University of Washington

HuskySat-2 PAYLOAD Interface Control Document

ICD-PAY-001

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Acronyms & Symbols List

Acronym	Definition
HSL	Husky Satellite Lab
HS-2	HuskySat-2
CDH	Command and Data Handling
UNP	University Nanosatellite Program
LEO	Low Earth Orbit
LOST	LOST Open-Source Star Tracker
FOUND	Found Open-Source Universal Navigational Determiner
COTS	Commercial Off-The-Shelf
ADCS	Attitude Determination and Control System
CDH	Command and Data Handling System
THR	Thermal control subsystem
STR	Structures subsystem
EPS	Electrical Power Subsystem
BMS	Battery management system
PDS	Power distribution system
COM	Communications Subsystem
IC	Integrated Circuit

Symbol	Definition
**	Number managed by the team, but unable to be provided due to NDA regulations

Purpose and Scope

This Interface Control Document (ICD) defines the **electrical**, **mechanical**, **thermal**, and **data** interfaces required for the payload to be successfully integrated into HuskySat-2. The payload subsystem includes all hardware to support the scientific customer of HuskySat-2. Husky Sat-2 (HS-2) is a 3U CubeSat developed by the Husky Satellite Lab (HSL) at the University of Washington in Seattle. Designed to operate in LEO, HS-2 aims to demonstrate the capabilities of its novel navigation technology: LOST (Lost Open-Source Star Tracker) and FOUND (FOUND Open-Source Universal Navigational Determiner). LOST and FOUND enable GPS-independent navigation for small satellites using a unique star tracker and horizon tracker package developed here at HSL. The payload subsystem includes all hardware to support the operation of LOST and FOUND.

PAYLOAD

The payload subsystem has the following hardware components:

Table 1. Payload Hardware

Hardware	Description	Datasheet (Public)
XIMEA xiC-MC031CG-SY	Camera for FOUND imaging	xiC-USB3-Sony-CMOS…
XIMEA xiC-MC031CG-SY	Camera for LOST imaging	xiC-USB3-Sony-CM…
Sagitta Star Tracker	Attitude truth measure	SGT-ARC-MAN-v11.8
piNAV-NG	GNSS Receiver	piNAV-NG Datasheet (r…
miniPatch-L1 antenna	GNSS Antenna	miniPATCH-L1_Datash…
Edmund Cr 6mm f/4 lens	Lens for FOUND camera	spec_35142.pdf
Edmund Cr 16mm f/16 lens	Lens for LOST camera	spec_35166.pdf
Payload PCB	Manages communication and electrical interfaces for the PAY hardware.	NA

Table 2. Payload Wires

Hardware	Description	Datasheet (Public)
Star Tracker Nano-D wire		https://www.digikey.com/en/products/detail/omnetics/MNPO-15-WD-18-0-N-EJS-C/11560862
PiNav antenna wire	SMA connector	piNAV-NG Datasheet…
Ximea wire connector	Ribbon Cable wire	Flat-ribbon-flex-cable-d…

Interface Identification and Definitions

1. Interface Overview

Electrical Interfaces: Defines the power distribution structure, including the 3.3V, 5V, and 12V voltage rails allocated by the power budget. Establishes the physical connectors, pinouts, and signal characteristics managing power and data delivery to the subsystem

Mechanical Interfaces: Captures physical dimensions, mass properties, and mounting requirements of subsystem components, as well as how they interface with each other and the spacecraft structure.

Thermal Interfaces: Specifies the heat generated by each component, establishes operational and survival temperature boundaries, and details the physical conduction paths mounting interfaces that connect the components to the structure.

Software Interfaces: Any exchange of information to, from, or inside the subsystem. Describes the data, data type, connections, and protocols.

1.0 Electrical Interfaces

The PDS PCB distributes varied voltage via boost and buck converters to specific components within the PAY PCB. The PAY GNSS and C3D camera receive 3.3V while the Sagitta star tracker receives 5V. The PAY PCB is also connected to the common ground.

