PAYLOAD USER GUIDE

Project: RIDESHARE **Rev:** v1.1 **Date:** Feb/2026

CHANGE RECORD			
ISSUE	**DATE**	**CHANGED BY**	**REASON FOR CHANGE AND AFFECTED SECTIONS**
1.0	18/02/2026	NG, OH, OM, MF	Initial release
1.1	27/02/2026	OM	Corrected hyperlink error in table of contents and list of figures and tables

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GLOSSARY

ABCL	As-Built Configuration Data List
AD	Applicable Document
AOCS	Attitude and Orbit Control System
ASSY	Assembly
BOL	Beginning Of Life
CADM	Configuration and Data Management
CAM	Camera
CCB	Configuration Control Board
CDHS	Command and Data Handling System
CDR	Critical Design Review
CEO	Chief Executive Officer
CI	Configuration Item
CIDL	Configuration Item Data List
CIL	Critical Item List
CM	Configuration Management
CoC	Certificate of Conformity
COM	Communication
COTS	Commercial Off-the-shelf items
CP	Critical Process/Change Proposal
CR	Change Request
CSP	CubeSat Space Protocol
DM	Documentation Management
DRB	Delivery Review Board
DWG	Drawing
EIDP	End Item Data Package
EM	Engineering Model
EOL	End Of Life
EQM	Engineering Qualification Model
ESD	Electrostatic Discharge
FM	Flight Model
FMECA	Failure Mode, Effects, and Criticality Analysis
FPGA	Field-Programable Gate Array
FR	Final Review
FTE	Full Time Employee
GNSS	Global Navigation Satellite System
GS	Ground Station
GSE	Ground Support Equipment
ICD	Interface Control Document
IOR	Interim Operation Review
IOV	In-Orbit Validation
LEO	Low Earth Orbit
MAIT	Manufacturing, Assembly, Integration and Test
MECH	Mechanical
ML	Model
MMPP	Materials, Mechanical Parts, and Processes
NC	Non-Conformance
NCR	Non-Conformance Report
NRB	Non-Conformance Review Board
OBC	On-Board Computer
OPS	Operations and customer interaction platform
OQR	Operation Qualification Review
PA	Product Assurance
PAM	Product Assurance Manager
PDR	Preliminary Design Review
PLD	Payload
QA	Quality Assurance
QM	Qualification Model
QTY	Quantity
RAMS	Reliability, Availability, Maintainability and Safety
RD	Reference Document
RFA	Request For Approval
RFD	Request For Deviation
RFQ	Request For Quotation
RFW	Request For Waiver
ROM	Rough Order of Magnitude
RX	Receiver
SAM	Serviceable Available Market
SDR	Software Defined Radio
SE	System Engineer
SOM	Service Obtainable Market
SRR	System Requirements Review
SSO	Sun-Synchronous Orbit
TAM	Total Addressable Market
TBC	To Be Confirmed
TBD	To Be Determined
TRL	Technology Readiness Level
TRX	Transceiver
TS	Technical Specification
TT&C	Telemetry, Tracking and Command
TX	Transmitter
UHF	Ultra-High Frequency
WP	Work Package

1 INTRODUCTION

1.1 PURPOSE

This document describes requirements for compatibility with the satellite bus and workflow that customers can expect when integrating their payloads with Spacemanic CubeSat platforms during RIDESHARE missions. The document provides an overview of platform’s main subsystems and supports payload designers in developing their hardware to be compatible with electrical and mechanical interfaces of the satellite.

Guidelines presented are intended to enable efficient and safe payload integration by promoting design choices that align with the platform architecture and operational constraints early in the development cycle. Noncompliance with any individual guideline does NOT automatically disqualify a payload from flight. In such cases, customers are encouraged to inform Spacemanic at an early stage to identify potential adaptations or mitigation measures, which can be jointly assessed to ensure successful mission for all parties.

1.2 COMPANY OVERVIEW

Spacemanic CZ s.r.o. is a full-service nanosatellite provider based in the Czech Republic, delivering complete mission solutions for CubeSat-class satellites.

Founded in 2019, we support clients through every phase of the satellite journey, from mission design and platform development to integration, launch, and operations. Our modular and flight-proven technologies power missions across scientific, commercial, and technology demonstration domains. Backed by a growing track record of 10+ successful missions and a team of experienced engineers, we make access to space simpler, faster, and more flexible. Learn more about our missions on our website: https://spacemanic.com/missions/

Spacemanic is your gateway to cost-effective, high-performance space solutions.

2 APPLICABLE AND REFERENCE DOCUMENTS

APPLICABLE DOCUMENTS

AD	Reference	Issue	Date	Document Title
[AD01]	-	10	09/2024	SpaceX – Rideshare Payload User's Guide
[AD02]	ESA-TECMTT-TS-009705	1.0	24/05/2018	Thermal Vacuum/Balance Test Specification Template for CubeSat Systems
[AD03]	CP-CDS-R14.1	14.1	02/2022	CubeSat Design Specification
[AD04]	SM-INT-TMP-0058	2.0	16/02/2026	Payload Input Form

REFERENCE DOCUMENTS

AD	Reference	Issue	Date	Document Title
-	-	-	-	-

3 RIDESHARE OVERVIEW

3.1 PAYLOAD SELECTION

To submit a payload for rideshare mission or review for a dedicated mission, payload crew shall follow these simple steps:

1. **Download the payload input form** PDF template from Spacemanic public GitLab repository: https://gitlab.com/spacemanic-public/payload-guide
2. **Fill in** the template with as much information as possible.
   If you wish, we can sign an NDA even at this stage, just contact rideshare@spacemanic.com, let us know your organization name and website and we will send you a template.
3. **Submit** the filled in payload input form to rideshare@spacemanic.com and we will be in touch!

The payload input form is **not a formal binding document**. Guidance on the expected information and instructions for completing the form are described in APPENDIX A.

Upon submission, the payload is assessed by the Spacemanic team. Suitability is reviewed and any required clarifications are requested from the customer. Satellite performance and joint satellite operations are finalized prior to formal commitment to the rideshare program.

If the payload is selected, contractual formalities are completed and a kick off meeting is held to introduce all payload crews participating in the RIDESHARE program.

3.2 SCHEDULE & MILESTONES

Figure 3-1 lists the activities and milestones of the rideshare program. The complete list of deliverables per phase is in section 9.

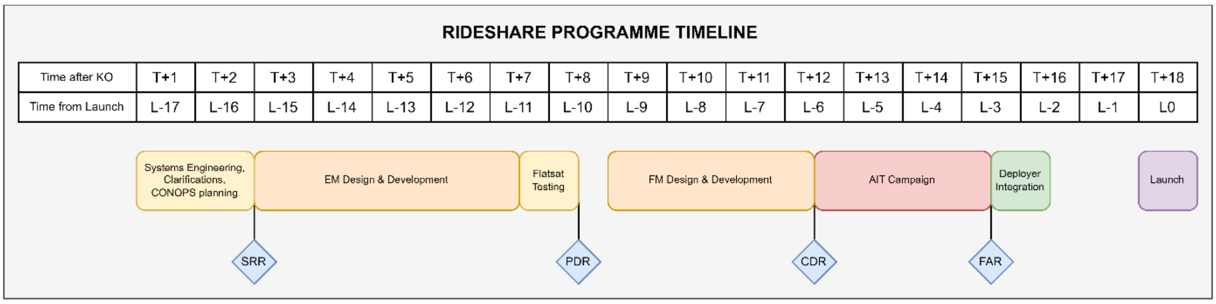

Figure 3-1: Rideshare program timeline

Over the course of the program, the following milestones apply:

3.2.1 System Requirements Review (SRR)

During this initial phase, each payload crew is provided with a mission Interface Control Document (ICD) corresponding to their payload. The ICD document serves as the primary means for description of payload characteristics and interfaces. The ICD is maintained iteratively and updated throughout the program to reflect the most recent and agreed data.

