Rascal Interface Control Document

Saint Louis University

Rascal



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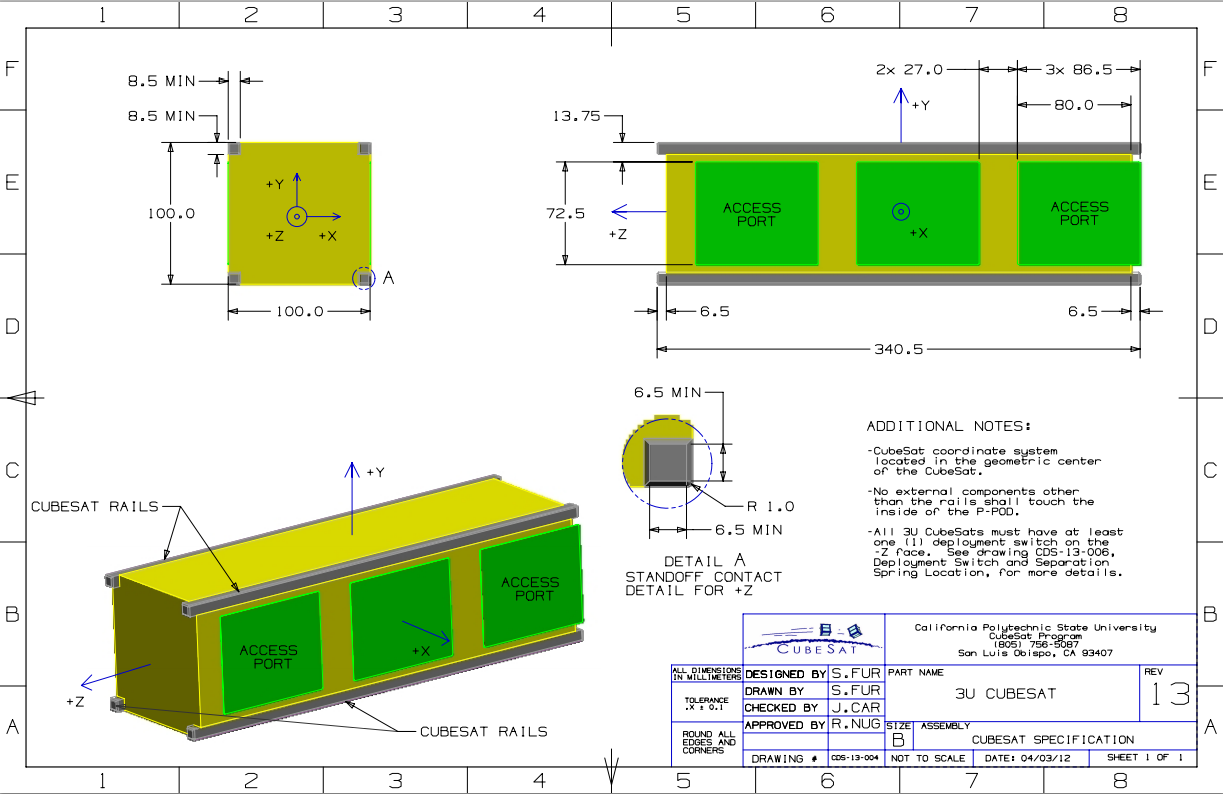
# Interface Overview

This Interface Control Document (ICD) serves to define all relevant interfaces between the Space Systems Research Lab’s (SSRL) Rascal payload (consisting of a 3U secondary spacecraft and 1.5U propulsion/image processing unit) and Boeing’s Colony-II bus. These interfaces consist of three major types:

1. **Mechanical -** structural interfaces that involve the physical connections between SSRL-Boeing components.
2. **Electrical –** digital/analog interfaces that involve data communication and power transmission to and from SSRL-Boeing components.
3. **Radio –** RF interfaces that involve data transmission between the ground and either the secondary or primary spacecraft.

Beyond these three designations, each interface can be broken down into three general categories: those that interface the secondary spacecraft with the primary spacecraft, those that interface the image processing/propulsion unit with the rest of the primary spacecraft, and those that interface both spacecraft to the ground. Each of interfaces within these categories will be defined in the sections that follow.

This document will make frequent use of the coordinate system definitions laid out for 3U spacecraft in the CubeSat Design Specification (CDS), Revision 13. A visualization of this coordinate system is provided in Figure 1-1. This is the coordinate system that will be used throughout this ICD, unless otherwise stated.



