



Unicorn Payload Interface Control Document (ICD) / Payload User Guide (PUG) v1.0

About Unicorn-2

Unicorn-2 is a flight proven Pico-satellite (Picosat) platform conforming to the PocketQube (PQ) standard. Unicorn-2 is classed as a 3p (triple PocketQube) and was the first 3p to be launched into orbit and become operational. This document is intended to give an overview of the payload interface to the Unicorn platform.

Unicorn-2 was designed to democratise access to space for organisations wanting reliable, low-cost and fast development cycles for in-orbit demonstration..



Unicorn team shipping out completed Unicorns to launch site

Heritage

On the 6th of December 2019, two Unicorn-2 platforms were launched into orbit. The launch was part of Alba Cluster 2 and validated both Unicorns and the Albapod systems. These were placed in orbit using Rocketlab's Electron launch vehicle. The customer confirmed reception of the signal from the spacecraft, the first Unicorn to phone home from orbit!

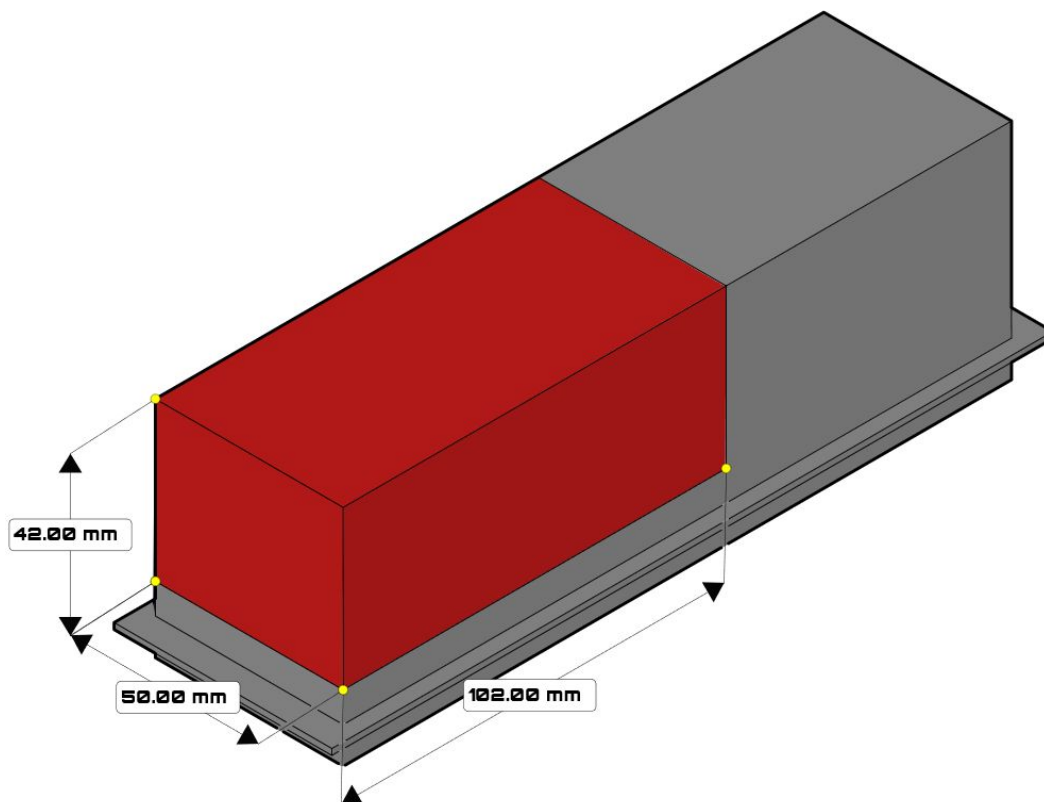


Launch of Alba Cluster 2 on Electron's 'Running out of Fingers' launch

1. Mechanical Interface

Total available volume

Dimensional Drawing



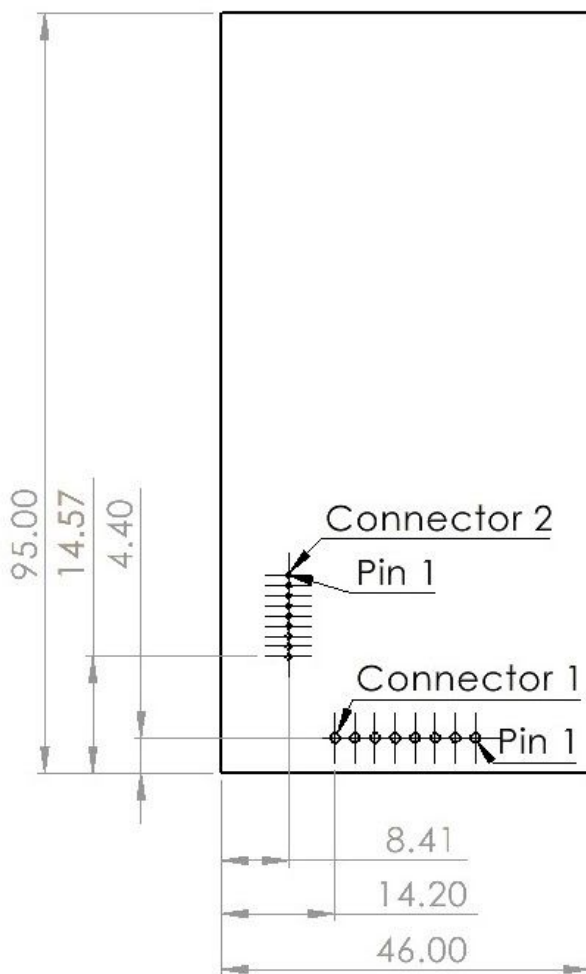
The total volume available is approximately 2p, or in cubesat terminology 0.25U.

Total available mass

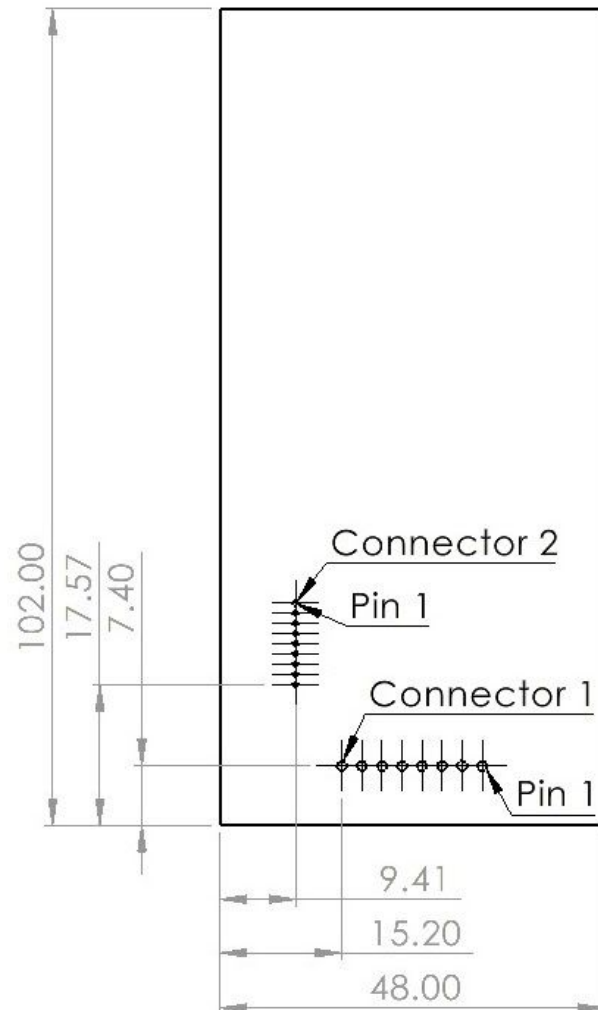
Payloads flying on Unicorn must have a mass of less than or equal to 200 grams.

