Electrical Power System (EPS) and Simplex Module Interface Control Document (ICD)

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This document describes the functional, physical, and electrical characteristics of the EPS and Simplex satellite power module. The interface control document is intended to provide the payload integrator with the necessary technical information to integrate with the Electrical Power System module.

Document Classification	
X	NSL Proprietary

1. Operational Description

This module contains the Electronic Power System and a built in EyeStar-S3 Simplex. As such, it can be considered an "All-in-one" subsystem, with all necessary internal components to run a satellite and accommodate a payload. The unit has flight heritage since 2014, and has been used an many successful flights since then. The EPS system receives power from the solar arrays, and charges the batteries. The battery voltage is then converted to BUSS+ (6 – 7.4 V), 3.3 V, and 5.0 V switched outputs. These outputs are made available to the payload, and can be controlled via the Power Distribution Interface. Data can then be downlinked over the Globalstar netowrk with the EyeStar-S3 Simplex, by using the automatic Beacon Mode, or sending custom data packets with the Serial Mode.

The EPS and Simplex Module includes the following hardware:

- Processor: Flight proven processor which controls other subsystems and provides interface to payload.
- Batteries: The battery module is made up of 2 cell LiPoly packs (7.4 V, capacity 2.5 Ah). NSL can build custom battery modules with flight aproved LiPoly batteries (1-3 packs, with extra battery module available for additional 2 packs).
- Maximum Power Point Trackers (MPPTs): These provide a constant-current/contant-voltage charge chacteristic with maximum charge current of 2.0 A from the solar arrays. The charger employs a peak BUSS voltage of 8.0 V. The input regulation loop is used to maintain the solar panel at peak output power.
- Voltage Regulators
- EyeStar-S3 Simplex (includes separate antenna): Globalstar connected simplex transmitter. With an 8 byte/s max throughput, and over 90% connectivity with global coverage. Live streaming data is available on the NSL Online Console.
- NSL Receiver: Currently implemented solely as a shut-off mechanism for FCC requirements. Only required if there is no other receiver onboard. Consult NSL for more info.
- Sensors
    - 1x Temperature Sensor (with ports for 5x more): The unit monitors the temperature of the EPS board. There are connectors for the 4 solar temperatures, and one other EPS/battery sensor with the five auxiliary inputs. The EPS communicates with each temperature sensor on a 1-wire bus. Each sensor has a resolution of 16 bits delivered in a 2 byte word. The value passed out of the unit is the raw signal reading. These are programmed to interface with NSL temperature sensors.
    - Nadir Sensor: 8x8 pixel Grid IR Sensor, with 2 byte pixels.
    - IR Sensor: Single pixel from the Grid IR Sensor, 2 bytes.

The EPS and Simplex Module has the following integrated options:

- Boost Converters: To accommodate low voltage solar arrays, or to provide a higher voltage output.

- Custom Power Switches: If higher currents or different voltages are needed for the payload.
- Custom firmware: If it is desired to have the EPS run the payload, and to have NSL write and run the payload Con Ops.
- Sensors: Particle Detector(s), 9-axis IMU, Plasma Probe, Camera, GPS.

The EPS and Simplex Module has connectors which interface to the following systems:

- Solar Arrays
- Deployment Inhibits
- Remove-Before-Flight Inhibit
- EyeStar-S3 Antenna (included)
- NSL Receiver Antenna (included)
- Nadir Horizon and IR Sensor (included with EyeStar-S3 antenna)
- Payload. These connectors will be the only ones used if using an NSL FastBus. These provide
    - Power: Switched 3.3/5.0 V and BUSS+
    - Serial Data Interface
    - Analog/Digital Inputs

The EPS and Simplex Module also comes with access to the NSL Online Console. Here, you can view your Simplex data live-streaming, and download it for further analysis.

2. Block Diagram

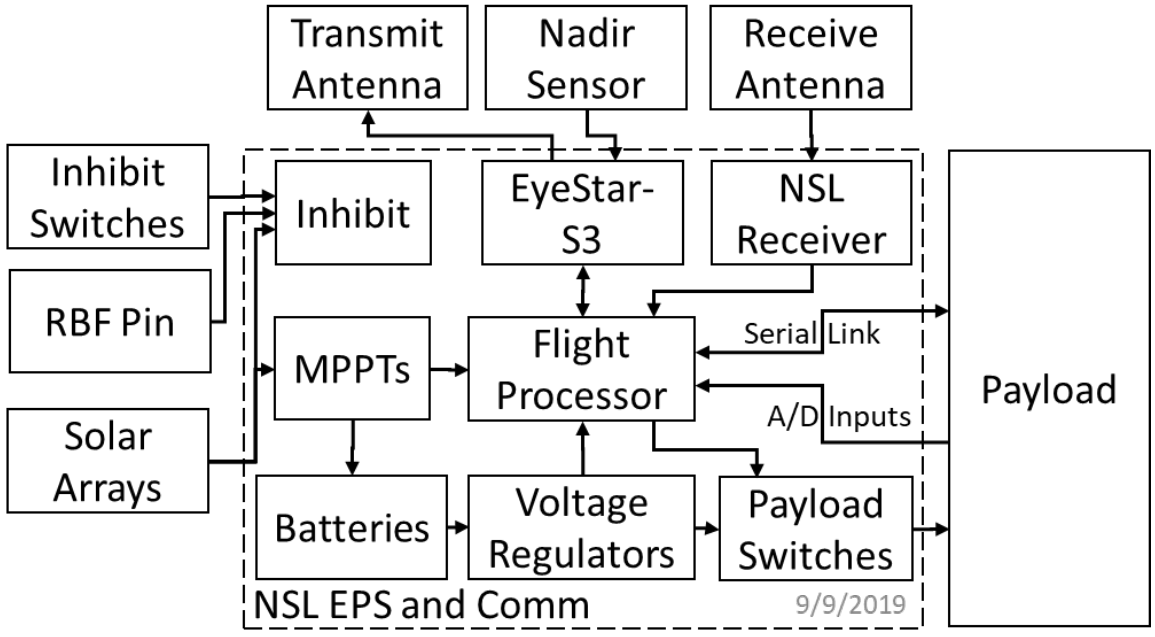

Figure 1 NSL EPS and Simplex "All-in-one" system block diagram. Note the dotted line box shows the EPS and Simplex unit hardware, while the boxes above that show included peripheral hardware.

