CubeSat Development Platform

Datasheet

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Supporting the Development of Future Space Missions

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General Description

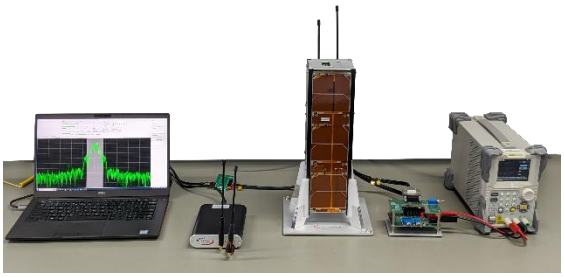
The ISISPACE CubeSat Development Platform (CDP) is the quickest and easiest solution to test, train, and practice spacecraft operation and payload integration on representative satellite hardware. As the CubeSat Development Platform architecture is based on ISISPACE's heritage platform design, it also provides a reliable and representative environment for the development of future missions using our 1-3U platform. The setup includes the required ground support equipment and software libraries for interfacing with the satellite and is optimized for using it in a laboratory environment. The unit comes with our UHF/VHF transceiver, which is compatible with ISISPACE ground station radio products and kits in VHF, and UHF. This product is perfect to emulate a ground station during end-to-end testing in the lab, at test sites or at the launch site.

Product Features

- Up to 2U of payload volume
- 3x Engineering model solar panels with integrated sensors
- UHF/VHF transceiver
- Electrical VHF/UHF Antenna Model
- 3-axis magnetorquer & magnetometers
- Multiple 3.3V and 5V regulated and switchable power lines
- UART(RS-232), SPI, GPIO, and I^2C bus data interfaces available
- 2x2 GB redundant on-board memory storage

Software features

- On board
  - FreeRTOS
  - Hardware abstraction layer
  - System interface Library
  - Demonstration software
- Ground PC
  - IDE and debug terminal
  - Radio GSE software and GUI



In the Box

- ISISPACE CubeSat Development Platform
- CDP User Manual
- Payload Integration Procedure
- Software Development Kit (SDK)
- OBC Programming & Debug Interface
- Power EGSE
- RF EGSE
- Horizontal, Vertical & Stack 1U Jig
- Tooling set
- 20 hours of Engineering support
- Excluded: Laptop & power supply

Flight heritage & Quality Assurance

- Design based on heritage from several CubeSat missions and platform since 2014.
- ISISPACE product assurance and quality control standards

Optional Support & Services

- Training workshops:
  - Flight software development
  - Satellite AIT/AIV
  - Satellite operations
  - Systems engineering & satellite design
- Customised workshops, e.g. AIV support

Subsystems

Command & Data Handling

The ISISPACE on-board computer (OBC) is a flight proven, high performance processing unit based around an ARM9 processor with a clock speed of 400 MHz and offers a multitude of standardized interfaces. Combined with its daughterboard architecture, the OBC allows for easy addition of mission specific electronics or interfaces, making it the ideal candidate for a main mission computer or payload processing unit.

Communication

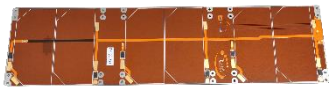
The ISISPACE VHF uplink/UHF downlink transceiver (TRXVU) is a full-duplex communication system for CubeSat TT&C applications. It is low power, low mass, and highly configurable, offering the flexibility of changing data rates and frequencies in flight. It comes with an ISISPACE Electrical Antenna which has identical functional, electrical, and software interfaces as a flight antenna model but does not feature the flight antennas and mechanical parts. Communication with the TRXVU can be through the data umbilical or the diamond antennas using the RF EGSE. The antenna includes LED indicators for reporting the antenna deployment status (stowed/deployed)

Power Conditioning & Distribution

The ISISPACE Compact Electrical Power System (ICEPS – Type B) is a compact power system, ideal for powering 1U CubeSats. The system leverages wide bandgap semiconductor technologies, implementing GaN-FETs to improve solar power conversion efficiency and performance. It is equipped with an integrated heater, hardware-based Maximum Power Point Tracking (MPPT) and hardware voltage and over-current protection. It has a low (idle) power consumption and dedicated emergency low power mode for EPS survivability.

Engineering Model Solar Panels

The CDP contains three ISISPACE Engineering Model solar Panels that are electrically representative to flight model solar panels, including sensors, but without the solar cells populated. Each panel is equipped with a temperature sensor and a photodiode, which delivers analogue sensor data to the onboard computer.



Attitude Control & Determination

The ISISPACE MagneTorQuer subsystem (IMTQ) is a 3-axis magnetic actuation and control system for CubeSats, designed as a stand-alone detumbling system. It provides an actuation of 0.2 Am^2 in every axis and contains an onboard three axis magnetometer, current sensors for each torquers, temperature telemetry of actuators and includes a detumbling algorithm.