1.1- Power

RS-485 interface enables differential output, reducing common-mode noise between input. Inhibits implemented at BMS level to ensure electrical integrity.

Overview of Payload Electrical Interfaces

Table 3. Payload Power Interfaces

Section	Input Voltage (V)	Meets Input Voltage Req.	TYP Power Draw (W)	Power Draw Max (W)	TYP Current Draw (A)	Peak Current Draw (A)	Description
EPS PCB to Payload PCB	5	☑	5e-5	10e-5	1e-5	2e-5	Payload PCB ICs Power draw
EPS PCB to Payload PCB	3.3	☑	0.396	0.446	0.12	0.135	USB Hub IC power draw
EPS PCB to eUSB Flash	5	☑	0.14	0.25	0.025	0.05	32GB eUSB Flash
EPS PCB to Cameras	5	☑	3.1	3.2	0.62	0.64	Power values not combined, both payload cameras draw the same power each.
EPS PCB to Star Tracker	5	☑	1.5	-	0.3	-	COTS Sagitta Star Tracker
EPS PCB to GNSS Receiver	3.3	☑	0.54	-	0.038	-	GNSS Receiver
EPS PCB to IMMU	5	☑	-	0.22	-	0.040	ADCS IMU Connects to Payload PCB

1.1.1 EPS PCB to Payload

The Payload PCB nominally receives 8.34 W of power at 5 V from the PDS PCB in receive mode. The peak power draw of the Payload PCB is 9.7501 W. The payload PCB also nominally receives 0.5214 W of power at 3.3V. The 3.3V rail has a peak power draw of 0.776 W

1.2 - Data

Table 4: Payload Data Interfaces

Section	Signal	Direction	Protocol	Description
LOST Camera	USB	Bidirectional	USB 2.0	USB Camera to USB Hub to BBB
FOUND Camera	USB	Bidirectional	USB 2.0	USB Camera to USB Hub to BBB
eUSB Flash	USB	Bidirectional	USB 2.0	USB Flash Memory to USB Hub to BBB
GNSS Receiver	LVTTL	TX	UART	TXD signals from GNSS Receiver
IMMU	LVTTL	Bidirectional	UART	TX/RX signals from inertial measurement and magnetometer unit
Sagitta Star Tracker	RS-485 (Full Duplex)	Bidirectional	UART	TXD/RXD signals from Sagitta Star Tracker, full-duplex RS-485 transceived to UART
USB Hub High Speed Indicator	LVTTL	Input	GPIO	Active-Low indicator of USB2.0 high speed data transfer from USB2514 USB Hub
USB Suspend State Indicator	LVTTL	Input	GPIO	Active-High indicator of downstream USB ports being suspended from USB2514 USB Hub
USB Hub Reset	LVTTL	Output	GPIO	Active-Low reset signal for USB2514 USB Hub
GNSS Receiver Reset	LVTTL	Output	GPIO	Active-Low reset signal for GNSS Receiver
FOUND Trigger	LVTTL	Output	GPIO	Active-High camera trigger

IN				input signal for FOUND camera
FOUND Trigger Out	LVTTL	Input	GPIO	Active-low camera trigger output signal for FOUND camera
LOST Trigger IN	LVTTL	Output	GPIO	Active-High camera trigger input signal for LOST camera
LOST Trigger Out	LVTTL	Input	GPIO	Active-low camera trigger output signal for LOST camera

1.3 Pinouts

1.3.1 Pinout Diagram

Assignment	Pin	J1	J1	Pin	Assignment
5V	POWER	1	2	POWER	3.3V
5V	POWER	3	4	POWER	3.3V
IMU_Restore	SIGNAL	5	6	GND	
IMU_UART2_RX	SIGNAL	7	8	SIGNAL	USB_HUB_RESETn
IMU_UART2_TX	SIGNAL	9	10	SIGNAL	GNSS_RESETn
IMU_SYNC_OUT	SIGNAL	11	12	GND	
IMU_SYNC_IN	SIGNAL	13	14	GND	PDS_WD_RESETn
	GND	15	16	GND	
	GND	17	18	GND	
5V	POWER	19	20	POWER	3.3V
5V	POWER	21	22	POWER	3.3V
5V	POWER	23	24	SIGNAL	HS_IND
	GND	25	26	SIGNAL	SUSP_IND
GNSS_VPP	SIGNAL	27	28	POWER	5V
GNSS_PF	SIGNAL	29	30	POWER	5V
	GND	31	32	GND	

