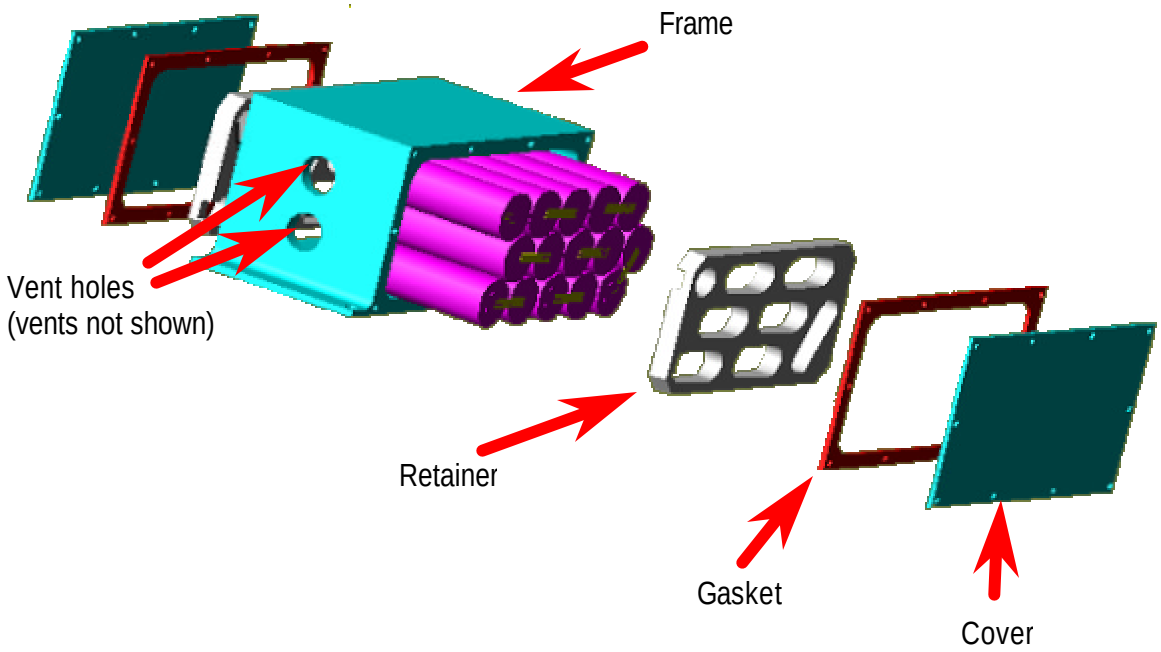
ION-F Battery Box

- Common battery box design (differ in aspect ratio only)
- Single-piece aluminum construction
- Covers and electrical connector interface with Teflon gaskets to prevent electrolyte leakage
- Two (redundant) Teflon vents to allow gases to escape
- Gore VE61221 Adhesive Membrane Vents
- Polypropylene potting material installed on cell ends to absorb leaked electrolyte
- PIG Mat 203
- Exterior Iridite conversion coating
- Interior electroless nickel and Solithane coating

Each individual cell is wrapped in a PVC sleeve (pending approval from the Materials Working Group) and epoxied directly to the other cells in a single row (USU) or hexagonal close-pack (UW, VT) formation.

The pack is securely held within the box. The internal dimensions of the frame are exactly the external dimensions of the pack, with tolerance for variation in cell diameter and thickness of the box interior coatings.

The retainers (Delrin) do not slip over the cells but rather provide a structural support for the connections between the cells. A PIG-Mat pillow is placed between the retainers and the covers. Again, this dimension allows some tolerance for variation in cell height and internal coatings on the covers. The PIG-Mat pillow will compress slightly during installation, creating a very secure package.



ION-F Battery Packs

1. Introduction

This document defines a set of fabrication requirements for three separate battery packs for the Ionospheric Nanosatellite Formation (ION-F). It also describes how the ION-F program will use the batteries, the level of acceptance testing that is required, and the documentation that must accompany the completed battery packs.

The Air Force Office of Scientific Research (AFOSR) and the Defense Advanced Research Projects Agency (DARPA) have jointly funded a number of universities to design, build, and fly nanosatellites. Under this program, the universities are to make use of student labor and pursue low-cost space experiments that explore useful applications or technologies for nanosatellites. The Air Force Research Labs (AFRL) is managing the University Nanosatellite Program for AFOSR and DARPA, and the Air Force Space Test Program is providing for the launch costs launch. The universities in the University Nanosatellite Program were encouraged and expected to obtain additional funding from other sources, including other government agencies, cost sharing, and industry donations. In January of 1999 AFRL committed the program to a launch on the Space Shuttle through the Space Test Program (STP) and helped organize Utah State University, along with the University of Washington and Virginia Polytechnic Institute & State University into a team, called ION-F, for a joint shuttle launch. Each of these universities is developing a 15-kg spacecraft as part of the ION-F formation.