All co-hosted payloads are reviewed, and relevant considerations are communicated among all payload crews to ensure common understanding of the process and any potential constraints.

3.2.2 Preliminary Design Review (PDR)

At the end of this phase, payload teams are expected to deliver a representative engineering model (EM) suitable for "flatsat" testing. Description of the expected technical readiness is in section 4.1.1.

A major collocation meeting is held following flatsat testing and submission of updated ICDs.

3.2.3 Critical Design Review (CDR)

Following successful flatsat testing, the payload design shall proceed to finalization and optimization based on a PDR review, leading to a verified flight model of the payload. Description of the expected technical readiness is in section 4.1.2.

A major collocation meeting is held prior to delivery of the payload to Spacemanic premises for satellite integration.

3.2.4 AIT Campaign

All subsystems and payloads undergo acceptance testing before being integrated into the complete satellite. This usually involves electrical and communication bus compatibility verification. More details about specific activities and testing are provided in *3.2.4 AIT Campaign.*

Prior to shipment of the satellite, a Flight Acceptance Review (FAR) meeting is held to review the status and confirm the final satellite configuration.

3.2.5 Integration into Deployer

Payload crew members may be present during integration activities. However, all physical handling and manipulation of the satellite is strictly permitted by Spacemanic personnel only. The deployer integration location depends on the selected launch provider and is confirmed at PDR level.

If specific considerations, such as filling pressure vessels or propulsion systems need to take place during the deployer/rocket integration, this already needs to be communicated in the payload input form in early stages of the mission.

Following integration, the satellite remains powered off until successful deployment in orbit.

3.3 LAUNCH

The launch campaign commences upon securing a launch slot with the selected launch provider. Throughout the rideshare program, required information is collected from payload crews and consolidated for submission to the relevant authorities in order to obtain all necessary licenses or for launch documentation. The payload crews are expected to actively and promptly engage with Spacemanic when collecting this information to ensure timely completion of all legal requirements.

3.3.1 Launch Vehicle

Launch vehicle selection introduces an additional set of requirements that apply in addition to the platform level requirements described in this document. Customers shall therefore consider the applicable launch vehicle user manuals alongside this document during payload design and verification.

Any currently available launch vehicle may be considered (Falcon 9, PSLV, Ariane 6, etc.). However, based on current market availability and flight cadence, Falcon 9 is considered the most likely launch vehicle and serves as a practical reference for initial payload design considerations.

The most detailed and up to date information on Falcon 9 characteristics, environments, and other constraints is provided in the Rideshare Payload User's Guide published by SpaceX and available on the SpaceX website at https://www.spacex.com/rideshare/ .

Section 4 of SpaceX – Rideshare Payload User's Guide defines the flight environments aboard Falcon 9 relevant for CubeSats *[AD01]*.

3.3.2 Orbital Parameters

The determination of the target orbit is fully controlled by the launch provider. The launch provider is not obligated to respond to any customer request to change orbital parameters and reserves the right to change the launch schedule on short notice.

Specific orbital parameters are updated in corresponding payload specific ICD throughout the program once launch is confirmed and reserved. *Table 3-1* lists the orbital parameters of a common Transporter mission.

The anticipated orbital life span for CubeSats is typically in range of 2 to 5 years. The disposal of CubeSats is typically handled by destructive re-entry via natural decay of orbit.

Table 3-1: Typical orbital parameters expected for RIDESHARE program

Parameter	Value
Type of orbit	SSO
Altitude	500-550 km
Inclination	~97.5°
LTAN	~10:00 to 12:00 (typically Transporter)
Orbital period	~94 min
Time in sunlight	~59 min
Time in eclipse	~35 min
Lifetime	2-5 years

4 VERIFICATION & TESTING

4.1 PAYLOAD

4.1.1 Engineering Model

The EM shall demonstrate electrical interface compatibility and be software representative. Breadboard models, development PCBs and similar states are accepted, see example in Figure 4-1.

It is **NOT** necessary for EM to be mechanically representative. The preliminary hardware representation shall be provided in the form of a CAD model to enable virtual mechanical fit-checks within the satellite assembly. Mounting points and external dimensions are expected to reflect the intended final design.

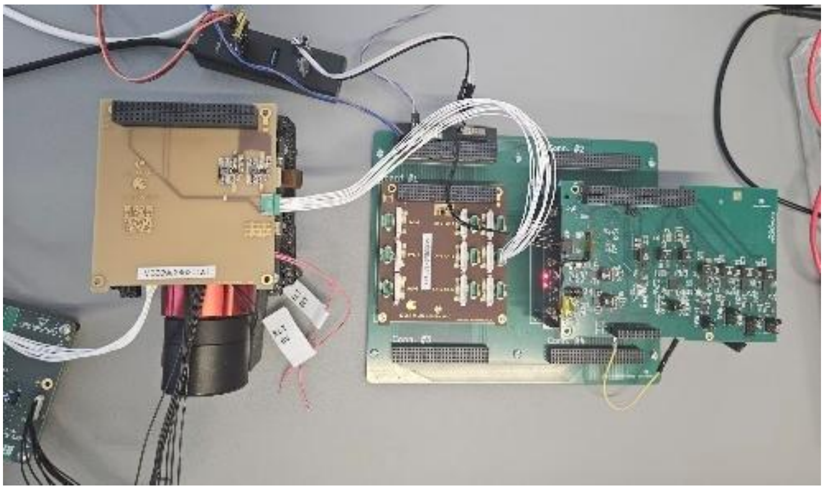

Figure 4-1: Illustration of a payload breadboard/flatsat model being tested for compatibility

Prior to delivery to Spacemanic premises, the following is expected:

- Submission of the most up to date ICD
- Submission of the most up to date CAD
- Submission of the verified firmware (binary and loading tooling)
- Verification of the EM at payload crew's own premises

An example test setup for own testing is described in APPENDIX B.

4.1.2 Flight Model

The FM shall be fully software and hardware representative. All integration steps specific for payloads will be addressed in the ICD.

It is **NOT** required for payloads to be environmentally tested on a subsystem level unless specifically required by the launch provider (e.g. in case of pressure vessels, payload testing is a responsibility of the payload crew).

Expectations prior to delivery of the flight unit to Spacemanic:

- Submission of the most up to date ICD
- Submission of the most up to date CAD
- Submission of the verified firmware
- Verification of the FM at payload crew's own premises

Activities permitted to be done on the payload flight unit when at Spacemanic:

- Application of glue
- Application of top-level mechanical parts (subject to approval in ICD)
- Firmware updates

Any other requests shall be described in mission ICD and are subject to agreement with Spacemanic.