GNSS_UART4_TX	SIGNAL	33	34	POWER	3v3A
GNSS_UART4_RX	SIGNAL	35	36	SIGNAL	LOST_TRIG_IN
	GND	37	38	SIGNAL	LOST_TRIG_OUT
SGT_RS485_RX+	SIGNAL	39	40	SIGNAL	FOUND_TRIG_IN
SGT_RS485_RX-	SIGNAL	41	42	SIGNAL	FOUND_TRIG_OUT
	GND	43	44	GND	
	GND	45	46	GND	
SGT_RS485_TX-	SIGNAL	47	48	GND	
SGT_RS485_TX+	SIGNAL	49	50	GND	
	GND	51	52	GND	

2.0 Mechanical Interfaces

2.1 Interface Overview

Payload's mechanical interfaces to the Structures (STR) subsystem cover four elements: the Payload PCB, compressed along the four M3x0.50 structural rods (Grainger 25DM52) at the top of the PCB stack; the GNSS Receiver board, mounted on top of the Payload PCB; the GNSS antenna, external, mounted via dedicated brackets; and the payload structure: LOST, FOUND, and the star tracker, mounted entirely on STR-owned payload plates, brackets, baffle clamps, and camera blocks. STR is the authoritative source for all of this hardware's fastener sizing, torque, and back-out method; per the Structures ICD's own Purpose and Scope statement, payload-structure mechanical content is referenced here, not duplicated. See the Structures ICD (ICD-STR-1) Section 2.6 (PCB stack), Section 2.7.3 (GNSS antenna), and Sections 2.1-2.5 and 2.8 (payload structure).

2.2 Payload PCB and GNSS Receiver: Fasteners and Mounting Facts

- CDH-to-Payload-PCB standoff: McMaster 95947A512, M3x0.5 hex standoff, 13.73mm, sets the spacing up to Tie 1's bottom-face nut. Structures ICD Index, Table 2.6-2, Fastener ID F-10.

- Tie 1 bottom-face nut: McMaster 93625A100, M3x0.5 nylon-insert locknut, ~0.96 N-m, sits directly below Payload PCB and closes out the Transceiver-Splitter-CDH-Payload PCB zone. Table 2.6-2, Fastener ID F-14.
- Payload PCB is the top of the rod-compressed portion of the stack. Tie 1's body rests directly on top of it, and Tie 1's own top-face nut (Fastener ID F-15) sits directly above the tie body.
- GNSS Receiver board sits on top of the Payload PCB, separate from the 4 structural rods and from Tie 1.

2.3 GNSS Antenna: Fasteners and Mounting Facts

- 2 custom brackets, -Y face (opposite FOUND, +Y). Structures ICD Section 2.7.3.
- Bracket-to-primary-structure: McMaster 92125A128, M3x0.5, 8mm, with M3 locknuts, 2 per bracket (4 total), ~0.66 N-m. Structures ICD Index, Table 2.7-2, Fastener ID F-05.
- Antenna-to-bracket: McMaster 92125A088, M2.5x0.45, 10mm, with M2.5 locknuts, 2 per bracket (4 total), ~0.37 N-m. Table 2.7-3, Fastener ID F-04.

2.4 Payload Structure (LOST, FOUND, Star Tracker): References Only

This hardware is entirely STR-owned; fastener sizing, torque, quantities, and geometry are not repeated here.

