



# CubeSat ICD

*Interconnect Specifications*

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# Table of Contents

1.0	Scope of Document . . . . .	1
2.0	Applicable Documents . . . . .	1
2.1	StenSat Group Documents . . . . .	1
2.2	Industry Documents and Specifications . . . . .	1
	. . . . .	1
3.0	CubeSat Electrical Interconnect Definitions . . . . .	2
3.1	Solar Panel Interconnect . . . . .	2
3.1.1	Connector Specification . . . . .	2
3.1.2	Solar Panel Pin Definitions . . . . .	2
3.1.2.1	Solar Panel Z+ Pin Definition . . . . .	2
3.1.2.2	Solar Panel Z- Pin Definition . . . . .	2
3.1.2.3	Solar Panel Y+ Pin Definition . . . . .	3
3.1.2.4	Solar Panel Y- Pin Definition . . . . .	3
3.1.2.5	Solar Panel X+ Pin Definition . . . . .	3
3.1.2.6	Solar Panel X- Pin Definition . . . . .	4
3.1.2.7	External Diagnostic Port . . . . .	4
3.1.3	Signal Descriptions . . . . .	5
3.1.3.1	Unregulated Voltage . . . . .	5
3.1.3.2	Regulated Voltage . . . . .	5
3.1.3.3	1-Wire Bus . . . . .	5
3.1.3.4	Sensor Signal . . . . .	5
3.1.3.5	Ground . . . . .	5
3.1.3.6	TxD Signal . . . . .	5
3.1.3.7	RxD Signal . . . . .	5
3.1.3.8	External Charge Sense . . . . .	6
3.2	Spacecraft Stack Interconnect . . . . .	6
3.2.1	Stack Interconnect Connector Specification . . . . .	6
3.2.2	Connector Pin Definitions . . . . .	6
3.2.2.1	RF Solder Side Connector . . . . .	7
	. . . . .	7
	. . . . .	8
3.2.2.3	CPU Solder Side Connector . . . . .	9
3.2.2.4	Attitude Control Component Side Connector . . . . .	10
3.2.2.5	Attitude Control Solder Side Connector . . . . .	11
3.2.2.6	Top Battery Board Component Side Connector . . . . .	12
3.2.2.6	Top Battery Board Solder Side Connector . . . . .	13
	. . . . .	13
3.2.3	Stack Interconnect Signal Description . . . . .	17
3.2.3.1	RX MOD . . . . .	17
3.2.3.2	TX MOD . . . . .	17
3.2.3.3	Payload Analog 1 and 2 . . . . .	17
3.2.3.4	Payload Digital 0 - 3 . . . . .	17
3.2.3.6	Payload Power Control . . . . .	18
3.2.3.7	Payload Reset . . . . .	18
3.2.3.8	SPI SDO . . . . .	18
3.2.3.9	SPI SDI . . . . .	18

3.2.3.10 SPI SCK . . . . .	19
3.2.3.11 WIRE1, WIRE2, WIRE3 . . . . .	19
3.2.3.12 DIAGNOSTIC TXD . . . . .	19
3.2.3.13 DIAGNOSTIC RXD . . . . .	19
3.2.3.14 KILLINH . . . . .	20
3.2.3.15 XMIT POWER . . . . .	20
3.2.3.16 RF POWER CONTROL . . . . .	20
3.2.3.17 PAYLOAD SQUELCH . . . . .	21
3.2.3.18 ATTITUDE POWER CONTROL . . . . .	21
3.2.3.19 EXT CHARGE SENSE . . . . .	21
3.2.3.20 BOT BATT CONTROL . . . . .	21
3.2.3.21 Z- Sensor, Z+ Sensor . . . . .	22
3.2.3.22 Z+ Unregulated Voltage, Z- Unregulated Voltage . . . . .	22
3.2.3.23 Regulated Voltage . . . . .	22
3.2.3.24 GND . . . . .	22

## **1.0 Scope of Document**

## **2.0 Applicable Documents**

### **2.1 StenSat Group Documents**

- Payload Interface Specification
- CubeSat System Specification
- Operations Document
- Assembly Instructions Manual

### **2.2 Industry Documents and Specifications**

- Dallas Semiconductor 1-Wire Bus Specification
- Component Datasheets

## 3.0 CubeSat Electrical Interconnect Definitions

### 3.1 Solar Panel Interconnect

Refer to drawing CUBESAT-0002 for the interconnect schematic.

