3.3 Science Data System

3.3.1 Science Data System Overview

The science data system consists of 4 subsystems that have been outsourced from our Japanese collaborators at Tokai University and Toyama Prefectural University, TPU. Tokai University will provide a magnetometer and a sun sensor. These flight instruments are stand-alone subsystems.

TPU will provide two ionosphere density measurement instruments: a radio receiver mounted inside the nose cone and an ion and electron probe measurement circuit. The three-channel dual-output receiver measures the received field strength from 3 ground-based beacons. The plasma density can be determined from spatial variations of field strength due to partial reflection and attenuation. Each partially reflected beacon frequency, f, is related to the electron density, N, by the equation:

$$f_p := 9 \cdot \sqrt{N_e}, \qquad (3.3.1)$$

where the electron density in the in the D region of the ionosphere increases with altitude. At the lowest beacon frequency a distinctive attenuation occurs between 85 km and 90 km. Therefore, for a successful mission, the rocket must attain an altitude of 85-90 km. These field strength measurements will then be used to calibrate the relative density measurements obtained from the ion and electron probes.

This overview contains information pertinent to all of the outsourced subsystems such as payload architecture, flight computer provisions, power supply provisions, and Molex connectors. Then the following sections describe the 4 subsystems (the magnetometer, the sun sensor, the radio receiver, and the density probes), the testing procedures, the assembly instructions and the integration notes.

Payload Architecture

Deck assignments have placed the sun sensor above the flight data printed circuit boards (PCB's) on deck plate #2, the magnetometer on deck plate #4, and the radio receiver and probe PCB's on deck plate #5. The metallic band ion and electron probes will be located on the outer nose cone skin, while the magnetic loop radio antenna will be mounted to the nose cone above deck plate #5. There will be a thin Mu shield between the magnetic loop antenna and the rest of the payload. Figure 3.3.1.1 indicates the deck assignments within the nose cone.

Flight Computer Provisions

The flight computer supports the science data subsystems by providing 16-bit analog to digital conversion (ADC) at a 100 Hz sampling rate. Table 3.3.1.1 shows the flight computer provisions to each subsystem. All connections to the flight computer will be with 8-pin Molex connectors. The University of Alaska Fairbanks Student Rocket Project 4 (UAF SRP4) will provide anti-aliasing filters for the radio receiver and probe subsystem analog outputs in another section of the payload.

Table 3.3.1.1: Flight Computer Provisions For the Science Data Subsystems

Subsystem	# of Channels	ADC bits	# of Cables	Input Voltage Range
Magnetometer	3	16	1	-2.5 to +2.5 V
Sun Sensor	1	12	1	0-5 V
Radio Receiver	6	16	3	0-5 V
Probes	4	16	2	0-5 V

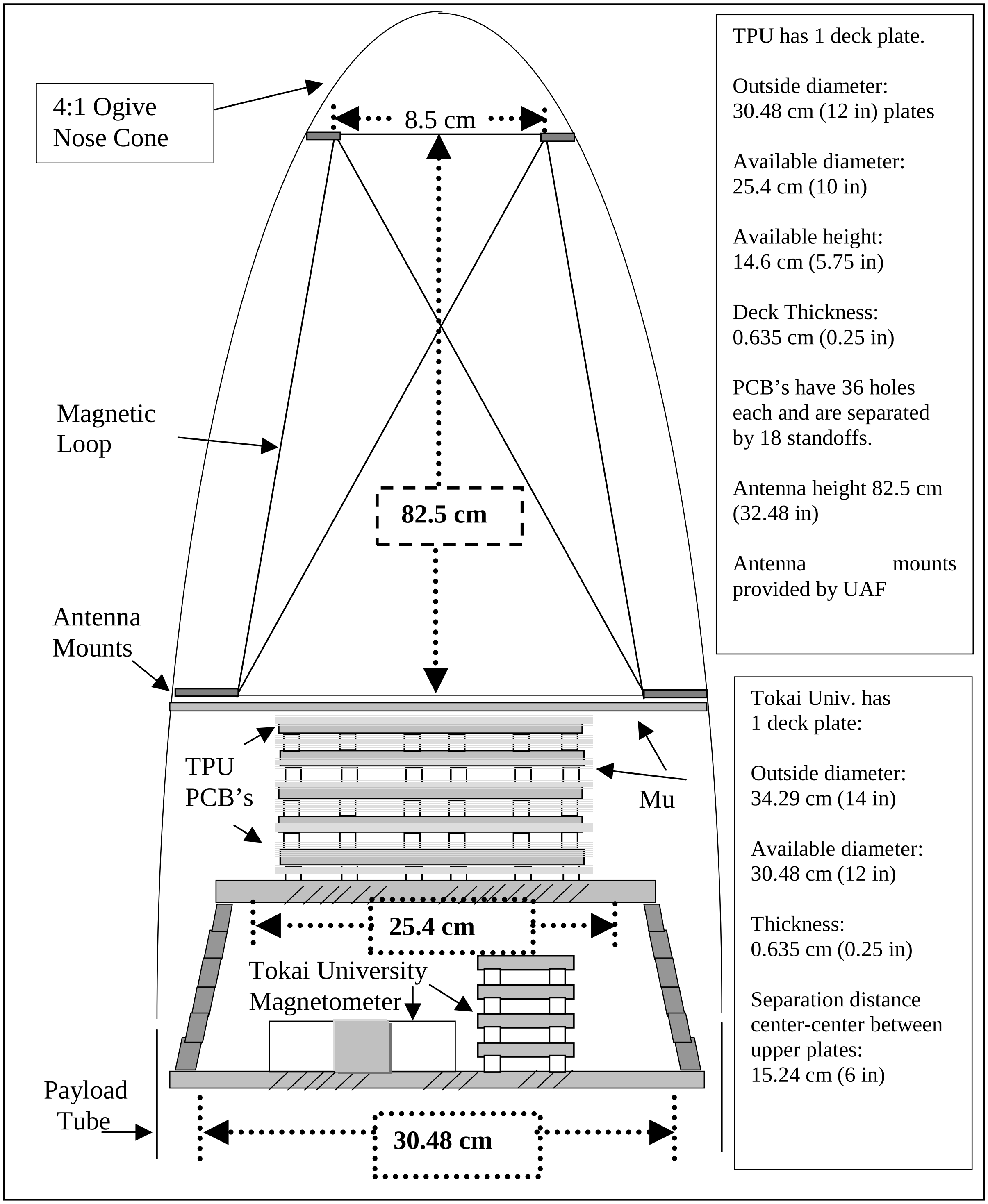

Figure 3.3.1.1: Deck assignments within the nose cone

Power Supply Provisions

The power supply system supports the science data subsystems by providing + 15 V, -15 V, + 5 V and a ground. The predicted subsystem current draw on the power supply is listed in Table 3.3.1.2. All voltages supplied by the power regulator will have a dynamic 2% ripple of 7 mV at 150 kHz. Ripple at the harmonics will decrease by at least 10 dB per harmonic. It is recommended that all subsystems implement further ripple filtering at their power input connections if their circuits will be sensitive to the ripple. Ferrite chips attached to the input power traces is recommended. Figure 3.3.1.2 illustrates the connector pin assignments and ferrite chip placement. To prevent induced noise on the power bus, it is extremely important that no subsystem attach an inductive load directly to the input power connection.

Table 3.3.1.2: Science Data Subsystem Power Budget

Voltage Levels	+15 V	-15 V	+5 V	+15 V Power	-15 V Power	+5 V Power
Subsystem	mA	mA	mA	W	W	W
Magnetometer	67	67	0	1	1	0
Sun Sensor	25	25	0	0.3	0.3	0
Radio Receiver	85*3	60*3	0	3.825	2.7	0
DC/DC	0	10	0	0	0.15	0
Power Filter	10	10	0	0.15	0.15	0
Ion Probe	0	0	2	0	0	0.01
Total	357	292	2	5.275	4.3	0.01

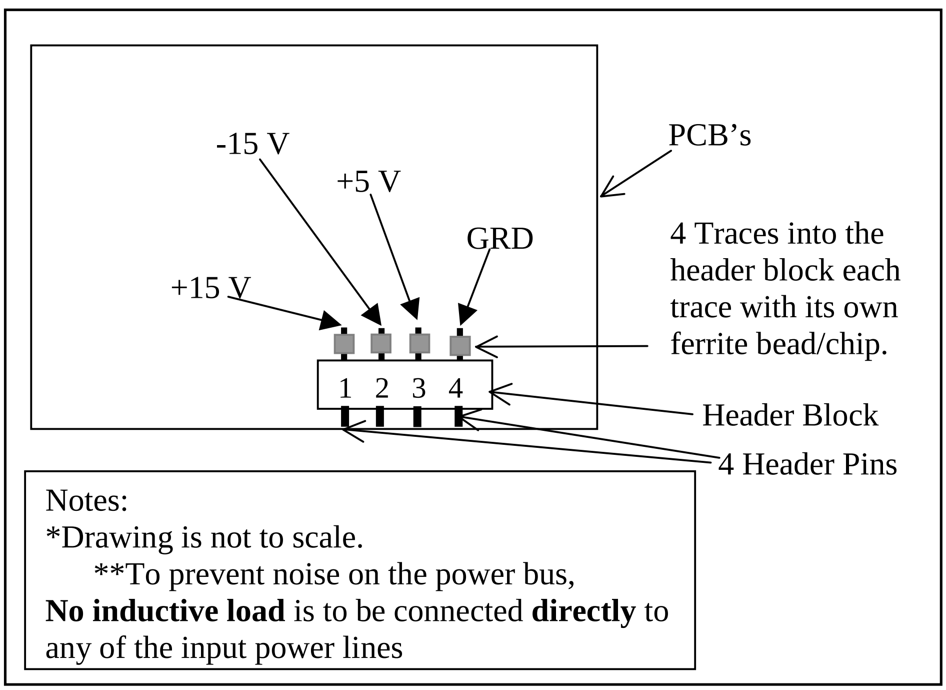

Figure 3.3.1.2: Pin assignment for the power bus showing ferrite chips on each PCB.

Molex Connectors

Table 3.3.1.3 lists the Molex connector part numbers that will interface between the payload and the science data subsystem. Unless otherwise specified, UAF SRP4 will supply all the terminal housings and crimp terminals, while Tokai University and TPU will supply all the male headers. Probes and sensors may have other types of connectors. The specific sections will delineate the other connector details as needed.