Although the ION-F team is putting forth a best faith effort to provide functional satellites that will meet the mission objectives, the contracting details only require the universities to provide satellites that will meet NASA shuttle safety. The Air Force is not requiring any functional acceptance testing above what is required to insure shuttle-safe payloads. This is partly in recognition that success of the University Nanosatellite Program is not purely measured by mission success but includes educational elements to the program and must be low cost. This level of testing and documentation flows down from the ION-F team to the suppliers of the battery packs for the spacecraft.

We require a best of faith effort of the supplier to provide functional battery packs for the ION-F spacecraft application. Testing requirements on the cells of the battery are only those that are required by the Nanosat-2 Payload Hazard Report. The applicable item is:

“In order to preclude shorting hazards internal to the cells, each cell is acceptance tested to screen out cells that have internal electrical defects that cause cell shorting.”

The Safety verification method is

“ION-F will perform Cell Inspection and Acceptance test that will include thermal vacuum testing and internal short testing to screen out defective cells.”

2. Acceptance Tests

The following minimum set of testing shall be performed on every cell that is incorporated into the ION-F battery packs. Failure on any of the tests or measurements shall result in rejection of the non-conforming cell or battery pack.

2.1 Cell Preparation and Visual Inspection

All cells shall be stripped of their insulating sleeves, and washed if necessary to remove traces of electrolyte residue. All cells shall be visually inspected for defects and cells shall be rejected which have damage that is more than superficial from a mechanical or electrical standpoint.

2.2 Thermal Vacuum testing

All cells shall be placed in a thermal vacuum chamber and subjected to a vacuum equivalent to 100,000-ft altitude and temperature cycled. While under vacuum the cells shall be cold soaked for 2-4 hours at -20 ± 2 °C. While under vacuum the cells shall be heated to 40 ± 2 °C and soaked for 2-4 hours.

All cells shall be visually inspected following the thermal vacuum temperature cycling for any mechanical defects or leaks caused by thermal vacuum testing. Leaks shall be detected by applying phenolphthalein around the crimp seal and vent hole areas of each cell.

The open circuit voltage of each cell shall be measured to verify that there are no internal shorts within the cells. Any cell with an open circuit voltage of < 0.9 Volts shall be rejected.

2.3 Battery Pack testing

The Open Circuit Voltage of each ION-F battery packs shall be measured to verify that there are no internal shorts within the assembled pack. Any battery pack with an open circuit voltage less than 0.9*(number of cells in the battery) shall be rejected.

2.4 Other Testing

Any other cell or battery level testing as deemed reasonable by the supplier and at the supplier discretion. Additional tests are not required.

3. Reporting

1. A Certificate of Compliance stating the cell model and/or part no., the cell date code, and the Acceptance Testing results for all cells used in producing the ION-F battery packs.

2. Copies of test process logs or other similar documentation identifying the equipment used for each test measurement and calibration status of that equipment.

3. A list of references to either documentation or program names where more extensive cell level testing has been previously conducted on the cell types used in the ION-F battery packs, and a very brief description of the level of testing done.

4. A list of tests and results of any other testing done on the cells or battery packs. If no additional testing was conducted then this must be noted.

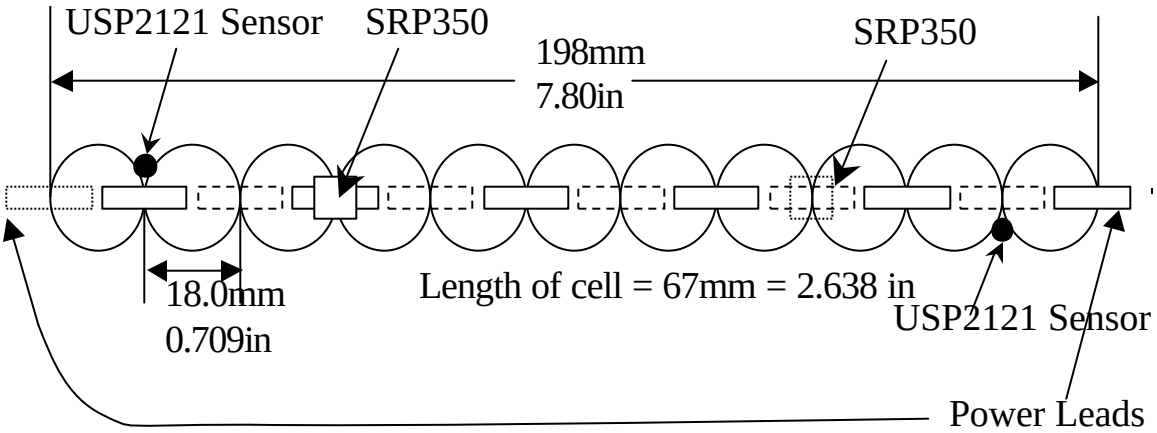
4. Battery Pack Assembly

Six battery packs shall be produced for ION-F according to data presented in Table 4-1. The assembly sketches show location of temperature sensor USP2121 for each of the packs. This temperature sensor shall not be procured and installed by the battery pack supplier. It shall be the responsibility of the ION-F team to install temperature sensors on the delivered battery packs. Each battery pack includes two Raychem SRP350 Polyswitches for over temperature and over current protection to be installed by the supplier. The individual cells shall be wrapped in a PVC sleeve.