#### 3.1.1 Connector Specification

#### 3.1.2 Solar Panel Pin Definitions

##### 3.1.2.1 Solar Panel Z+ Pin Definition

Pin	Description
1	Z+ Unregulated voltage (solar cell raw voltage)
2	Regulated voltage
3	Z- Unregulated voltage (solar cell raw voltage)
4	Regulated voltage
5	1-wire bus
6	
7	
8	Ground
9	Z+ Sensor
10	Ground

##### 3.1.2.2 Solar Panel Z- Pin Definition

Pin	Description
1	Z- Unregulated voltage (solar cell raw voltage)
2	Regulated voltage
3	Z- Unregulated voltage (solar cell raw voltage)
4	Regulated voltage
5	1-wire bus
6	
7	
8	Ground
9	Z- Sensor
10	Ground

### 3.1.2.3 Solar Panel Y+ Pin Definition

Pin	Description
1	Y+ Unregulated voltage (solar cell raw voltage)
2	Regulated voltage
3	Y+ Unregulated voltage (solar cell raw voltage)
4	Regulated voltage
5	1-wire bus
6	
7	
8	Ground
9	Y+ Sensor
10	Ground

### 3.1.2.4 Solar Panel Y- Pin Definition

Pin	Description
1	Y- Unregulated voltage (solar cell raw voltage)
2	Regulated voltage
3	Y- Unregulated voltage (solar cell raw voltage)
4	Regulated voltage
5	1-wire bus
6	Ext Charge Sense
7	RxD
8	Ground
9	TxD/Y- Sensor
10	Ground

### 3.1.2.5 Solar Panel X+ Pin Definition

Pin	Description
1	X+ Unregulated voltage (solar cell raw voltage)
2	Regulated voltage

3	X+ Unregulated voltage (solar cell raw voltage)
4	Regulated voltage
5	1-wire bus
6	
7	
8	Ground
9	X+ Sensor
10	Ground

#### 3.1.2.6 Solar Panel X- Pin Definition

Pin	Description
1	X- Unregulated voltage (solar cell raw voltage)
2	Regulated voltage
3	X- Unregulated voltage (solar cell raw voltage)
4	Regulated voltage
5	1-wire bus
6	
7	
8	Ground
9	X- Sensor
10	Ground

#### 3.1.2.7 External Diagnostic Port

PIN	Description
1	TxD
2	RxD
3	Ext Charge Sense
4	Regulated voltage
5	NC
6	Ground

### **3.1.3 Signal Descriptions**

#### *3.1.3.1 Unregulated Voltage*

This signal is the unregulated voltage directly from the series of solar cells on the solar panel. With six GaAs solar cells in series, the voltage range is 0 to 4.2 volts. The maximum current is 900ma.

#### *3.1.3.2 Regulated Voltage*

The regulated voltage is the power conditioned by the power subsystem. The voltage is set to 3.3 volts. Maximum current is 1000 ma.

#### *3.1.3.3 1-Wire Bus*

The 1-wire bus is a data bus for communicating with peripheral devices on the solar panel. The bus is an open collector signal with a 4.7 Kohm pullup resistor. The resistor resides on the controller board.

- High level signal: 3.0V to regulated voltage level
- Low level signal: 0.0V to 0.8 volts
- High input source current:
- Low input source current:

#### *3.1.3.4 Sensor Signal*

The sensor signal is a direct connection to the sun sensor. The voltage level indicates the level of light exposure.

- Voltage range: 0 - 3 volts
- Impedence:

#### *3.1.3.5 Ground*

The ground is the spacecraft common ground.

#### *3.1.3.6 TxD Signal*

The TxD signal is the processor asynchronous serial interface transmitter signal.

