HASP Payload Specification and Integration Plan

Payload Title: LSU Solar Eclipse Video Streaming System (VSS) Payload

Payload Class: Large

Payload ID: 12

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Payload Specifications

Overview and Maximum Clearance

The VSS is composed of two structures. The main payload box, which is a rectangular box mounted directly to the HASP Plate. This box contains the control electronics, video streaming electronics, and the Micro-Trak RTG APRS beacon. The Ubiquiti enclosure will be located in the CSBF box below the HASP Gondola and contains the Ubiquiti modem and antenna. The main payload box and Ubiquiti payload will both be constructed out of Polystyrene foam and covered in a protective Econokote layer. Both of these payloads are still currently in the preliminary design stage, thus no working drawings or models are included in this document.

Based on early preliminary designs, the VSS's maximum total vertical clearance will be approximately 5 inches, 6.5 inches under the vertical clearance limit.

The VSS will not be flying anything potentially hazardous to HASP or the ground crew between or after launch.

Mounting

The main payload box will be mounted to the HASP plate via thin aluminum bars attached to four 90 degree brackets, which will screw directly into the HASP plate. The bars attached to the brackets will create a "cage" that the payload box will fit into. The payload will be secured into this cage via another thin aluminum bar attached to a hinge. The mounting method for the Ubiquiti payload has yet to be determined.

Table 1: Preliminary Weight Budget

Component	**Classification**	**Weight (g)**	**Uncertainty (±)**
Mounting Materials	Measured	885	300
Foam	Estimated	50	25
Electrical Components	Estimated	300	100
Other	Estimated	150	100
Total:		1385	525

Power Specifications

The HASP Interface provides 75W of continuous power to the payload. The expected average power draw is 24.7W continuously. The payload includes transmitters that will draw over the average power. The maximum expected power draw is 29.1W during full transmission. The expected current draw from HASP is 0.8 - 1A. The detailed power budget is presented in **Table 2.**

Table 2– Power Budget.

Component	Voltage (V)	Power (mW)
Main HASP Regulator	30	1950.82
Video Electronics Regulator	12	1822.22
Control Electronics Regulator	12	531.18
Micro-Trak Beacon	12	371.00
Arduino	12	300.00
Power Relay (x3)	12	720.00
Raspberry Pi (Control)	5	2500.00
Raspberry Pi (Video)	5	4600.00
M5 Video Modem	5	11800.00
Current Sensors (x3)	5	150.00
Level Converters (x2)	5	10.00
Totals		24755.22

The payload will utilize five separate converters to provide power. The regulators are a Delta Electronics S24SP12004PDFA DC/DC 30V/12V Converter, a Texas Instruments PTN78020WAH 12V/5V DC/DC Converter, a GE Critical Power AXA003A0XZ 12V/5V DC/DC Converter, and two Texas Instruments PTN04050 Variable Boost Converters. The efficiency of these regulators is shown in **Table 3.**

Table 3 – Regulator Efficiency

Regulator	Efficiency
Delta Electronics S24SP12004PDFA	92%
Texas Instruments PTN78020WAH	90%
GE Critical Power AXA003A0XZ	85%
PTN04050 Variable Boost Converters	90%

The power distribution of the payload is shown in **Figure 1**.

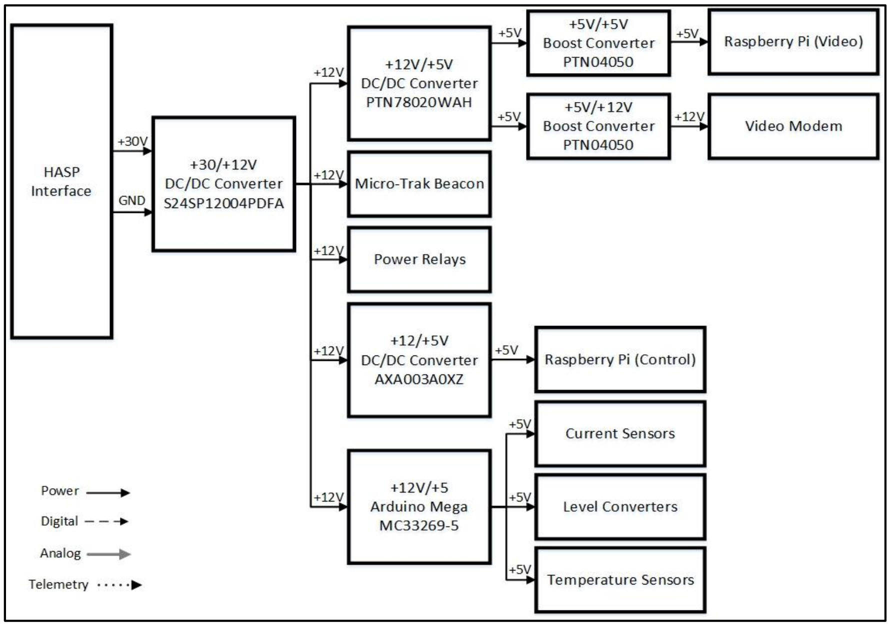

Figure 1 – Power Distribution Diagram. The HASP gondola's power interfaces through the EDAC connector and is distributed to the VSS.

The VSS will use the 8 power lines from the EDAC 516 connector on the HASP Interface to receive power. The EDAC lines used are shown in **Table 4.**

Table 4: EDAC Pins	
Pins A, B, C, D	+30 VDC
Pins W, T, U, X	GND

Downlink Telemetry Specifications

Serial data downlink will be streamed. Downlink will be composed of regular data transmissions. The serial downlink rate is 134 bytes per data transfer. Large classification payloads on HASP have an allotted data rate of 4800 baud, which allows for 600 bytes of data transfer per second. We shall be sending a downlink data transmission every 10 seconds. Data will be transmitted in comma delineated, ASCII format.