3. Mechanical

The EPS and Simplex unit integrates the Power Management, Communication, and Batteries into one system.

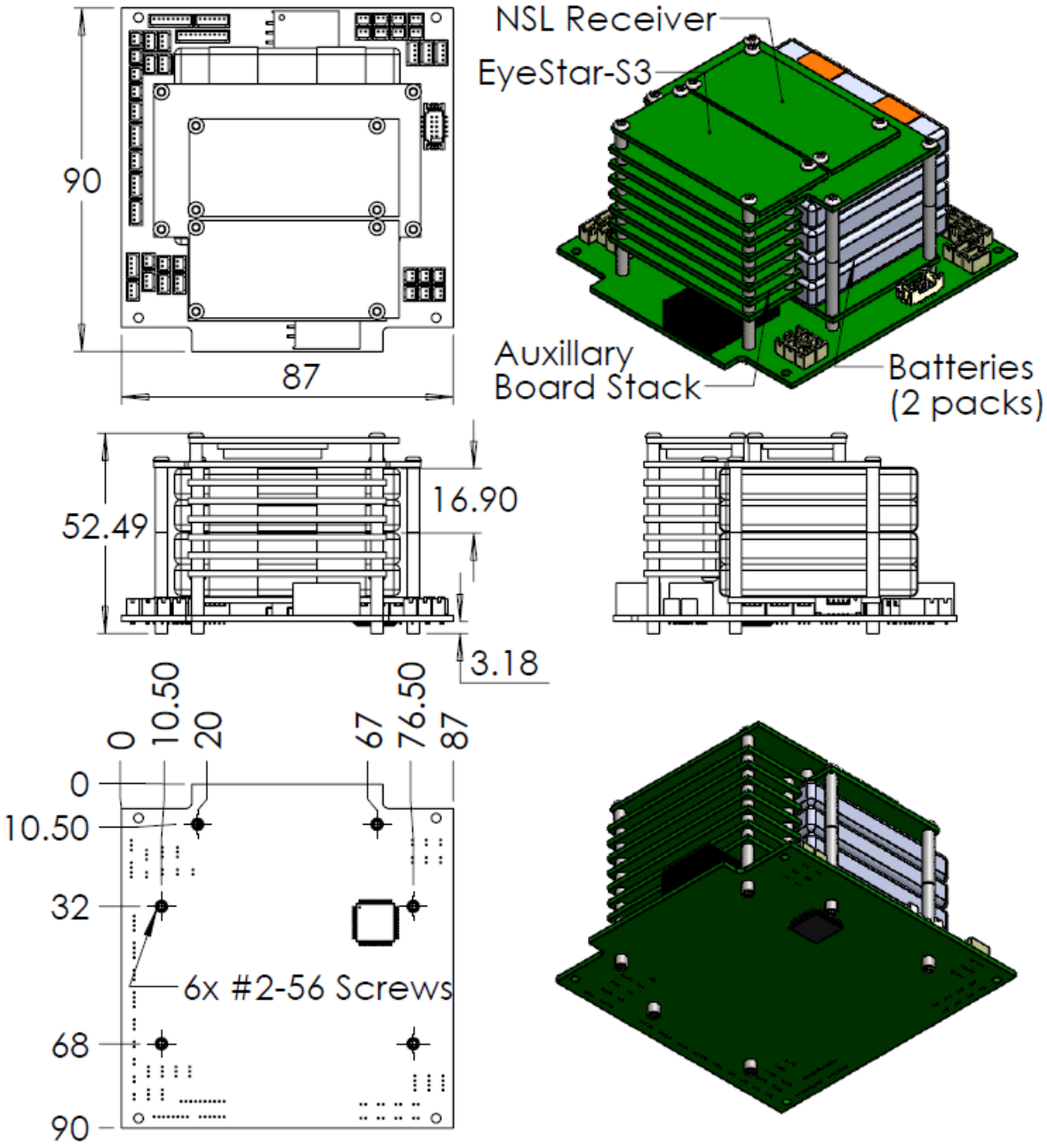

Figure 2 Mechanical layout of EPS and Simplex unit. Note that a 2-pack battery configuration is shown. Adding or removing packs changes the height dimension by 17 mm. Height can also be affected by auxiliary boards.

3.1. EPS Mechanical Specifications

Characteristic	Spec	Units
Dimensions (2 packs)	90 x 87 x 53	mm
Weight (2 packs)	327	g
Operating Temperature	-30 to +60	°C