Table 4-1: Battery Packs

Part Number	Cell Type	Number of Cells	Assembly Sketch
USU1	Sanyo HR-4/3AU	11	USU
USU2	Sanyo HR-4/3AU	11	USU
UW1	Sanyo KR-1400AE	20	UW
UW2	Sanyo KR-1400AE	20	UW
VT1	Sanyo KR-1400AE	15	VT
VT2	Sanyo KR-1400AE	15	VT

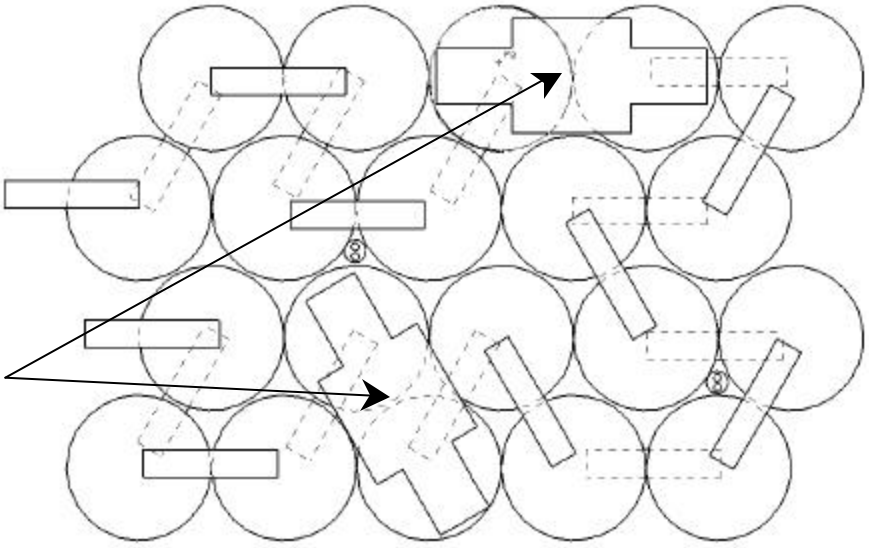
4.1 USU Drawing



Item	Quantity
Polyswitches Per Pack – SRP350	2
Battery Interconnects per pack	9
USP2121 Sensors Per Pack	2
Leads per pack	6 (2 power, 4 from sensors)
Leads from box sensor (DS18B20)	1
Leads to box sensor (DS18B20)	2