Mechanical electrical connector location

Unicorn Regular

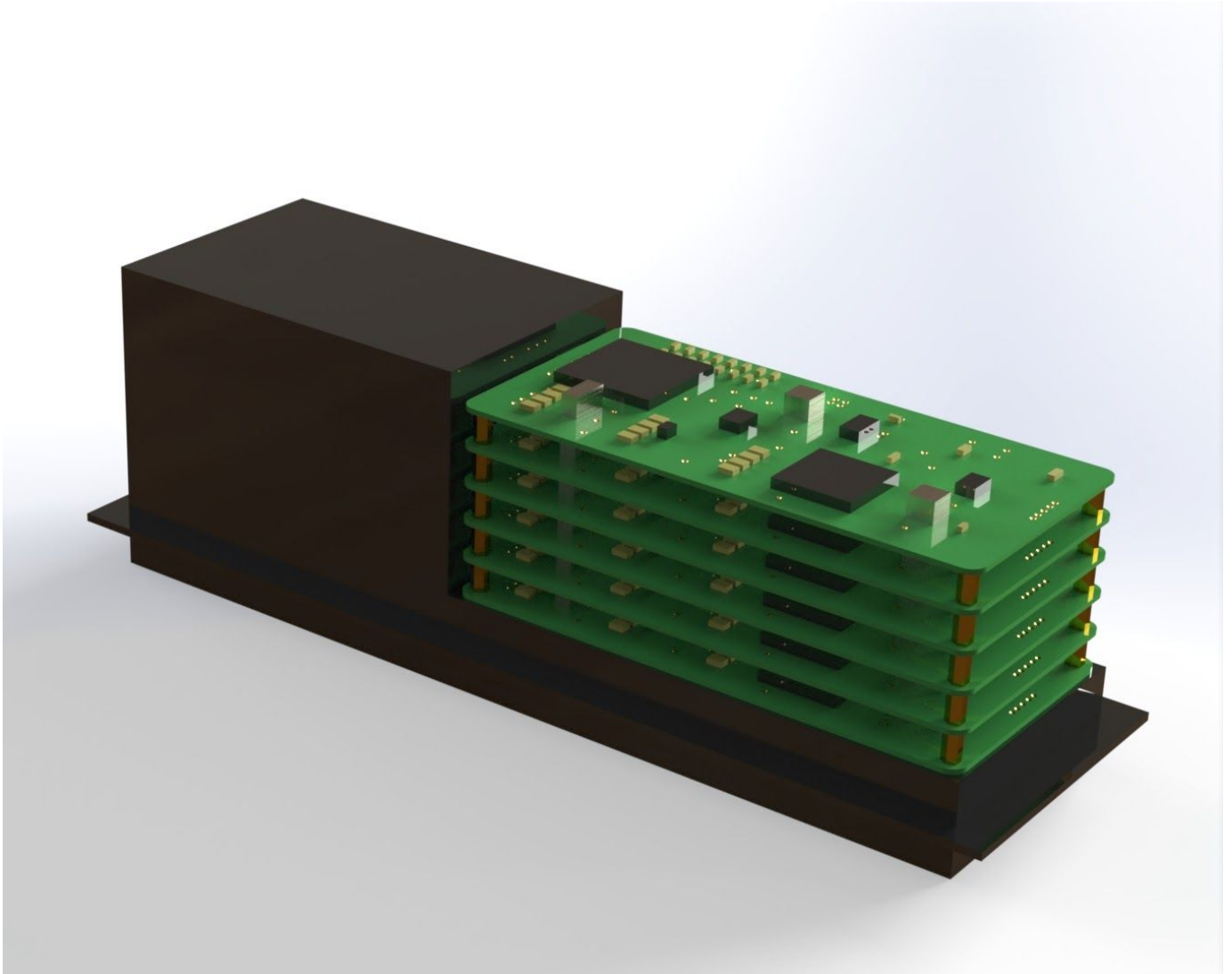


Unicorn XL



Mechanical examples pcb stacks

Horizontal 6 board stack pcb example

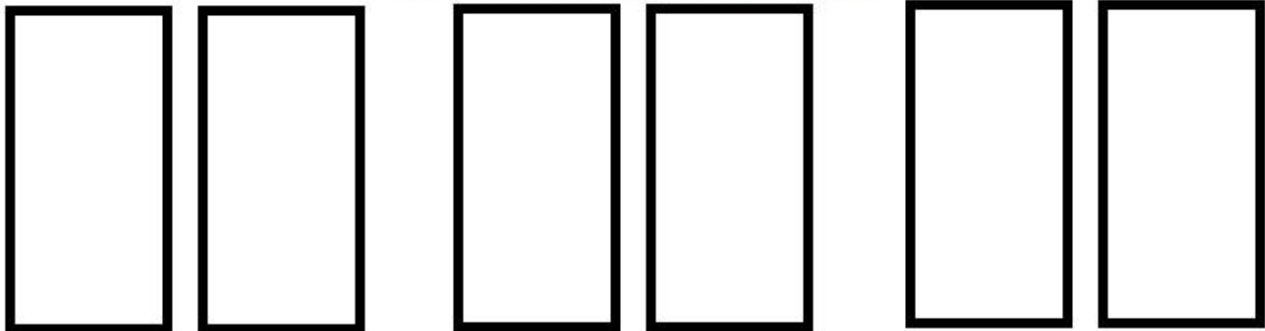


	Dimensions	Board Name
Recommended board size:	46mm (w) x 95mm (l)	Unicorn Regular Payload Board
Maximum board size:	48mm (w) x 102mm (l)	Unicorn XL Payload Board