3.2. EyeStar-S3 Patch Antenna

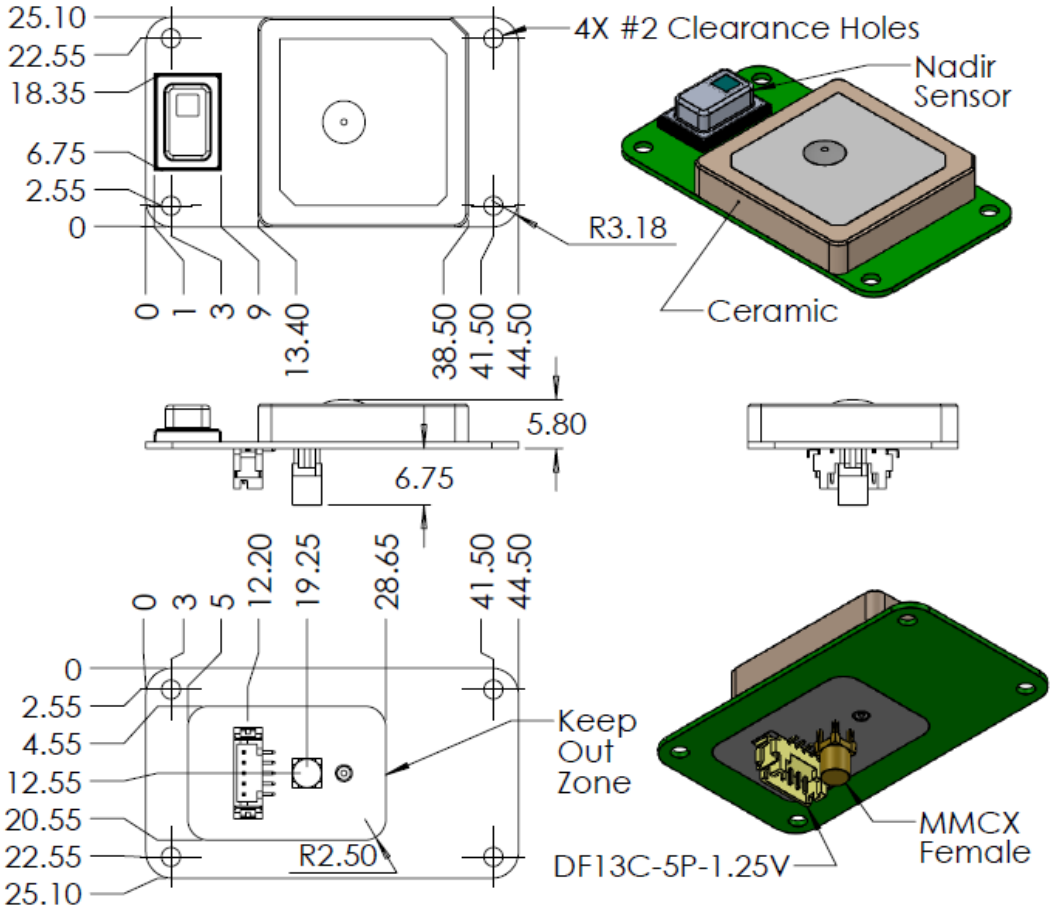

Figure 3 EyeStar-S3 Patch Antenna mechanical layout. Note the nadir sensor and associated connector on the bottom. Cables are included for the RF and nadir sensor data.

The Simplex patch antenna assembly, coax cable, and nadir sensor cable are designed to integrate with the EyeStar module. The recommended cable length between the module and antenna is 6”, with a max allowable length of 24”. Antenna mounting holes are #2 Clearance holes.

Note that the antenna requires a recessed surface for the cable connector. Include a keep out zone of at least 10 mm around the outside of the antenna assembly.

3.2.1. Simplex Patch Antenna Physical Characteristics

Characteristic	Spec	Units
Dimensions	44.5 x 25.1 x 6	mm
Weight	15	g
Operating Temperature	-30 to +60	^{o}C

4. Power

The EPS is designed for integration with a satellite with four body and deployable external solar arrays. The module can accommodate various panel configurations. The EPS connects to the solar panels via independent MPPT or Boost units. The outputs of the MPPT's are connected together in parallel to provide battery and Buss power. There are 10 switched outputs, with seven configurable +5.0 or +3.3 V preset at NSL, one BUSS+, and two fixed +3.3 V. These are controlled by the Payload computer via the Payload Data Interface. All voltages, currents, and temperatures can be sent to the EyeStar-S3 module to be transimitted through the Globalstar network to the NSL Console. There are also three unregulated BUSS+ outputs, which are not switched and always on.

4.1. Payload Power Sets

There are six sets of payload power banks, which govern the total payload power draw, and operate independently. Each of these may encompass more than one power line, depending on the configuration. The current limits for the payload relate to the total current draw from each of those power sets, as opposed to the current draw from each individual line. The sum of the individual current draws of each line in a set is what contributes to the current limit max. The different sets of payload power are: Unregulated BUSS+, Switched BUSS+, Switched Configurable 3.3 V, Switched Configurable 5.0 V, Switched Fixed 3.3 V, and Switched Fixed 3.3 V. SW1 – SW6 are the configurable switched 3.3 or 5.0 V lines, which need to be configured before shipping. SW7 is the switched BUSS+ line, SWX is one fixed switched 3.3 V line, and SWY is the other fixed switched 3.3 V line. Each of these sets of power lines has their own total current draw limits.

SW1A and SW1B are controlled via the same switch. These are intended to be used for the payload flight processor, which many times requires both 3.3 and 5.0 V power. This is considered, by default, a "critical switch", and will be left on in low power modes. This also means that, unless otherwise specified, any payload commands to turn off SW1 will be ignored and treated as a reset command. SWX and SWY are intended for use with deployable solar burn wires, each controlling two opposing sides.