4.2 UW drawing

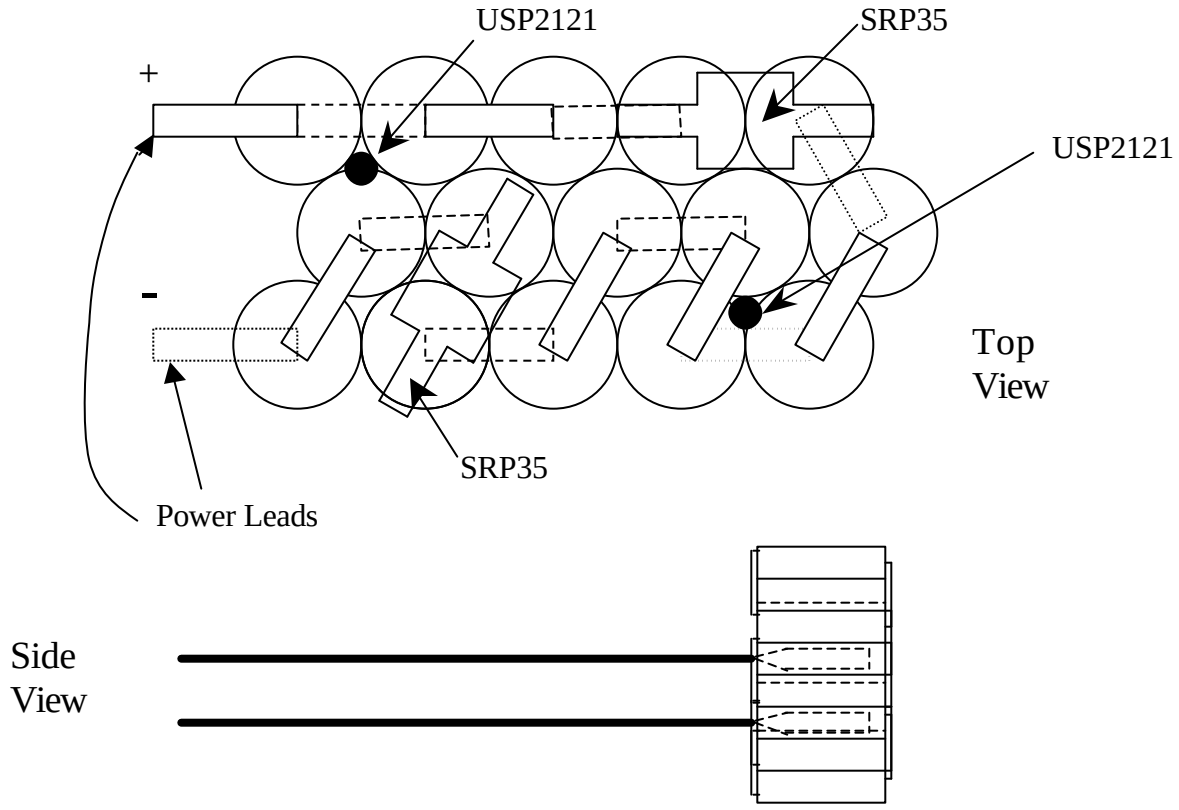
Top View



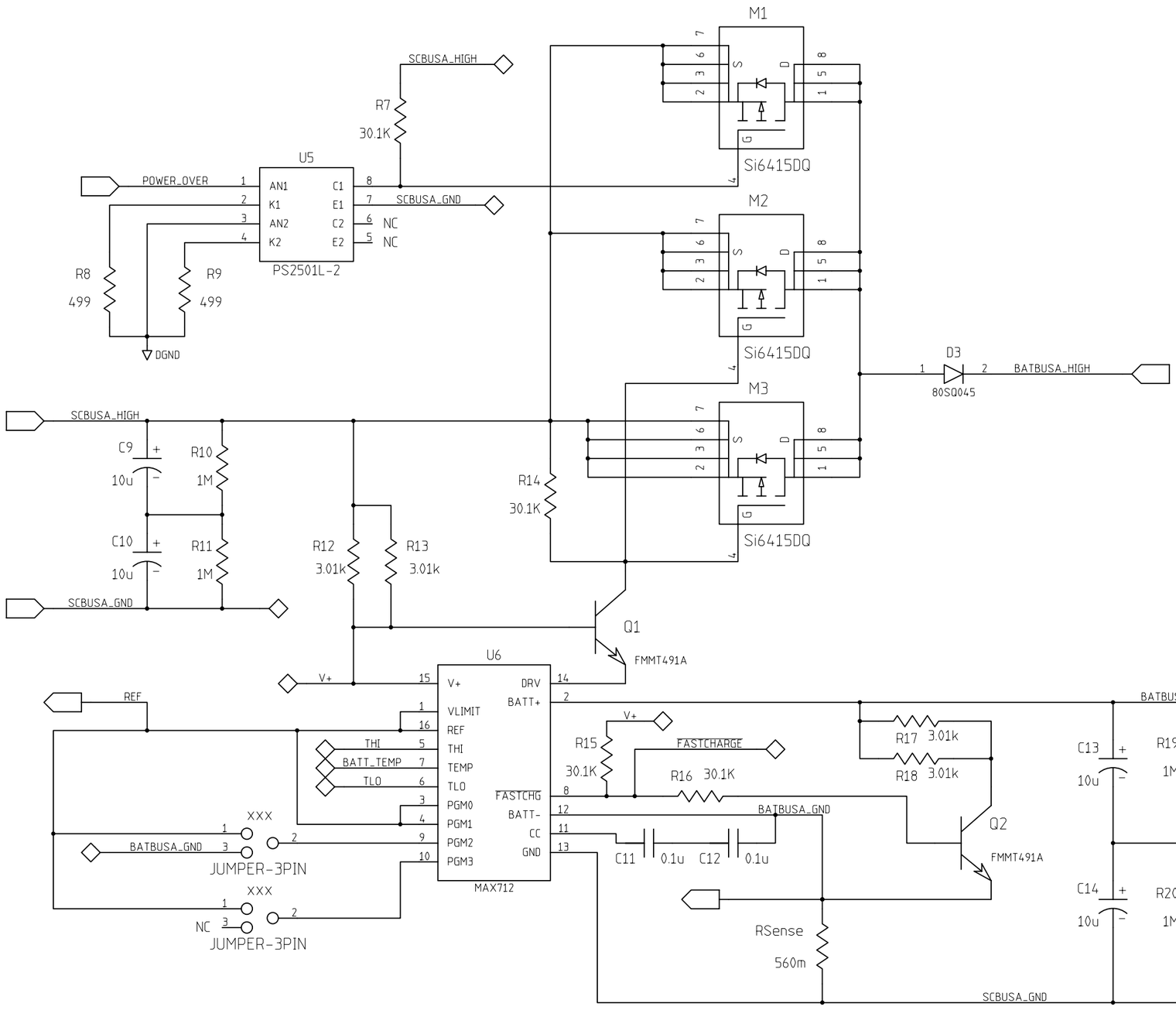
Side View

Item	Number
Polyswitches per pack - SRP350	2
Battery Interconnects per pack	19 (1 on +, 1 on – terminals)
USP2121 Sensors per pack	2
Leads per pack	6 (2 power, 4 from sensors)
Leads from box sensor (DS18B20)	1
Leads to box sensor (DS18B20)	2
Battery Packs	2