- Axis/face assignment: Structures ICD Section 2.1.
- Payload plates and L-brackets: Structures ICD Section 2.2, Index Tables 2.2-1, 2.2-2.
- Baffle clamps (LOST and FOUND): Structures ICD Section 2.3, Index Table 2.3-1.
- Camera mounting blocks (LOST and FOUND): Structures ICD Section 2.4, Index Tables 2.4-1, 2.4-2.
- Star tracker mounting: Structures ICD Section 2.5, Index Tables 2.5-1, 2.5-2.
- Keep-out zones and assembly sequencing: Structures ICD Section 2.8.

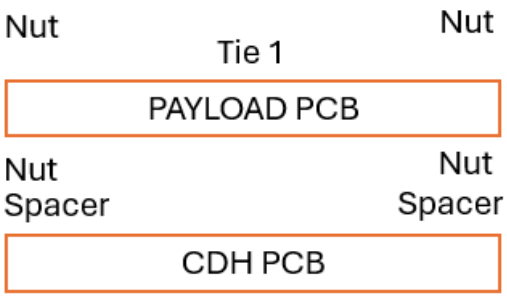


Figure1: PCB Stack

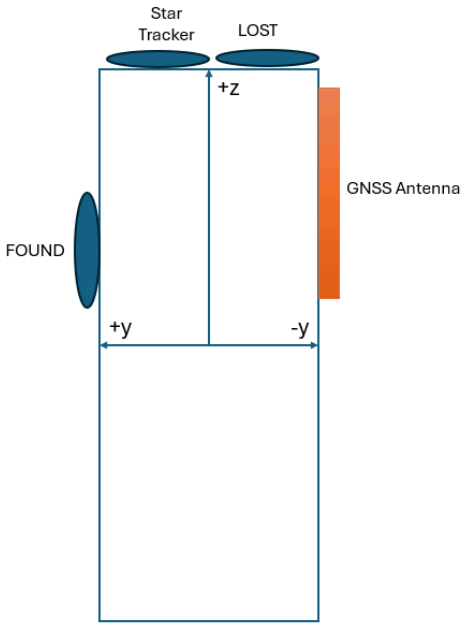


Figure 2: Payload Components Location

3.0 Thermal Interfaces

Table 5: Payload Thermal Interfaces

Component	Heat Generation (W)	Min Operating (C)	Max Operating (C)	Connections
Sagitta	*1.5*	*-20*	*50*	*Mounting Brackets, fasteners*
XiQ-S7 MQ013MG-E2-S7-FL Camera	*3.1*	*0*	*50*	*Lense, mounting block*
LOST & FOUND Baffles	*0*	*0*	*50*	*Baffle clamp to lateral plate; lens and camera interfaces*
GNSS Antenna	*0.02*	*-40*	*85*	*Mounted opposite of Found in -y face*

Payload PCB + Receiver	*0.83*	*-40*	*85*	*Direct/flush mount to Payload PCB; four dedicated*

The Payload subsystem consists of two optical navigation instruments (LOST and FOUND cameras), a star-tracker truth measure (Sagitta), and a GNSS receiver with one patch antenna. The Sagitta star tracker imposes the tightest stated payload thermal limit with an operating band of −20 to +50 °C in the thermal budget, whereas the cameras require 0 to +50 °C operation. Heat dissipated by these payload components is conducted through the camera mounting blocks (ref. ICD-STR-1 Section 2.4), star-tracker brackets (ref. ICD-STR-1 Section 2.5), baffle clamps (ref. ICD-STR-1 Section 2.3). Payload PCB, which is then coupled to structural components (Tie 1, ref. ICD-STR-1 §2.6) and secondary structure (M3 rods, standoffs, rails) for final rejection to the external primary structure frame. The Acktar Magic Black coating applied to the interior surfaces of the Sagitta, FOUND, and LOST baffles provides high emissivity ($\varepsilon \approx 0.85–0.93$), enabling these internal radiative surfaces to effectively reject thermal energy to space. The GNSS receiver, budgeted at 0.07 W dissipation, mounts via custom aluminum brackets (ref. ICD-STR-1 §2.7) on the −Y face (opposite FOUND) to the primary structure.