4.2. Power Specifications

Specification	Min	Typical	Max	Unit
MPPT				
Input Voltage	8		30	V
Output Current	0.0		2.0	A
Operating Frequency		100		KHz
Efficiency		98		%
Batteries				
Capacity			2.5	Ah
Voltage	6.1		7.4	V
Mass (1 Pack)		44		g
Packs	1		3	#
Unregulated BUSS+				
Output Voltage	6.1	7.4	10.0	V
Output Current (Total)		2.0	4.0	A
Efficiency	98.7	99.0	99.5	%
BUSS+ Switched				
Output Voltage	6.1	7.4	10.0	V
Output Current		0.5	2.0	A
Operating Frequency		700		KHz
Efficiency	90	92	94	%
+5.0 V Switched				
Output Voltage	4.9	5.0	5.1	V
Output Current (Total)		0.5	1.5	A
Operating Frequency		700		KHz
Efficiency	90	92	94	%
+3.3 V Switched				
Output Voltage	3.1	3.3	3.4	V
Output Current (Total)		0.5	1.5	A
Operating Frequency		700		KHz
Efficiency	90	92	94	%

4.3. Power Line Ratings

Specification	Port	Type	Type	V Min	V Max	I Max	Notes
Inputs							
Solar Array 1-4	JP24/26/31/35	NA	Solar	8.0	30.0	2.0 A	Per array
Battery 1-4	JP37/38/34/36	NA	Battery	6.0	7.4	2.5 A	Per battery
Outputs							
SW1A	JP41	Switched	Configurable	+3.3	+5.0	1.5 A + 1.5 A	These Outputs must be set up with NSL before shipping, to specify 3.3 or 5.0 V output
SW1B	JP48	Switched	Configurable	+3.3	+5.0		
SW2	JP43	Switched	Configurable	+3.3	+5.0		
SW3	JP46	Switched	Configurable	+3.3	+5.0		
SW4	JP50	Switched	Configurable	+3.3	+5.0		
SW5	JP52	Switched	Configurable	+3.3	+5.0		
SW6	JP54	Switched	Configurable	+3.3	+5.0		
SW7: BUSS+	JP44	Switched	Fixed	+6.0	+10.0	2.0 A	
SWX	JP10/11	Switched	Fixed	+3.3	+3.3	1.5 A	Request 5.0 V if needed
SWY	JP12/13	Switched	Fixed	+3.3	+3.3	1.5 A	
BUSS+ 1	JP22	Constant	Unregulated	+6.0	+10.0	4.0 A	Always on
BUSS+ 2	JP23	Constant	Unregulated	+6.0	+10.0		
BUSS+ 3	JP25	Constant	Unregulated	+6.0	+10.0		

4.4. Default Output Switch Status

All of the switched outputs are in the off state at EPS power up. Upon entering “Normal Mode”, the “critical switches” (default SW1A and SW1B) will be turned on. There is also a watchdog timer, which will power all of the switched outputs off and reset the critical switches if the EPS detects no activity for five minutes on the Payload Data Interface serial port. It is recommended to send the switch output command to the EPS every minute, as a payload “heartbeat”.

4.5. PDI Control and Monitoring

The Power Distribution Interface controls and monitors the switched outputs’ voltage, current, temperature, and status. All are available to be sent to the ground. There are 10 switched outputs on the board. Each switch can be commanded on or off, each has hardware built-in over current protection for automatic shutdown, and each can provide status to the ground via the EyeStar-S3 module.

5. Serial Interface

There are two distinct functions for the serial interface, labeled “Payload Data Interface”, to control the switched outputs and to downlink data through the EyeStar-S3. In order to enable this serial port, the ISO V+ line must be set to 5.0 V. If this is not connected, the Payload Data Interface will remain inactive.

Serial Protocol

Communications	Min	Typical	Max	Unit
Protocol		Serial TTL or LVTTL		
Transmission Speed		38.4		Kb
Bus Voltage	2.5	3.3 / 5.0	5.2	V

Can accommodate I2C, RS-232, and RS-422 logic on request.

5.1. Switched Outputs Protocol

The serial interface allows the connection of one external serial device. The baud rate is 38.4kb with one start bit, one stop bit, and no parity. The interface is compatible with LVTTL / TTL level signals. The Tx, Rx, and Busy lines from the payload are digitally isolated. The serial interface has a full range of commands that allows the user to queue commands or requests to the EPS. All of the following packets (specified below) are in hexadecimal.

The board is simple to use once commands request formats are known. On power up, the outputs are switched off. Each switch has an on or off state that is set in the output command string. Each command is described in detail in this section.

5.1.1. Write Output Switch

Total Packet Size: 21 Bytes	
Header	Switch Data
4 Bytes	17 Bytes
Hex: ‘50 50 50 0B’	‘00’ = Off, ‘FF’ = On

This 21-byte command is used to set all switched outputs. When this command is sent, the EPS will switch the output on or off based on whether the byte controlling the respective switch is set to FF or 00.

Bytes 1-4 of the Output Switch packet are the header, while bytes 5-13 command the switched outputs. Bytes 14-21 can be configured to send pre-set, custom commands to the EPS. This can include switching power profiles, enabling or disabling certain instruments, changing modes, changing the beacon rate, signaling re-entry, or others. This must be discussed with NSL, as this likely includes Con Ops involvement and customized firmware.

Write Output Switch

Byte #	Function	Command (Hex)	Result
1-4	Header	50 50 50 0B	Function Declaration
5	SW1A/1B	00 or FF	Off or On
6	SW2	00 or FF	Off or On
7	SW3	00 or FF	Off or On
8	SW4	00 or FF	Off or On
9	SW5	00 or FF	Off or On
10	SW6	00 or FF	Off or On
11	SW7	00 or FF	Off or On
12	SWX	00 or FF	Off or On
13	SWY	00 or FF	Off or On
14	Unused	00	N/A
15	Unused	00	N/A
16	Unused	00	N/A
17	Unused	00	N/A
18	Unused	00	N/A
19	Unused	00	N/A
20	Unused	00	N/A
21	Unused	00	N/A

5.2. EyeStar-S3 Communication Protocol

The EyeStar-S3 transmits either in Beacon Mode or in Serial Mode. In Beacon Mode, pre-configured packets are sent autonomously to the Globalstar network. These contain important health and safety information about the EPS and satellite, as well as analog and digital input samples. When not actively in Beacon Mode, the unit is available to be used in Serial Mode. Here, the payload is able to send any data that can fit in the packet size over the network.