Battery Cells Per Pack	20
Type of Cell	Sanyo Cadnica KR1400AE
Pins in Connector	6 out of Box 1 in/out, 4 in (11 total)

4.3 VT Drawing

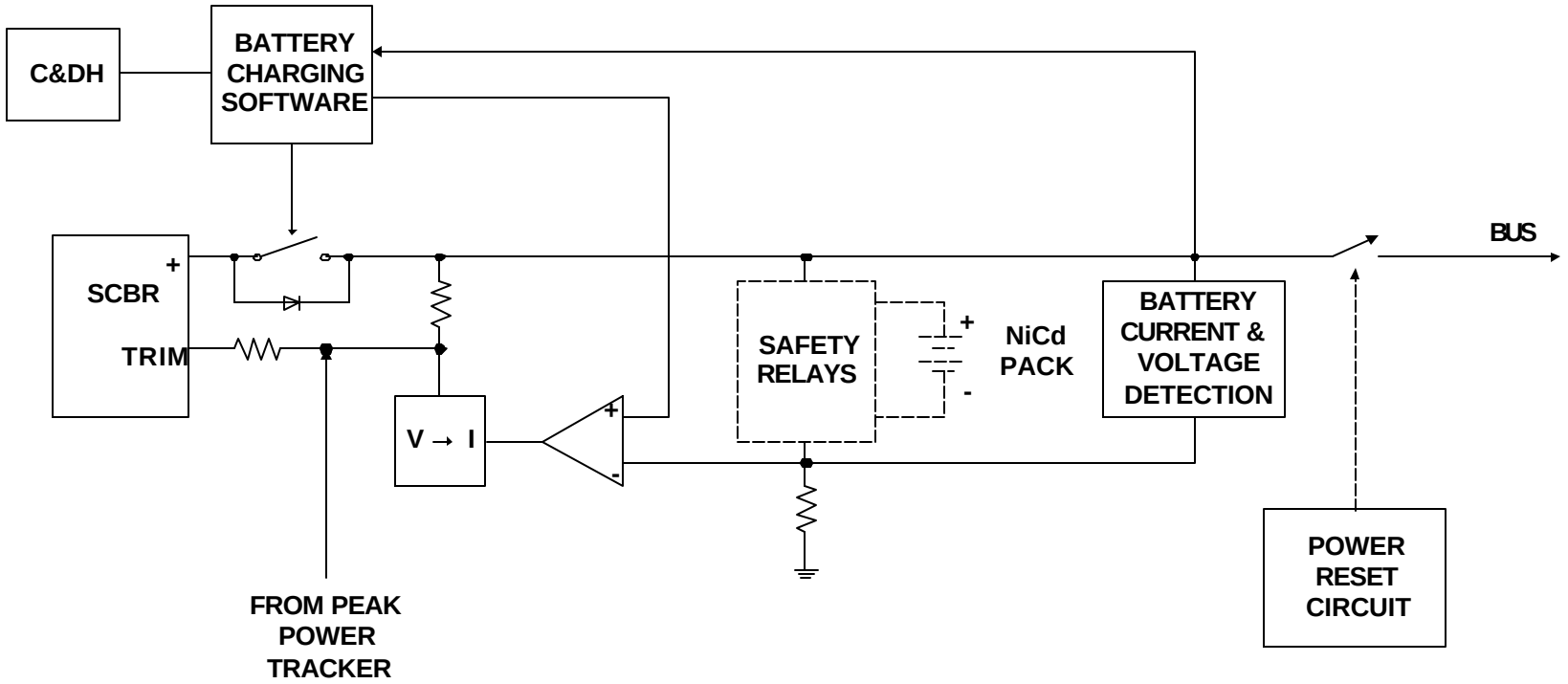


Item	Quantity
Polyswitches Per Pack – SRP350	1
Battery Interconnects per pack	13
USP2121 Sensors Per Pack	2
Leads per pack	6 (2 power, 4 from sensors)
Leads from box sensor (DS18B20)	1
Leads to box sensor (DS18B20)	2