5 SATELLITE PLATFORM

5.1 COORDINATE SYSTEM

All co-hosted payloads shall provide isometric view of the payload model including XYZ axes and views of all faces, including the defined origin of the coordinate system.

The satellite coordinate system for 8U is illustrated in Figure 5-1 with origin placed at a geometric center. It is strongly recommended to use the same system to avoid confusion and potential misplacements.

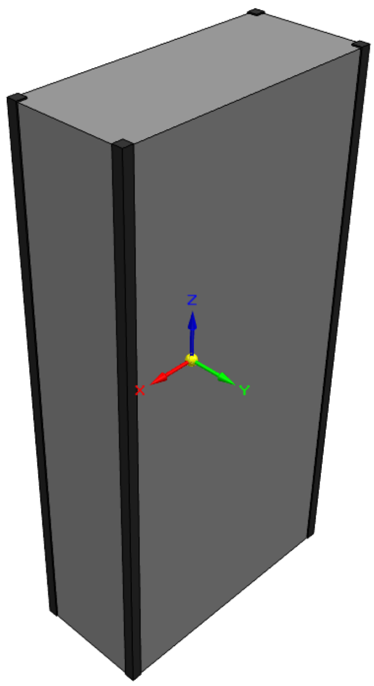

Figure 5-1: Satellite coordinate system view

5.2 PAYLOAD SIZE & MOUNTING

Two available options for payload integration are possible. The CAD model of the satellite frame will be provided to all customers for fit checks to ensure compatibility.

5.2.1 PC104 Mounting

The PC104 board standard interface is the preferred mounting approach, as it provides the simplest integration path. A board footprint of 88 × 92 mm is recommended to allow sufficient space for harness routing.

Due to the modular platform architecture, no strict limitation is imposed on payload height beyond the physical constraint of the purchased payload volume inside the satellite.

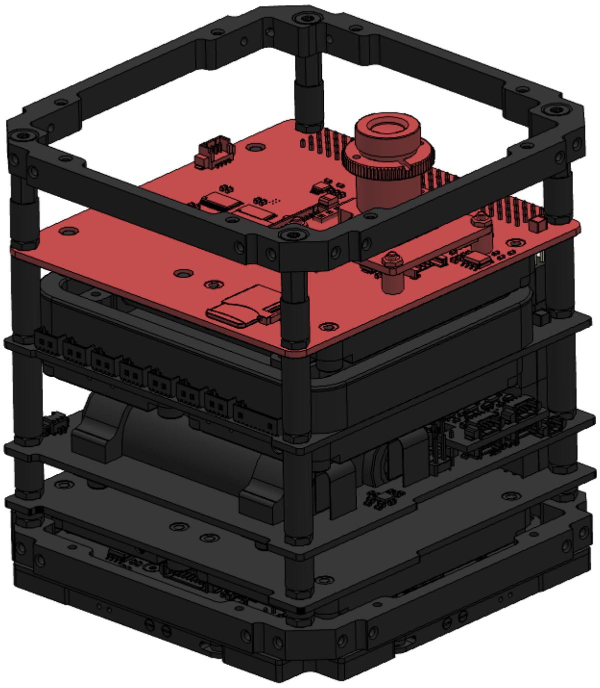

Figure 5-2: Example PC104 mounting (illustrative only)

5.2.2 Frame Mounting

Direct mounting of a payload to the satellite frame is permitted. The mechanical mounting and shielding parts shall be adapted to ensure no mechanical interference is introduced. As a result, detailed dimensional constraints are defined after review of the payload input form.

Preliminary lateral dimensions are 96 × 96 mm, with payload height being treated as a variable parameter depending on the purchased payload volume inside the satellite. It is preferred to implement M3 screw mounting interface from all sides in contact with the satellite frame as illustrated in Figure 5-3.

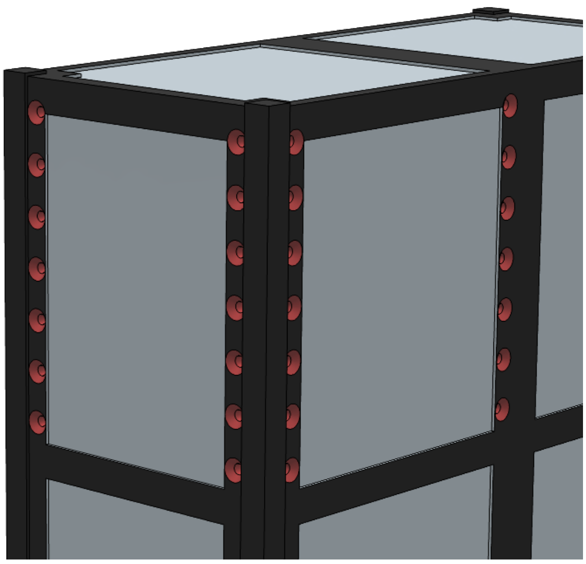

Figure 5-3: Frame mounting (illustrative only)

5.3 ELECTRICAL INTERFACE

The electrical connection between the platform and the payload shall be established via harness connected to the PC104 interconnector board.

5.3.1 Power System

The satellite platform power system offers one power output per payload at one of 3.3 V, 5 V, or 12 V levels. The power draw is limited up to 4 A, with configurable software overcurrent protection limit.

The satellite platform uses three buses for communication – RS485 (KISS packets), CAN and I2C. Cubesat Space Protocol v1 (CSP) is used as the communication protocol, creating a decentralized network architecture. All payloads **shall** implement at least two buses, internal control, data storage and communication interface via CSP. This means, the payload will be a standalone system with only power and data connection to the satellite.

5.3.2 Interconnector Board & Harnessing

Harness connection is used to connect payloads with the satellite platform. Interconnector Board is included in the satellite assembly providing a cable connector interface with power and communication lines.

Two harnessing connection options are available on the Interconnector Board for each payload. Each payload defines its own electrical interface on the payload side of the harness. It is **not** required for the payload to use the same connector type as implemented on the Interconnector Board.

Platform side:
The connector type is fixed.

Payload side:
Option 1 (preferred): If the payload uses the same connector type as the satellite, Spacemanic provides the complete cable assembly, including cables and housings on both ends.

Option 2: If the payload uses a different connector, the payload crew is responsible for providing payload open ended cable with housing on the payload side. The other end is finished at Spacemanic premises during integration.

In specific cases, H1H2 connection may be allowed, this should be discussed with Spacemanic in the early design to ensure compatibility.

Primary - Harwin Datamate M80-8281642P

This connector will be used for interfacing the payload to the platform in the satellite assembly.