5.2.1. Serial Mode

Payload sends data to the modem over the Payload Data Interface, when the BUSY signal is LOW. Once data is sent to the modem, the modem will return an ACK to acknowledge the packet. If the packet is good, the modem will set the BUSY line HI and send the data to the Globalstar network. If the packet is not good, the BUSY line will not respond. Once finished sending, the BUSY line is set back to LOW and the module waits to receive the next packet from the payload. In order to enable the Payload Data Interface, the ISO V+ line must be set to 5.0 V. If this is not connected, the Payload Data Interface will remain inactive.

Total Packet Size: 21 Bytes	
Header	Payload Data
4 Bytes	17 Bytes
Hex: '50 50 50 0C'	Raw Payload Data

For more in-depth information on the operation, use, and characterization of the EyeStar-S3, see the EyeStar-S3 Interface Control Document.

5.2.2. Beacon Mode

In Beacon Mode, important status and health data is automatically sent to the EyeStar-S3 for transmission. Every Beacon can be configured with a number of preset packet definitions. Each of these packets groups together related data to be downlinked with the Beacon, if desired. These include the switch status, switch current, temperature, solar voltage, solar current, battery voltage, battery current, battery coulomb counter, analog/digital inputs, integrated sensor data, Grid IR data, GPS data, camera, etc. Speak with NSL to specify which packets should be included in the Beacon. Each of these packets will be transmitted twice with every Beacon. The interval between Beacons (Beacon Interval or Beacon Rate) is preconfigured before shipping. This defaults at 15 minutes, and can range from 1 – 60 minutes.

See NSL for a list of preset Beacon packets that can be selected.

Analog and Digital Inputs

There are seven analog 0 – 5 VDC and eight digital inputs that are read and sent to the EyeStar-S3 Module. These will be sampled at regular intervals between Beacons, and can be transmitted during the Beacon Mode.

5.3. Diagnostic Mode

The DIAG data pin will pulse HI to LO at a five second rate as the transmit inhibit timer counts down, after deployment. If the DIAG pin is grounded at power up the Transmit Inhibit Timer is disabled and the DIAG data pin will echo the data going to the EyeStar-S3 module for monitoring.

6. Other Info

6.1. Maximum Power Point Tracking Module

These provide a constant-current/contant-voltage charge chacteristic with maximum charge current of 2.0 A from the solar arrays. The charger employs a peak BUSS voltage of 8.0 V. The input regulation loop is used to maintain the solar panel at peak output power.

6.2. Battery Module

The battery module is made up of 2 cell Li-Poly packs (7.4 V, capacity 2.5 Ah). NSL can build custom battery modules with flight aproved Li-Poly batteries (1-3 packs, with extra battery module available for additional 2 packs).

6.3. Solar Array Inputs

The solar array voltage range is 8 to 30 VDC with a current range of 0.5 to 2.0 A. NSL can build custom panels of different sizes.

6.4. Battery Charging

The batteries may be charged through the Diag Port, by using the Batt- as negative, and the B1/2+ and B3/4+ as positive. These charge the batteries connected to Battery Input 1/2, and Battery Input 3/4 respectively. These lines are limited to 1.5 A. Use the included NSL Battery Charger to charge batteries. Consult NSL on use of this charger.

6.5. Deployment Switch Input Setup

There are six switches in the system, plus solar inhibit, to enable the EPS. There are two Remove-Before-Flight (RBF) switches, two Battery+ deployment switches, two Battery- deployment switches, and the solar detection circuit. Once all of these inhibits are active, the EPS will enable the battery pack to connect BUSS+ to the system. The two RBF, Battery+, and Battery- switches are connected in parallel, so only three of the six switches (one of each type) must be connected in order for the EPS to activate.

7. EPS Modes

The EPS has several modes that it will activate based on the timing, Con Ops, and battery power.

#	Mode	Condition	Action	Duration	Notes
0	Deploy	All inhibits on	Activate TX Inhibit Timer	TX Inhibit Timer	
1	1st Contact	TX Inhibit ends	Transmit Wake Up Beacons	Beacon # * 15 s	
2	Burn X	1st Contact finsh	Activate SWX for X burn wires, 1x Beacon	1.5 m	If needed
3	Burn Y	Burn X finish	Activate SWY for Y burn wires, 1x Beacon	1.5 m	If needed
4	Normal	1st Contact / Burn Finish	Enter Normal Con Ops	~	
5	NSL Use				
6	NSL Use				
7	NSL Use				
8	Low Power	BUSS+ < 6.5 V	Beacon Interval * 4	Until BUSS+ > 7.0 V	Back to 4
9	Power Save	BUSS+ < 6.0 V	Beacon Interval * 8, all SW = 00	Until BUSS+ > 7.0 V	Back to 4

8. Connectors

8.1. Solar Connectors

Mating connector: DF13-3S-1.25C, Pins: DF13-2630SCFA

8.1.1. Solar Interface 1 – JP24

Solar Array	Connector	EPS
Solar+ >>	JP24.1	>> Solar+
SLEN >>	JP24.2	>> SLEN
GND	JP24.3	GND

8.1.2. Solar Interface 2 – JP26

Solar Array	Connector	EPS
Solar+ >>	JP26.1	>> Solar+
SLEN >>	JP26.2	>> SLEN
GND	JP26.3	GND

8.1.3. Solar Interface 3 – JP31

Solar Array	Connector	EPS
Solar+ >>	JP31.1	>> Solar+
SLEN >>	JP31.2	>> SLEN
GND	JP31.3	GND

8.1.4. Solar Interface 4 – JP35

Solar Array	Connector	EPS
Solar+ >>	JP35.1	>> Solar+
SLEN >>	JP35.2	>> SLEN
GND	JP35.3	GND

8.2. Aux Solar

8.2.1. Solar Interface AUX – JP39

Mating connector: DF13-4S-1.25C, Pins: DF13-2630SCFA

Solar Array	Connector	EPS
Solar+ >>	JP39.1	>> Solar+
Solar+ >>	JP39.2	>> Solar+
GND	JP39.3	GND
GND	JP39.4	GND

