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Design Team 2
Command and Data Handling Requirements (revised)

1. SCOPE

The following is the specification for the command and data handling system of the pico-satellites for the CubeSat mission.

1.1 General

This specification establishes the design, construction, performance, development, and test requirements for the command and data handling system, herein referred to as C&DH.

2. APPLICABLE DOCUMENTS

2.1 Government Documents

TBD

Industry Documents

TBD

3. REQUIREMENTS

3.1 Item Definition

The C&DH system facilitates the data transfer between the various systems in the satellite be they a digital or an analog signal. The C&DH system will include the following hardware.

- Microprocessor board
- Digital to Analog Converter, herein referred to as DAC
- Analog to Digital Converter, herein referred to as ADC
- Data bus for sensors
- Power cables
- Data cable for the GPS system
- Data cable for the communication system
- Analog on/off cables

3.1.1 High Level Functional Block Diagram

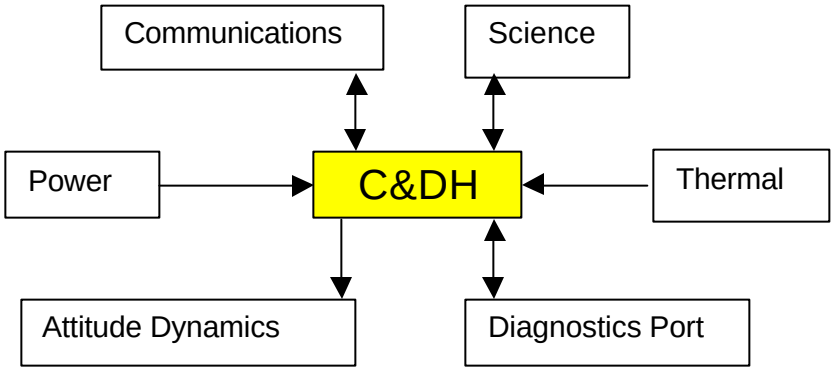

Figure 1: The data exchange routes for the C&DH system.

3.1.2 Interface Definition

The flow of data between C&DH and the various systems is still mostly TBD. As of this moment data flow will be one-way from the power system to C&DH and two-way between the communication and the attitude dynamics systems. The exact nature of the data sharing between the C&DH and the attitude dynamics has not yet been determined but there will be some sort of exchange to facilitate CubeSat separation and attitude corrections. For the thermal system, two-way data exchange depends on whether any active thermal solutions will be needed, i/e. heaters being turned on and off. There is still quite a gray area as to what the GPS and the communication system will need of the C&DH system and this is caused by the utter lack of space-rated GPS receivers and the need to have a board built for the mission.

3.1.2.1 Physical

- The structure should accommodate mounting holes to mount the board on with nuts and bolts
- All sockets and solders must be permanently affixed onto the pins and the board
- The diagram below displays the physical I/O lines from and to the C&DH sub-system