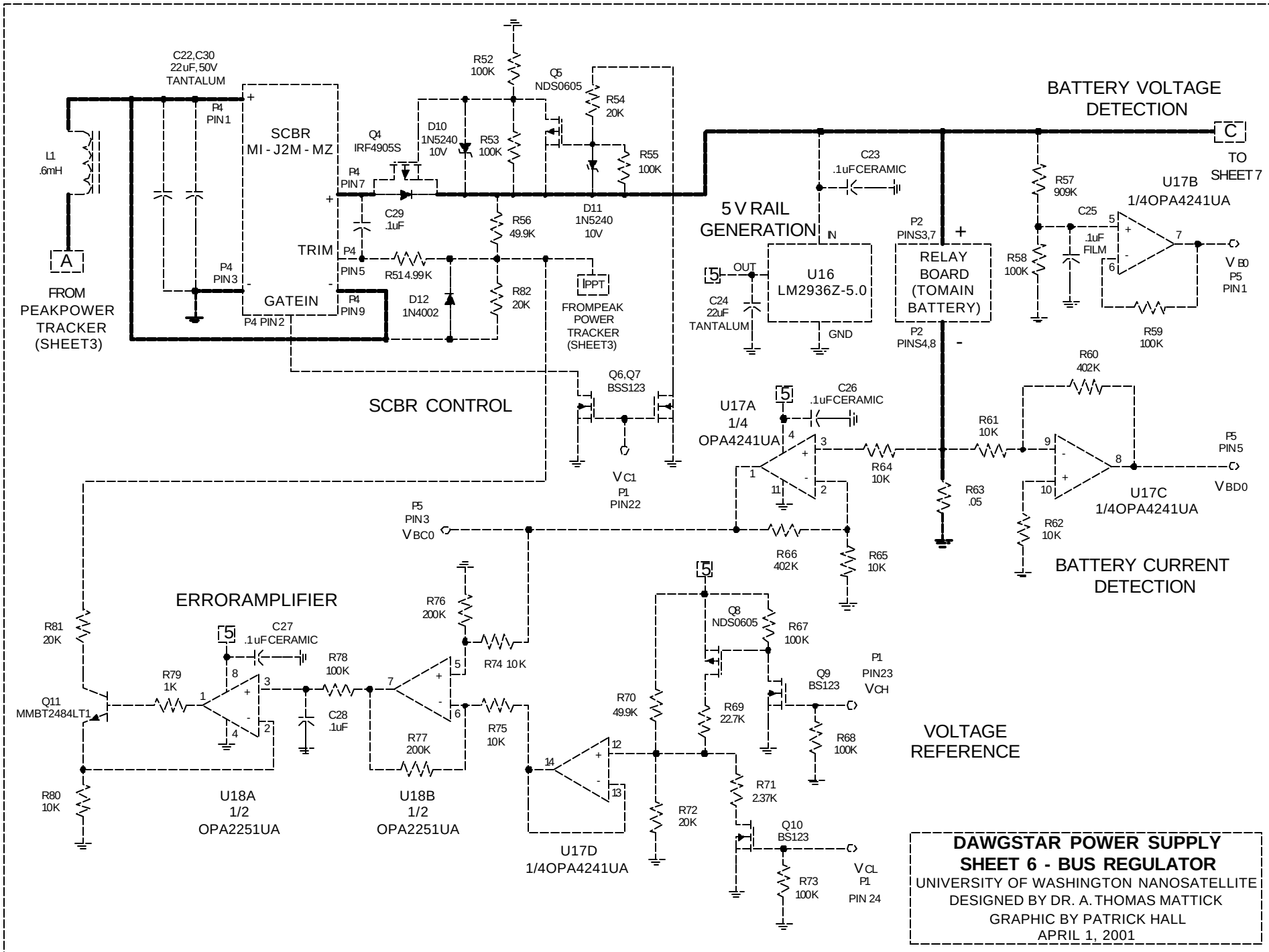


SPACE DYNAMICS LABORATORY	
UTAH STATE UNIVERSITY RESEARCH FOUNDATION	
North Logan, Utah 84341	
TITLE	Power Board Two Power Control
SCHEMATIC NAME: PB2	INSTANCE NAME:
DRAWING NUMBER: 30-0014	SCH REV: -
SCHEMATIC: OF	INSTANCE: OF
SCH-INST SHEET: 03 OF 09	

Form Number QF0411 Rev B



DAWGSTAR POWER SUPPLY
SHEET 5 - BUS REGULATOR
UNIVERSITY OF WASHINGTON NANOSATELLITE
DESIGNED BY DR. A. THOMAS MATTICK
GRAPHIC BY PATRICK HALL
APRIL 1, 2001