Table 3.3.1.3: Molex Connector Details for Magnetometer and Sun Sensor. All values in mm (in)

Part Number	Part Name	Description	Length	Ctr.-Ctr. Length 1st to nth pin	Height	Width
22-12-2081	Male header	Rt. Angle 8 pin	20.07 (0.79)	17.78 (0.7)	2.36 (0.093)	9.45 (0.475)
22-12-2084	Male Header	Rt. Angle 8 pin Locking Ramp	20.07 (0.79)	17.78 **(0.7)**	2.36 (0.093)	9.45 (0.475)
22-01-3087	Terminal housing	Locking ramp Polarizing ribs	20.9 (0.82)	17.78 (0.7)	4.83 (0.19)	12.7 (0.5)
22-12-2044	Male header	Rt. Angle 4 pin Locking Ramp	10.16 (0.4)	7.62 (0.3)	6.35 (0.25)	9.78 (0.385)
22-01-3047	Terminal housing	Locking ramp Polarizing ribs	10.7 (0.42)	7.62 (0.3)	4.83 (0.19)	12.7 (0.5)
08-05-0114	Crimp terminal	Brass w/ Tin plating	2.11 (0.083)	N/A	1.91 (0.075)	9.7 (0.385)

3.3.2 Magnetometer

Function

The magnetometer is a tri-axial fluxgate device that provides attitude determination. It will also determine magnetic perturbations associated with current systems in the D-region of the ionosphere. The general magnetometer specifications are:

- Sensitivity: +/- 1.5 nT.
- Dynamic range: +/- 70,000 nT.
- Analog output: +/- 2.5 V below 50 Hz.
- 3 Channel outputs (x, y, z).
- Sensor drive frequency: 9.6 kHz.

Figure 3.3.2.1 is a block diagram of the magnetometer. A crystal oscillator generates a 153 kHz signal that is divided to get a 19.2 kHz reference signal and a 9.6 kHz sensor coil drive signal. The output of the flip coil sensors are filtered, amplified and fed to a phase detector. A second output from the coil is sent through a V-I converter. A current controlled integrator samples the phase of both the reference frequency and the sensor. The output of the integrator is then limited between –2.5 V and +2.5 V, and an anti-aliasing filter limits the output frequency to 18.5 Hz.

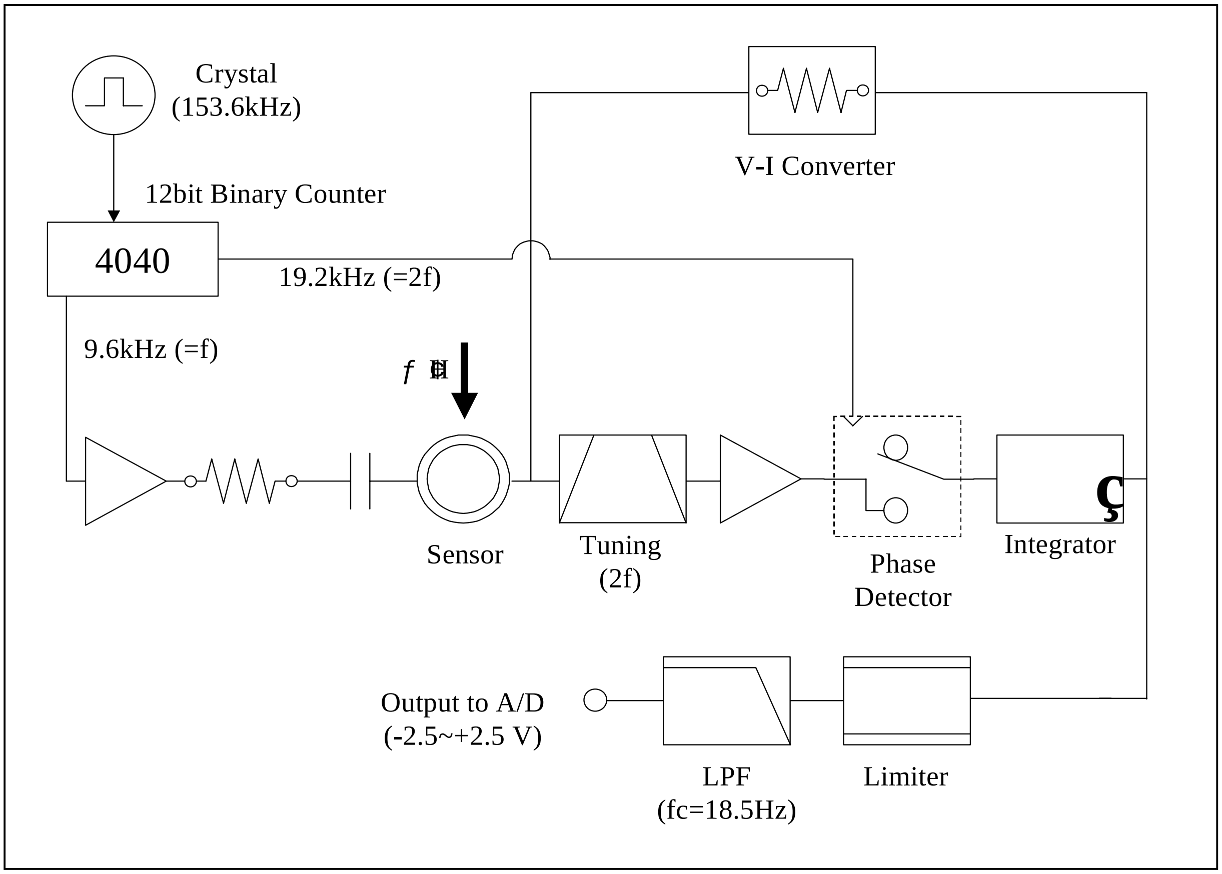

Figure 3.3.2.1: Magnetometer Block Diagram provided by Tokai University

Interface Requirements

The magnetometer interfaces with 3 other systems: the flight computer, the power supply, and the payload architecture. Table 3.3.2.1 shows the magnetometer connector pin assignments.

Table 3.3.2.1: Magnetometer Connector Pin Assignment

Connector	Part Number	PCB Pin Number	Items
Data	22-12-2081	J1-1	X signal OUT
Data	22-12-2081	J1-2	Signal GND
Data	22-12-2081	J1-3	Y signal OUT
Data	22-12-2081	J1-4	Signal GND
Data	22-12-2081	J1-5	Z signal OUT
Data	22-12-2081	J1-6	Signal GND
Data	22-12-2081	J1-7	
Data	22-12-2081	J1-8	
Power	22-12-3047	J2-1	+15 V
Power	22-12-3047	J2-2	-15 V
Power	22-12-3047	J2-3	+5 V
Power	22-12-3047	J2-4	GRD

Figure 3.3.2.2 shows the magnetometer PCB's and connector designations. The 36 PCB holes will not be drilled into deck plate #4. Instead, the magnetometer placement proposal illustrated in Figure 3.3.2.3 suggests 2 separated PCB stacks positioned at opposite corners of the sensor coils for spin balancing. Then the 2 sensors coils will be mounted perpendicular to each other and centered on the deck plate. Figure 3.3.2.4 indicates the sensor coil outer perimeters and approximates the position of the mounting holes. Due to their irregular shape and unknown factors, the mounting holes in the deck plate will be drilled after receiving the subsystem.

Magnetometer PCB Specifications

- Size: 60 mm x 60 mm x 64 mm (2.36 in x 2.36 in x 2.52 in).
- Mass: 200 g (0.44 lbs).
- Data connector type: Molex Male Header #22-12-2084.
- Power connector type: Molex Male Header #22-12-2044.
- Connector positions: as shown in Figure 3.3.2.2 below. All connector designations must be marked on each PCB.
- Mounting standoffs type: 4 brass pipe spacers, nuts and screws per PCB (M3 x 5 mm).

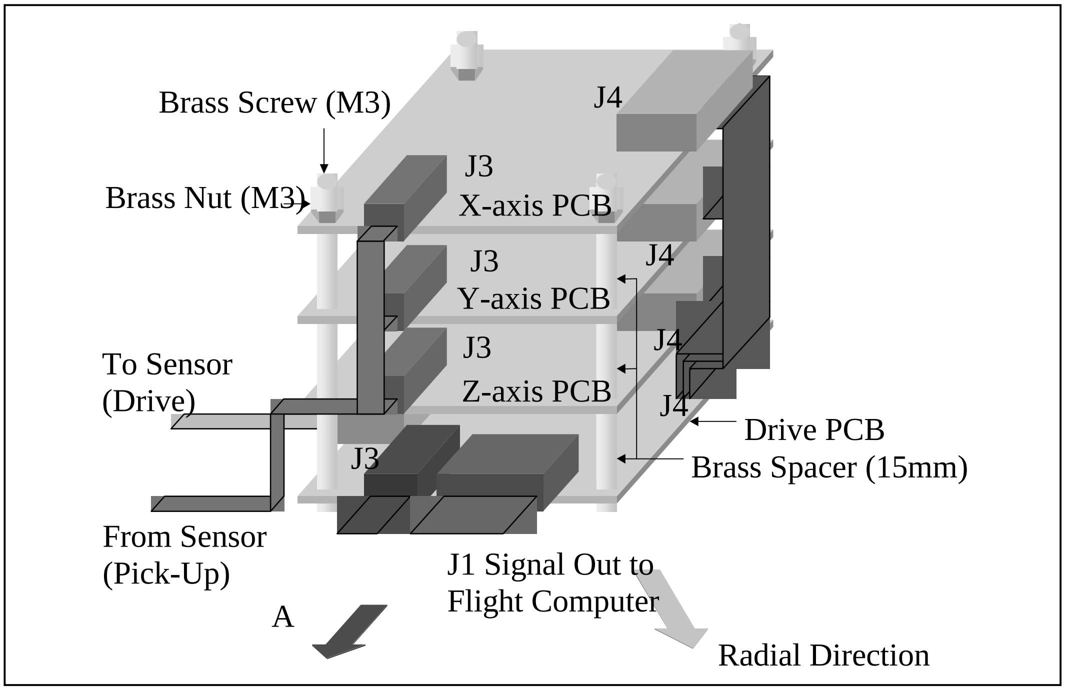

Figure 3.3.2.2: Magnetometer PCB's Initial Stack Assignment.