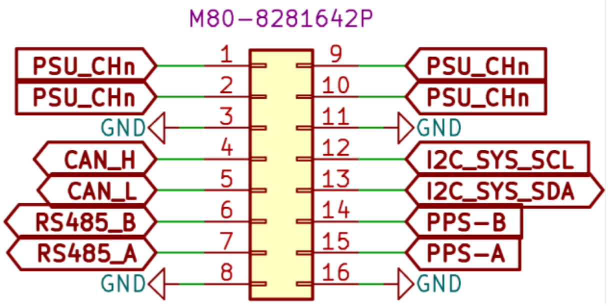

Figure 5-4: Primary payload connector Harwin Datamate M80-8281642P

Table 5-1: Primary payload connector Harwin Datamate M80-8281642P pinout

Pin	Signal	Voltage	Description
1	PWR	-	Voltage of the selected PSU channel
2	PWR	-	Voltage of the selected PSU channel
3	GND		
4	CAN CSP H	3.3 V typ.	Platform CAN
5	CAN CSP L	3.3 V typ.	Platform CAN
6	RS485 CSP B	3.3 V typ.	Platform RS485
7	RS485 CSP A	3.3 V typ.	Platform RS485
8	GND		
9	PWR	-	Voltage of the selected PSU channel
10	PWR	-	Voltage of the selected PSU channel
11	GND		
12	I2C CSP SCL	3.3 V typ.	Platform I2C
13	I2C CSP SDA	3.3 V typ.	Platform I2C
14	PPS-B	3.3 V typ.	Reserved
15	PPS-A	3.3 V typ.	PPS Out from GNSS if available
16	GND		

Secondary – 2x Molex Pico-Lock 504050-0891

This is a secondary connector used mainly for development. Edge facing connectors may be blocked by structural elements of the final assembly. Two 8 pin connectors are implemented separating power and communication signals while satisfying higher power demands. These two connectors form one cable harness.

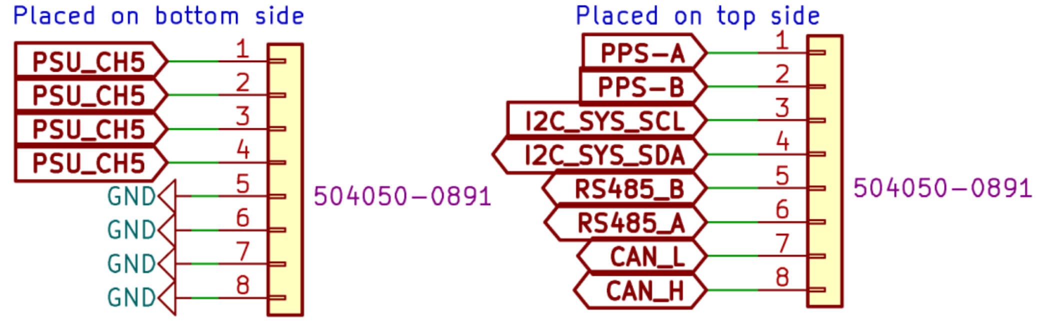

Figure 5-5: Secondary payload connector Molex Pico-Lock 504050-0891

Table 5-2: Secondary payload connector Molex Pico-Lock 504050-0891 pinouts

Pin	Signal	Voltage	Description
B-1	PWR	-	Voltage of the selected PSU channel
2	PWR	-	Voltage of the selected PSU channel
3	PWR	-	Voltage of the selected PSU channel
4	PWR	-	Voltage of the selected PSU channel
5	GND		
6	GND		
7	GND		
8	GND		
T-1	PPS-A	3.3 V typ.	PPS Out from GNSS if available
2	PPS-B	3.3 V typ.	Reserved
3	I2C CSP SCL	3.3 V typ.	Platform I2C
4	I2C CSP SDA	3.3 V typ.	Platform I2C
5	RS485 CSP B	3.3 V typ.	Platform RS485
6	RS485 CSP A	3.3 V typ.	Platform RS485
7	CAN CSP H	3.3 V typ.	Platform CAN
8	CAN CSP L	3.3 V typ.	Platform CAN

5.3.3 Communication Bus Interfaces

The satellite communication bus is made of three different communication buses (CAN, RS485 and I2C), all implementing Cubesat Space Protocol (CSP) v1. These are used in a redundant manner. Subsystems are connected to these buses (at least two) in a CSP network where each system can be reached from each other system. This leads to a decentralized network of nodes.

Each payload **shall** be a standalone system = not controlled from the satellite CDHS and have its own memory (other than basic commands send to the payload controller for scripted satellite operation). Any option conforming to CSP v1 is acceptable.

Spacemanic offers OBC modules as part of normal product portfolio, including example software (Eddie, Deep Thought) which can be used as the payload controller.

All payloads **shall** implement at least two buses and communication via CSP. I2C **shall** implement isolation (e.g. as shown in Figure 5-6). Table 5-3 lists the parameters of each communication bus.

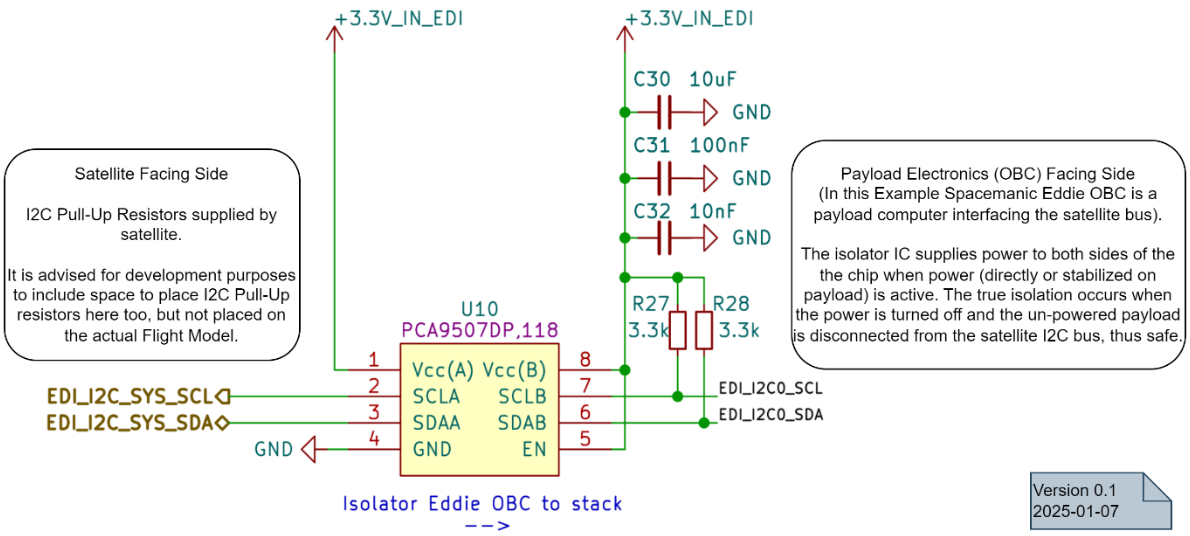

Figure 5-6: Example of minimal implementation of satellite I2C bus isolation circuit

Table 5-3: Satellite buses parameters

Bus	Speed	Hardware addressing	Voltage level
CAN CSP	1 Mbps	Yes	3.3 V
RS485 CSP (KISS packets)	38400 baud (limited by some subsystem MCU resources)	No	3.3 V
I2C CSP	100 kHz	Yes	3.3 V

CubeSat Space Protocol relevant resources:

- Basic info: https://libcsp.github.io/libcsp/
- Elementary implementation: https://github.com/libcsp/libcsp
- Compatible "light" implementation: https://gitlab.com/vzlu/sw/mcu/libcsp-lite

The CSP v1 address space is limited to 32 nodes. This includes all subsystems of the platform with payloads and the ground segment. Three categories of devices are present in this address space;

the Space segment with systems and payloads of the satellite, the EGSE segment for development activities and configuration on the ground, and the Ground segment for radio ground station use.