Table 5: Downlink DATA Transmission

ASCII Characters	**Name**	**Description**	**Format**
4 Byte String	Header - Data	Record type indicator for DATA transmission	DATA
2 Byte String	MRC	Most Recent Command Received	XX
8 Byte String	Timestamp	Current RTC time	HH/MM/SS
7 Byte String	Temperature Sensor 1	Records temperature.	TMP0 XXX
7 Byte String	Temperature Sensor 2	Records temperature.	TMP1 XXX
7 Byte String	Temperature Sensor 3	Records temperature.	TMP2 XXX
7 Byte String	Temperature Sensor 4	Records temperature.	TMP3 XXX
7 Byte String	Temperature Sensor 5	Records temperature.	TMP4 XXX
7 Byte String	Temperature Sensor 6	Records temperature.	TMP5 XXX
7 Byte String	Temperature Sensor 7	Records temperature.	TMP6 XXX
7 Byte String	Temperature Sensor 8	Records temperature.	TMP7 XXX
7 Byte String	Temperature Sensor 9	Records temperature.	TMP8 XXX
7 Byte String	Temperature Sensor 10	Records temperature.	TMP9 XXX
7 Byte String	Current Sensor 1	Records current.	CRT1 XXX
7 Byte String	Current Sensor 2	Records current.	CRT2 XXX
7 Byte String	Current Sensor 3	Records current.	CRT3 XXX
6 Byte	Status	Error status.	ER

String			XXXX
1 Byte String	Checksum	Truncated check.	X
4 Byte String	Footer	Record Type End indicator.	ENDD
18 Bytes	ASCII Formatting	Commas, colons, and spaces between each piece of data to clearly delineate different data fields.	,
134 Bytes Total			

As shown in **Table 5**, the data sends the current timestamp, the temperature sensor data, status update, and a checksum.

Uplink Commanding Specifications

The VSS shall be connected to HASP's uplink command system. Uplink commands shall be used in response to errors and manual adjustments to the system; therefore, uplinks will not be utilized at regular intervals. The VSS will not use any on-board receivers.

Table 6: Uplink Data Format

Byte:	Hex Value:	Description:
1	1	Start of Heading (SOH)
2	2	Start of Text (STX)
3	Command Byte 1	First byte of command transmitted from ground
4	Command Byte 2	Second Byte of command transmitted from ground
5	3	End of Text (ETX)
6	D	Carriage Return (CR)
7	A	Line Feed (LF)

The uplink data format will be the default/suggested format listed in the Interface Manual. Commands will be received by the Control Raspberry Pi.

Uplink Commands

Uplink commands will consist of two bytes in hexadecimal format. The first byte will correspond to a specific uplink command, while the second will correspond to any data required for that command.

Table 7: Uplink Commands

Byte 1 - 00	Turns on the beacon.
Byte 2 - 01	Turns off the beacon.
Byte 3 - 02	Turns on the video Pi.
Byte 4 - 03	Turns off the video Pi.
Byte 5 - 04	Turns on the Ubiquiti.
Byte 6 - 05	Turns off the Ubiquiti.
Byte 7 - 06	Turns on the stream.
Byte 8 - 07	Turns off the stream.
Byte 9 - 08	Requests info from the payload.

Integration and Logistics

Table 8: Team Pleiades HASP Integration	
Logistics	
Arrival date	Friday, July 29th
Arrival time	4:00 PM
Time required for integration	2 hours
Participants	
Brad Landry	HASP Project Manager
Adam Majoria	Solar Eclipse Project Manager
Connor Mayeux	Software Section Lead
Kyle Hamer	Software Section Member
Joshua Collins	Electrical Section Lead
Victor Fernandez-Kim	Assistant Project Manager
Samuel Reid	Electrical Section Member
Jordan Causey	Mechanical Section Member
Allen Davis	Mechanical Section Lead
Additional LSU Support	
Equipment	Multimeter, soldering station, oscilloscope, crimping tool, wire spools

Successful payload integration to HASP would be achieved if:

- VSS systems are powered and are drawing expected current values
- All downlink and uplink communications are functioning
- VSS experiences no mounting issues, meets regulations, and is stable

- VSS’s video streaming is functioning as designed
- All systems remain within operating temperature ranges thermal vacuum testing and unexpected errors are resolved

During transportation, the VSS will be disassembled and packed to prevent damage to its components and structures. The payload box and electronics within it will be removed from the HASP Platform. The VSS’s accompanying ground station will also be disassembled and packed for transport.

Integration Steps and Checks for Successful Integration

1. ___ Inspect individual components for damage or irregularities
2. ___ Weigh payload. The VSS makes up 1.385 kg of the allowable 20 kg
3. ___ Mount payload to HASP gondola and confirm no mechanical instability
4. ___ Confirm that the VSS does not sit beyond any restricted areas (including height). Maximum constraints: 38 x 30 x 30 cm
5. ___ Connect the EDAC 516 and RS 232 connectors to payload
6. ___ Power on and determine current draws across electronics and confirm with expected values
7. ___ Run flight software. Confirm telemetry communication is functioning
8. ___ Power off and remove SD card. Check for saved video/data and check for irregularities

Thermal Vacuum Chamber Testing

1. ___ Mount the VSS within thermal vacuum chamber
2. ___ Power on and run thermal vacuum software
3. ___ Power down, remove payload, and check for issues