Type of missions:	FPGA/OBC processing heavy, payloads converting from PC 104 layouts	

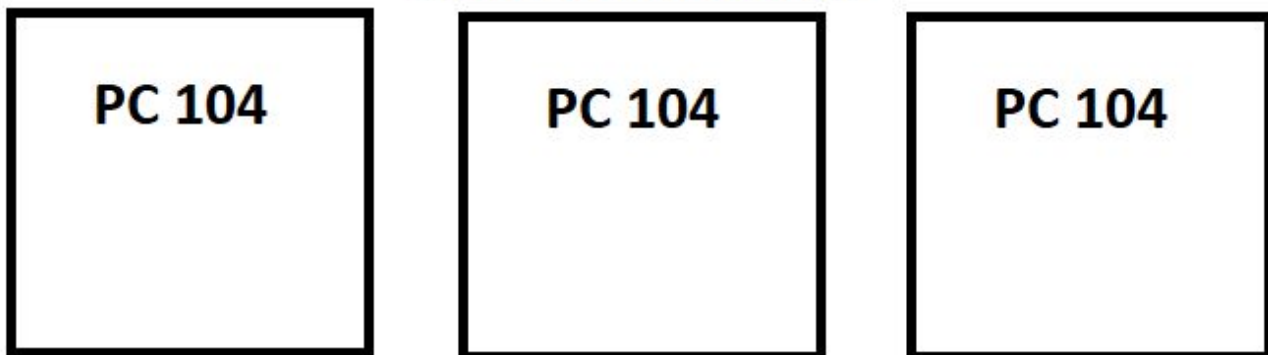
Unicorn vs PC/104

This Unicorn R & XL board configuration is designed in part for customers who have previous payloads designed in the PC/104 cubesat form factor. Payload teams can split up their boards into smaller Unicorn R and Unicorn XL boards to accommodate the equivalent surface area of 3 PC/104 boards within 6 Unicorn boards.