Table 5-4: CSP address space allocation defines what address shall be used for each device connected to the satellite CSP network.

All satellite subsystems are implemented as CSP devices with a number of available services exposed on specific "ports".

All CSP systems as a rule support a collection of basic services usually provided by the software library itself (e.g. libcsp). These occupy the first set of service numbers. Only a selection of these services is strictly required by the Corvus platform to be implemented (Table 5-5, Table 5-6).

More detailed description of the protocol is available at: https://libcsp.github.io/libcsp/.

The CMP service (port number 0) exposes a mechanism to manipulate certain configurations of the CSP interface such as manipulation of routing rules, getting and setting of the system clock, retrieval of system identification data packet (hardware and software identification, identity) and direct manipulation of memory fields (this is a dangerous operation and usage should be carefully tested and considered before execution on a satellite deployed in space).

Table 5-4: CSP address space allocation

CSP Address	Usage	Segment
0	Reserved localhost	-
1	Reserved – platform	SPACE
2	Reserved - platform	
3	Reserved - platform	
4	Reserved - platform	
5	Reserved - platform	
6	Reserved - platform	
7	Reserved - platform	
8	Reserved - platform	
9	Reserved - platform	
10	Reserved - platform	
11	Reserved - platform	
12	PLD RESERVED	
13	PLD RESERVED	
14	PLD RESERVED	
15	PLD RESERVED	
16	PLD RESERVED	
17	PLD RESERVED	
18	PLD RESERVED	
19	PLD RESERVED	
20	EGSE (RS485 Lab Computer)	EGSE (DEV)
21	EGSE (CAN Lab Computer)	
22	GS Reserved	GROUND
23	GS Reserved	
24	GS Reserved	
25	GS Reserved	
26	GS – Downlink via UHF (automation)	
27	GS – Downlink via S-band (automation)	
28	GS – Downlink via UHF (terminal)	
29	GS – Downlink via S-band (terminal)	
30	-	
31	Reserved broadcast	-

Table 5-5: Basic CSP services

CSP Service Port	Name	Description	Required
0	CMP	CSP Management Protocol	YES
1	PING	Basic connection test. Echoes back the data sent to this port.	YES
2	PS	List of tasks / processes running	NO
3	MEM_FREE	Available free memory on the device	NO
4	REBOOT	Soft reboot of the node	YES
5	BUF_FREE	Request the number of free CSP buffers	NO
6	UPTIME	Request the number of seconds from start	YES

Table 5-6: Implementation of CMP services

Number	Service	Description	Required
1	Ident	Identification of the target (name, revision)	YES
2	Router Set	Routing table manipulation	YES
3	Interface Statistics	Request statistical data of an interface	NO
4	Peek	Peek direct physical memory value on address	NO
5	Poke	Manipulate direct physical memory on address	NO
6	Clock	Get or Set target's clock (usually UTC/UNIX) as number of seconds and microseconds	YES
7	Reserved for CSP v2	-	-

The following shows an example of CSP service definitions format expected from the payload crew:

EXAMPLE CSP SERVICE: **HOUSEKEEPING**

CSP Port: 9 (0x09)

Description: Request housekeeping data

Request Payload: none or ignored

Response:

The device responds with a plain 8-bit packed housekeeping data structure.

```
typedef struct __attribute__((packed)) { // SVC_HK OBC housekeeping data
    uint32_t resetCnt;                   // Count of all MCU resets (nonvolatile)
    uint16_t lastRstSrc;                 // Last source of reset
    uint16_t bufOutRsts;                 // Number of resets due to “out of buffers” error
    uint32_t uptime_rst;                 // Uptime since last reset
    uint32_t uptime_rot;                 // Uptime cumulative total
    uint32_t timestamp_rtc;              // RTC timestamp
    uint32_t packets_recvd;              // Number of all packets received on CSP (nonvolatile)
    uint16_t fs_free_blocks;             // Number off free blocks in file system
    int16_t temperature_mcu;             // Temperature of OBC MCU in [0.01 C]
} edi_obc_hk_t;
```

Total size 28 Bytes.

5.3.4 Data Transfer

The satellite features two radio systems:

- omnidirectional UHF antenna for platform TT&C,
- directional S-band antenna for high volume data transfer

Typically, the SSO orbit contact windows offer a total of 40 min of contact per day with one ground station (assumed case for RIDESHARE). Typical speeds for RIDESHARE are shown in Table 5-7.

Table 5-7: Typical speeds of radio systems assumed for RIDESHARE

Radio system	Speed
UHF uplink	9600 bps
UHF downlink	19200 bps
S-band downlink	250 kbps (up to 512 kbps)

5.4 ATTITUDE CONTROL

The platform AOCS is planned to be capable of the following pointing modes:

- Sun pointing (with set axis)
- Nadir pointing
- Inertial pointing
- Ground target tracking
- Slew mode

The AOCS has an option of payload protection (Sun pointing with opposing face), however, even with this function, there is a risk of 10-30 seconds illumination when transferring between the eclipse and sunlight.

Table 5-8 provides the performance specifications for the AOCS system present on the platform, please consider them as the best-case scenario as the exact performance is never the exact value as the model due to the real environment effects and electromagnetic cleanliness of the final system. Relative pointing error would be determined once the RIDESHARE satellite reaches at least PDR.

Table 5-8: AOCS planned performance

Mode	Parameter	Value
Sun pointing	Pointing accuracy (sunlight)	< 5 deg for 63.8% of time in sunlight
	Slew rate	> 2 deg/s
Nadir pointing	Pointing accuracy (sunlight)	< 1 deg @ 1 sigma (with set axis)
	Slew rate	> 2 deg/s
Ground target tracking (communication)	Pointing accuracy (sunlight)	< 2.5 deg @ 1 sigma
	Slew rate	> 5 deg/s
Inertial pointing	Pointing accuracy (sunlight)	< 2.5 deg @ 1 sigma
	Slew rate	> 2 deg/s
Slew mode	180 deg flip duration	< 180 s including acceleration/deceleration

5.5 THERMAL INTERFACE

The satellite platform does not implement any active heating, cooling elements or coupling to the payloads. Any thermal interfaces **shall** be discussed within mission specific ICD to determine necessary additional calculations and design adjustments to accommodate for payload requiring thermal interface. Nominal range for heated elements **shall** be provided by the payload crew in the payload thermal interface section.

5.6 PRESSURIZED SYSTEMS

Pressurized vessels are permitted. However, the customer is responsible for any additional payload testing prior to integration in the satellite platform. This includes any required leak or burst testing. Use the SpaceX – Rideshare Payload User's Guide [AD01] if your payload falls into pressurized systems.

5.7 MATERIALS

You may use the following sources to identify hazardous materials within your assembly:

- SpaceX – Rideshare Payload User's Guide [AD01]
- https://www.law.cornell.edu/cfr/text/49/172.101
- https://www.law.cornell.edu/cfr/text/49/173.50

Recommended materials for your payload include: aluminum, titanium, peek, PTFE, Teflon etc. You should aim to avoid materials not suitable for space – typically with higher outgassing (>1% TML).