C22,C30
22uF,50V
TANTALUM
L1
.6mH
A
FROM
PEAKPOWER
TRACKER
(SHEET3)
P4
PIN1
P4
PIN3
SCBR
MI - J2M - MZ
GATEIN
P4 PIN2
P4
PIN9
R52
100K
Q5
NDS0605
R54
20K
D10
1N5240
10V
R53
100K
Q4
IRF4905S
P4
PIN7
R55
100K
C29
.1uF
TRIM
P4
PIN5
R51 4.99K
D12
1N4002
R56
49.9K
D11
1N5240
10V
R82
20K
IPPT
FROMPEAK
POWER
TRACKER
(SHEET3)
BATTERY VOLTAGE
DETECTION
C
TO
SHEET 7
C23
.1uFCERAMIC
5 V RAIL
GENERATION
IN
OUT
U16
LM2936Z-5.0
GND
C24
22uF
TANTALUM
P2
PINS3,7
+
RELAY
BOARD
(TOMAIN
BATTERY)
P2
PINS4,8
-
R57
909K
U17B
1/4OPA4241UA
C25
.1uF
FILM
R58
100K
R59
100K
VBD0
P5
PIN1
SCBR CONTROL
Q6,Q7
BSS123
VC1
P1
PIN22
U17A
1/4
OPA4241UA
C26
.1uFCERAMIC
R60
402K
R61
10K
R64
10K
R63
.05
U17C
1/4OPA4241UA
P5
PIN5
VBD0
R62
10K
BATTERY CURRENT
DETECTION
P5
PIN3
VBC0
R66
402K
R65
10K
ERRORAMPLIFIER
R81
20K
C27
.1uFCERAMIC
R78
100K
R79
1K
Q11
MMBT2484LT1
C28
.1uF
R80
10K
U18A
1/2
OPA2251UA
R76
200K
R74 10K
R77
200K
R75
10K
U18B
1/2
OPA2251UA
U17D
1/4OPA4241UA
Q8
NDS0605
R67
100K
Q9
BS123
P1
PIN23
VCH
R70
49.9K
R69
22.7K
R68
100K
R71
2.37K
R72
20K
Q10
BS123
VCL
P1
PIN 24
R73
100K
VOLTAGE
REFERENCE
DAWGSTAR POWER SUPPLY
SHEET 6 - BUS REGULATOR
UNIVERSITY OF WASHINGTON NANOSATELLITE
DESIGNED BY DR. A. THOMAS MATTICK
GRAPHIC BY PATRICK HALL
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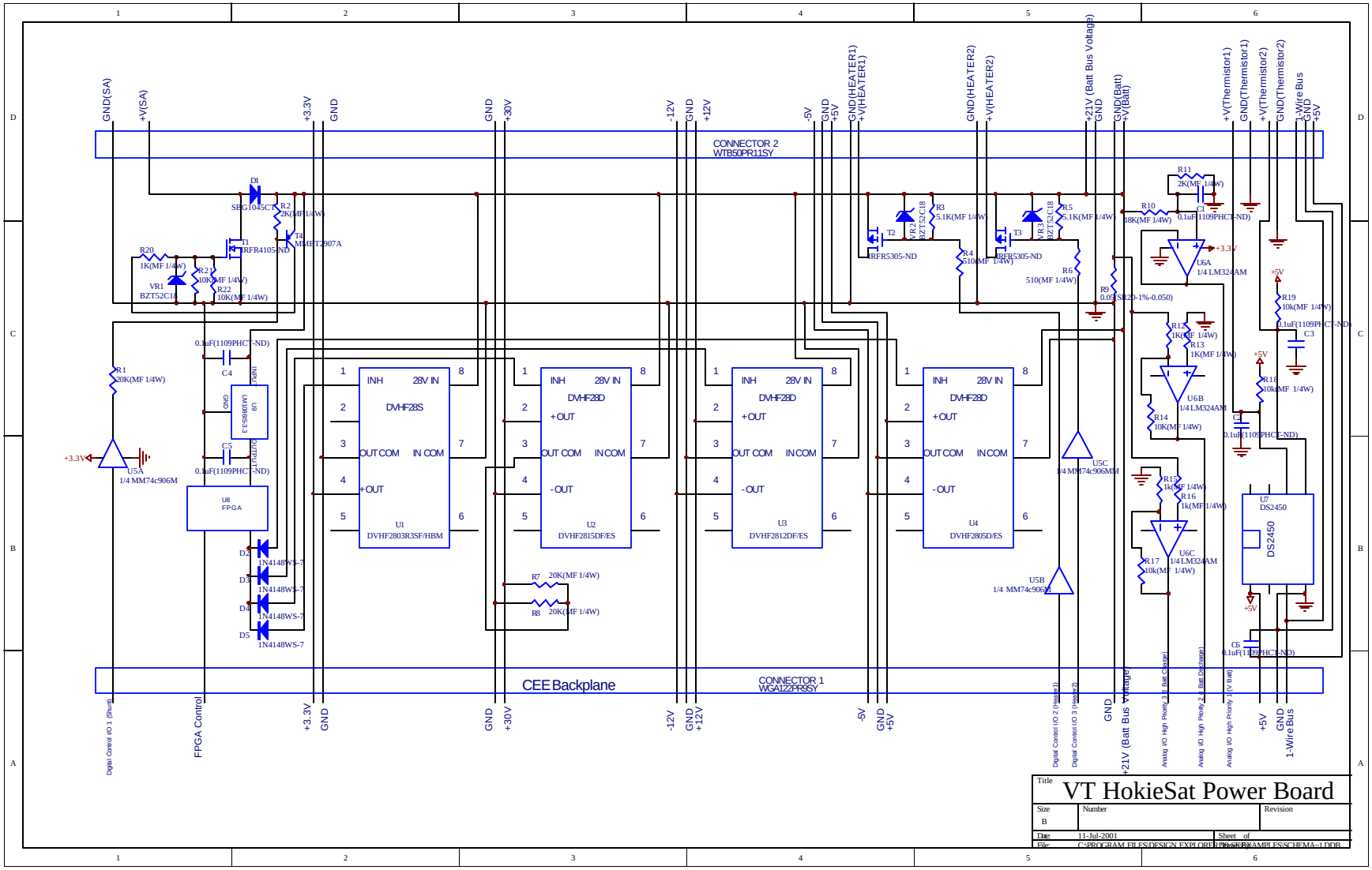
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+V(SA)
+3.3V
GND
GND
+30V
-12V
GND
+12V
-5V
GND
+5V
GND(HEATER1)