8.3. Remove Before Flight

Mating connector: DF13-2S-1.25C, Pins: DF13-2630SCFA

Note that RBF 1 and RBF 2 are paralleled together

8.3.1. RBF 1 – JP32

Spacecraft	Connector	EPS
RBF1 – C >>	JP27.1	>> RBF1 – C
RBF1 – NC >>	JP27.2	>> RBF1 – NC

8.3.2. RBF 2 – JP33

Spacecraft	Connector	EPS
RBF2 – C >>	JP28.1	>> RBF2 – C
RBF2 – NC >>	JP28.2	>> RBF2 – NC

8.4. Deployment Inhibit Switch – To Batteries

Mating connector: DF13-2S-1.25C, Pins: DF13-2630SCFA

Note Switches 1+ and 2+ (Battery+), as well as 3- and 4- (Battery-), are paralleled together

8.4.1. Deploy Switch 1 – JP27

Spacecraft	Connector	EPS
DPS1+ – C >>	JP27.1	>> DPS1+ – C
DPS1+ – NC >>	JP27.2	>> DPS1+ – NC

8.4.2. Deploy Switch 2 – JP28

Spacecraft	Connector	EPS
DPS2+ – C >>	JP28.1	>> DPS2+ – C
DPS2+ – NC >>	JP28.2	>> DPS2+ – NC

8.4.3. Deploy Switch 3 – JP29

Spacecraft	Connector	EPS
DPS3- – C >>	JP29.1	>> DPS3- – C
DPS3- – NC >>	JP29.2	>> DPS3- – NC

8.4.4. Deploy Switch 4 – JP30

Spacecraft	Connector	EPS
DPS4- – C >>	JP30.1	>> DPS4- – C
DPS4- – NC >>	JP30.2	>> DPS4- – NC

8.5. Battery Inputs

NSL Use

Mating connector: DF13-2S-1.25C, Pins: DF13-2630SCFA

8.5.1. Battery Input 1 – JP37

Battery	Connector	EPS
B1+ >>	JP37.1	>> B1+
B1- >>	JP37.2	>> B1-

8.5.2. Battery Input 2 – JP38

Battery	Connector	EPS
B2+ >>	JP38.1	>> B2+
B2- >>	JP38.2	>> B2-

8.5.3. Battery Input 3 – JP34

Battery	Connector	EPS
B3+ >>	JP34.1	>> B3+
B3- >>	JP34.2	>> B3-

8.5.4. Battery Input 4 – JP36

Battery	Connector	EPS
B4+ >>	JP36.1	>> B4+
B4- >>	JP36.2	>> B4-

8.6. BUSS+ Outputs

NSL Use only

Mating connector: DF13-4S-1.25C, Pins: DF13-2630SCFA

8.6.1. BUSS+ 1 – JP22

Spacecraft	Connector	EPS
BUSS+ <<	JP22.1	<< BUSS+
BUSS+ <<	JP22.2	<< BUSS+
GND	JP22.3	GND
GND	JP22.4	GND

8.6.2. BUSS+ 2 – JP23

Spacecraft	Connector	EPS
BUSS+ <<	JP23.1	<< BUSS+
BUSS+ <<	JP23.2	<< BUSS+
GND	JP23.3	GND
GND	JP23.4	GND

8.6.3. BUSS+ 3 – JP25

Spacecraft	Connector	EPS
BUSS+ <<	JP25.1	<< BUSS+
BUSS+ <<	JP25.2	<< BUSS+
GND	JP25.3	GND
GND	JP25.4	GND

8.7. Analog/Digital Inputs

8.7.1. Analog Inputs – JP20

Mating connector: DF13-8S-1.25C, Pins: DF13-2630SCFA

Spacecraft	Connector	EPS
Analog Input 1 >>	JP20.1	>> Analog Input 1
Analog Input 2 >>	JP20.2	>> Analog Input 2
Analog Input 3 >>	JP20.3	>> Analog Input 3
Analog Input 4 >>	JP20.4	>> Analog Input 4
Analog Input 5 >>	JP20.5	>> Analog Input 5
Analog Input 6 >>	JP20.6	>> Analog Input 6
Analog Input 7 >>	JP20.7	>> Analog Input 7
GND	JP20.8	GND

8.7.2. Digital Inputs – JP21

Mating connector: DF13-10S-1.25C, Pins: DF13-2630SCFA

Spacecraft	Connector	EPS
Digital Input 1 >>	JP21.1	>> Digital Input 1
Digital Input 2 >>	JP21.2	>> Digital Input 2
Digital Input 3 >>	JP21.3	>> Digital Input 3
Digital Input 4 >>	JP21.4	>> Digital Input 4
Digital Input 5 >>	JP21.5	>> Digital Input 5
Digital Input 6 >>	JP21.6	>> Digital Input 6
Digital Input 7 >>	JP21.7	>> Digital Input 7
Digital Input 8 >>	JP21.8	>> Digital Input 8
+5.0 V* <<	JP21.9	<< +5.0 V*
GND	JP21.10	GND

*Note: +5.0 V included for switches associated with Digital Inputs. This line is constantly on, and limited to 100 mA

8.8. Serial Connectors

8.8.1. DIAG Port – JP1

Mating connector: DF13-10DS-1.25C

Pins: DF13-2630SCFA

Spacecraft	Connector	EPS
BUSS+ <<	JP1.1	<< BUSS+
Solar+ <<	JP1.2	<< Solar+
Diag_Data <<	JP1.3	<< Diag_Data
Diag_Enable >>	JP1.4	>> Diag_Enable
Batt- <<	JP1.5	<< Batt-
GND	JP1.6	GND
B1/2+ <<	JP1.7	<< B1/2+
NA	JP1.8	NA
B3/4+ <<	JP1.9	<< B3/4+
GND	JP1.10	GND

8.8.2. Payload Data Interface – JP9

Mating connector: DF13-6S-1.25C

Pins: DF13-2630SCFA

Spacecraft	Connector	EPS
ISO V+* >>	JP9.1	>> ISO V+*
RX >>	JP9.2	>> RX
TX <<	JP9.3	<< TX
BUSY <<	JP9.4	<< BUSY
GND	JP9.5	GND
NA	JP9.6	NA

*Note: ISO V+ must be set higher (5.0 V) to enable the serial interface. Leaving this line open will keep the port inactive. Can use the "critical switches" (default SW1A/B).