- Impedence: CMOS logic
- High voltage level: Regulated voltage - 0.2 volts
- Low voltage level: < 0.8 volts
- High current source level: 1ma
- Low current source level: 1ma

#### *3.1.3.7 RxD Signal*

The RxD signal is the processor asynchronous serial interface receiver signal.

- Impedence: CMOS logic
- High voltage level: Regulated voltage - 0.2 volts

- Low voltage level: < 0.8 volts
- High current source level: 1ma
- Low current source level: 1ma

#### *3.1.3.8 External Charge Sense*

This signal is used to indicate to the spacecraft that it is being powered through the diagnostic port. This signal is used to keep the spacecraft from attempting to deploy its antennas.

- Impedence: CMOS logic
- High voltage level: Regulated voltage - 0.2 volts
- Low voltage level: < 0.8 volts
- High current source level: 1ma
- Low current source level: 1ma

## **3.2 Spacecraft Stack Interconnect**

Refer to drawing CUBESAT-0002 for the interconnect schematic.

### **3.2.1 Stack Interconnect Connector Specification**

There are up to two connectors for each circuit board. The component side connector is the SAMTEC QTE-020-03-F-D-A. The solder side connector is the QSE-020-01-F-D-A. Refer to appendix TBD for mounting locations on the circuit board.

### 3.2.2 Connector Pin Definitions

Blank descriptions indicate no connection.

#### 3.2.2.1 RF Solder Side Connector

Pin	Description	Pin	Description
1	Rx Mod	2	GND
3	GND	4	Tx Mod
5		6	GND
7	GND	8	
9		10	GND
11		12	XMIT OFF
13		14	
15		16	
17	XMIT POWER	18	WIRE1
19		20	
21		22	
23		24	
25	WIRE3	26	KILLINH
27		28	
29	RF POWER CONTROL	30	
31		32	
33		34	Z+ SENSOR
35	Z+ UNREG VOLTAGE	36	Z+ UNREG VOLTAGE
37	GND	38	GND
39	REGULATED VOLTAGE	40	REGULATED VOLTAGE

### 3.2.2.2 CPU Component Side Connector

Pin	Description	Pin	Description
1	Rx Mod	2	GND
3	GND	4	Tx Mod
5		6	GND
7	GND	8	
9		10	GND
11		12	XMIT OFF
13		14	
15		16	
17	XMIT POWER	18	WIRE1
19		20	
21		22	
23		24	
25	WIRE3	26	KILLINH
27		28	
29	RF POWER CONTROL	30	
31		32	
33		34	Z+ SENSOR
35	Z+ UNREG VOLTAGE	36	Z+ UNREG VOLTAGE
37	GND	38	GND
39	REGULATED VOLTAGE	40	REGULATED VOLTAGE

### 3.2.2.3 CPU Solder Side Connector

Pin	Description	Pin	Description
1	RX MOD	2	GND
3	GND	4	TX MOD
5	PAYLOAD ANALOG 1	6	GND
7	GND	8	PAYLOAD ANALOG 2
9	PAYLOAD DIGITAL 0	10	GND
11	PAYLOAD DIGITAL 1	12	
13	PAYLOAD DIGITAL 2	14	PAYLOAD POWER CONTROL
15	PAYLOAD DIGITAL 3	16	PAYLOAD RESET
17		18	WIRE1
19	SPI SDO	20	WIRE2
21	SPI SDI	22	TXD DIAGNOSTIC
23	SPI SCK	24	RXD DIAGNOSTIC
25	WIRE3	26	KILLINH
27	PAYLOAD SQUELCH	28	EXT CHARGE SENSE
29	ATTITUDE POWER CONTROL	30	
31		32	BOTTOM BATTERY POWER CONTROL
33		34	Z+ SENSOR
35	Z+ UNREG VOLTAGE	36	Z+ UNREG VOLTAGE
37	GND	38	GND
39	REGULATED VOLTAGE	40	REGULATED VOLTAGE