4.0 - Software Interfaces

4.1 - PAYLOAD Software

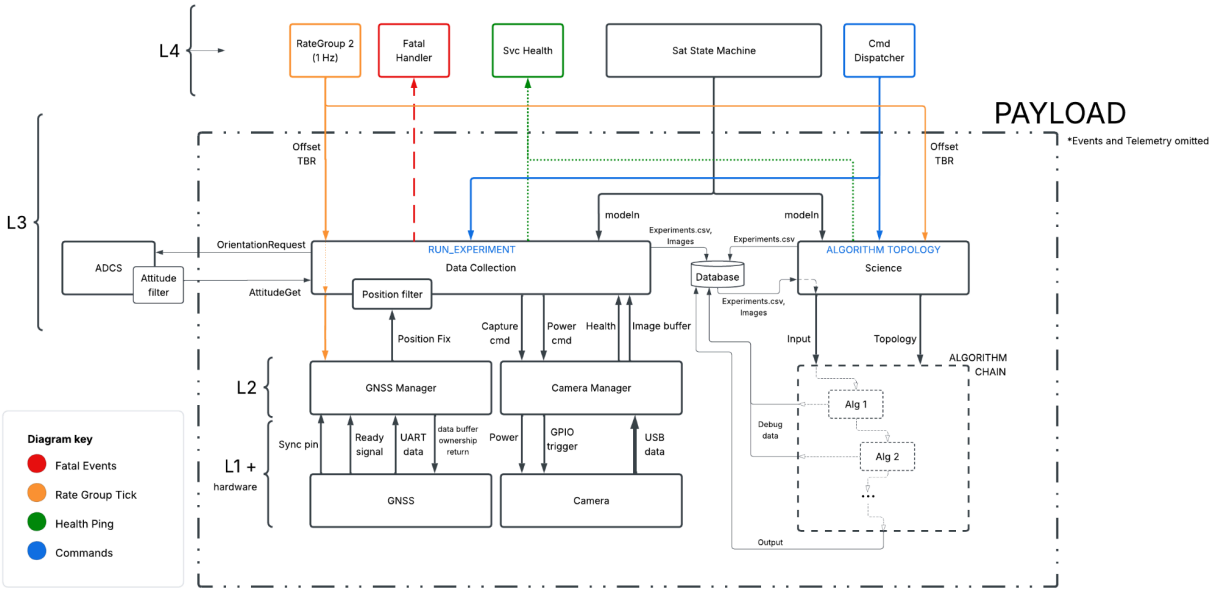


Figure 1

Figure 1 highlights the Payload software topology with specific F' components, namely how Data Collection retrieves images and truth measures for experiments while Science runs the LOST and FOUND algorithms to conduct these experiments. It also shows the data interfaces between components and how they interact with other parts of the software subsystem like the top-level state machine. For more detail about experiments, see the Mission Design Document and Software Design Document.

4.1.1 - CameraManager F' Component

The primary interface for the Command and Data Handling Subsystem (CDH) to send/receive data from the FOUND and LOST cameras (Ximea MC031MG-SY) is USB3.0 from hardware specifications. The cameras also contain camera trigger pins, which are activated through GPIO.

Table 6: PAY F' CameraManager port table:

Name	I/O	Type	Description

captureImageIn	Input async	DataCollection.CameraCapture{
		imageType: Types.ImageType,
		delay: F32,
		outputPath: string
		}
			Requests one capture of imageType, writing the retrieved frame to outputPath

cameraPower	Input async	DataCollection.CameraPower	Power camera on/off
healthCheckIn	Input sync	DataCollection.CameraCheckup	Health check request from application (power cycle camera)
cameraTriggerOut	Output	Drv.GpioWrite	GPIO camera trigger

Table 7: PAY F' CameraManager command table:

