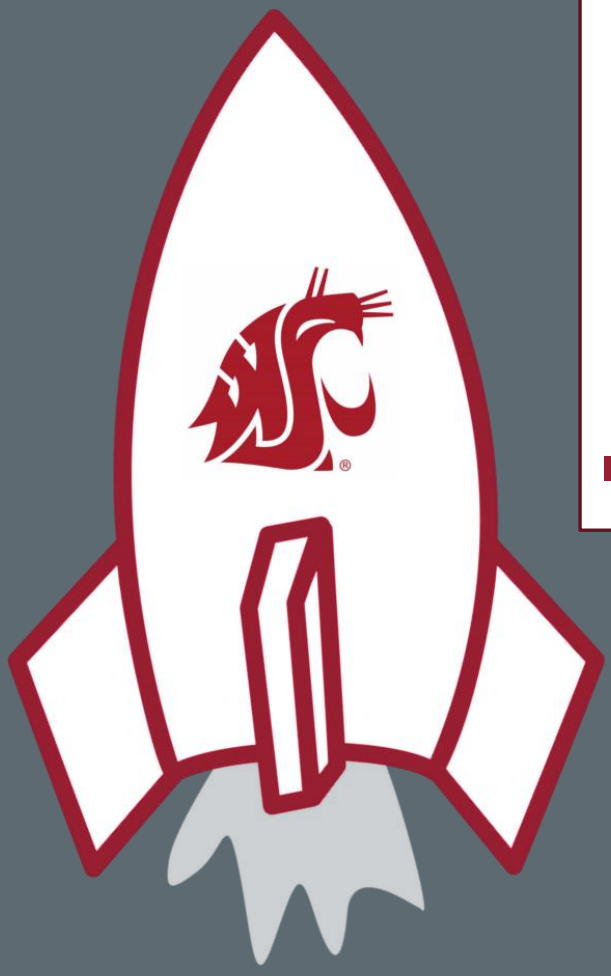
This document details the +X panel design

+X Panel

Design Document

Revision: V1.0.3



Reid Collins

Table of Contents

1 Introduction

This document details the design of the +X panel printed circuit board. It explains how the +X Panel schematic meets all requirements.

1.1 Functions

The +X panel is responsible for the following:

- Bi-directional low gain antenna for communicating with the ground station (with deployment mechanism)
- GPS Patch Antenna
- Photodiode sensor for ADCS

1.2 Requirements

The system requirements can be viewed here.

2 Detailed Description

This section references the +X 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 Low-Gain Antenna

The low-gain antenna is deployed via high-power resistors burning through a monofilament. This is referenced in the schematic as the Antenna Deploy Release. Once deployed, the low-gain antenna is used to transmit/receive data from the ground station. Transmission from this antenna consists of lower speed data transfers to the ground. Larger transmissions, such as sending images, are handled by the high-gain antenna on the -Z panel.

2.1.2 GPS Patch Antenna

The GPS antenna[1] is used to receive GPS information for the attitude control (ADCS) subsystem.

2.1.3 Photodiode Sensor

The +X panel board contains one photodiode sensor which is used to send data pertaining to the position of the sun to the ADCS subsystem via I^2C.

2.2 Schematic

2.2.1 Photodiode

The photodiode[2] is found on page 2 of the schematic. There is one photodiode on the face of the +X panel which has data sent to the avionics board via I^2C from an analog-to-digital converter (ADC)[3]. This particular photodiode has a spectral sensitivity of $6.3\ nA/lx$ and the expected illuminance is on the order of $< 1\ Mlx$. This makes the expected voltage drop across the load resistor about $0.9\ V$.

2.2.2 Low – Gain Antenna

The low-gain antenna is located on page 3 of the schematic. This antenna is used to receive data from the ground station as well as to transmit smaller data packages such as telemetry data. This antenna interfaces with the communications board via a coaxial cable. The antenna has a length of $357\ mm$,

[1] GPS Antenna Document
[2] Photodiode Document
[3] ADC Document

an impedance of 50Ω, a gain of $2.15\ dB$, and a linear polarization. The antenna is deployed using a thermal knife, also shown on page 3 of the schematic. The thermal knife consists of two $1\ W$ resistors which are used to burn through a monofilament, releasing the antenna. The power for the thermal knife is provided by the EPS.

2.2.3 GPS Patch Antenna

The GPS patch antenna is found on page 3 of the schematic. The antenna is connected to the avionics board via a coaxial cable. This is used to send GPS data to the attitude control subsystem for locational purposes. This antenna is $25mm\ x\ 25mm$ with a thickness of $4\ mm$. The antenna has an impedance of 50Ω, a center frequency of $1575\ MHz\ \pm\ 3\ MHz$, a bandwidth of $10\ MHz$ for $-10\ dB$, and right-hand circular polarization.

2.3 Board

The board shall be double-layered with $1\ oz$ 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.

Trace Width:	$0.2\ mm$
Vias:	$0.3\ mm$, unlimited count
Separation:	$0.2\ mm$
Length:	Unlimited

Devices with specific placement and routing considerations are noted in the schematic, see "CAD Note".

2.3.1.1 I^2C - I2C_[SDA_ADCS, SCL_ADCS]

Length:	Each node shall be length matched $\pm\ 1.0\ mm$
Stubs:	$< 10.0\ mm$

2.3.1.2 RF Traces

Track Width:	$1.5\ mm$
Gap Width:	$0.5\ mm$
Dielectric Thickness:	$0.9\ mm$

3 Testing