### 3.2.2.4 Attitude Control Component Side Connector

Pin	Description	Pin	Description
1	RX MOD	2	GND
3	GND	4	TX MOD
5	PAYLOAD ANALOG 1	6	GND
7	GND	8	PAYLOAD ANALOG 2
9	PAYLOAD DIGITAL 0	10	GND
11	PAYLOAD DIGITAL 1	12	
13	PAYLOAD DIGITAL 2	14	PAYLOAD POWER CONTROL
15	PAYLOAD DIGITAL 3	16	PAYLOAD RESET
17		18	WIRE1
19	SPI SDO	20	WIRE2
21	SPI SDI	22	TXD DIAGNOSTIC
23	SPI SCK	24	RXD DIAGNOSTIC
25	WIRE3	26	KILLINH
27	PAYLOAD SQUELCH	28	EXT CHARGE SENSE
29	RF POWER CONTROL	30	
31		32	BOTTOM BATTERY POWER CONTROL
33		34	Z+ SENSOR
35	Z+ UNREG VOLTAGE	36	Z+ UNREG VOLTAGE
37	GND	38	GND
39	REGULATED VOLTAGE	40	REGULATED VOLTAGE

### 3.2.2.5 Attitude Control Solder Side Connector

Pin	Description	Pin	Description
1	RX MOD	2	GND
3	GND	4	TX MOD
5	PAYLOAD ANALOG 1	6	GND
7	GND	8	PAYLOAD ANALOG 2
9	PAYLOAD DIGITAL 0	10	GND
11	PAYLOAD DIGITAL 1	12	
13	PAYLOAD DIGITAL 2	14	PAYLOAD POWER CONTROL
15	PAYLOAD DIGITAL 3	16	PAYLOAD RESET
17		18	WIRE1
19	SPI SDO	20	WIRE2
21	SPI SDI	22	TXD DIAGNOSTIC
23	SPI SCK	24	RXD DIAGNOSTIC
25	WIRE3	26	KILLINH
27	PAYLOAD SQUELCH	28	EXT CHARGE SENSE
29	ASPI MISO	30	ASPI MOSI
31	ASPI SCK	32	BOTTOM BATTERY POWER CONTROL
33		34	Z+ SENSOR
35	Z+ UNREG VOLTAGE	36	Z+ UNREG VOLTAGE
37	GND	38	GND
39	REGULATED VOLTAGE	40	REGULATED VOLTAGE

### 3.2.2.6 Top Battery Board Component Side Connector

Pin	Description	Pin	Description
1	RX MOD	2	GND
3	GND	4	TX MOD
5	PAYLOAD ANALOG 1	6	GND
7	GND	8	PAYLOAD ANALOG 2
9	PAYLOAD DIGITAL 0	10	GND
11	PAYLOAD DIGITAL 1	12	
13	PAYLOAD DIGITAL 2	14	PAYLOAD POWER CONTROL
15	PAYLOAD DIGITAL 3	16	PAYLOAD RESET
17		18	WIRE1
19	SPI SDO	20	WIRE2
21	SPI SDI	22	TXD DIAGNOSTIC
23	SPI SCK	24	RXD DIAGNOSTIC
25	WIRE3	26	KILLINH
27	PAYLOAD SQUELCH	28	EXT CHARGE SENSE
29	ASPI MISO	30	ASPI MOSI
31	ASPI SCK	32	BOTTOM BATTERY POWER CONTROL
33		34	Z+ SENSOR
35	Z+ UNREG VOLTAGE	36	Z+ UNREG VOLTAGE
37	GND	38	GND
39	REGULATED VOLTAGE	40	REGULATED VOLTAGE

### 3.2.2.6 Top Battery Board Solder Side Connector

Pin	Description	Pin	Description
1	RX MOD	2	GND
3	GND	4	TX MOD
5	PAYLOAD ANALOG 1	6	GND
7	GND	8	PAYLOAD ANALOG 2
9	PAYLOAD DIGITAL 0	10	GND
11	PAYLOAD DIGITAL 1	12	
13	PAYLOAD DIGITAL 2	14	PAYLOAD POWER CONTROL
15	PAYLOAD DIGITAL 3	16	PAYLOAD RESET
17		18	WIRE1
19	SPI SDO	20	WIRE2
21	SPI SDI	22	TXD DIAGNOSTIC
23	SPI SCK	24	RXD DIAGNOSTIC
25	WIRE3	26	KILLINH
27	PAYLOAD SQUELCH	28	EXT CHARGE SENSE
29	ASPI MISO	30	ASPI MOSI
31	ASPI SCK	32	BOTTOM BATTERY POWER CONTROL
33		34	Z+ SENSOR
35	Z+ UNREG VOLTAGE	36	Z+ UNREG VOLTAGE
37	GND	38	GND
39	REGULATED VOLTAGE	40	REGULATED VOLTAGE