Name	Opcode	Description	Parameters	Response
N/A				

Table 8: PAY F' CameraManager event table

Name	Description
CaptureStarted	captureImageIn accepted
CaptureCompleted	The camera was triggered and reported success
CaptureFailed	The camera was triggered but reported failure
GpioTriggerError	cameraTriggerOut returned a non-OK Drv.GpioStatus
XiApiError	An xiAPI call (xiOpenDeviceBy, xiSetParam, xiStartAcquisition, xiGetImage, ...) returned a non-XI_OK status
ImageWriteError	The retrieved frame was received but could not be written to the requested outputPath

Table 9: PAY F' CameraManager telemetry table:

Name	Type	Description
LastCaptureStatus	Payload.CameraStatus	Result of the most recently completed captureImageIn request
CapturesCompleted	U16	Number of captureImageIn requests completed (success or failure) since boot
LastHealthCheckStatus	Payload.CameraStatus	Result of the most recent

		healthCheckIn call
LastImageBytes	U32	Size in bytes of the frame retrieved by the most recent successful xiGetImage

Table 10: PAY F' CameraManager parameters table:

Name	Type	Default	Description
CAMERA_TIMEOUT_MS	U32	2000	TimeOut argument (milliseconds) for xiGetImage in captureImageIn_handler

4.1.2 - GnssManager F’ Component

Table 11: PAY F’ GnssManager port table:

Name	I/O	Type	Description
drvReceiveIn	Input async	Drv.ByteStreamData	Raw bytes pushed by the UART driver's read thread
drvReceiveReturnOut	Output	Fw.BufferSend	Returns buffer ownership to the driver after a chunk has been consumed
drvConnected	Input async	Drv.ByteStreamReady	Fired once by the driver when the UART connection is opened and ready
resetOut	Output	Drv.GpioWrite	RESET pin
vppIn	Input async	Svc.Cycle	Fires on the VPP pin’s rising edge to signal synchronization timing
schedIn	Input async	Svc.Sched	RateGroup1 (1 Hz) tick
getGnssFix	Input sync	Payload.gnssFixGetter_p	Accessor for the last published GNSS fix
positionOut	Output	Payload.gnssFix_p	Publishes the cached position/velocity/time/classification snapshot on every tick

Table 12: PAY F’ GnssManager command table:

Name	Opcode	Description	Parameters	Response
N/A				

Table 13: PAY F’ GnssManager event table

Name	Description
SmStateUpdate	state transition event
GnssBannerRecognized	receiver boot banner recognized
GnssBannerTimeout	no boot banner seen within BANNER_WAIT_TICKS
GnssChecksumFail	checksum fail

GnssUnparseableLine	unparseable line
GnssLineOverflow	accumulator overflow, partial line discarded
GnssUartError	Uart error
GnssForcedReset	Forcing RESET state

Table 14: PAY F' GnssManager telemetry table:

Name	Type	Description
GnssDateTime	Payload.DateTime	Date/Time of position capture
GnssPosition	Payload.PositionData	Position capture
GnssVelocity	Payload.VelocityData	Velocity capture
GnssHealth	Payload.GnssHealthData	BusVoltage, Core1V2, Core3V3, TotalCurrent, AntennaCurrent, CoreTemp
GnssFixClassification	Payload.GnssFixClassificationData	GnssFixClass, TimeSinceAutonomousFixTicks, SentenceRxCtr, ChecksumFailCtr, FieldParseErrorCtr, LinesIgnoredCtr, LineOverflowCtr, ConsecutiveUartErrors

Table 15: PAY F' GnssManager parameter table:

Name	Type	Default	Description
RESET_WAIT_TICKS	U32	60	Ticks to wait in ENABLE for the receiver's boot before giving up and returning to RESET
DROP_MAX_AGE_TICKS	U32	360	Ticks since the last Autonomous fix
MAX_CONSECUTIVE_UART_ERRORS	U32	20	Consecutive UART errors before forcing

			a return to RESET

4.1.3 - DataCollectionApplication F’ Component

Table 16: PAY F’ DataCollectionApplication port table:

Name	I/O	Type	Description
modeIn	Input sync	DataCollection.DataColModePort	Mode command from SatStateMachine, carrying Types.DataColMode.
schedIn	Input async	Svc.Sched	Rate group tick; drives pingIn/pingOut and the state machine's tick signal
cameraPower[2]	Output	DataCollection.CameraPower(powerOn)	Power lostCameraManager/foundCameraManager (port index 0/1) on or off.
cameraCheckup[2]	Output	DataCollection.CameraCheckup	Health check request from application (power cycle camera)
cameraCapture[2]	Output	DataCollection.CameraCapture(mageType)	Triggers one camera's capture of the current experiment's imageType.
positionGet	Output	DataCollection.PostionGet()	Requests the current estimated position vector
attitudeGet	Output	DataCollection.AttitudeGet()	Requests the current estimated attitude quaternion.
OrientationRequest	Output	DataCollection.OrientationRequest()	Request a satellite orientation

Table 17: PAY F’ DataCollectionApplication command table:

Name	Opcode	Description	Parameters	Response
QUEUE_EXPERIMENT	0	Adds a new entry into experiments.csv to queue an experiment. expId parameter	{ expId: U8 imageTypeCode: Payload.ImageType	N/A

		reserves all ids from expId to expId+(count-1)	cameraCode: Payload.Camera }	

Table 18: PAY F' DataCollectionApplication event table

Name	Description
SmStateChanged	State machine state changed
ExperimentStarted	Data collection started for experiment
ExperimentQueued	Experiment submitted to experiments.csv
ExperimentCompleted	Data collected for experiment
ExperimentFailed	Experiment resulted in DISABLE
NoAvailableOrientation	No orientation can satisfy this experiment's image requests at this time
CameraCheckupFailed	Camera checkup gave a code other than OK
StorageCheckFailed	No storage left or other error
CameraPowerOnFailed	Camera did not turn on
ExperimentsCsvWriteFailed	Table could not be updated

Table 19: PAY F' DataCollectionApplication telemetry table:

Name	Type	Description
State	Payload.DataCollectionApplicationState	Current state of dataCollectionApplicationStateMachine

ExperimentsCompleted	U32	Number of experiments with data collected
ExperimentsFailed	U32	Number of experiments that ended in a DISABLE state
QueuedExperiments	U8	Number of experiments without data collected

Table 20: PAY F' DataCollectionApplication parameter table:

Name	Type	Default	Description
imagePartitionDir	String size 39	"/mnt/science_images"	Where to store images
storageFullThresholdBytes	U64	10485760	When to consider storage "full"

4.1.4 - ScienceApplication F' Component

Table 21: PAY F' ScienceApplication port table:

Name	I/O	Type	Description
modeIn	input	Sat.ScienceModePort	Mode command from SatStateMachine
schedIn	input	Svc.Sched	Rate group tick; drives the per-tick image processing loop
compressRequestOut	output	Science.CompressRequest	Request compression of a flagged image ahead of downlink
pingIn/pingOut	In/Out	Svc.Ping	Health monitoring

Table 22: PAY F' ScienceApplication command table:

Name	Opcode	Description	Parameters	Response
SET_ALGORITHM	0	Ground command setting one slot in the array of which	index: U8 algorithm: Science.Algorithm	

		algorithms run, in what order		
SET_ALGORITHM_PRESET	1	Ground command setting one slot to a named predefined algorithm	index: U8 preset: Science.AlgorithmPreset	
CLEAR_ALGORITHM	2	Ground command clearing one topology slot back to unconfigured	index: U8	
CLEAR_SCIENCE_TOPOLOGY	3	Ground command clearing entire topology back to unconfigured		

