Subsystem Design Specification

University of Toronto Aerospace Team
Onboard Computer

August 17, 2025

Contents

1 Subteam Overview

1.1 Technical Responsibilities

The electrical team has two main deliverables for the spacecraft:

1. The OnBoard Computer (OBC)
2. The Payload Controller (PAY)

Each deliverable is an STM32-based PCB that is designed, validated, and tested in-house.

As the board is being designed in house, the team is also responsible for:

- Ensuring boards can be manufactured for flight when the time comes
- Creating and maintaining datasheets for each board
- Maintaining the Interface Control Document

1.2 Other Responsibilities

- Training up members of the subteam to work on OBC and PAY via onboarding projects.
- Maintaining the Altium library– ensuring that all components can withstand the space environment.
- Maintaining the lab space (MY618) for electrical testing and PCB bring-up.
- Placing PCB fabrication and component orders

2 Applicable Documents and Standards

2.1 Technical Documents

- OBC Datasheet
- PAY Datasheet
- Master Connection Sheet

2.2 Standards Documents

3 Subsystem Requirements

3.1 Electrical System Requirements

From the FINCH-Spacecraft-ElectricalSystem, requirements for the existence of OBC and PAY are derived. Seen in Table 1 are also other higher-lever requirements of the system including the common bus to connect OBC, PAY, and the board for the Electrical Power System (EPS).

Req. ID	Description	Parent Req.	Verification Method
FINCH-Spacecraft-ElectricalSystem	The electrical system shall provide the necessary electrical functionality for the mission to function.	FINCH-Mission-Objective	Demonstration
FINCH-OBC-ControlAndOps	The OBC shall control the modes of operation of the satellite.	FINCH-Spacecraft-ElectricalSystem	Demonstration
FINCH-Payload Controller-PayloadOps	The Payload Controller shall support necessary operations for executing the mission of the payload	FINCH-Spacecraft-ElectricalSystem	Demonstration
FINCH-Spacecraft-CommonBus	The spacecraft shall utilize a common bus which includes the lines for power and communication between OBC, EPS, and PAY.	FINCH-Spacecraft-ElectricalSystem	Test
FINCH-Spacecraft-CANBus	The spacecraft shall use CAN Bus for communication between nodes on the electrical system.	FINCH-Spacecraft-CommonBus	Test
FINCH-Spacecraft-Electrical Grounding	The grounding system for the spacecraft shall include a separate chassis and signal ground.	FINCH-Spacecraft-ElectricalSystem	Analysis
FINCH-Spacecraft-Electrical Soldering Standard	Electrical components shall be soldered in accordance to IPC Type 3 or equivalent	FINCH-Spacecraft-ElectricalSystem	Inspection