6 x Unicorn Boards

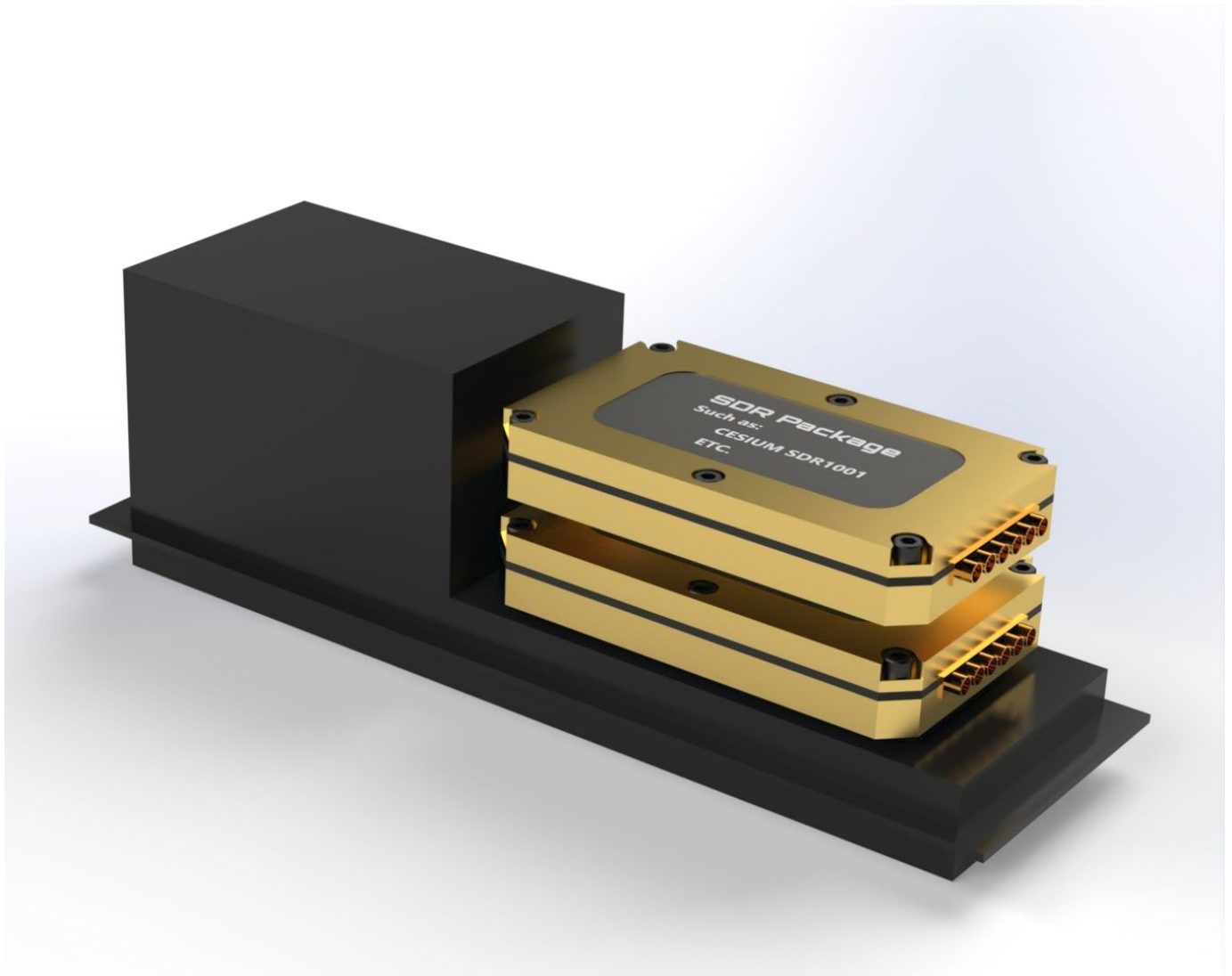


3 x PC104 Boards



Name of Board	Surface area of Board (cm ²)	QTY	Total Area (cm ²)
Unicorn R	43.70	6	262.20
Unicorn XL	48.96	6	293.76
PC/104	86.40	3	259.20