Table 23: PAY F' ScienceApplication event table

Name	**Description**
StateChanged	State machine transition
ImageProcessed	An image was successfully processed
ProcessingFailed	Algorithm processing failed for an image; left in place for a later retry.
MarkProcessedFailed	An image's pristine pre-run snapshot could not be copied into its processed/ subdirectory before running the algorithm; it will be reprocessed on a later tick.
AlgorithmSet	Ground set topology slot `index` to run `algorithmName`
AlgorithmCleared	Ground cleared topology slot `index`
TopologyCleared	Ground cleared the entire algorithm topology (all 10 slots)
AlgorithmIndexInvalid	SET_ALGORITHM/CLEAR_ALGORITHM given an index outside [0, 9]
ExperimentCompleted	Every configured algorithm ran successfully against one experiments.csv opportunity

NoExperimentReady	No experiments.csv opportunity currently covers every configured algorithm's inputImage
MalformedExperimentLine	A non-comment experiments.csv line could not be parsed
NoMatchingInputCombination	None of algorithm slot `index`'s requiredInputCombinations entries could be satisfied

Table 24: PAY F' ScienceApplication telemetry table:

Name	Type	Description
ExperimentsCompleted	U32	Experiments fully completed and moved to completeExperiments.csv since boot.
ImagesProcessed	U32	Images successfully processed since boot.
ImagesFailed	U32	Images that failed algorithm processing since boot.

Table 25: PAY F' ScienceApplication parameter table:

Name	Type	Default	Description
N/A			

4.2 - PAYLOAD Data Interface Details

4.2.1 PAY (2 instances) to Ximea MC031MG-SY

Description:

Wired/Wireless	Wired
Communications Protocol	USB 3.1 Gen 1
Signal Type	Digital, GPIO

Data Format	N/A
Protocol (if defined)	GPIO
Type of Data	Signal to take image
Software	LinuxGpioDriver
Commands/Inputs	- Start/stop capture (via GPIO camera triggers)
Data rate	~3.9 MiB per frame per trigger, 5 Gbps signaling

4.2.1 Ximea MC031MG-SY (2 instances) to PAY

Description:

Wired/Wireless	Wired
Communications Protocol	USB 3.1 Gen 1
Signal Type	Digital
Data Format	XI_IMG struct from xiGetImage — raw grayscale (10 bit) pixel buffer + metadata, format set by XI_PRM_IMAGE_DATA_FORMAT
Protocol (if defined)	XIMEA xiAPI, USB
Type of Data	Image
Software	Linux USB kernel driver, CameraManager
Commands/Inputs	- Start/stop capture (via GPIO camera triggers)
Data rate	~3.9 MiB per frame per trigger, 5 Gbps signaling

4.2.2 piNav-NG GNSS to PAY

Description: 3D position vector

Wired/Wireless	Wired
Communications Protocol	UART
Signal Type	Digital
Data Format	ASCII:

	- $PSLSP: GPS time (s), GPS week, ECEF position X/Y/Z (m) - $PSLSV: CEF velocity X/Y/Z (m/s) - $PSLSS: bus voltage, 1.2V core voltage, 3.3V core voltage, total current (mA), antenna current (mA), core temperature (°C, signed) - $GPGGA / $GPGLL / $GPRMC / $GPVTG / $GPGSA: INVALID/AUTONOMOUS/DROP_ESTIMATED flag for every fix GPIO: - VPP pin for if position fix taken was valid
Protocol (if defined)	UART, GPIO
Type of Data	Position, time, velocity, voltages, currents, temps
Software	GnssManager, LinuxUartDriver, LinuxGpioDriver
Commands/Inputs	N/A
Data rate	9600 baud rate, 8 bits, 1 stop bit

5.0 References

1. Appendix L: Interface Requirements Document Outline - NASA
2. Sagitta data sheet/user manual
3. Xcam C3D Interface Control Document (under NDA)
4. The basics of CSP — Cubesat Space Protocol

Revision History

Revision	Date	Change	Author	Approved By	Notes
1	9/9/2025	Version 1 created	Catherine Collison	UNP	
2	10/6/2025	Payload ICD	Systems Team	Catherine Collison	For PDR Submission
3	9/29/2026	Hardware Change	Josh Lando		