Table 1: Electrical System Requirements

3.2 OBC Requirements

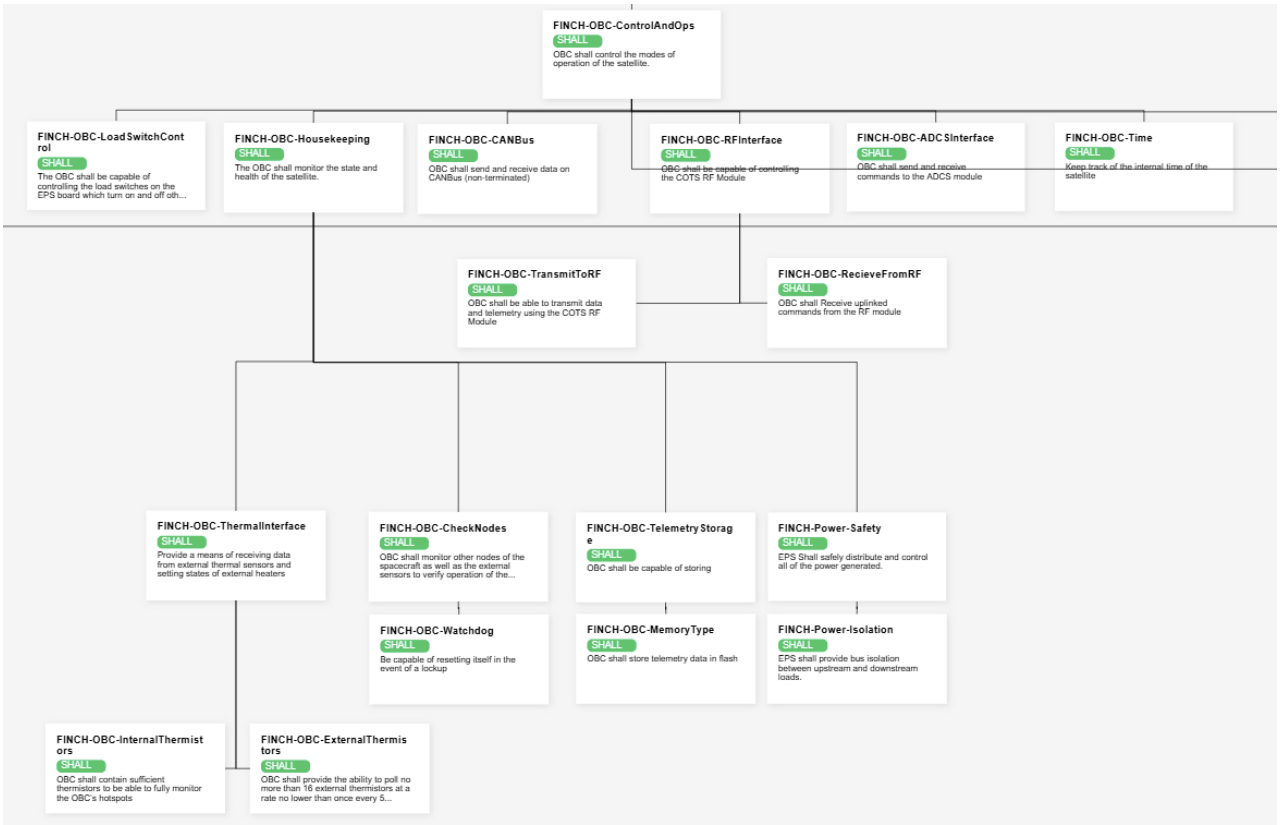

Figure 1: Requirement tree view of the requirements for the OnBoard Computer

Req. ID	Description	Parent Req.	Verification Method
FINCH-OBC-LoadSwitch Control	The OBC shall be capable of controlling the load switches on the EPS board which turn on and off other nodes on the satellite (	FINCH-OBC-ControlAndOps	Demonstration
FINCH-OBC-CANBus	The OBC shall send and receive data on CANBus (non-terminated)	FINCH-OBC-ControlAndOps, FINCH-Spacecraft-CANBus	Test
FINCH-OBC-Time	The OBC shall track of the internal time of the satellite	FINCH-OBC-ControlAndOps	Test
FINCH-OBC-Housekeeping	The OBC shall monitor the state and health of the satellite.	FINCH-OBC-ControlAndOps	Test
FINCH-OBC-CheckNodes	OBC shall monitor other nodes of the spacecraft as well as the external sensors to verify operation of the spacecraft is going without fault.	FINCH-OBC-Housekeeping	Test, Analysis
FINCH-OBC-Watchdog	The OBC shall be capable of resetting itself in the event of a lockup	FINCH-OBC-CheckNodes	Test
FINCH-OBC-TelemetryStorage	The OBC shall be capable of storing telemetry and housekeeping data.	FINCH-OBC-Housekeeping	Test
FINCH-OBC-MemoryType	The OBC shall store telemetry data flash memory.	FINCH-OBC-TelemetryStorage	Test
FINCH-OBC-ThermalInterface	Provide a means of receiving data from external thermal sensors and setting states of external heaters	FINCH-OBC-Housekeeping	Test
FINCH-OBC-Internal Thermistors	The OBC shall contain sufficient thermistors to be able to fully monitor the OBC's hotspots.	FINCH-OBC-ThermalInterface	Test
FINCH-OBC-External Thermistors	The OBC shall provide the ability to poll no more than 16 external thermistors at a rate no lower than once every 5 seconds.	FINCH-OBC-ThermalInterface	Test

Table 2: OBC Requirements

3.3 PAY Requirements

Figure 2 and Table 3 summarize the requirements for the Payload Controller system.

Notable is the compression requirement which has only become a "should" recently after PAY was designed. The reason why the requirement suddenly became a "should" comes from a spec from optics saying that the whole sensor will not be used. Initial requirement for compression assumed the whole sensor would be used.