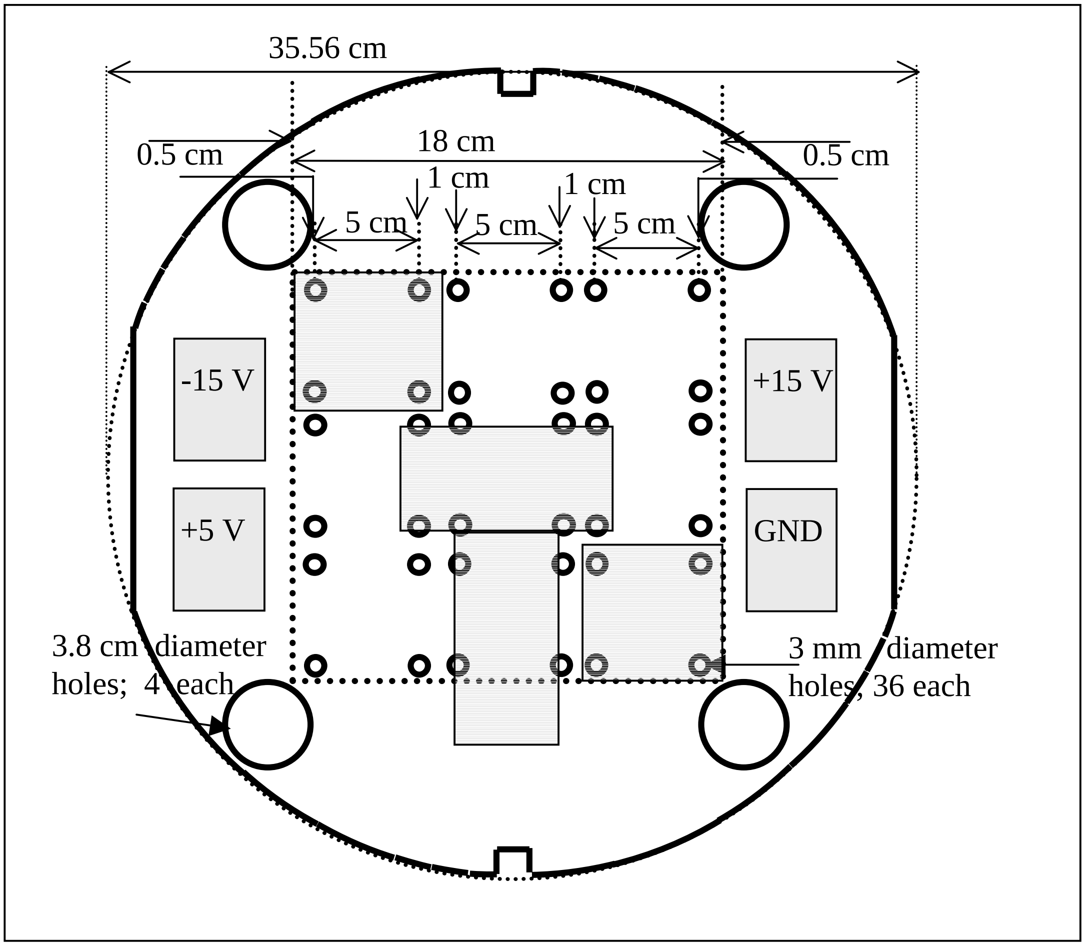

Figure 3.3.2.3: Proposed spin balanced magnetometer placement on deck plate #4 showing two separated magnetometer PCB stacks instead of one..

Magnetometer Sensor Specifications

- Size: 56 mm x 97 mm x 35 mm.
- Mass: 150 g
- Sensor (Drive) connector type: Molex Housing #22-01-3047, Molex Terminal #08-50-0114.
- Sensor (Pick-up) connector type: Molex Housing #22-01-3047, Molex Terminal #08-50-0114.
- Deck plate #4 sensor mounting position: positioned to spin balance as shown in Figure 3.3.2.5 below.
- Sensor mounting holes: Reference sensor template as shown in Figure 3.3.2.4.
- Mounting hardware type and size: M4 brass screws, brass washers and nuts (8 sets.)

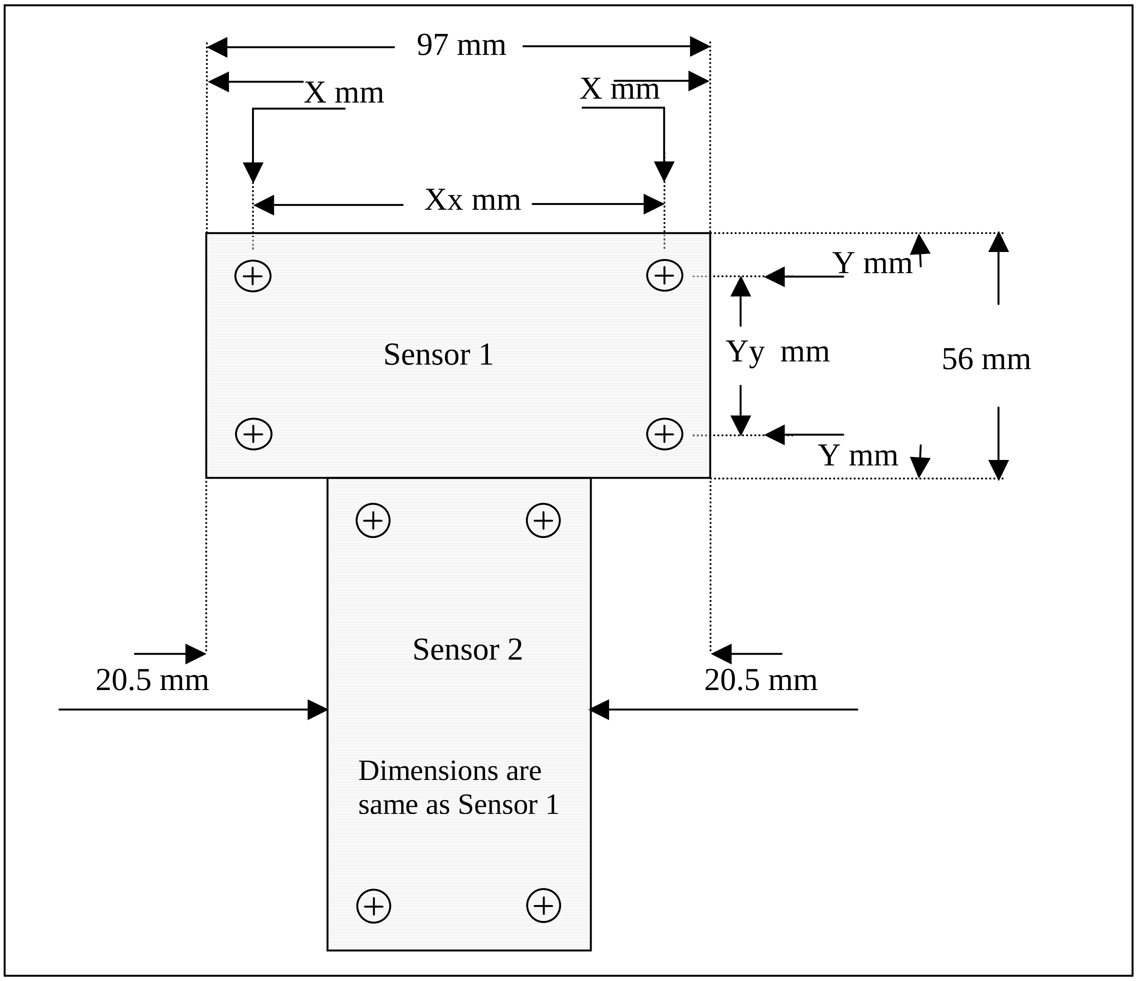

Figure 3.3.2.4: Magnetometer Sensor Coil Outer Perimeter Template. Mounting hole position dimensions are needed.

3.3.3 Sun Sensor

Functions

The sun sensor will provide attitude determination azimuthally from the point of liftoff to the separation event. The sun sensor is a linear diode device providing a dynamic range of +/- 60 degrees. A signal conditioning circuit provides a single analog channel output of 0-5 V and less than 50 Hz. Its total power requirement is 0.6 W with current consumption estimates found in Table 3.3.1.2.

Interface Requirements

The sun sensor interfaces with 3 other systems: the flight computer, the power supply, and the payload architecture. Table 3.3.3.1 provides the sun sensor connector pin assignments. Figure 3.3.3.1 shows the sun sensor physical dimensions, while Figure 3.3.3.2 shows the placement of the sensor on a payload tube faceplate and the placement of the sensor PCB above the flight instrument PCB's on deck plate #2. Sun sensor specifications include:

- Size: 114.3 mm x 35 mm x 30 mm (4.5 in x 1.38 in x 1.1 in)
- Mass: 100 g (0.22 lbs)
- Mounting holes 6.65 mm (0.2618 in) in "L" bracket.
- Sensor connector: shall be on a 5 cm (2 in) lead.
- Slot size: 10 mm x10 mm (0.4 x 0.4 in).