Structure

The ISISPACE 3U structure acts as the payload mounting interface, and accommodates avionics boards and components in a stack. The stacks of PCBs and other flight modules can be built up first in the secondary structure and integrated with the load-carrying frames at the end of the process. The modular chassis allows up to three 1-Unit stacks of PCBs, or other modules, to be mounted inside the chassis.

Ordering information

Please contact sales@isispace.nl for ordering information.

Platform Specifications

Parameter		Typical Value	Comments
Physical Characteristics			
Mass		Platform mass: <1.8 kg	
Data Characteristics			
Data Storage		2x2 GB	
Data bus		I^2C	
Operating System		FreeRTOS	
Electrical Characteristics			
Power available to payload		Up to 15W	On a regulated +5V power line
Battery capacity		45 Wh	ICEPS Type B (4 cells)
Maximum Current		Up to 3 A per power line Up to 4 A total draw from batteries	Batteries have a current outflow limit of 4 A at the battery voltage
RF Characteristics			
Uplink Frequency (VHF)	Amateur Band	145.8 – 146 MHz	Please note that for flight models, the operator must ensure compliancy with ITU and IARU regulations when using the amateur band.
	Commercial Band	148 – 150.05 MHz	
Downlink Frequency (UHF)	Amateur Band	435 – 438 MHz	
	Commercial Band	400.15 – 402 MHz	
Uplink Bitrate		9.6 kbps	
Downlink Bitrate		1.2 – 9.6 kbps	Variable
Data Link Layer Protocol		AX.25	Uplink & Downlink
AOCS Characteristics			
Detumbling Capability in flight		≤1°/s spin in each axis	Enabled by the ISISPACE MagneTorQuer (IMTQ)
Attitude Sensors		Photodiodes on Engineering Model side panel	Available to use as Coarse Sun Sensors