6 AIT CAMPAIGN

6.1 FACILITIES & STORAGE

Integration activities are by default done at Spacemanic HQ in ISO 8 equivalent environment. In case of sensitive payload on board, an ISO 5 cleanroom could be used for the satellite integration and subsequent testing of fully integrated satellite.

The payload and fully integrated satellite platform will experience typical laboratory conditions on the ground in the temperature range of 20-25°C and further conditions as defined by the launch provider user guide (typically in similar range with no specific accommodation possible on the provider side).

See chapter 5 in SpaceX – Rideshare Payload User's Guide [AD01] for more details.

6.2 PAYLOAD INTEGRATION

Payload crew members may supervise the integration process (on premise or via teleconferencing), but handling of flight hardware during the act of integration is reserved to Spacemanic personnel. In all cases, integration and testing activities are performed exclusively by Spacemanic personnel. Customers shall describe integration steps for their payload in mission ICD.

Customers are responsible for providing all necessary Ground Support Equipment, and Remove Before Flight elements for their payload integration.

6.3 ENVIRONMENTAL TESTING

This section describes tests to be performed on the fully integrated satellite during the AIT campaign.

Table 6-1: Typically expected satellite level environmental testing

Description	Y/N	Notes
Quasi static	No	Unless required by launch provider
Random vibration	Yes	Specific characteristic is subject to launch provider selection
Thermal vacuum bakeout	No	Specific requests by payload crew may be facilitated at an extra cost – need be communicated in the payload input form.
Thermal vacuum cycling	No	Unless required by launch provider
Leak Test	No	Only in cases when pressurized systems are onboard according to launch provider requirements – extra costs responsibility of the specific payload crew.

6.3.1 Random Vibration

The exact random vibration test definition is defined after securing a launch slot. An example test specification is provided below, based on Sections 6.6 and 6.7 (Protoflight Unit) of SpaceX – Rideshare Payload User's Guide *[AD01]* and other considered launchers' documentation (PSLV, Ariane 6, etc.).

The satellite is tested as a fully integrated assembly in its flight configuration.

The payload is typically NOT required to be tested separately. Payload crew may choose to perform this test at their own discretion.

Table 6-2: Preliminary random vibration test envelope

Frequency (Hz)	PSD (g^2/Hz)
20	0.01
50	0.015
700	0.015
800	0.03
925	0.03
2000	0.00644
GRMS	**5.57**

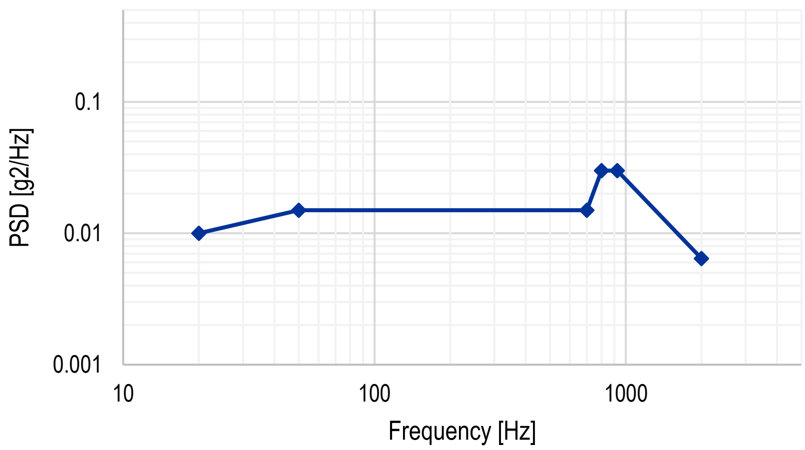

Figure 6-1: Preliminary random vibration test envelope

7 RIDESHARE CONSIDERATIONS

A set of additional information will be collected to assess the effects on other payloads and platform. It serves to inform all parties about potential risks and constraints. If there are questions regarding co-hosted payloads a multi-party meeting would be held to resolve potential conflicts as soon as possible. List of typical expected consideration description is listed in Table 7-1. The mission specific content is iteratively shared between all payload teams in ICDs.

Table 7-1: Payloads Rideshare considerations

Scope	Typical Consideration
Thermal constraints and emissions	E.g., outgassing information at certain limits, temperature limits, active heating, active cooling, etc.
Electromagnetic interference and emissions	E.g., high current electromagnetic emissions, crystal constraints, etc.
Power consumption and sharing	E.g., non-linear peaks, extreme peaks in consumption, cp-utilization of payload time between payloads to avid negative effects (parallel operation of e.g. heater of payload 1 and diagnostic sensors on payload 2), etc.
Data handling and telemetry conflicts	E.g., parallel operation of two or more payloads requiring instantaneous high data rata data downlink, etc.
Materials, outgassing and contamination	E.g., non-standard materials, special coatings, higher outgassing or intended outgassing, etc.
Deployable mechanisms	E.g., devices obstructing field of view (such as sensors on arms), creating moment, type of actuator, etc.
Propulsion systems	Type of propulsion, expected particle release, expected utilization, constraints during integration, and testing, etc.
Field of view blockage	Field of view of sensor in degrees, placement within assembly, etc.

8 CONOPS

8.1 MISSION PHASES AND PAYLOAD ACCESS

Figure 8-1 illustrates the major points of the mission phases.