Horizontal 2 COTS radio boards stacked



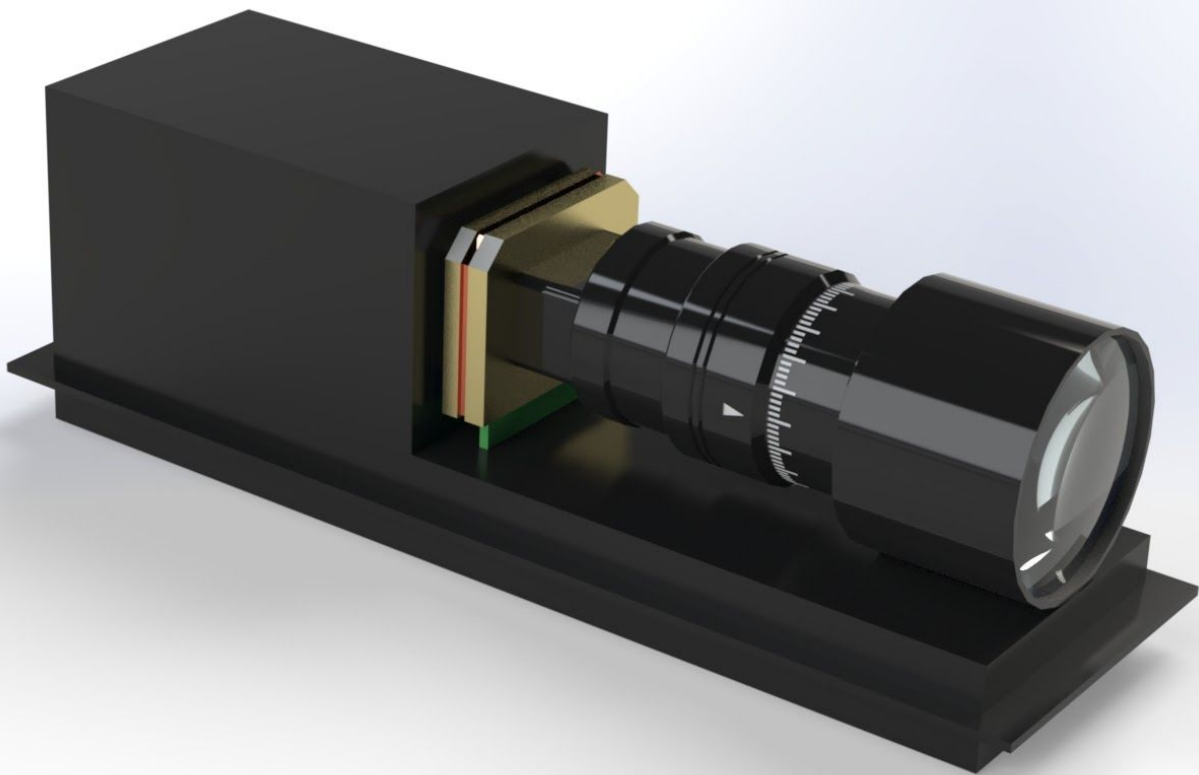
Type of Payload

Software Defined Radio (SDR) with Antenna front end

Type of mission:

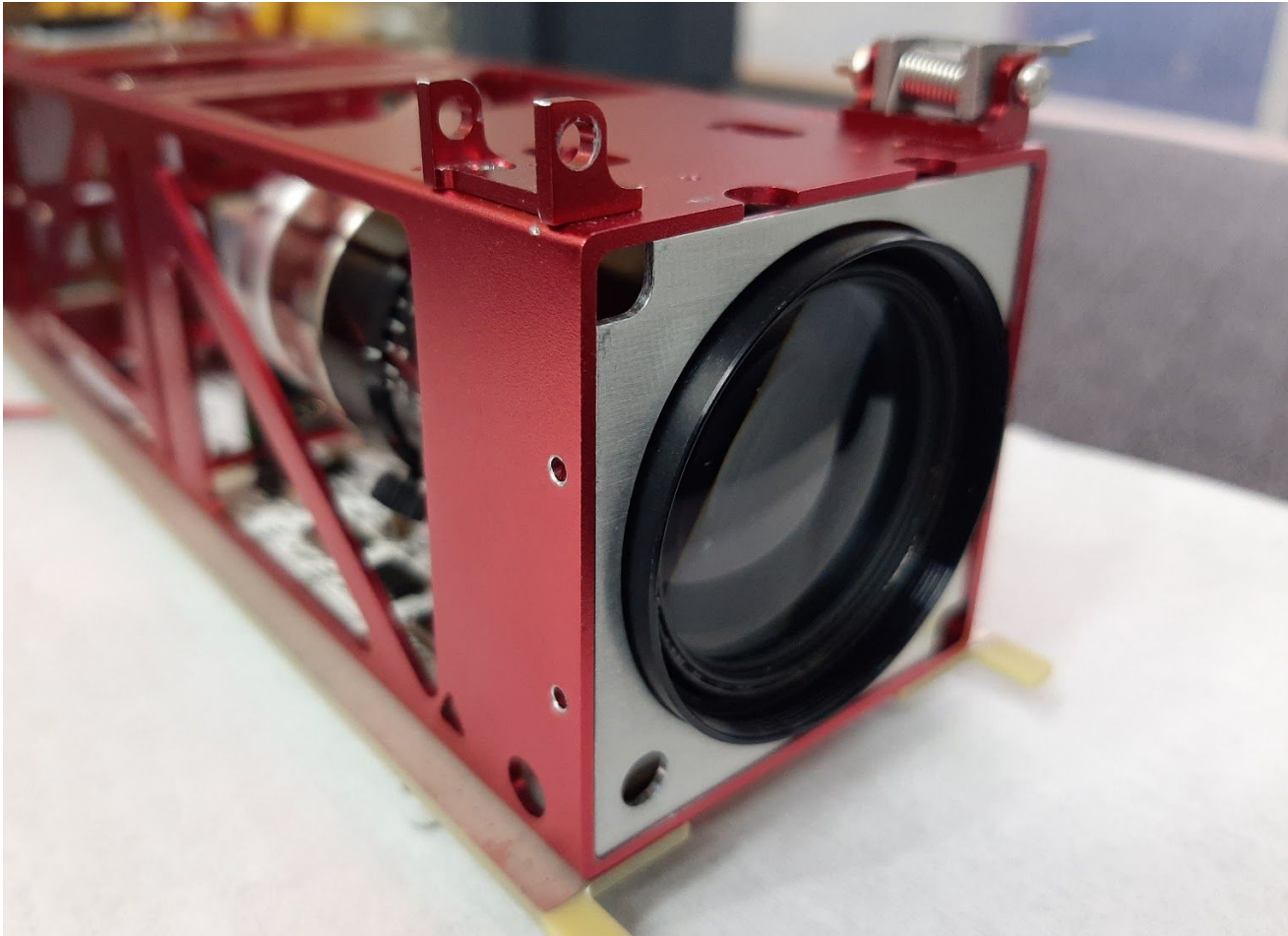
Internet of Things (IOT), Spectrum monitoring, ADSB receiver,
Spectrum Bring into Service mission, radio occultation, intersatellite network

Earth Observation Payload examples



Type of Payload: Earth Observation imager,

Type of mission: Optical, Near Infrared, Hyperspectral, Tech Demo, Early commercialisation,



Unicorn-2a mission with Alba Imaging Solution, 25m GSD at 500km Orbit

.Deployables

Deployable mechanisms/payloads are welcome on AlbaPod, but cannot touch the wall due to the increased risk jamming the pusher plate. All deployables must be constrained while in the AlbaPod. The only face available for payload deployables is the top face of the Unicorn payload bay. The maximum available envelope is 9mm. Deployable payloads must attach to the Unicorn payload bay chassis.