**Figure 1‑1 3U CubeSat Coordinate System Definition**

# Primary-Secondary Spacecraft Interfaces

There exist two main interfaces between the primary and secondary spacecraft:

* Primary-Secondary Separation Mechanism
* Secondary Spacecraft Power Inhibit

The former interface is mainly mechanical in nature, though it will require power to be transferred from the primary to the secondary spacecraft. The latter interface is purely mechanical in nature, taking the form of a simple contact switch. Each interface is described in greater detail in the following sections.

## Primary-Secondary Separation Mechanism

The former interface is mainly mechanical in nature, consisting of two solenoids (each housed within the secondary spacecraft) that latch onto two connection points that extend from the primary, as shown in Figure 2-1. These interface points are located along the vertical center line of the Y-/Y+ faces of the Primary and Secondary Spacecraft respectively, with each point being 5 cm from the Z-/Z+ face of the secondary spacecraft respectively. Four springs will also be used in order to achieve spacecraft separation once the solenoid latches are retracted. The interface for these springs will also be located along the Y-/Y+ faces of the Primary and Secondary Spacecraft respectively, with each spring representing a corner of a 15x5cm rectangle, whose center is located at the center of the Y- face of the secondary spacecraft. A mechanical drawing of each of these integration points is provided in Figure 2-2.

|  |  |
| --- | --- |
|  |  |
| **Figure 2‑1 Example Drawings of Primary-Secondary Mechanical Interface.** The left figure shows a magnified view of the solenoid latch interface, while the right figure shows a magnified view of the separation spring interface. | |

Since the secondary spacecraft is set to be off until separation, it is required that the primary spacecraft transfers power to the secondary spacecraft’s separation mechanism. This will be accomplished through the use of external electrical contact ports, one each for the Primary and Secondary Spacecraft. These ports will be at least 5V, 2.5A rated. A block diagram of this arrangement is shown in Figure 2-3. This diagram specifies that the command for separation originate from a ground station. This command is then received by the Colony-II bus COM system and passed to the Command Data Handling (CDH) system of the Primary Payload. The CDH system then interprets this command and allows for current to flow from the Primary Spacecraft, to the Power Transfer contacts, to the Secondary Spacecraft, and then directly to each of the separation solenoids. Thus, the Primary Payload’s CDH system is responsible for the actual relaying of power to the spacecraft power transfer ports, with the Colony-II bus only being required to receive and relay the actual separation command. This will involve the use of a wire harness to connect the corresponding 5V and GND ports of the CDH system to those of the power transfer port.

SEP Block Diagram.tif

## Secondary Spacecraft Power Inhibit

The latter interface is also mainly mechanical in nature, consisting of a simple switch that will be compressed when the secondary spacecraft is conjoined with the primary spacecraft. In this state, the switch would cut off all power between the secondary spacecraft’s batteries and the rest of the secondary spacecraft, ensuring that the secondary spacecraft has enough power to remain active over the course of its 15 day mission. When the secondary spacecraft separates from the primary spacecraft, this switch will actuate to its on state, allowing the secondary spacecraft to be powered on. A block diagram of this arrangement is provided in Figure 2-2.



# Primary-Colony-II Bus Interfaces

The main interface between the Primary Payload (PLD) and the Colony-II (COL-II) bus is a D-subminiature DB-25 connector, as shown in Figure 3-1. This interface will be used for passing power from COL-II to the PLD, as well as relaying data collected by the PLD to the communications and attitude determination and control systems (ADC) provided by COL-II and data commands and ADC sensor information from COL-II to the PLD.



**Figure 3‑1 Example DB-25 Pinout**

**Table 3‑1 Primary-Colony-II Bus Interface Pinout**

| Pin Number | Pin Name | Pin Name (Shorthand) | Signal Origin |
| --- | --- | --- | --- |
|  | Live Image Data Transmit | TX1 | PLD |
|  | Queried Payload Data | DAT1 | PLD |
|  | Queried COL-II Data | DAT2 | COL-II |
|  |  |  |  |
|  |  |  |  |
|  | 5V Bus | 5V | COL-II |
|  | 3.3V Bus | 3.3V | COL-II |
|  | Ground | GND | COL-II |
|  | Ground | GND | COL-II |
|  | Unregulated | UNREG | COL-II |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  | 5V Bus | 5V | COL-II |
|  | 3.3V Bus | 3.3V | COL-II |
|  | Ground | GND | COL-II |
|  |  |  |  |
|  | Unregulated | UNREG | COL-II |
|  |  |  |  |
|  |  |  |  |

Table 3-1 shows the pinout of the PLD-COL-II Interface. This table l