

ProtonX-Box™ Avionics Suite for CubeSats

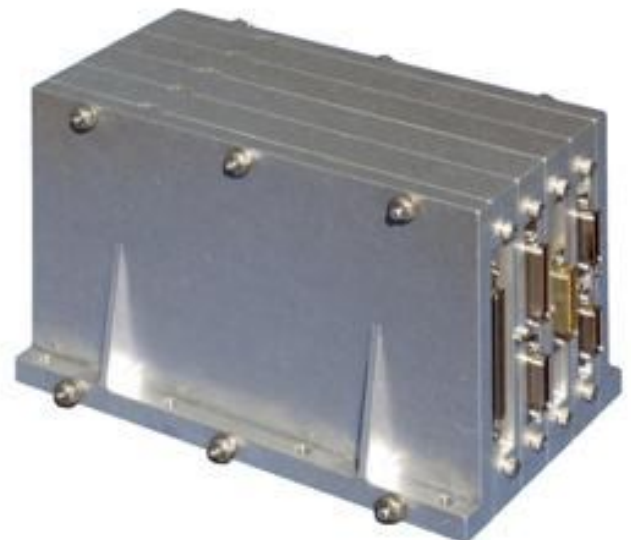
Overview

Space Micro offers a custom avionics suite perfect for CubeSats. The ProtonX-Box™ saves size and power while offering customization capability that can be built to exactly meet a wide range of applications. It is cost effective, lightweight, and easy to expand and customize without sacrificing performance or standard form factors.



Highlights

One of the most troublesome issues for satellites today is matching standards and dealing with compatibility issues without sacrificing performance, size, or weight. The Space Micro ProtonX-Box™ avionics suite's impressive modularity solves these problems by providing an easily expandable, customizable box with interchangeable slices that is lightweight and matches a wide range of satellite standards. It is AFRL Plug and Play (PNP) compatible, and matches standard form factors such as PC-104 for CubeSat, cPCI (3U/6U), PCI-104S, or fully customized. A typical five slice ProtonX-Box™ for CubeSat weights approximately 700g, depending on the configuration.



4-Slice ProtonX-Box™ in PCI-104S form factor

Applicability

The ProtonX-Box™ is perfect for any space avionics application due to its modularity, customization, and weight. It is particularly well suited for small satellites since slices can easily be removed or swapped out, thereby only using the resources that are absolutely necessary. With a wide range of available slices, it can provide all the functionality that even advanced satellite payloads require.

SMI-XBOX-PC104-XXXXX

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ProtonX-Box™ Avionics Suite for CubeSats

Features

- Wide variety of possible slices to customize to any application
- PC/104 form factor for CubeSats
- Highly expandable
- Impressive modularity
 - Processors
 - I/O
 - Sensors
 - PS Cards
- Small size and lightweight
- Unique/Custom needs
- Dedicated Communications and Data Handling (C&DH) subsystem
- All-in-one flight processor for C&DH
- Dedicated payload processing for speed and memory requirements
- Redundant boards co-located to simplify connection
- Image processing

Applications

- CubeSats

Examples of Available Modular Boards

Space Micro offers a number of board “slices” for the ProtonX-Box™, with many more in development.

Proton 200k™ Space Computer (SMI-P200k-PC104-XXXXX)

- Qualified Space Computer for onboard data processing and C&DH
- 8000 MIPS Fixed Point, 4000 MIPS with SEU mitigated to 1E-4 errors/day
- 1.8GFLOPS @ 300MHz Floating Point, 900MFLOPS @ 300MHz with SEU mitigated to 1E-4 errors/day



Proton 200k™ Space Computer

Analog IO Board

(SMI-AIO-PC104-XXXXX)

- Configurable with 12-bit /8-bit input/output channels
- 64 single ended multiplexed channels of resistance or voltage output measurements
- 6 single channels, single ended or differential
- Attitude controls such as gyroscope, magnetometer, and sun/star trackers
- Environmental controls such as mixed thermal sensors
- Any instrument requiring simultaneous measurements

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Digital IO Board

(SMI-DIO-PC104-XXXXX)

- Programmable UARTs
- 16 channels of RS-422/485 serial communications
- LVDS interface
- 36 bit bi-directional, programmable discrete logic I/O

Switched Power Card

(SMI-SWITCHED_POWER-PC104-XXXXX)

- Contains 4 H-bridges that can be configured to 8 half-bridges
- 8 high-side switches
- Switches external 28V spacecraft power
- Switches redundant slices



Switched Power Card

GPS Board

(SMI-GPS-PC104-XXXXX)

- Controls, monitors, and receives data from a separate COTS global navigation satellite system receiver

Power/Battery Management Board

(SMI-EPS-PC104-XXXXX)

- Manages 4 solar panels in parallel with spacecraft battery
- Switches panel connection to power bus depending on battery charge level and spacecraft current consumption

Power Supply Board

(SMI-POWER_SUPPLY-PC104-XXXXX)