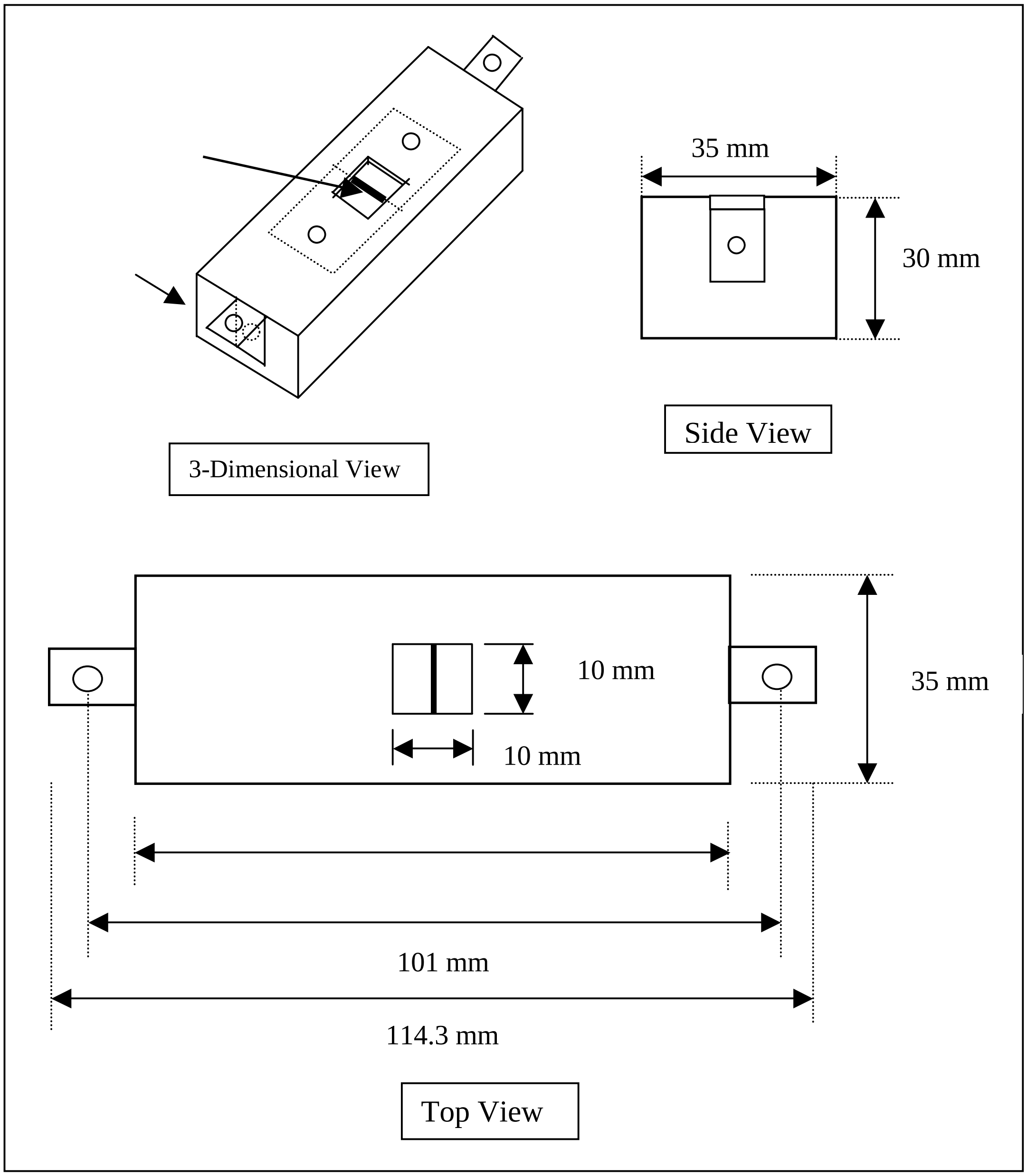

Figure 3.3.3.1: Sun Sensor Physical Dimensions

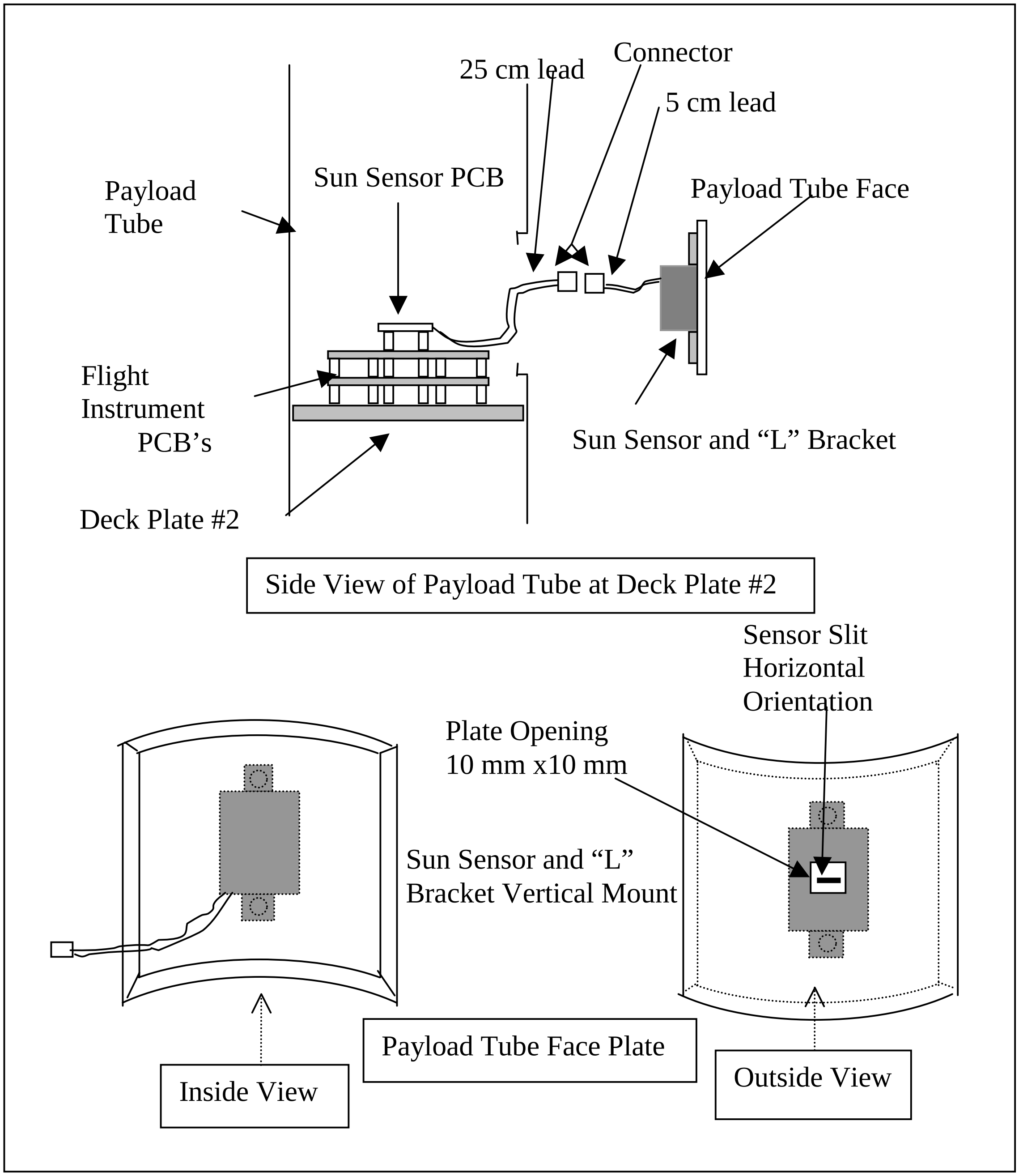

Figure 3.3.3.2: Sun sensor PCB placement is above the flight instrument PCB's and the sensor box placement is on a payload tube faceplate.

Sun Sensor PCB specifications

- Size: 60 mm x 60 mm x 10 mm (2.36 in x 2.36 in x 0.39 in).
- Mass: 30 g (0.066 lbs)
- PCB sensor connector: shall be on a 25 cm (10 in) lead.
- Data connector type: Molex Male Header #22-12-2044.
- Power connector type: Molex Male Header #22-12-2044.

- Number of mounting holes per PCB: 4 each 3 mm holes.
- Number of standoffs per PCB: 4.

Table 3.3.3.1: Sun sensor connector pin assignments.

Connector	Part Number	Pin Number	Items
Data	22-12-2041	J1-1	Lo
Data	22-12-2041	J1-2	Hi
Data	22-12-2041	J1-3	
Data	22-12-2041	J1-4	GND
Power	22-12-2044	J2-1	+15 V
Power	22-12-2044	J2-2	-15 V
Power	22-12-2044	J2-3	+5 V
Power	22-12-2044	J2-4	GRD

3.3.4 Radio Receiver Subsystem

Function

The radio receiver will provide 3 beacon cutoff frequencies in the 200 to 1000 kHz range. The general radio receiver specifications are:

- Receiver frequencies: 257 kHz, 660 kHz, and 820 kHz.
- Frequency bandwidth: 20 kHz.
- IF frequency: 455 kHz.
- Analog output: 0-5 V
- Cutoff frequency: <50 Hz
- Rx channels: 6.

Figure 3.3.4.1 shows the block diagram of the radio receiver. The pre-amplifier printed circuit board, PCB, has a dual function. It provides preamplification of the incoming radio frequencies, and it filters the incoming power to further reduce the power regulator ripple. Figure 3.3.4.2 is the pre-amp circuit schematic diagram. Figure 3.3.4.3 shows the receiver super-heterodyne circuit which produces a modulated IF frequency of 455 kHz. Figure 3.3.4.4 shows the IF amplifier schematic, while Figure 3.3.4.5 shows the detector circuit.