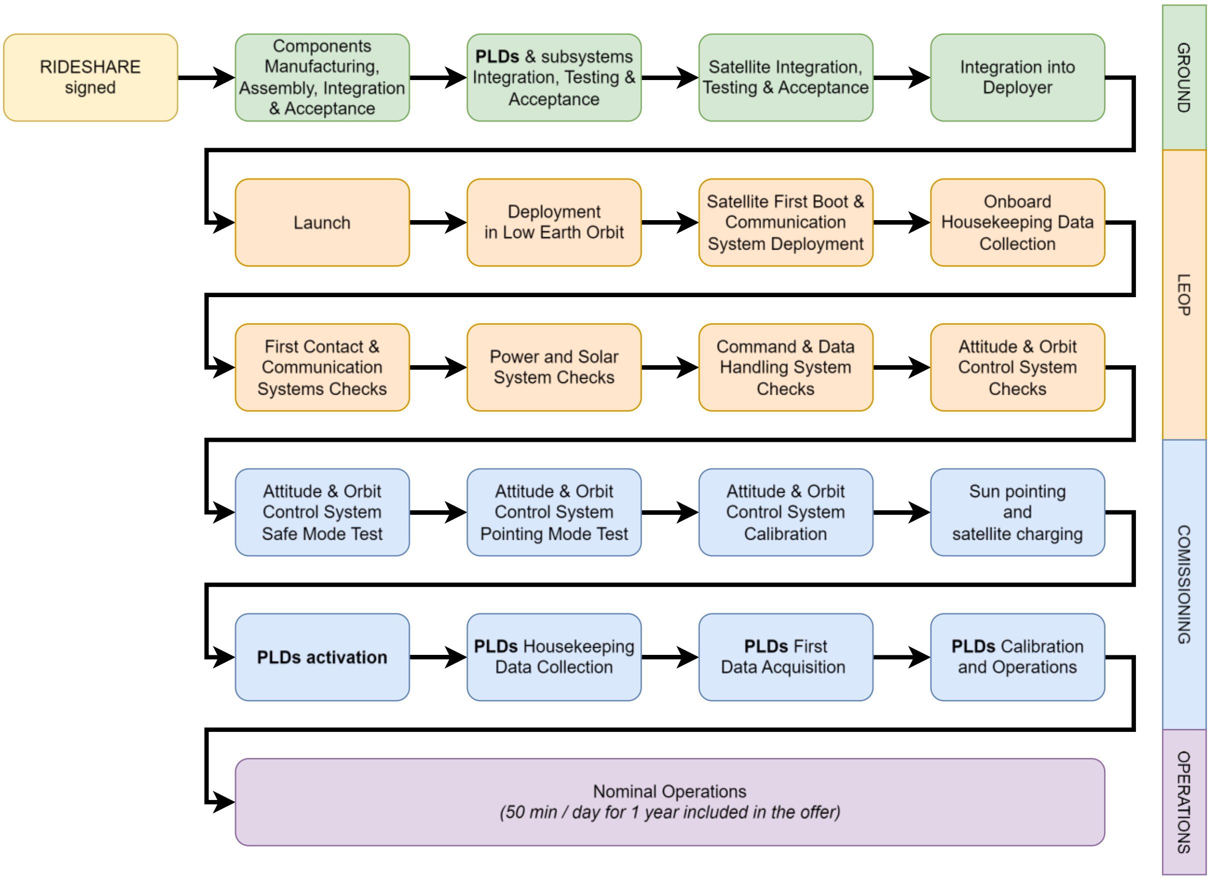

Figure 8-1: Mission phases illustration

The following subchapters provide more detail on the activities during each phase after launch.

8.1.1 Launch and Early Orbit Phase (LEOP)

The LEOP begins immediately after deployment from the launch vehicle.

- During the LEOP, **payload teams have no direct access to their payloads**
- Platform subsystems are sequentially powered on, checked, and verified by the spacecraft operator
- Activities include antenna deployment, power system stabilization, attitude acquisition, and subsystem health verification
- **Payloads remain powered off or in a safe inactive state during this phase**

Typical LEOP duration ranges from several days up to approximately two weeks depending on the mission complexity.

8.1.2 Commissioning Phase

After successful completion of LEOP, the commissioning phase begins.

- AOCS is activated and calibrated
- **Payloads are activated one at a time or in coordinated groups**
- Functional checks, calibration, and initial data acquisition are performed
- Commissioning activities are executed according to the pre-agreed procedures

Payload commissioning profile may include:

- One-time activation and checkout
- Repeated activation cycles
- Continuous or periodic monitoring

The specific commissioning profile is agreed during the mission planning within the payload ICD.

8.1.3 Nominal Operations Phase

After successful commissioning, payloads enter nominal operations.

- Spacecraft operational time is shared between all hosted payloads
- Payload access is provided according to a predefined operational schedule
- Operations may be sequential or coordinated between multiple payloads

At the end of each payload operation window, the spacecraft is expected to be returned fully charged to ensure sufficient energy for subsequent users.

Example of a simple multi-payload operations may include a week of operation per payload cycling between the crews, returning the spacecraft fully charged.

A more complex example may include active payload and passive payload utilizing the payload time simultaneously while not affecting or intentionally affecting each other and sharing the data downlink.

8.2 PAYLOAD ACCESS AND OPERATIONAL AUTHORITY

Payloads are operated through a **scheduled and mediated access model**. Payload crews **shall** provide health checks indicators which can be collected by the satellite CDHS via the CSP buses.

- Payload teams do not directly control spacecraft subsystems
- Payload commands are submitted in advance according to agreed timelines
- Commands are executed by the spacecraft operator or by onboard autonomy as approved

Real-time commanding is generally not supported unless explicitly agreed in advance.

8.3 OPERATIONAL MODES

Satellite operations are split into various modes depending on the subsystems and components utilization and satellite pointing. The modes can be split into the following categories:

- **Idle/charging modes** – only necessary components are running to ensure satellite's survival and maximize power generation. This could include a low power payload controller for the purpose of health checks and other CSP commands. Orientation in this mode will be dictated by satellite design to maximize power generation
- **Measurement modes** – usually, only one (per payload) but can be several modes in which the payload is operated at or near its full capability. These modes frequently have specific pointing requirements or minimum undisturbed durations. These modes can also include data processing modes in which gathered data is being processed by payload to decrease data downlink volume.
- **Specific modes –** These would be any other modes not fitting into the first two categories. This could for example include pre-heating of the payload or any other preparation steps before the measurement itself.

8.4 POWER AND ENERGY CONSTRAINTS

During the charging, the satellite will orient itself in Sun pointing mode to maximize power generation. In case of loss of power or reaching low charge state, the satellite will disable non-critical subsystems, enter low power safe mode and attempt to reach full charge in order to preserve operations.

In case of the RIDESHARE program, the satellite usable stored energy is approximately 46 Wh (assuming 100% charge to the 50% depth of discharge, chemical energy 92 Wh). Table 8-1 summarizes the power constraints for the RIDESHARE program. The exact depth of discharge will be confirmed at PDR.

Table 8-1: RIDESHARE program example power constraints

Parameter	Value	Unit
Battery chemical energy	92	Wh
Battery depth of discharge (TBC at PDR)	50	%
Minimum battery usable energy	46	Wh

The RIDESHARE program payloads are expected to exploit a regulated channel 3.3/5/12 V with overcurrent protection and backup @ 4 A. After agreement with Spacemanic, payloads may also be allowed to utilize the 1x unregulated V_{Bat} output with overcurrent protection (13.6 – 16.8 V).

Table 8-2: RIDESHARE program power input

Parameter	Value	Unit
Regulated channel voltage	3.3 / 5 / 12	V
Regulated channel maximum current	4	A
Unregulated (V_{Bat}) voltage	13.6 – 16.8	V

The exact energy available to payload is dependent on the AOCS operations, duty cycle and mission specific depth of discharge.

8.5 JOINT PAYLOAD OPERATIONS

Joint operations may be supported when compatible payloads share spacecraft resources and could be operated in parallel. Examples include:

- A low-power passive payload operating continuously while a high-power payload is active intermittently
- Multiple payloads operating sequentially within a single orbit

Joint operations are evaluated case by case and subject to power, pointing, and data handling compatibility. Joint operations are not guaranteed unless explicitly agreed by Spacemanic.

8.6 DATA AND TELEMETRY ACCESS

Payload crews receive housekeeping data related to their payload and relevant spacecraft parameters. Typical housekeeping data may include:

- Payload power channel current and voltage (consumption)
- Spacecraft attitude information
- Solar panel and platform temperatures

Housekeeping data is typically collected at rates up to 1 Hz. The data delivery format, latency, and access method are defined during the mission planning. Science data downlink allocation is defined per payload based on mission constraints.

