This document explains the function of the -Z Panel, its schematic level design, its board level design, and its functional testing

-Z Panel

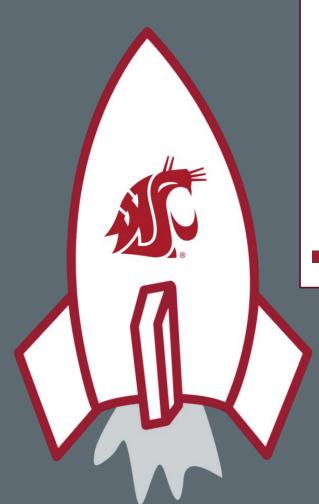High Gain Communication Antenna

Revision: 1.0.4

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Table of Contents

1 Introduction

This document explains how the -Z Panel will fulfill the following Functions and conform to the following Requirements. This document refers to the -Z Panel version 1.0.

1.1 Functions

The -Z Panel is responsible for the following:

- Provide the high gain communication antenna
- Provide a Sun sensor for the ADCS

1.2 Requirements

The system requirements and -Z panel requirements can be found here.

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2　Detailed Description

This section references the -Z panel schematic. Page numbers will be listed and may have coordinates listed (number and letter combination found around the frame).

2.1　Functional Block Diagram

The block diagram can be found on the first page of the schematic.

2.1.1　High Gain 230mm Antenna

The high gain antenna is responsible for maintaining a good downlink for communication and is controlled by the Comms system.

2.1.2　Antenna Deploy Release

The antenna deploy release is responsible for deployment of the high gain antenna and is controlled by the EPS system.

2.1.3　Photodiodes

The photodiode is used as a sun sensor for the ADCS system to determine the location of the sun.

2.1.4　Analog-to-Digital Converter

The analog to digital converter (ADC) is meant to convert the photodiode analog signal to a digital signal for the ADCS system.

2.2　Schematic

2.2.1　Isolated Grounds

On page 2 of the schematic (A5), are the four isolated grounds found on the board. Power ground (PGND) is directly connected to the backplane and most of the power chain. The other grounds are shorted to PGND using a 0Ω resistor rated up to $2A$, the expected current is less than $50mA$ each. Digital ground (DGND) connects to the digital circuity including monitoring circuits. Analog ground (AGND) connects to analog monitoring circuits including the ADCs, their voltage reference, and the thermistors. Chassis ground (CHASSIS) is connected to the mechanical features including bolt holes.

2.2.2　Photodiode

The photodiode can be found on page 2 (A1) of the schematic connected to the ADC. This photodiode is connected through the ADC to the ADCS system. This photodiode has a spectral sensitivity of $6.3nA/lx$ and the expected illuminance is on the order of $< 1Mlx$. This makes the expected voltage drop across the load resistor about $0.9V$. There is one photodiode on the -Z panel and the datasheet can be found here.

2.2.3   Analog-to-Digital Converter

The ADC is located on page 2 (A2) of the schematic. The ADC connects the photo diode to the ADCS system so the ADCS system can determine the location of the sun. The rest of the ADC inputs are used to measure temperature at various locations on the board. The ADC datasheet can be found <u>here</u>.

2.2.4   Antenna Deploy Release

The deploy release system is located on page 2 of the schematic. Four flaps function to hold the antenna down before release that are loaded with springs. There are contacts on the springs to verify if the flaps have been opened. The springs are part of RF ground and when deployed the contacts will read high. The deployment system functions by cutting the monofilament line used to tie the flaps together with high temperature 15Ω resistors. When the line is cut the springs push the flaps to swing out and the antenna is deployed. The flaps also form the reflective ground plane for the helical antenna.

2.2.5   High Gain 230mm Antenna

The antenna contact is located on page 2 of the schematic. The antenna is helically shaped with a circular polarization. The antenna is held down by 4 flaps ready for an irreversible deployment. Directivity of the antenna is $48.5669\ dB$ and the gain is $11.8\ dB$. The impedance is $\sim\!200\ \Omega$.

2.3   Board

The board shall be double layered with $1oz$ copper and ENIG finish.

2.3.1   Layout Constraints

Unless specified in the following subsections, all signals shall use the default parameters specified below. Signals in the following subsections do not include their sense signals unless specified. Trace width can be broken if a trace needs to bottleneck down to a pin, the bottleneck shall be minimized. There must be an impedance matching stub between the 50 ohm coax to the ~200 ohm antenna.

Trace width:	$0.2mm$
Vias:	$0.3mm$, unlimited count
Separation:	$0.2mm$
Length:	unlimited

2.3.1.1   I²C-I2C_[SDA, SCL]

Length:	Each node shall be length matched $\pm1.0mm$
Stubs:	$< 10.0mm$

2.3.1.2   RF Traces – LOW_GAIN_[P,N, COAK],

Track Width:	$1.5\ mm$

Gap Width: 0.5 mm

Impedance: 50Ω

2.3.1.3   RF Ground

There will be a ground pour for RF ground.

3   Testing

All tests shall be performed at room temperature and not under vacuum unless otherwise specified. If any modifications are performed, take note. Include enough information to understand circuit behavior and for others to replicate the results. Include any software written to execute the test and link it in the test notes section. Save all software, waveforms, etc. in a subfolder of the board's test folder for each test.

- Waveforms shall be captured whenever appropriate
- Have the event take fill the screen (for fast events, zoom in; for slow events, zoom out)
- Label each channel accurately
- Only have bandwidth limiting if necessary for the test (this applies to the oscilloscope and probe settings)
- If ringing or overshoot occurs, use a ground spring or differential probe

Common test instructions can be found on the wiki.

3.1   Antenna Deploy Release

Results: Pass/Fail

3.1.1   Test Instructions

Apply 3.7 V to thermal knife resistors. Set up wiring harness for deployment system. Test melting the wire. Verify sensing node has high impedance when in deployment state. Verify deployment system functional. Measure antenna parameters.

3.1.2   Passing Criteria

Deployment system is functional.

3.1.3   Test Data

Wire Melted	Deployment Contacts	Deployment	*Pass/Fail*

VSWR	Impedance	Gain	Directiviy

3.1.4 Test Notes
Delete me if no notes are required.

3.2 Photodiode
Results: Pass/Fail

3.2.1 Test Instructions
Verify the spectral voltage changes with different light levels. Apply different light levels by using a lamp and moving it close to the diode. Record voltages measured.

3.2.2 Passing Criteria
Photodiode functions and applies a varying voltage with different light levels.

3.2.3 Test Data

Test Case	V_{Diode}	Pass/Fail

3.2.4 Test Notes
Delete me if no notes are required.

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