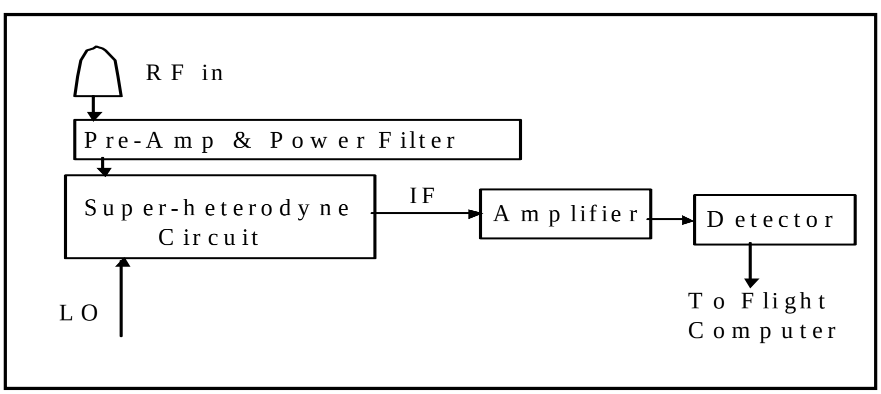

Figure 3.3.4.1: Receiver block diagram for the Science Data System

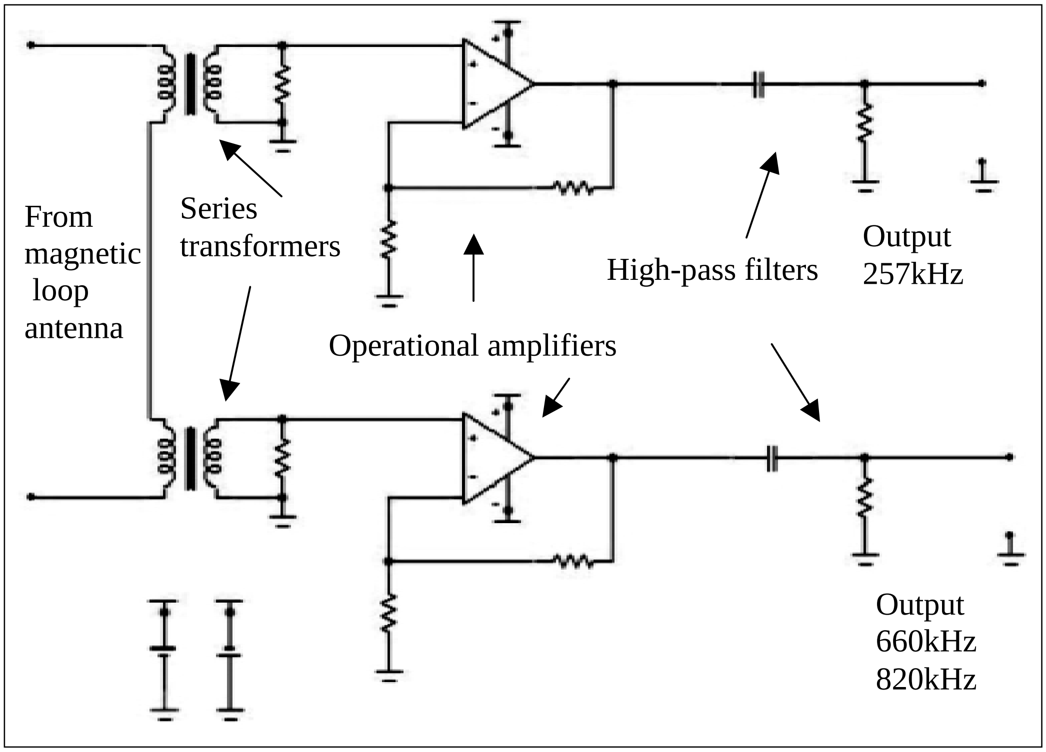

Figure 3.3.4.2: Antenna Pre-amplifier

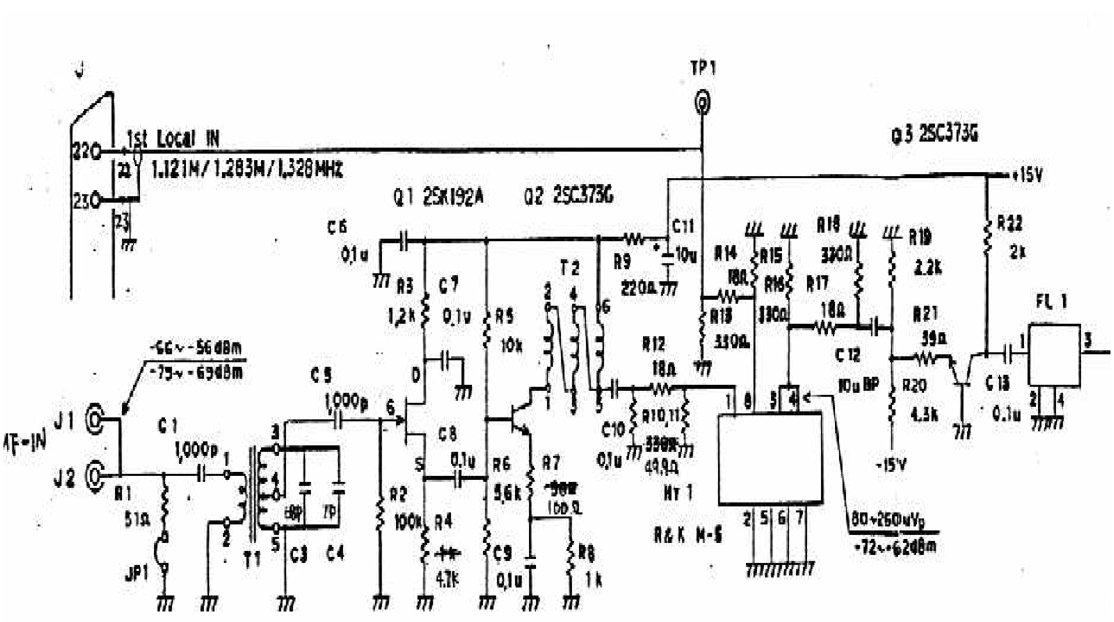

Figure 3.3.4.3: The receiver super-heterodyne circuit for the Science Data System

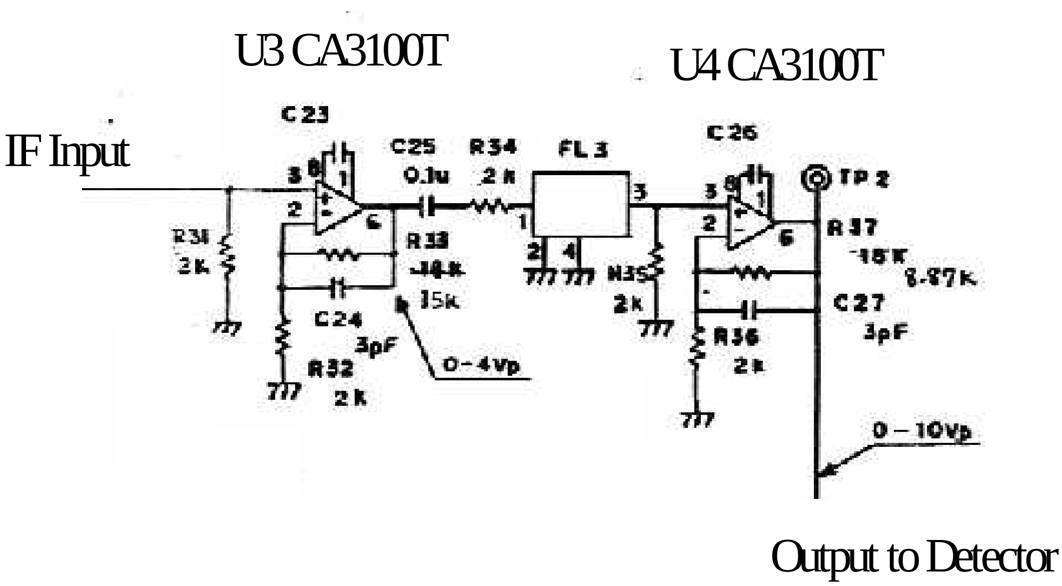

Figure 3.3.4.4 The receiver IF amplifier for the Science Data System

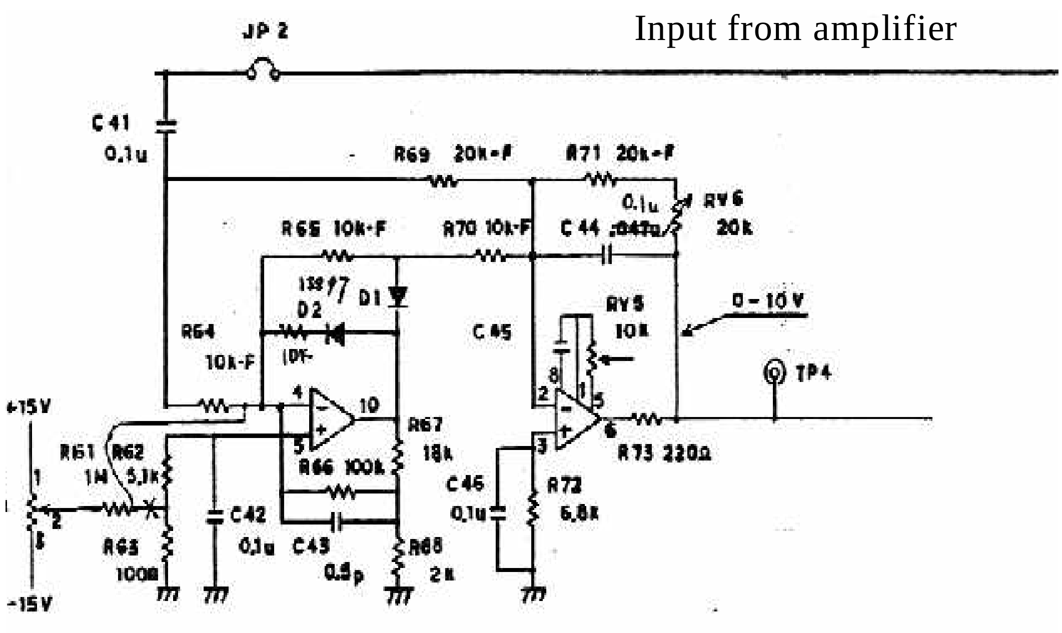

Figure 3.3.4.5: The receiver detector for the Science Data System

Interface Requirements

The radio receiver subsystem interfaces with 3 other systems: the flight computer, the power supply, and the payload architecture. Figure 3.3.4.6 indicates the location in the nose cone of the PCB's and magnetic loop antenna provided by TPU. It also shows the location of the probe on the nose cone surface. Section 3.3.5 covers the ion and electron probes.

Magnetic loop antenna

Figure 3.3.4.7 and Figure 3.3.4.8 show the antenna drawing and photo respectively. The specifications of the magnetic loop antenna are:

- Trapezoidal size: 82.5 cm x 30 cm x 8.5 cm x 3.5 cm (32.48 in x 11.81 in x 3.35 in x 1.38 in).
- Brace size: 82.5 cm x 30 cm x 83 cm (32.48 in x 11.81 in x 32.67 in).
- Mass Estimate: 0.535 g (0.0012 lbs)
- Connector type: 4 pin Winchester.
- Antenna lead wire size:28-30 gauge
- Antenna lead length: 50 cm (20 in).
- Antenna leads must be labeled.