9 DELIVERABLES

9.1 PAYLOAD CREW TO SPACEMANIC DELIVERABLES

Table 9-1: List of primary deliverables from payload crew to Spacemanic

Item	Description	Milestone
Payload input form	Preliminary information provided by the payload crew to support payload selection, prior to project kick-off	Payload selection
Payload ICD draft(s)	Signed iteration of the ICD by the payload crew, multiple iterations are expected, level of detail required at each stage is typically mission specific depending on the type of payload, but should be sufficient to perform EM testing, may include attachments such as test reports etc.	PDR
EM hardware	Hardware sufficient to fulfill the requirements of the EM testing specified in the respective payload ICD as illustrated in section 4.1.1 Engineering Model	PDR
EM CAD model	CAD model of the payload assembly	PDR
Payload ICD draft(s)	Signed iteration of the ICD by the payload crew, reflected results of the EM testing, this version should reflect the current version of FM and specify tests for FM testing	CDR
FM hardware	Hardware sufficient to fulfill the requirements of the FM testing specified in the respective payload ICD as illustrated in section 4.1.2 Flight Model	CDR
FM CAD Model	Fully developed FM representative payload assembly	CDR
Payload ICD	Signed iteration of the ICD by the payload crew reflecting minor edits based on FM testing (if applicable) and ready for operator for LEOP and Commissioning (minor revisions are still expected over the mission lifecycle)	Flight Acceptance Review (FAR)

9.2 SPACEMANIC TO PAYLOAD CREW DELIVERABLES

Item	Description	Milestone
ICD template	ICD template for the payload crew (and support with iterations)	Upon contract signature
CAD model	Frame CAD model for fit checks	Upon contract signature
DDF draft	Design definition file draft (DDF) explaining the mission and satellite concept in detail inclusive of the preliminary technical budgets.	PDR
Report	EM testing summary	post-PDR
DDF draft	Signed DDF iteration reflecting the higher detail of design post-PDR and EM testing	CDR
Report	FM testing summary	post-CDR
DDF draft	Signed DDF iteration reflecting the higher detail of design post-CDR and FM testing ready for operator for LEOP and Commissioning	post-CDR
Report	Flight Acceptance Review summary	FAR

APPENDIX A PAYLOAD INPUT FORM

This section explains how to best fill out the payload input form [AD04].

The most up to date version of the payload input form can be found on the Spacemanic public GitLab: https://gitlab.com/spacemanic-public/payload-guide

The form is split in five sections marked by the blue vertical bar on the left, each of which is discussed in the subsections below. Generally, it is important to fill in as much detail as possible.

If required, NDA may be signed prior to sending the filled in payload input form to Spacemanic to avoid unnecessary information barriers which could delay the process on either side. If this is applicable, please do get in touch: rideshare@spacemanic.com

A.1 CUSTOMER DETAILS

Please ensure this section is fully complete to ensure we can perform validation of the customer and get in touch quickly if needed.

If you wish to include contributors, colleagues or other participating organizations in the information chain, please make sure to include their contact, so we can keep them in the loop.

Please ensure the point of contact is a person from the organization responsible for the payload and capable and authorized of communicating the technical and contractual information (signatory may of course be different, but a clear information link between Spacemanic and your organization is required).

A.2 PAYLOAD MISSION SPECIFICATION

If your payload does not have a name yet, please provide a working title so we can reference it in our documentation. Please include the desired launch window, orbit and mission duration required to fulfill your objectives. Payload launch readiness should reflect both the hardware and software in terms of controller and independent data storage.

Mission Objectives

Please ensure you communicate the mission objectives clearly, if applicable, with measurable outcomes (e.g. achieving xx Ns with propulsion IOD). If your project is linked to some other project, may it be initial demonstration or similar previous work, please include a comment so we can look it up. The more context you provide, the better idea we will get on how to best accommodate your needs.

Any Special Considerations/Development Support Required

Any special considerations needs are to be communicated here, if you have a ready hardware optical payload, but lack the controller capability, please make sure you include information about this. Although support such as payload development is not considered in the RIDESHARE program, we may have an alternative opportunity available we could match your mission with and help seek support in getting the payload ready. RIDESHARE program considers multiple launch windows in the coming years, so it is always possible your mission could just get moved to a later date to provide enough time to get ready. The special considerations need field may also include information such as need for specific pointing maneuvers, heat dissipation or instant telemetry packets requirement.

A.3 PAYLOAD TECHNICAL SPECIFICATION

Please make sure you provide as much detail as possible. **The payload input form is not a legally binding document**. As such, it should illustrate the payload design and readiness, where possible, please at least provide rough envelopes followed by "TBC" (e.g. "Mass: 2 kg TBC"). The rough envelopes help us understand the state of development as well as interfacing constraints within the platform.

Preliminary Payload CAD Attached

If you can, please also share a CAD model. Black box envelope of the payload is sufficient to give us an idea of the payload shape, dimension and possible center of mass.

CSP v1 Compatibility

If you are not sure if your payload is CSP v1 compatible, tick "No" and describe the payload software interfacing in the special considerations field on the first page (or ANNEX if you are running out of space).

Data Rates

Please make sure you provide the unit with the daily data uplink and downlink volumes.

AOCS Requirements

If your payload does not require any AOCS operation, put "N/A", this field is reserved for optical payloads, RF directional antennas and similar applications. If your payload is for example computational and is using the platform communication interface, there is no need to use this field.

Operational Modes

Please provide the expected operational modes – you may refer to the state machine logic, or simply describe which component is active in each mode. The goal is to get an idea on the concept of operations with regards to the power consumption and satellite availability and charging.

A.4 SERVICES

In case of RIDESHARE program, tick "Yes" and fill in the launch year (e.g. 2027 / 2029 / 2031).

If you are looking for or would like to consider a dedicated & tailored mission, where you do not have to share the availability of the satellite with other payloads, feel free to fill in the remaining tick boxes:

- Vibration launch qualification testing – system level testing, required by launch providers
- TVAC launch qualification testing – typically optional, usually done with optical payloads
- Launch booking and deployer fee – gets your satellite from table to orbit
- Frequency allocation and licensing – coordination required to communication with your satellite
- LEOP & Commissioning – gets you a satellite ready to be operated after launch
- Operation past LEOP – no station? no problem! Get the data, we operate the satellite for you

A.5 ANNEX

Reserved in case you are running out of space in any of the field or need to provide further detail.

Please refrain from adding extra comments in the email in case of RIDESHARE program submissions as they might get missed.

APPENDIX B LABORATORY GS INTERFACE SETUP

This appendix lists the parts and software required for a minimal Raspberry Pi laboratory ground station setup which can be used for a test of communication interface prior to EM testing.

Parts

- Raspberry Pi (recommended 4 and greater) with Raspbian OS (headless is sufficient)
- CAN & RS485 Hat by Waveshare
    - https://www.waveshare.com/wiki/RS485_CAN_HAT#BCM2835
- CAN Alternative - PEAK PCAN-USB
    - https://www.peak-system.com/PCAN-USB.199.0.html?&L=1
- RS485 Alternative - Generic RS485 USB
- Recommended to use FTDI based devices for best OS support

Software

- VCOM - VZLU satellite terminal
    - https://gitlab.com/vzlu/sw/vcom
- Build and install according to instructions in the repository
- Basic verification of connectivity is ensured without extra plugins using
    - ping, ident, cmp commands
    - pt - pass-through command