2. Electrical/Software Interface

Electrical Interface 1

Connector: 2.54mm pitch through hole

Pin No	Allocation	Comments
8	I2C SCL	Payload I2C Bus
7	I2C SDA	Payload I2C Bus
6	3v3 Payload	Line rated for 500mA
5	Ground	Payload GND to Unicorn
4	SPI CLK	Payload SPI Bus
3	SPI MISO	Payload SPI Bus
2	SPI MOSI	Payload SPI Bus
1	SPI Chip Select	Payload SPI Bus

Electrical Interface 2

Connector: 1.27mm pitch through hole

Pin No	Allocation	Comments
8	GPIO	Unicorn GPIO for Payload
7	UART RX	UART, Payload to Unicorn
6	UART TX	UART, Unicorn to Payload
5	NC	
4	NC	
3	Ground	Payload GND to Unicorn
2	3v3 Payload	Additional connection to Interface 1, Pin 6
1	5V Payload	Line rated for 500mA

The electrical interface can be customised depending on the payload customer's requirements, this should be included at the proposal stage.

Power budget

For a nominal 500km SSO orbit, Unicorn payloads will have up to 3.0 watt-hours (Wh) available per orbit. This can be improved depending on utilisation of ADCS and mission pointing requirements.

Software interface

Unicorn supports 3 payload communication protocols as standard. These are UART, SPI and I2C. Please see default settings below:

- **UART** baud rate: up to 230 400, LSB first, no parity, 8 data bits, 1 stop bit.
- **SPI** (payload is slave): bitrate: 500 000, data size: 8 bits, POL0_PHA0
- **I2C** (payload is slave): bitrate: 400 000

Alba can add support for additional payload communication protocols as required, this should be included at the proposal stage.

3. Other Information

Materials Payload Bay

It is expected that all materials in Unicorn payload bay will be low outgassing and be baked out before flight.

Alba can provide cad files of the payload bay area and structure in order to determine the best mechanical mounting of the payload to the payload chassis.

Propulsion

If you are looking to fly propulsion systems, please contact us to discuss.

Pressure Vessels

No pressurised containers are allowed onboard.

4. Qualification Testing/Flight Acceptance

All Unicorn payloads must complete a vibration test for sinusoidal and random vibration before being integrated into AlbaPod. This can be found within the launch vehicle suppliers Payload User Guide (PUG). All PocketQubes must complete a thermal vacuum bakeout, to boil off sublimates and derisk outgassing issues for pod integration.

Licensing

All payloads must have frequencies coordinated by IARU, ITU and any national spectrum management agency. Satellites must be registered to their countries space objects registry (if in place).

Payload and Spacecraft Integration

Integration into Unicorn will occur at Alba Orbital premises unless otherwise agreed. We expect this to occur approximately 90-120 days before launch. Integration of spacecraft into Albapod will occur 60-90 days before launch. Unicorn customers are required to be onsite for this procedure. Our current address is:

105, 201 & 209 Oxford House,
71 Oxford Street,
Glasgow, G5 9EP
Scotland, United Kingdom

Facilities

All payload integration occurs within Alba Orbital's Class 10,000 cleanroom. Customer will have access to:

- Tyvek suits, gloves and masks will be provided to all customer staff during integration.
- ESD protected benches and wrist straps.
- Benchtop power supplies, up to 30v/5a on request
- Wifi and Wired internet
- Office hot desking facilities
- Breakout sofa area and meeting room facilities on request



Alba Orbital Class 10,000 cleanroom

Access to the Payload after Integration

There will be no way to remove a PocketQube from the AlbaPod after integration. Please ensure you do not require access. The next time to access the payload will be on orbit!

Contact

If you require more information about Unicorn-2, please get in touch via email, our address is:

e: contact@albaorbital.com

5. Disclaimer

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