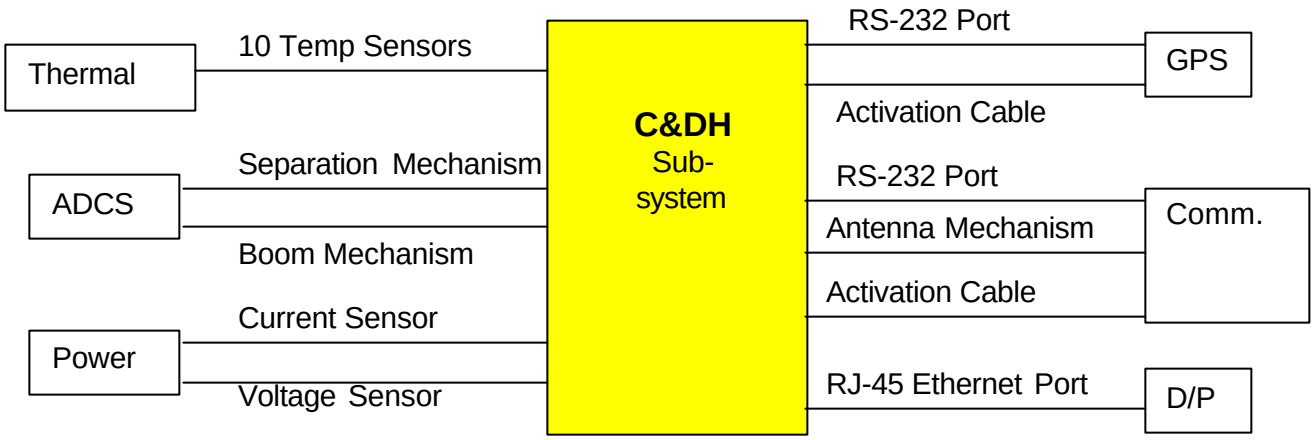

Figure 2: I/O layout of C&DH sub-system

3.1.2.2 Electrical

The C&DH sub-system shall operate off of 7-15 V unregulated power source.
Maximum current shall be under 75 mA with the correlating maximum power to be under 0.53 W.

3.1.2.3 Informational

The C&DH system will facilitate any needed attitude adjustments, the reading and writing of GPS data, the communications schedule, and health monitoring of each system.

3.2 Characteristics

3.2.1 Performance Characteristics

a) Internal Data Collection Rate

The C&DH sub-system shall be able to receive the following data rate for health monitoring

Item	Quanity	Sampling rate (Hz)	Word Size (bits)	Required Data Rate (bps)
Power				
Voltage Sensor	1	1	8	8
Current Sensor	1	1	8	8
Thermal				
Temperature sensor	10	1	9	90
ADCS	N/A	N/A	N/A	N/A
		Total Data Rate:		106

b) Processing Speed

Shall be able to adjust its clock rate dynamically to conserve power during standby.

c) Data Storage

- The C&DH sub-system shall be able to store the following science data at the specified rate.
- The C&DH sub-system shall be able to load the following data through RS-232 ports
- The C&DH sub-system shall be able to store 2.2 MB of data per day and downlink it to the ground station through the communications sub-system

Item	Sampling rate (Hz)	Word Size (bits)	Required Data Rate (bps)
Signal Amplitude	72	11	792
Location	1/60th	33	0.55
Time Stamp	1/60th	11	0.18
	Total Data Rate:		792.73

Physical Characteristics

- The C&DH sub-system shall be able to fit with in a 8x6x2.5 cm volume of space
- The C&DH sub-system shall not weigh more than 100 g
- The C&DH sub-system shall not consume more than 0.8 Watts per orbit

3.2.3 Reliability

All C&DH hardware and software shall have an operational lifetime of forty-five (45) days. Other requirements to be determined

3.2.4 Maintainability

No in flight maintenance shall be required.

3.2.5 Environments

The C&DH system shall be capable of operating in the space environment. Thermal and structural environment during launch is listed in the P-POD document. Space flight environment conditions are still TBD.

3.2.5.1 Natural

- Radiation - C&DH shall be able to recover from a fault caused by random collisions with high-energy particles or other radiation sources.
- Thermal – Shall be able to operate with in of -20°C to +70°C.
- Magnetic – TBD
- Lightening / Electrical Discharges - TBD

3.2.5.2 Induced

- Prelaunch - Relative Humidity of 0 - 95% (non-condensing). Other factors are TBD
- Launch –

Dynamic Load:	0.5 g at 2-20 Hz any direction
Static Load:	7.7 g any direction
Acoustic Load:	140 dB sound pressure

- Operational - TBD

3.3 Design and Construction

TBD

3.3.1 Wiring, Cabling, and Connectors

All data connections shall be done using typical COTS 2mm centers for .020 inch square pins.

3.3.2 Electronic Parts and Printed Wire Boards

TBD

3.3.3 Outgasing and venting

TBD

3.3.4 Corona

TBD