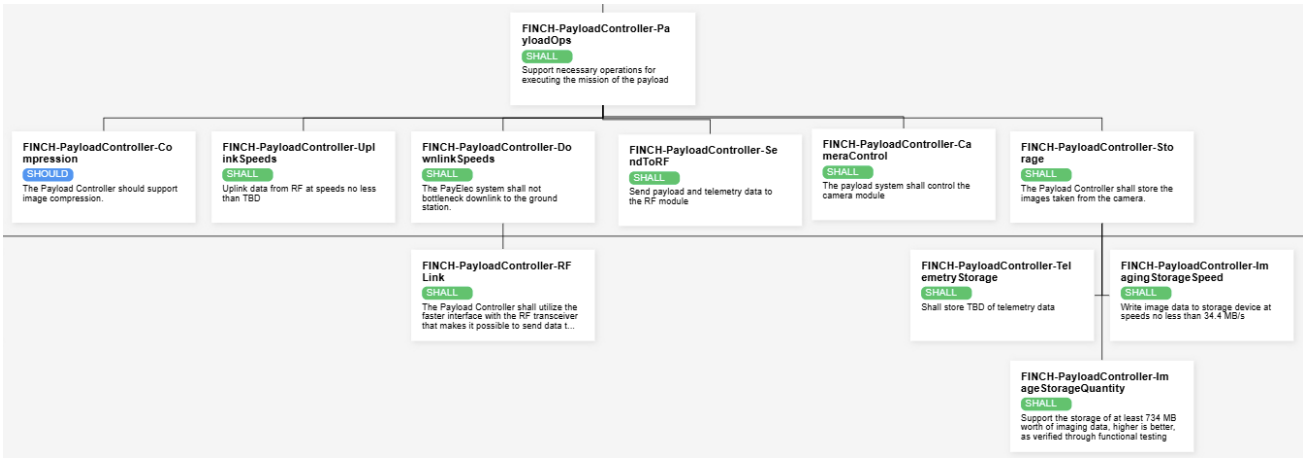

Figure 2: PAY Requirement Tree

Req. ID	Description	Parent Req.	Verification Method
FINCH-PayloadController-CameraControl	The Payload Controller shall control the camera module	FINCH-PayloadController-PayloadOps	Test, Analysis
FINCH-PayloadController-Storage	The Payload Controller shall store the images taken from the camera.	FINCH-PayloadController-Storage	Test
FINCH-PayloadController-ImagingStorageSpeed	The Payload Controller shall write image data to storage device at speeds no less than 34.4 MB/s	FINCH-PayloadController-Storage	Test
FINCH-PayloadController-ImageStorageQuantity	The Payload Controller shall support the storage of at least 734 MB worth of imaging data, higher is better, as verified through functional testing	FINCH-PayloadController-Storage	Test
FINCH-PayloadController-TelemetryStorage	The Payload Controller shall be capable of storing telemetry data.	FINCH-PayloadController-Storage	Test
FINCH-PayloadController-DownlinkSpeeds	The Payload Controller system shall not bottleneck downlink to the ground station.	FINCH-PayloadController-PayloadOps	Test
FINCH-PayloadController-RFLink	The Payload Controller shall utilize the faster interface with the RF transceiver that makes it possible to send data to the transceiver such that it does not bottleneck communication.	FINCH-PayloadController-DownlinkSpeeds	Test
FINCH-PayloadController-UplinkSpeeds	The Payload Controller system shall be capable of receiving data from the RF module directly.	FINCH-PayloadController-PayloadOps	Test
FINCH-PayloadController-SendToRF	The Payload Controller shall be capable of directly sending payload and telemetry data to the RF module.	FINCH-PayloadController-PayloadOps	Test
FINCH-PayloadController-Compression	The Payload Controller should support image compression.	FINCH-PayloadController-PayloadOps	Test

Table 3: Electrical System Requirements

4 Verification and Validation Plan

Electrical requirements will be verified via tests and demonstrations. The verification and validation plan will follow the following timeline:

5 High Level System Architecture

6 Detailed System Architecture

7 Possible Risks

8 Development Schedule and Status

9 Open Issues and Future Work