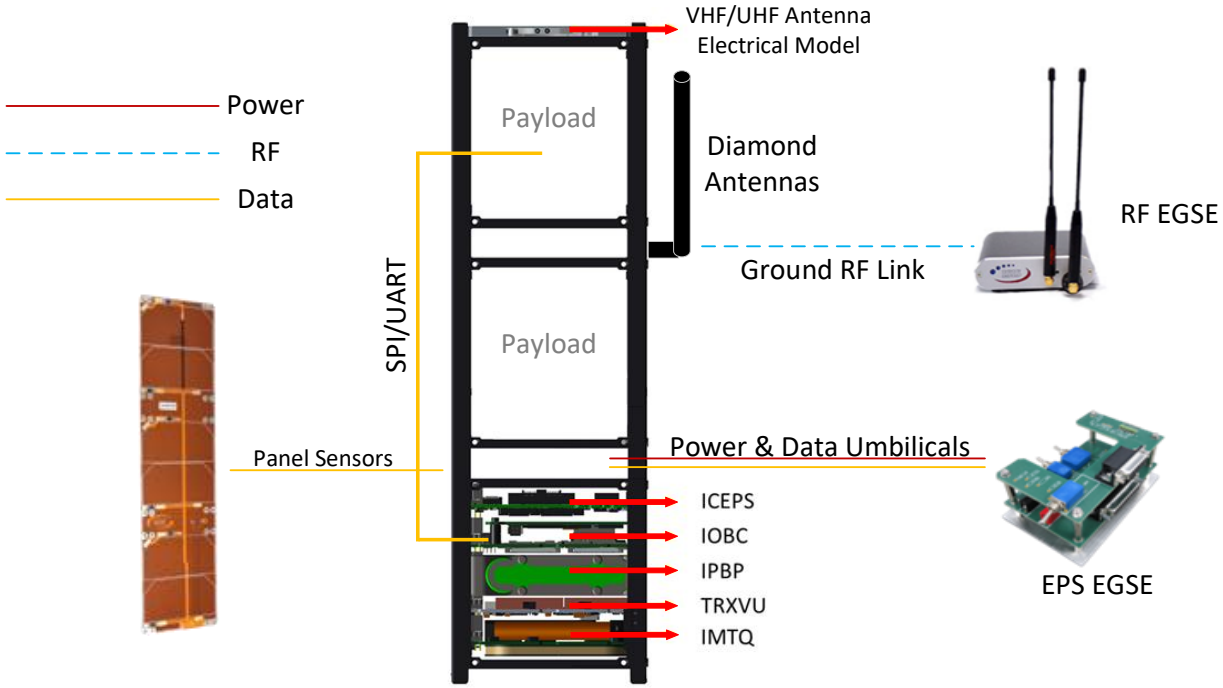
Payload Interfaces

Parameter		Typical Value	Comments
Data	Point to point	1x UART	LVCMOS compatible
		2x SPI	Not LVDS
		2x GPIO	Unidirectional, OBC output
	Via PC104 (CSKB) Stack Connector	1x I2C bus	
		1x GPIO	Unidirectional, OBC output
Power	Point to point	2x 5V	Switchable power line
		1x 3.3V	
	Via PC104 (CSKB) Stack Connector	3x 3.3V	Switchable power lines
		3x 5V	
		1x 3.3V	Permanent power line
		1x 5V	
		1x 16V (unregulated)	Permanent battery voltage power line
Mechanical	2U is available for use by the payload. Please refer to the following webpage regarding mechanical dimensions of CubeSat units: https://www.isispace.nl/cubesat-information/		

Harnessing & Grounding

Harnessing Scheme

The majority of the power and data interfaces within the platform go via the PC104 CubeSat Kit Bus (CSKB) interface on each subsystems. Some interfaces go via point-to-point harnessing, with umbilicals connecting the power GSE to the platform. The RF EGSE inteface with the radio via RF signal using two diamond antennas installed on one of the 3U panels.



Grounding Scheme

The grounding scheme of a satellite is a critical aspect of its design and operation to ensure its proper functioning and protection against electrical hazards. In a satellite, the grounding system typically consists of two main components: the structural grounding system and the electrical grounding system.

The structural grounding system is used to provide a low-impedance path for the dissipation of electrical charges that can accumulate on the surface of the satellite due to electrostatic discharges or other sources. In this system, the solar panels are hard-grounded to the satellite structure through the mounting bolts. This connection ensures that the entire satellite structure is at the same electrical potential and provides a safe path for the discharge of any electrical charges.

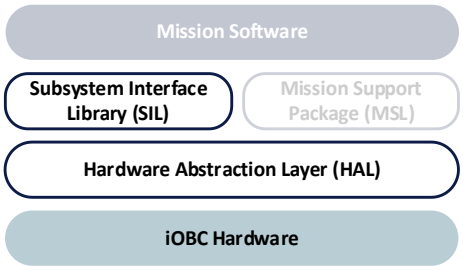
The electrical grounding system, on the other hand, is designed to provide a low-impedance path for the flow of electrical current in the event of a fault or a surge. The solar cell string, which consists of positive and negative terminals, is typically grounded using a capacitor. The purpose of this capacitor is to provide a low-impedance path for flow of the current. This helps to protect the solar cells and other electronic components from damage caused by electrical surges and other anomalies.

Software

To kick start your mission and flight software development, our CubeSat Development Platform comes with our Software Development Kit (SDK), which is built around the ISISPACE OBC and is a general-purpose computing board that adheres to the CubeSat standard. The SDK comes with demo code and software libraries, which can be used for accessing basic telemetry and command functions of each subsystem, including the user manual and how to use these libraries.

For interfacing with different subsystems, a Hardware Abstraction Layer (HAL) is provided which consists of the drivers to interact with all peripherals present on the IOBC board, and a Subsystem Interface Library (SIL) is provided for interfacing with different subsystems on the platform. The SDK consists of the following parts:

- Eclipse Integrated Development Environment: for developing, compiling, and debugging code
- ARM GCC compiler: used directly from Eclipse
- FreeRTOS: for simple multi-tasking of SW on the OBC
- Atmel SAM-BA: for flashing code to the OBC
- PuTTY console: for interfacing to the OBC
- Libraries from Atmel: for basic interfacing to the CPU
- FAT32 file system for SD-Cards
- ISISPACE Hardware Abstraction Layer with code examples to help users getting started quickly.



Flight Software Layers

Hardware Abstraction Layer (HAL)

The HAL allows for easy, efficient, and robust interfacing and consists of the following drivers, in addition to the libraries from Atmel and FAT32 file system: I2C, SPI, UART, ADC, PWM, GPIO, LED, FRAM, Timing, Watchdog and Reset, Supervisor interface. ISISPACE has developed additional libraries that can help in completing this task. Note that software for an entire mission involves some additional effort and shall be developed by the Customer. The OBC embedded SW can be developed and deployed to the OBC controller hardware using a computer running Microsoft Windows and a USB-to-Serial converter, which, connected via an umbilical cable, provides a separate full-duplex data channel between the development machine and the OBC controller.

Programs that control the attached hardware by interacting with the installed drivers are contained within the SDK installer package, along with applications that provide translation of program code to machine instructions (the compiler/linker toolchain) and a programming environment that aids in efficiently producing embeddable software.

Subsystem Interface Library

The (SIL) aims to simplify interfacing with different subsystems by providing a full implementation of their software command and control interfaces. This reduces the time required to develop the mission flight software.

Optionally, we can provide a dedicated Software development course to help you jump start your mission.

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