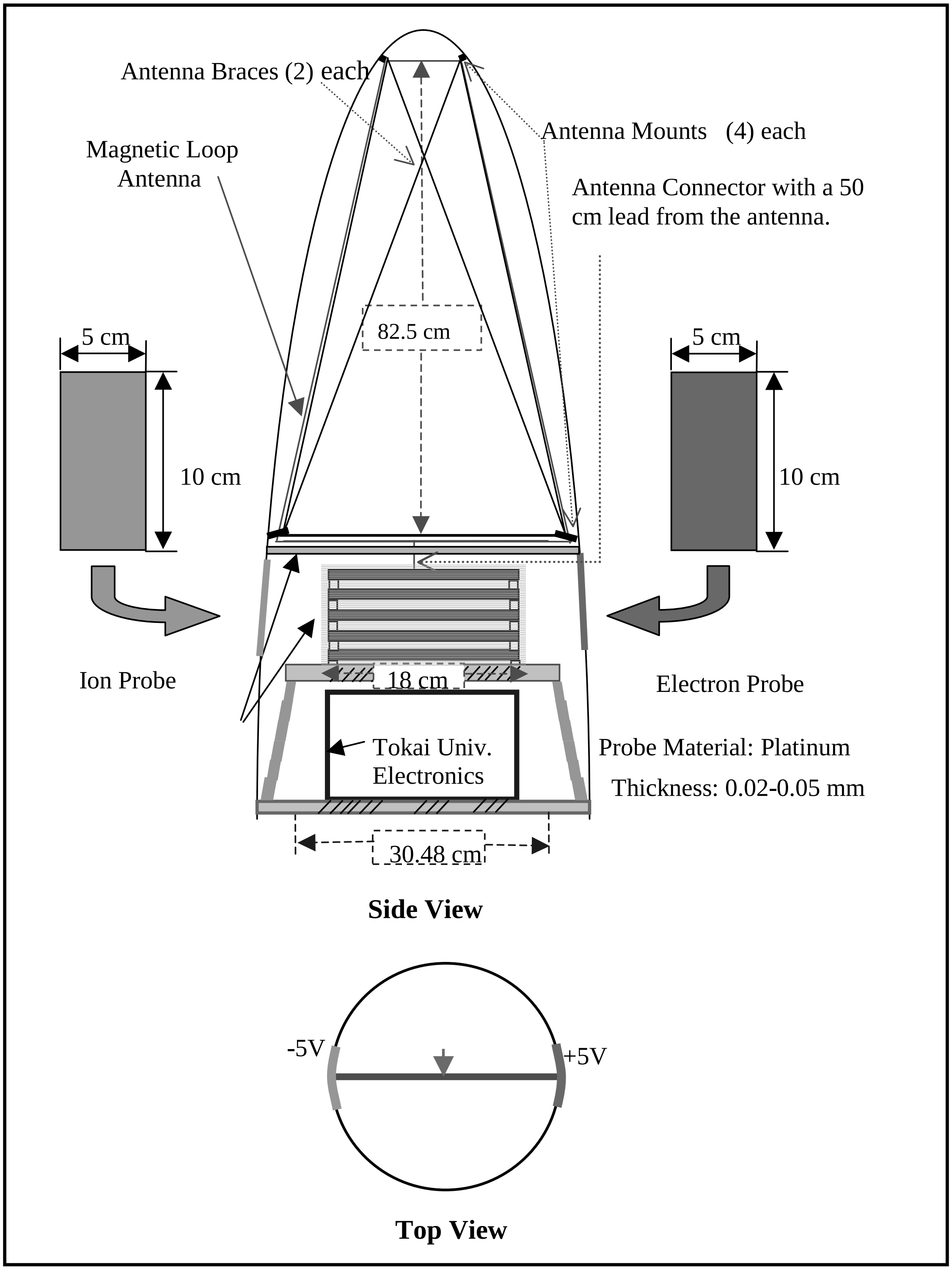

Figure 3.3.4.6: DC-Current Probe Placement Showing Antenna Mounting

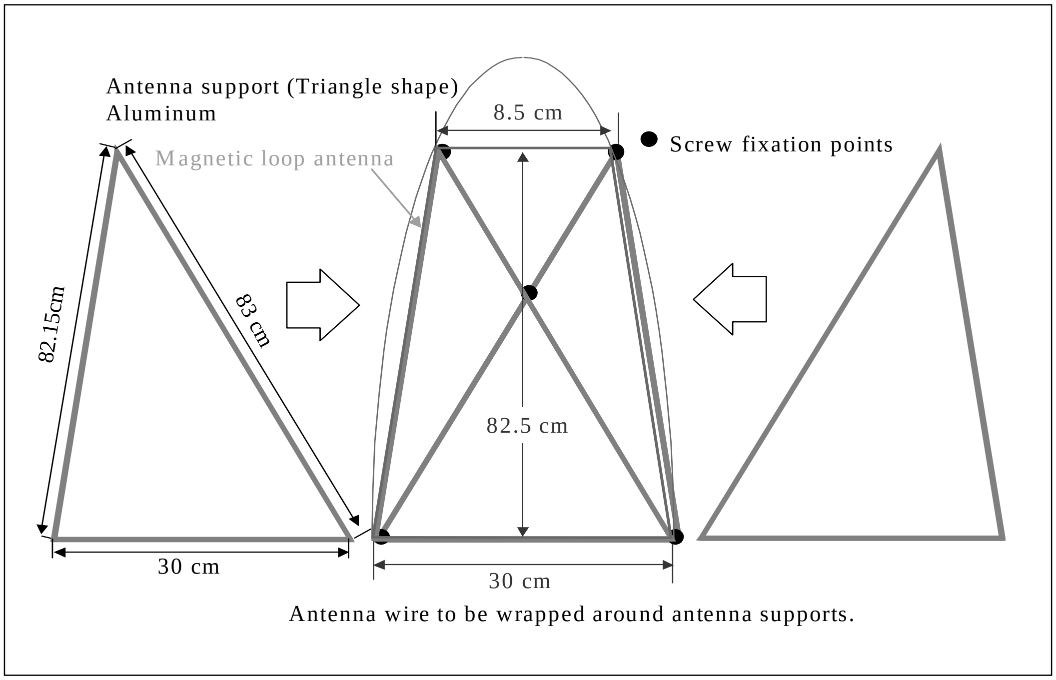

Figure 3.3.4.7: Magnetic Loop Antenna Drawing

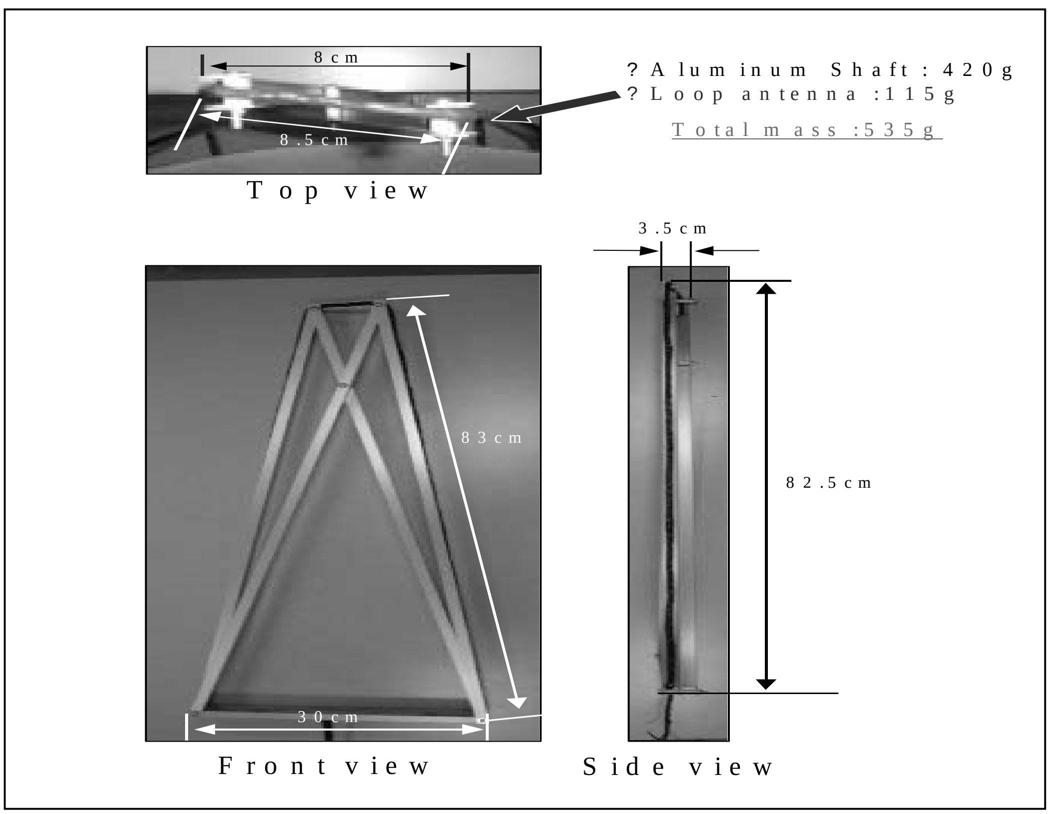

Figure 3.3.4.8: Photo of the magnetic loop antenna and braces.

Preamp and Power Filter PCB

All radio receiver and probe PCB's will be 18 cm x 18 cm x 2.5 cm (7.086 in x 7.086 in x 0.984 in). Each PCB will have 16 guaranteed holes and standoffs as indicated by the darkened PCB mounting holes in Figure 3.3.4.9 below. An attempt will be made to provide 36 mounting holes as the PCB standard; however, component placement on the board may override a hole position. Since the receiver and probe stack height is approximately 15 cm (5.9 in), it is unlikely another PCB would ever be stacked above the radio receiver and probe PCB's in future missions.

Figure 3.3.4.10 indicates the PCB stacking order on deck plate #5. The power from the bus terminals is input to the pre-amp and power filter board at J2-In. The filter circuit removes any remaining bus noise and then redistributes the power to the pre-amp circuit and to the lower boards through connector J2-Out. All PCB connectors must be labeled on the PCB's as show in Figure 3.3.4.11. The pre-amp board mass, connector specifications and other details are listed below:

- Mass: 250 g (0.55512 lbs).
- Power connector type (J2-In and J2-Out): Molex Male Header #22-12-2044.
- Antenna connector type (J1): 4 pin Winchester.
- RF output connectors (J3, J4, J5) type: SMA.

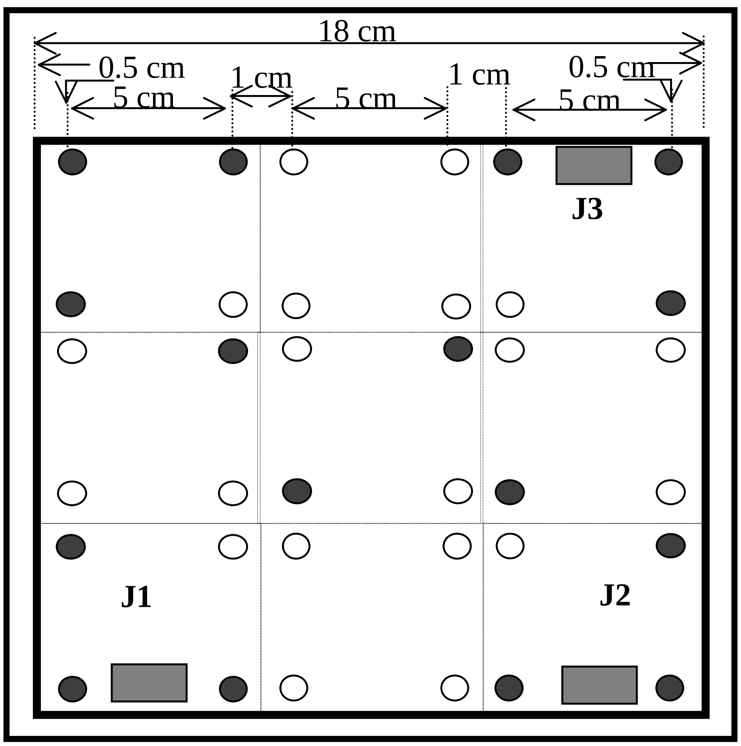

Figure 3.3.4.9: Standard science data PCB showing 36 holes with 16 standoff positions as darkened circles and relative connector placements.

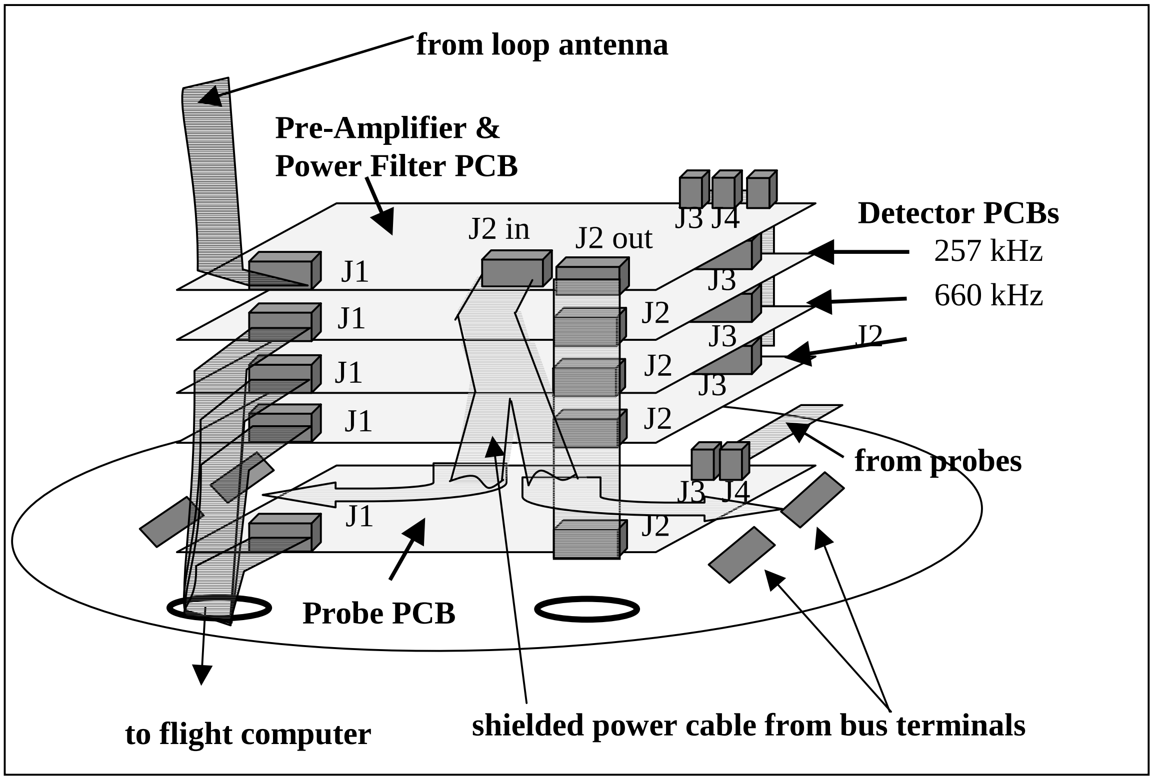

Figure 3.3.4.10: Scientific measurements PCB stack on deck plate #5 showing connectors and cables.