8.9. Thermal Sensor Inputs

Only for use with NSL Temperature Sensors

Mating connector: DF13-3S-1.25C, Pins: DF13-2630SCFA

8.9.1. Thermal Sensor 1 – JP14

Sensor	Connector	EPS
THM+5 <<	JP14.1	<< THM+5
1-Wire <>	JP14.2	<> 1-Wire
GND	JP14.3	GND

8.9.2. Thermal Sensor 2 – JP15

Sensor	Connector	EPS
THM+5 <<	JP15.1	<< THM+5
1-Wire <>	JP15.2	<> 1-Wire
GND	JP15.3	GND

8.9.3. Thermal Sensor 3 – JP16

Sensor	Connector	EPS
THM+5 <<	JP16.1	<< THM+5
1-Wire <>	JP16.2	<> 1-Wire
GND	JP16.3	GND

8.9.4. Thermal Sensor 4 – JP17

Sensor	Connector	EPS
THM+5 <<	JP17.1	<< THM+5
1-Wire <>	JP17.2	<> 1-Wire
GND	JP17.3	GND

8.9.5. Thermal Sensor 5 – JP18

Sensor	Connector	EPS
THM+5 <<	JP18.1	<< THM+5
1-Wire <>	JP18.2	<> 1-Wire
GND	JP18.3	GND

8.9.6. Thermal Sensor 6 – JP19

Sensor	Connector	EPS
THM+5 <<	JP19.1	<< THM+5
1-Wire <>	JP19.2	<> 1-Wire
GND	JP19.3	GND

8.10. Switched Outputs

Mating connector: DF13-2S-1.25C, Pins: DF13-2630SCFA

8.10.1. SW1A – 3.3/5.0 V – JP41

Spacecraft	Connector	EPS
SW1A+ <<	JP41.1	<< SW1A+
GND	JP41.2	GND

8.10.2. SW1B – 3.3/5.0 V – JP48

Spacecraft	Connector	EPS
SW1B+ <<	JP48.1	<< SW1B+
GND	JP48.2	GND

8.10.3. SW2 – 3.3/5.0 V – JP43

Spacecraft	Connector	EPS
SW2+ <<	JP43.1	<< SW2+
GND	JP43.2	GND

8.10.4. SW3 – 3.3/5.0 V – JP46

Spacecraft	Connector	EPS
SW3+ <<	JP46.1	<< SW3+
GND	JP46.2	GND

8.10.5. SW4 – 3.3/5.0 V – JP50

Spacecraft	Connector	EPS
SW4+ <<	JP50.1	<< SW4+
GND	JP50.2	GND

8.10.6. SW5 – 3.3/5.0 V – JP52

Spacecraft	Connector	EPS
SW5+ <<	JP52.1	<< SW5+
GND	JP52.2	GND

8.10.7. SW6 – 3.3/5.0 V – JP54

Spacecraft	Connector	EPS
SW6+ <<	JP54.1	<< SW6+
GND	JP54.2	GND

8.10.8. SW7 – BUSS+ – JP44

Spacecraft	Connector	EPS
SW7+ <<	JP44.1	<< SW7+
GND	JP44.2	GND

8.10.9. SWX 1 – 3.3 V – JP10

Spacecraft	Connector	EPS
SWX+ <<	JP10.1	<< SWX+
GND	JP10.2	GND

8.10.10. SWX 2 – 3.3 V – JP11

Spacecraft	Connector	EPS
SWX+ <<	JP11.1	<< SWX+
GND	JP11.2	GND

8.10.11. SWY 1 – 3.3 V – JP12

Spacecraft	Connector	EPS
SWY+ <<	JP12.1	<< SWY+
GND	JP12.2	GND

8.10.12. SWY 2 – 3.3 V – JP13

Spacecraft	Connector	EPS
SWY+ <<	JP13.1	<< SWY+
GND	JP13.2	GND

8.11. Communication Ports

Mating connector: DF13-4S-1.25C, Pins: DF13-2630SCFA

8.11.1. EyeStar-S3 Module – JP2

NSL Use only

EyeStar-S3	Connector	EPS
SYS +3.3 V <<	JP2.1	<< SYS +3.3 V
TX <<	JP2.2	<< TX
RTS >>	JP2.3	>> RTS
GND	JP2.4	GND

8.11.2. R25 – JP8

NSL Use only

Receiver	Connector	EPS
RX >>	JP8.1	>> RX
SYS +5.0 V <<	JP8.2	<< SYS +5.0 V
SYS +3.3 V <<	JP8.3	<< SYS +3.3 V
GND	JP8.4	GND

8.12. RF Ports

Both EyeStar-S3 and NSL Receiver RF Ports are on located on their respective chip carrier boards. These connectors are RA MMCX, with 6" coax cable to their antennas. Connectors should be soldered or epoxied on for flight qualification.