- 3 isolated DC-DC converters
- Powered by external 28V spacecraft power
- Produces 3.3V, 5V, and $\pm 12V$ for PCI-104
- EMI filtering



Power Supply Board

Dosimeter Board

(SMI-MRAD-PC104-XXXXX)

- Passive and active sensors to monitor radiation species for in orbit space weather monitoring

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Software Defined Radio Board

(SMI-SDR-PC104-XXXXX)

- In-space reconfigurable for future needs and standards
- Multiple band coverage and direct conversion
- Uses as a command, data, or relay link

Driver/Relay Board

(SMI-DRIVER/RELAY-PC104-XXXXX)

- Control valve or actuators
- Control servos for sensor or antenna pointing
- Control robotics



Driver/Relay Board

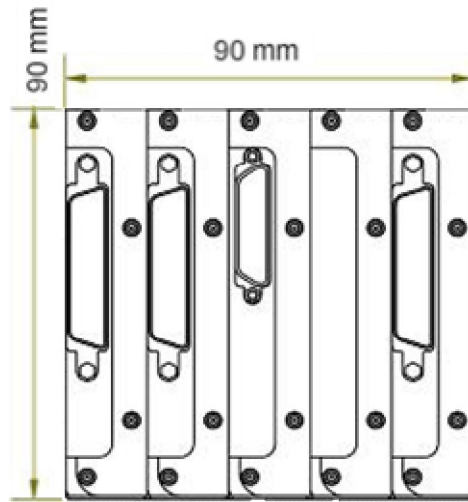
Other Popular Payload Boards

- Mass Spectrometer Board
- Magnetometer Board
- SpaceWire/Router Board
- Star Tracker Board
- Inertial Measurement Unit (IMU) Board
- Imaging Sensor/Star Camera Board
- Other I/O Board (such as 1553B/LVDS/1394 Board)
- More In Development

Modularity

Space Micro's ProtonX-Box™ is designed to provide for a high level of electrical and mechanical modularity, while simultaneously resulting in a very small size. It utilizes card-to-card stacking with a PCI bus as an electrical backplane giving it unlimited card expansion capability. In a CubeSat, all of the connectors can be directly board-to-board, thereby saving valuable space and weight. In some applications, the use of aluminum frame slices provide mechanical structure and thermal dissipation. In such cases, cards with different I/O requirements can be accommodated by using modular faceplates. This allows the frame itself to be identical for every card slice, while allowing the needed customization.

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Face of the avionics housing with connectors for CubeSat. Up to 5 cards can be fitted into a 1 U CubeSat.

Size, Weight, and Power

Board /Function	Footprint	Maximum Height (Total)	Weight	Power Consumption
SBC (Proton200k™)	3.550" x 3.775" (90x96 mm)	0.7" (18mm)	150g (0.33 lb)	4.24W
Analog IO	3.550" x 3.775" (90x96 mm)	0.7" (18mm)	150g (0.33 lb)	2.12W
Digital IO	3.550" x 3.775" (90x96 mm)	0.7" (18mm)	150g (0.33 lb)	1.12W
Power Supply	3.550" x 3.775" (90x96 mm)	0.7" (18mm)	200g (0.44 lb)	11W, depending on configuration
Battery Charger	3.550" x 3.775" (90x96 mm)	0.7" (18mm)	200g (0.44 lb)	0.45W
Power Switch	3.550" x 3.775" (90x96 mm)	0.7" (18mm)	180g (0.4 lb)	1.90W
GPS	3.550" x 3.775" (90x96 mm)	0.7" (18mm)	56g (0.12 lb)	1.65W
Dosimeter	3.550" x 3.775" (90x96 mm)	0.7" (18mm)	125g	<1.5W

The table above illustrates the size, weight, and power requirements of several available slices for the Space Micro ProtonX-Box™ avionics box in a CubeSat. Total mass including hardware, connectors, and fasteners for the current configuration with 5 slices listed in a CubeSat is approximately 700g (depending on slice selection). The total power used by a typical 5 slice stack is approximately 11W. The ProtonX-Box™ can be easily reconfigured for the CubeSat, depending on needs. Therefore, the size, weight, and power are different for each application.

ProtonX-Box™ Avionics Suite for CubeSats

Overview

Form Factor/Compatibility	PC/104 for CubeSat Also available in PCI-104S, cPCI(3U or 6U), AFRL PNP, or custom
Weight	1.54 lb (700 g) fully assembled with 5 slices, hardware, connectors, and fasteners. Other configurations & custom SWAP available
Size	Length depends on number of slices
Connectors	Board to board
End Slice Connectivity	Between slices and inter-vehicle
Frame and End Caps	Interfaces with CubeSat frame, or uses aluminum 6061-T651, configurable, conductive cooling, high strength, radiation shielding



ProtonX-Box™ for CubeSat applications with 5 boards. The form factor is customizable to meet the needs of CubeSats.

Contact Space Micro for complete systems characteristics, specific configurations, and availability

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