+V(HEATER1)
GND(HEATER2)
+V(HEATER2)
+21V (Batt Bus Voltage)
GND
GND(Batt)
+V(Batt)
+V(Thermistor1)
GND(Thermistor1)
+V(Thermistor2)
GND(Thermistor2)
1-Wire Bus
GND
+5V
CONNECTOR 2
WTB50PR11SY
CONNECTOR 1
WGA122PR8SY
CEE Backplane
DVHF28S
DVHF28D
DVHF2803R3SF/HBM
DVHF2815DF/ES
DVHF2812DF/ES
DVHF2805D/ES
INH
28V IN
OUT COM
IN COM
+OUT
-OUT
U1
U2
U3
U4
U5A
U5B
U5C
1/4 MM74c906M
U6A
U6B
U6C
1/4 LM324AM
U7
DS2450
U8
FPGA
U9
LM1086IS3.3
D1
SBG1045CT
D2
D3
D4
D5
1N4148WS-7
T1
IRFR4105-ND
T2
T3
IRFR5305-ND
T4
MMBT2907A
VR1
VR2
VR3
BZT52C18
R1
20K(MF 1/4W)
R2
2K(MF 1/4W)
R3
5.1K(MF 1/4W)
R4
510(MF 1/4W)
R5
5.1K(MF 1/4W)
R6
510(MF 1/4W)
R7
20K(MF 1/4W)
R8
20K(MF 1/4W)
R9
0.05(LSK20-1%-0.050)
R10
18K(MF 1/4W)
R11
2K(MF 1/4W)
R12
1K(MF 1/4W)
R13
1K(MF 1/4W)
R14
10K(MF 1/4W)
R15
1K(MF 1/4W)
R16
1k(MF 1/4W)
R17
10k(MF 1/4W)
R18
10k(MF 1/4W)
R19
10k(MF 1/4W)
R20
1K(MF 1/4W)
R21
10K(MF 1/4W)
R22
10K(MF 1/4W)
C1
0.1uF(1109PHCT-ND)
C2
0.1uF(1109PHCT-ND)
C3
0.1uF(1109PHCT-ND)
C4
0.1uF(1109PHCT-ND)
C5
0.1uF(1109PHCT-ND)
C6
0.1uF(1109PHCT-ND)
INPUT
OUTPUT
GND
+3.3V
+5V
Digital Control I/O 1 (Shunt)
FPGA Control
Digital Control I/O 2 (Heater1)
Digital Control I/O 3 (Heater2)
Analog I/O High Prio/Pr_1 (Batt Charge)
Analog I/O High Prio/Pr_2 (Batt Discharge)
Analog I/O High Prio/Pr_3 (V Batt)
Title
VT HokieSat Power Board
Size
B
Number
Revision
Date:
11-Jul-2001
Sheet of
File:
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