8.13. Auxiliary Ports

8.13.1. Particle Detector – JP5

NSL Use only

Mating connector: DF13-3S-1.25C

Pins: DF13-2630SCFA

Particle Detector	Connector	EPS
GND	JP5.1	GND
SYS +5.0 V <<	JP5.2	<< SYS +5.0 V
Data >>	JP5.3	>> Data

8.13.3. Aux Comm – JP6

NSL Use only

Mating connector: DF13-3S-1.25C

Pins: DF13-2630SCFA

Comm	Connector	EPS
TX <<	JP9.1	<< TX
RX >>	JP9.2	>> RX
GND	JP9.3	GND

8.13.2. Nadir Sensor – JP7

From EyeStar-S3 Antenna

Mating connector: DF13-4S-1.25C

Pins: DF13-2630SCFA

Nadir Sensor	Connector	EPS
SYS +5.0 V <<	JP7.1	<< SYS +5.0 V
CLK <<	JP7.2	<< CLK
Data >>	JP7.3	>> Data
GND	JP7.4	GND

8.14. Connector Plane Layout

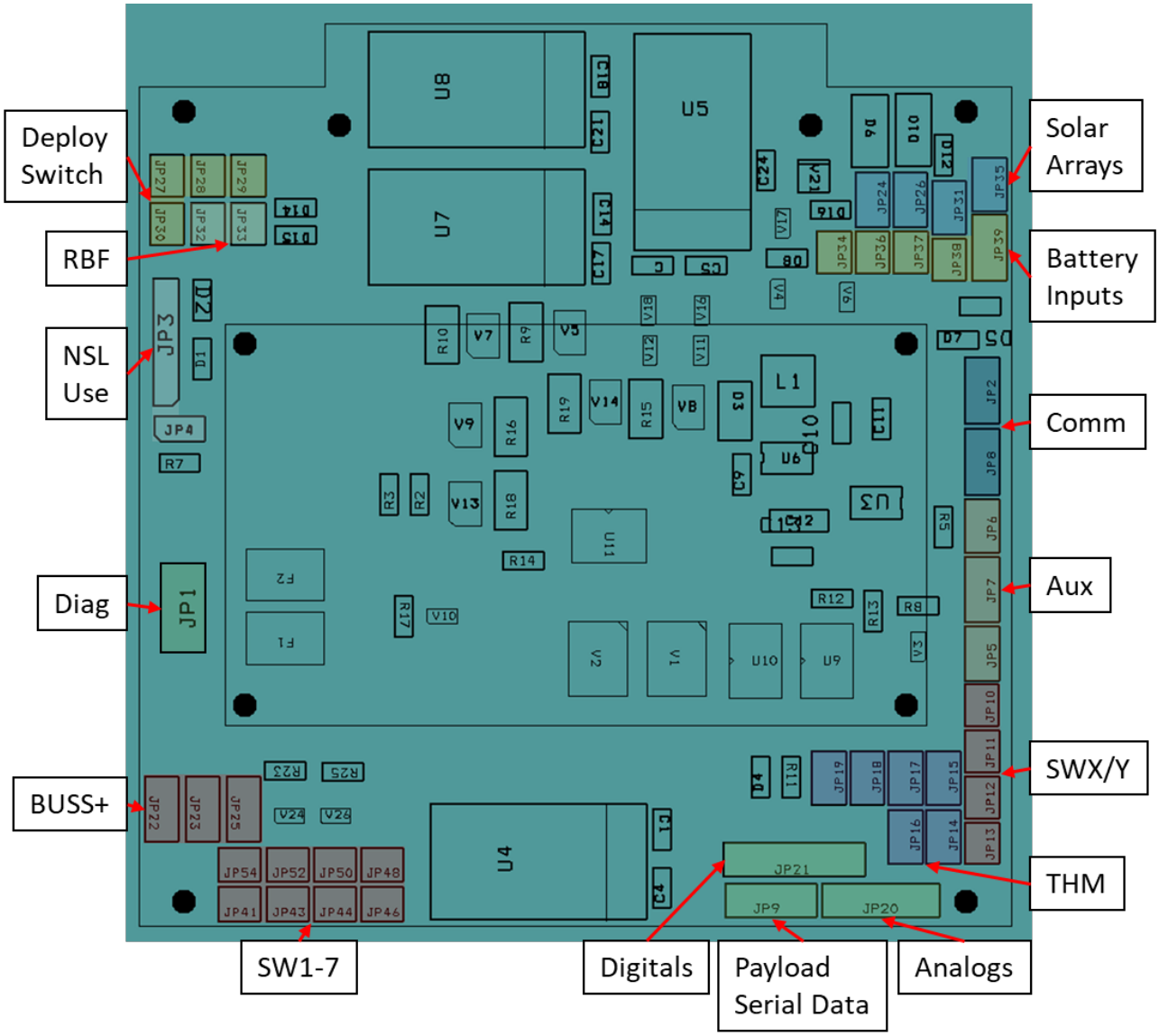

Figure 4 EPS Connector Plane layout, showing the placement of all connectors.

9. Enviromental

Characteristic	Spec	Units
Operating Temperature	-40 to +80	^{o}C
Storage Temperature	-50 to +100	^{o}C
Vacuum	10^{-5}	Torr

10. Customer Configuration

10.1.1. To be set up before shipment with NSL:

Function	Default	Range
Tx. Inhibit Delay	50 minutes	0 – 120 minutes
First Contact Repeat	10 Beacons	5 – 100
Beacon Interval	15 minutes	5 – 60 minutes
SW1A		3.3 OR 5.0 VDC
SW1B		3.3 OR 5.0 VDC
SW2		3.3 OR 5.0 VDC
SW3		3.3 OR 5.0 VDC
SW4		3.3 OR 5.0 VDC
SW5		3.3 OR 5.0 VDC
SW6		3.3 OR 5.0 VDC
SW7		BUSS+ ONLY
SWX		3.3 VDC ONLY
SWY		3.3 VDC ONLY
Reset Timing	1 minute	0 – 15 minutes
Critical Switches	SW1A + SW1B	SW1-7
Beacon Set	Contact NSL	