### 3.2.2.7 Bottom Battery Board Component Side Connector

Pin	Description	Pin	Description
1	RX MOD	2	GND
3	GND	4	TX MOD
5	PAYLOAD ANALOG 1	6	GND
7	GND	8	PAYLOAD ANALOG 2
9	PAYLOAD DIGITAL 0	10	GND
11	PAYLOAD DIGITAL 1	12	
13	PAYLOAD DIGITAL 2	14	PAYLOAD POWER CONTROL
15	PAYLOAD DIGITAL 3	16	PAYLOAD RESET
17		18	WIRE1
19	SPI SDO	20	WIRE2
21	SPI SDI	22	TXD DIAGNOSTIC
23	SPI SCK	24	RXD DIAGNOSTIC
25	WIRE3	26	KILLINH
27	PAYLOAD SQUELCH	28	EXT CHARGE SENSE
29	ASPI MISO	30	ASPI MOSI
31	ASPI SCK	32	BOTTOM BATTERY POWER CONTROL
33		34	Z- SENSOR
35	Z+ UNREG VOLTAGE	36	Z+ UNREG VOLTAGE
37	GND	38	GND
39	REGULATED VOLTAGE	40	REGULATED VOLTAGE

### 3.2.2.8 Bottom Battery Board Solder Side Connector

Pin	Description	Pin	Description
1	RX MOD	2	GND
3	GND	4	TX MOD
5	PAYLOAD ANALOG 1	6	GND
7	GND	8	PAYLOAD ANALOG 2
9	PAYLOAD DIGITAL 0	10	GND
11	PAYLOAD DIGITAL 1	12	
13	PAYLOAD DIGITAL 2	14	PAYLOAD POWER CONTROL
15	PAYLOAD DIGITAL 3	16	PAYLOAD RESET
17		18	
19	SPI SDO	20	WIRE2
21	SPI SDI	22	
23	SPI SCK	24	
25		26	
27		28	
29		30	
31		32	
33		34	Z- SENSOR
35	Z- UNREG VOLTAGE	36	Z- UNREG VOLTAGE
37	GND	38	GND
39	SWITCHED REG. VOLTAGE	40	SWITCHED REG. VOLTAGE

### 3.2.2.9 Payload Component Side Connector

Pin	Description	Pin	Description
1	RX MOD	2	GND
3	GND	4	TX MOD
5	PAYLOAD ANALOG 1	6	GND
7	GND	8	PAYLOAD ANALOG 2
9	PAYLOAD DIGITAL 0	10	GND
11	PAYLOAD DIGITAL 1	12	
13	PAYLOAD DIGITAL 2	14	PAYLOAD POWER CONTROL
15	PAYLOAD DIGITAL 3	16	PAYLOAD RESET
17		18	
19	SPI SDO	20	WIRE2
21	SPI SDI	22	
23	SPI SCK	24	
25		26	
27		28	
29		30	
31		32	
33		34	Z- SENSOR
35	Z- UNREG VOLTAGE	36	Z- UNREG VOLTAGE
37	GND	38	GND
39	SWITCHED REG. VOLTAGE	40	SWITCHED REG. VOLTAGE

### **3.2.3 Stack Interconnect Signal Description**

#### *3.2.3.1 RX MOD*

This signal is the output of the radio receiver located on the RF circuit board.

- Voltage: 1 volt
- Impedence: 15 Kohm
- Bandwidth: 25KHz

#### *3.2.3.2 TX MOD*

This signal is the input of the radio transmitter located on the RF circuit board. This input generates direct FM.