Detector PCB's

The detector PCB's each have the only one power connector, J2, and it is the same Molex male header as the pre-amp and power filter PCB. Refer to the Pre-amp and Power Filter section and Figures 3.3.1.7 through Figure 3.3.1.9 for details on connector positions and labels, stack mounting position, and deck mounting details. The mass, connector specifications and other details are listed below:

- Mass: 200 g *3 = 600 g (1.323 lbs).
- Power connector type (J2): Molex Male Header #22-12-2044.
- Data connector type (J1): Molex Male Header #22-12-2084.
- RF input connectors (J3, J4, J5) type: SMA.

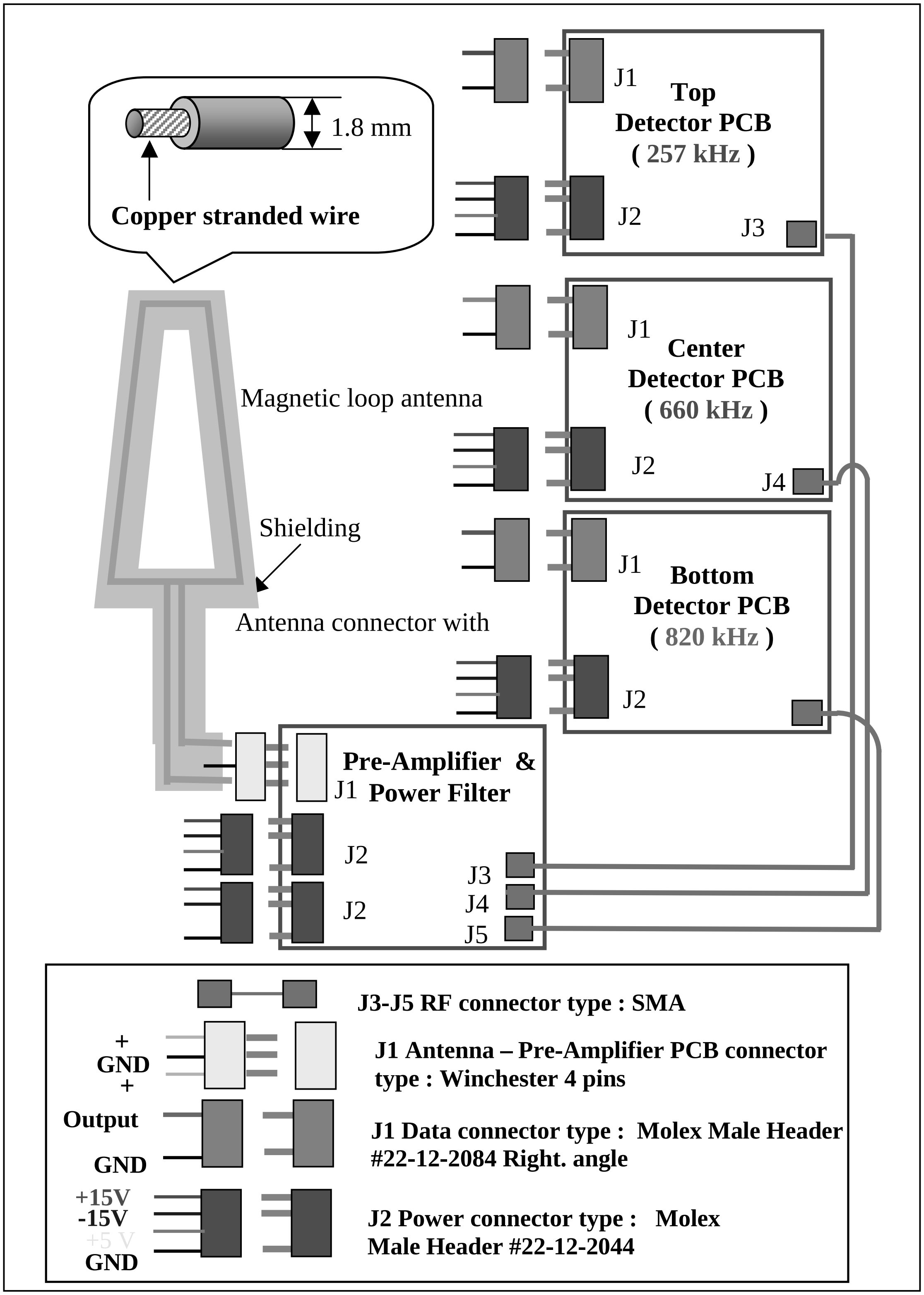

Figure 3.3.4.11: Pre-amp and detector PCB connector designations and placement.

Table 3.3.4.2 lists the radio receiver pin assignments.

Table 3.3.4.2: Radio Receiver Pin Assignments

Top Detector	Data	22-12-2084	J1-1	Lo Lo
Top Detector	Data	22-12-2084	J1-2	Lo Hi
Top Detector	Data	22-12-2084	J1-3	Hi Lo
Top Detector	Data	22-12-2084	J1-4	Hi Hi
Top Detector	Data	22-12-2084	J1-5	Spare
Top Detector	Data	22-12-2084	J1-6	Spare
Top Detector	Data	22-12-2084	J1-7	Spare
Top Detector	Data	22-12-2084	J1-8	GRD
Top Detector	Power	22-12-2044	J2-1	+15 V
Top Detector	Power	22-12-2044	J2-2	-15 V
Top Detector	Power	22-12-2044	J2-3	+5 V
Top Detector	Power	22-12-2044	J2-4	GND
Top Detector	Pre-amp	SMA	J3	RF Input
Center Detector	Data	22-12-2084	J1-1	Lo Lo
Center Detector	Data	22-12-2084	J1-2	Lo Hi
Center Detector	Data	22-12-2084	J1-3	Hi Lo
Center Detector	Data	22-12-2084	J1-4	Hi Hi
Center Detector	Data	22-12-2084	J1-5	Spare
Center Detector	Data	22-12-2084	J1-6	Spare
Center Detector	Data	22-12-2084	J1-7	Spare
Center Detector	Data	22-12-2084	J1-8	GRD
Center Detector	Power	22-12-2044	J2-1	+15 V
Center Detector	Power	22-12-2044	J2-2	-15 V
Center Detector	Power	22-12-2044	J2-3	+5 V
Center Detector	Power	22-12-2044	J2-4	GND
Center Detector	Pre-amp	SMA	J4	RF Input
Bottom Detector	Data	22-12-2084	J1-1	Lo Lo
Bottom Detector	Data	22-12-2084	J1-2	Lo Hi
Bottom Detector	Data	22-12-2084	J1-3	Hi Lo
Bottom Detector	Data	22-12-2084	J1-4	Hi Hi
Bottom Detector	Data	22-12-2084	J1-5	Spare
Bottom Detector	Data	22-12-2084	J1-6	Spare
Bottom Detector	Data	22-12-2084	J1-7	Spare
Bottom Detector	Data	22-12-2084	J1-8	GRD
Bottom Detector	Power	22-12-2044	J2-1	+15 V
Bottom Detector	Power	22-12-2044	J2-2	-15 V
Bottom Detector	Power	22-12-2044	J2-3	+5 V
Bottom Detector	Power	22-12-2044	J2-4	GND
Bottom Detector	Pre-amp	SMA	J5	RF Input
Pre-amp	Antenna	Winchester	J1-1	Positive
Pre-amp	Antenna	Winchester	J1-2	GRD
Pre-amp	Antenna	Winchester	J1-3	Negative
Pre-amp	Antenna	Winchester	J1-4	Spare
Pre-amp	Power	22-12-2044	J2-1	+15 V
Pre-amp	Power	22-12-2044	J2-2	-15 V
Pre-amp	Power	22-12-2044	J2-3	+5 V
Pre-amp	Power	22-12-2044	J2-4	GND
Pre-amp	Top Detector	SMA	J3	RF Output
Pre-amp	Center Detector	SMA	J4	RF Output
Pre-amp	Bottom Detector	SMA	J5	RF Output

3.3.5 Probe Subsystem

Function

The electron probe is biased at +5 V and designed to measure minute current fluctuations due to the electron density. Likewise, the ion probe is biased at –5 V and designed to measure minute fluctuations in ion density. They are thin platinum sheets that will be epoxied to the nose cone surface. Figure 3.3.5.1 indicates the probe board connector designations. Other probe details include:

- Size: 5 cm x 10 cm x 0.02-0.05 mm (1.968 in x 3.937 in x 7.9E-4 to 1.96E-3 in)
- Mass: 0.5 g (0.0176 oz)
- Probe temperature-handling capability: > 177^{o} C (350^{o} F).
- Probe channels: 4.
- Analog output: 0-5 V
- Cutoff frequency <50 Hz

Interface Requirements

The probe subsystem interfaces with 3 other systems: the flight computer, the power supply, and the payload architecture. The probes connect to the probe PCB by SMA connectors and 40 cm (15 in) long cables. Refer to Figure 3.3.4.6 for probe placement at the antenna nulls. Figure 3.3.5.1 indicates the probe PCB connector designations.

