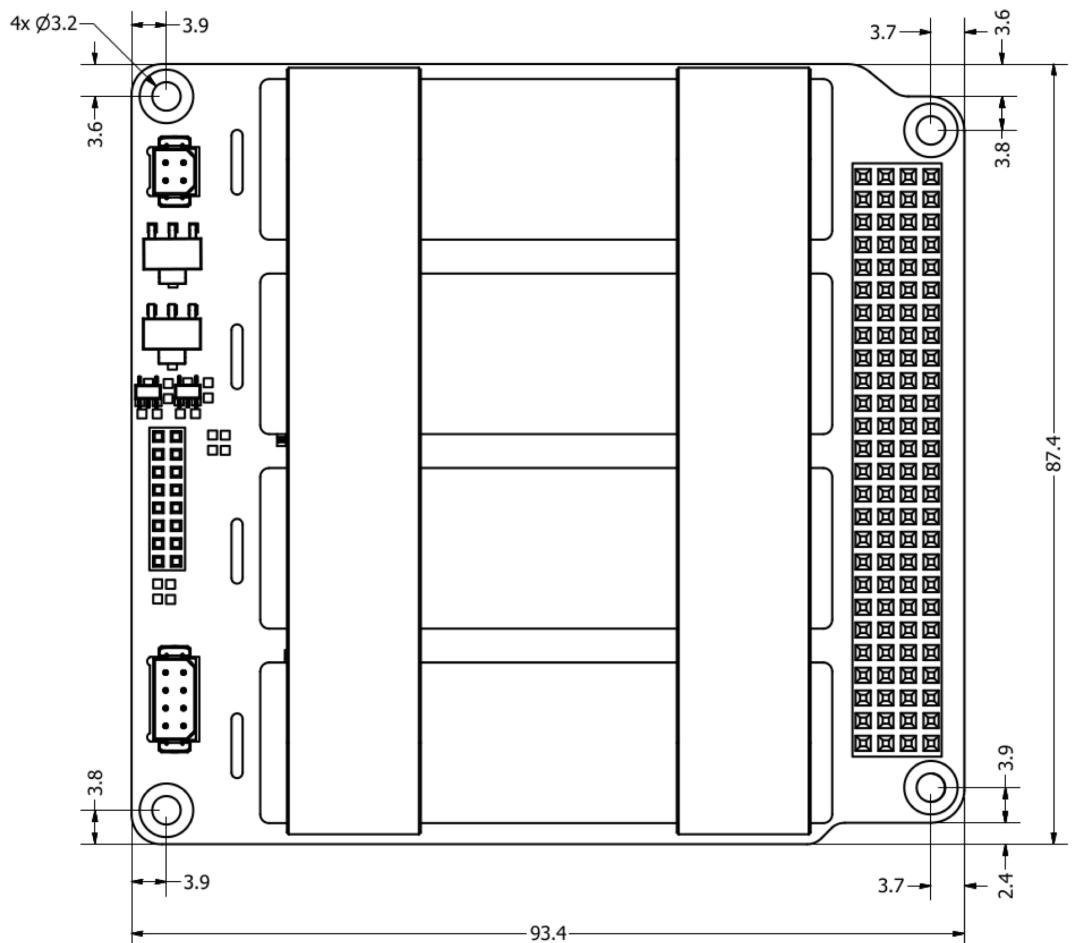
For SPI communication details please see the datasheet for the Texas Instruments TMP121.

Parameter	Condition	Min.	Typ.	Max.	Unit
Temperature Sensors					
- Range		-40		125	°C
- Accuracy		+/- 0.5	+/- 1.0	+/- 2.0	°C
- Vcc		2.7	3.3	5	V
- Icc			500		µA

7 Physical Dimensions

See last page for drawing with dimensions (Dimensions are given in mm). PCB material is:
Glass/polyimide, ESA ECSS-Q-ST-70-11-C, 1.60 mm thick.

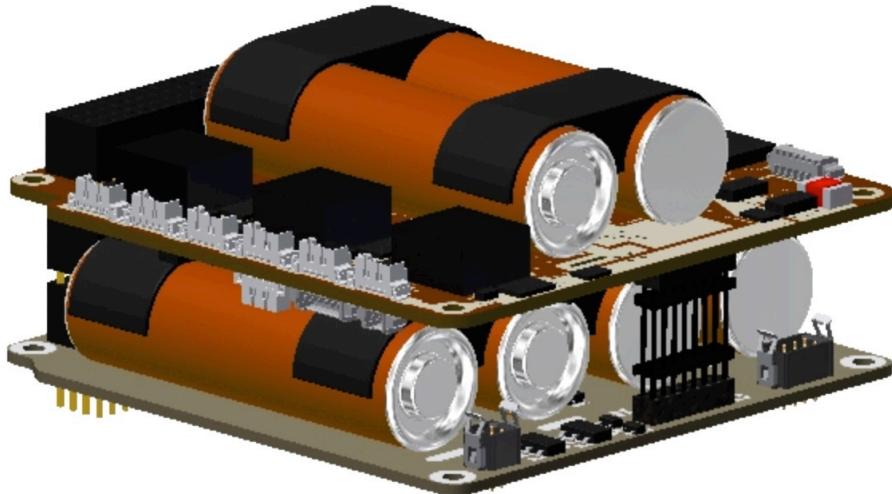
All dimensions in mm.



8 Configuration

The BP4 can be mated to the NanoPower P31u.

Shown below is the P31u on top and the BP4 below. Notice the stack connector between BP4 (P1) and P31u (P13) shown on the right.



Stacking height between the P31u and BP4 PCB is 23.5 mm.