- Voltage: 1 volt
- Impedence: 12 Kohm
- Bandwidth: 5 MHz

#### *3.2.3.3 Payload Analog 1 and 2*

These signals are inputs to an 8-bit analog to digital converter on the CPU circuit board. It is used by the payload circuit. The inputs measure DC signals.

- Voltage range: 0 - 3 volts
- Impedence: 10 Kohm

#### *3.2.3.4 Payload Digital 0 - 3*

These signals are digital IO signals for the payload section. These signals are configured by the CPU circuit board as either inputs or outputs.

- High level voltage: 2.4 - 3 volts
- Low level voltage: < 0.8 volts
- High level current source: 24ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### *3.2.3.5 XMIT ON/OFF*

This signal controls the transmitter output signal. When high, the transmitter is deactivated.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma

- Low level current source: 24ma
- Impedence: CMOS logic

#### 3.2.3.6 *Payload Power Control*

This signal is used to turn the payload on or off. The payload is on when the signal is high.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### 3.2.3.7 *Payload Reset*

This signal is used to assert a reset to the payload if the payload is designed to accept a reset. A low signal asserts a reset.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### 3.2.3.8 *SPI SDO*

This is the serial data output signal from the CPU circuit board SPI port that goes to the payload section.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### 3.2.3.9 *SPI SDI*

This is the serial data input signal from the CPU circuit board SPI port that goes to the payload section.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts

- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### 3.2.3.10 *SPI SCK*

This is the serial clock signal from the CPU circuit board SPI port that goes to the payload section.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### 3.2.3.11 *WIRE1, WIRE2, WIRE3*

These signals are the 1-wire buses that are distributed to various sections of the satellite. They are used to communicate with various sensors and control devices. The 1-wire buses are open collector with a 47 Kohm resistor pulling the bus high.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### 3.2.3.12 *DIAGNOSTIC TXD*

This is the asynchronous serial transmit signal from the CPU circuit board used for diagnostics.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### 3.2.3.13 *DIAGNOSTIC RXD*

This is the asynchronous serial receive signal from the CPU circuit board used for diagnostics.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### *3.2.3.14 KILLINH*

This signal is generated by the cutoff switch which determines if the satellite has been deployed into orbit. If the satellite is powered up while in the deployer tube, the KILLINH signal will indicate to the CPU circuit board to execute the diagnostics software.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### *3.2.3.15 XMIT POWER*

This signal controls the power level of the transmitter. A high level signal sets the transmitter to high output level.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### *3.2.3.16 RF POWER CONTROL*

This signal controls power to the RF circuit board. When the signal is low, the RF circuit board is unpowered.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### *3.2.3.17 PAYLOAD SQUELCH*

This signal controls the TX MOD from the payload section. The payload TX MOD signal is deactivated by a high level signal.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### *3.2.3.18 ATTITUDE POWER CONTROL*

This signal controls power to the attitude control circuit board. A high level signal activates the circuit board.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### *3.2.3.19 EXT CHARGE SENSE*

This signal indicates when an external voltage is applied for recharging the Li-ion cell.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### *3.2.3.20 BOT BATT CONTROL*

This signal controls power to the battery control circuit board.

- High level voltage: 3 volts
- Low voltage: < 0.8 volts
- High level current source: 24 ma
- Low level current source: 24ma
- Impedence: CMOS logic

#### *3.2.3.21 Z- Sensor, Z+ Sensor*

These signals are generated by the light sensor on the Z- panel and Z+ panel.

- Voltage range: 0 - 3 volts
- Impedence: TBD

#### *3.2.3.22 Z+ Unregulated Voltage, Z- Unregulated Voltage*

These two signals are the solar cell raw power.

- Voltage range: 0 - 4.2 volts
- Maxmum current: 900 ma
- Impedence:

#### *3.2.3.23 Regulated Voltage*

This is the regulated voltage that is distributed thru out the satellite. Most electronics use this voltage.

- Voltage: 3 volts
- Maximum current: 750ma

#### *3.2.3.24 GND*

This is the system ground. All signals are referenced to this ground.