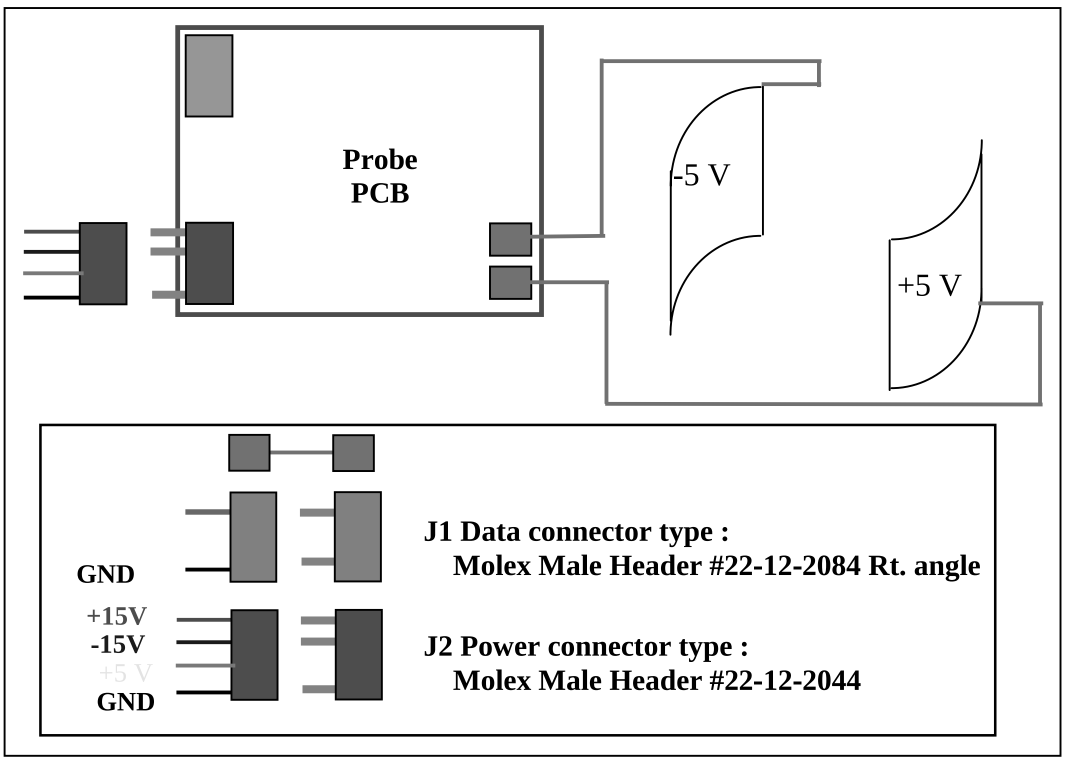

Figure 3.3.5.1: Probe PCB connector designations and placements. The probe connectors and cables are SMA and are provided by TPU.

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Probe PCB

Refer to Figures 3.3.4.9 and 3.3.4.10 for PCB details and Figure 3.3.4.11 for connector designations. Since the power system does not supply – 5 V, an on-board linear regulator will convert the –15 V to –5 V. Other probe board specifications include:

- Mass: 300 g (0.661 lbs).
- DC/DC converter: -15 V → -5 V @ 10 mA.
- Power connector type: Molex Male Header #22-12-2044.
- Data connector type: Molex Male Header #22-12-2084.
- Probe connectors: SMA

Table 3.3.5.1 lists the probe PCB connector pin assignments.

Table 3.3.5.1: Science Data System Connector Pin Assignment

PCB	Connector	Part Number	PCB Pin Number	Items
Probe	Data	22-12-2084	J1-1	Electron Lo
Probe	Data	22-12-2084	J1-2	Electron Hi
Probe	Data	22-12-2084	J1-3	Ion Lo
Probe	Data	22-12-2084	J1-4	Ion Hi
Probe	Data	22-12-2084	J1-5	Spare
Probe	Data	22-12-2084	J1-6	Spare
Probe	Data	22-12-2084	J1-7	Spare
Probe	Data	22-12-2084	J1-8	GRD
Probe	Power	22-12-2044	J2-1	+15 V
Probe	Power	22-12-2044	J2-2	-15 V
Probe	Power	22-12-2044	J2-3	+5 V
Probe	Power	22-12-2044	J2-4	GND
Probe	Ion Probe	SMA	J3-	
Probe	Electron Probe	SMA	J4	

3.3.6 Test Plan

The test plans described below are system level tests designed to provide confidence in the components prior to payload integration.

Magnetometer Testing

1. Connect the sensors to the magnetometer PCB's.
2. Connect an appropriate power supply to the PCB's.
3. Connect an oscilloscope to each of the 3 outputs.
4. Turn on the power supplies and test equipment.
5. Exercise the sensors through the full range of movement in each axis.
6. Calibrate the magnetometer.
7. Verify that each axial output produces a –2.5 to +2.5 V analog signal for the full range of motion.
8. Repeat the test while vibrating the circuit as specified in the Test Plan Document.

Sun Sensor Testing

1. Connect the sun sensor to the PCB.
2. Connect the PCB to an appropriate power supply.
3. Connect an oscilloscope or meter to the PCB output channel.
4. Turn on the power supply.
5. Expose the sensor slit to a light source that travels 180^{o} around the face of the slit.

6. Verify that the output varies from 0-5 V for a 120° range of motion.
7. Repeat the test while vibrating the circuit as specified in the Test Plan Document.

Probe Testing

1. Connect probes to the probe PCB.
2. Connect power supply to the PCB.
3. Connect voltmeter to the PCB output pins.
4. Turn on power supply.
5. Verify that the ion probe is at –5 V and that the electron probe is at +5 V.
6. Vary that the ion probe externally with –1 mV, -10 mV, -100 mV, –1 V and –5V.
7. Verify that the ion output varies between 0-5 V.
8. Vary the electron probe externally with 1 mV, 10 mV, 100 mV, 1 V and 5 V.
9. Verify the electron output varies between 0-5 V.
10. Repeat the test while vibrating the circuit as specified in the Test Plan Document.

Receiver Testing

1. Connect the preamp to the detectors.
2. Connect a 15 V power supply to the PCB's.
3. Connect a signal generator to the antenna input of the pre-amp through a variable attenuator.
4. Generate a 257 kHz sine wave on the signal generator.
5. Using the attenuator, vary the input signal level by 10 dB increments for the expected range. (5 adjustments)
6. Verify that the detector output varies at 455 kHz by using the oscilloscope and spectrum analyzer.
7. Repeat steps 4-6 for 660 kHz and 820 kHz input signals.
8. Remove the signal generator and attenuator from the pre-amp.
9. Connect the magnetic loop antenna to the pre-amp.
10. Connect the signal generator and attenuator to a small loop transmit antenna.
11. Repeat steps 4-7.
12. Repeat the test while vibrating the circuit as specified in the Test Plan Document.

3.3.7 Assembly Instructions

Magnetometer Assembly

1. Secure the sensors to deck plate #4 as shown in Figure 3.3.2.3.
2. Connect the sensor drive to the bottom PCB connector J3.
3. Connect the sensor pick up to the top 3 PCB's at connector J3.
4. Interconnect the PCB's with the cable provided by Tokai University at connectors J4.
5. Connect the flight computer to the top 3 PCB's connector J1.
6. Connect the Power supply to the bottom PCB connector J2.

Sun Sensor Assembly

1. Connect the sensor to the payload faceplate.
2. Secure the sensor PCB above the flight instrument PCB's using 4 standoffs.
3. Connect the sensor to the sensor PCB.
4. Connect the sensor PCB to the power supply at J2.
5. Connect the sensor PCB to the flight computer at J1.

Radio Receiver and Probe PCB Assembly

Refer to Figure 3.3.4.9 through Figure 3.3.5.1 in Section 3.3.4 and Section 3.3.5 during the PCB assembly.

1. Connect 16 standoffs to deck plate #4 as indicated in Figures 3.3.4.9.
2. Connect the probe PCB to the standoffs.

3. Connect 16 standoffs to the probe PCB in the same positions as in step 1.
4. Connect the 820 kHz detector PCB to the standoffs. Refer to Figure 3.3.4.10.
5. Repeat steps 3) and 4) to connect the 660 kHz detector PCB then the 257 kHz PCB and last the preamp PCB.
6. Connect the preamp PCB at J3-J5 to the detector PCB's at connectors using the SMA cables and connectors provided by TPU and as shown in Figure 3.3.4.10.
7. Connect the flight computer cable and connectors to the probe and detector PCB's at connectors J1 as shown in Figure 3.3.4.10 and Figure 3.3.4.11.
8. Connect the power supply bus terminal connector to the top PCB at J2-In.
9. Connect the Power distribution cable from the top PCB to the bottom 4 PCB's
10. Enclose the PCB's in Mu shielding.
11. When ready connect the antenna to the preamp and connect the payload to the nose cone.

Probe Assembly

1. Sand indents into the nose cone to fit the probes.
2. Epoxy the back of each probe to the nose cone. There shall be **No** epoxy on face of probe, which must be open to the atmosphere.
3. Attach probe cables to the probes through the nose cone ports.
4. Attach cables to the probe PCB as shown in Figure 3.3.4.11 and defined in Table 3.3.5.1
5. When ready to connect payload to the nose cone, connect both probe connectors.

Antenna Assembly

1. Mount the antenna to the nose cone.
2. Insert antenna leads through the magnetic shield.
3. Secure the magnetic shield to the nose cone just below the antenna.
4. Attach a Winchester connector to the antenna leads as indicated in Table 3.3.5.1 and as shown in Figure 3.3.7.1 below.
5. Attach the Winchester connector mate to the preamplifier antenna leads as indicated in Table 3.3.5.2.
6. Connect the connector and secure it to the PCB when ready to connect the payload to the nose cone.

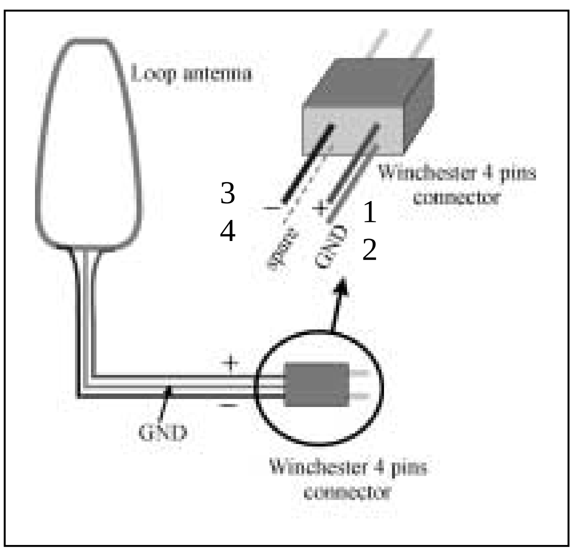

Figure 3.3.7.1: Antenna Winchester Connector

Table 3.3.7.1: Antenna Connector Color Code and Pin Assignment

Pin Number	Voltage	PCB Pin Number	Wire Color
1	Positive	J1-1	Red
2	GRD	J1-2	Black
3	Positive	J1-3	Red
4	Spare	J1-4	None

3.3.8 Integration Notes

Warning: Do not get any epoxy on the face of the ion and electron probes.