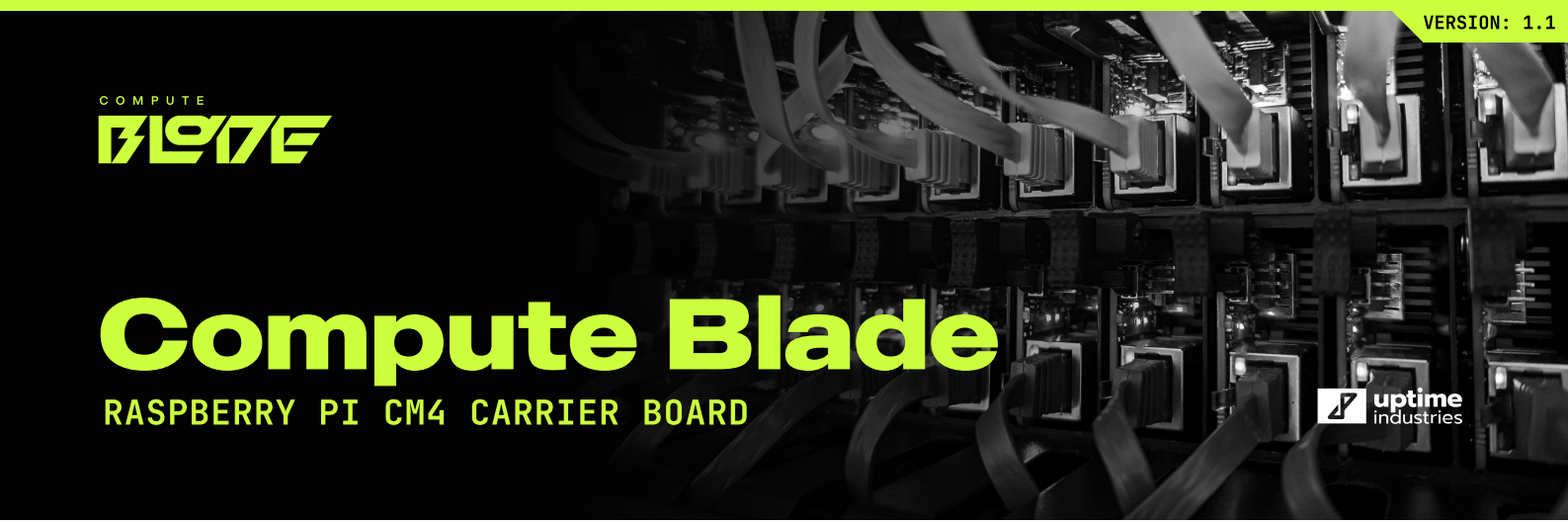
VERSION: 1.1

COMPUTE BLADE



Compute Blade

RASPBERRY PI CM4 CARRIER BOARD

uptime industries

Rack-mountable, PoE-powered carrier board for Raspberry Pi Compute Module 4 and compatible modules with all the necessary interfaces

The Compute Blade is a enterprise grade rack-mountable, PoE-powered carrier board for Raspberry Pi Compute Module 4 and compatible devices with all the necessary interfaces. With Compute Blade, you can create a high-density, low-power-consuming, plug-and-play blade server for home or data-center use.

Key Features

- Raspberry Pi CM4 support + clones
- NVMe SSD up to 22110 2230, 2242, 2260, 2280
- Power over Ethernet IEEE 802.3at (PoE+)
- Gigabit Ethernet
- Raspberry Pi CM4 by PoE 5.1V power supply
- WiFi, BT, and EEPROM write-protection
- HDMI (up to 4k60)
- USB-A, USB-C switchable USB input
- TPM 2.0, secure boot (DEV, TPM Version only)
- UART/PWM Fan Unit connector
- UART communication
- UART0 on the front
- nRPIBOOT
- Uptime high speed module support
- Controllable RGB LEDs

Document Version History

Release	Date	Description
1.0	Apr 17, 2024	Initial release
1.1	Aug 6, 2024	Images and schematics have been updated to reflect ComputeBlade V1.0 mk4 and V1.0 mk4-k update. It comes to replace the v1 and is available in two different silkscreened versions: a Kickstarter Edition and a version for general availability.

ComputeBlade Changelog

Version	Description
V0.9 RC2	Initial release
V1.0 mk1	Improvements: • Increased standoffs height for CM4 allows you to use different clones without worrying about the space under the module; • Power over Ethernet IEEE 802.3at (PoE+) up to 30W (normal operation 2-8W); • New PoE module (Silvertel AG5405) with one of the best characteristics in class; • Modified latch mounting holes for easier installation; • More test points added.
V1.0 mk4-k	Improvements: • Increased power on the 3.3V bus to 16.5W. Which will allow the use of future high-speed modules; • Added overload and short circuit protection to the 5V and 3.3V outputs on the board; • The possibility of powering the blade from the 5V pin has been removed; • Power Good LED on the board works even without the Compute Module; • The low-speed modules connection is turned 180°. Fixes: • The blue digital LED would light up sometimes on startup due to power interference. Added additional filtering to the diode signal line, and the problem was solved; • A certain number of devices from early v1 batches may experience a voltage surge at startup under certain conditions. In extreme cases, this could potentially destroy the device’s components. In cooperation with the manufacturer of the PoE module, additional stabilization of the PoE module output completely eliminated the problem.
V1.0 mk4	Improvements: • New TPM 2.0 module: OPTIGA TPM SLB 9672 as an upgrade of the previous generation;

Compute Blade Platform Applications

Home labs

An enterprise-level homelab experience that you can use to build, play with, and explore new technologies

Hosting provider

Provide dedicated resources and isolate customer machines on a physical layer, to protect against modern CPU/hypervisor exploits.

Edge servers

Reduce latency and extend compute power to make your processes leaner, more efficient, and more cost-effective.

CI/CD systems and Automated tests

Perform performance tests on dedicated hardware for results far more stable than running tests on virtual machines.

Stateless Computing

Seamlessly deploy specialized stateless computing platforms, such as OpenFaaS, onto the blades to enhance functionality and performance.

High Availability Computing

Deploy robust, high-availability computing to maintain critical operations and services with minimal downtime.

Smart Homes

Make your home server highly available and increase the possibilities e.g by adding more modules like the Uptime AI-Module.

Private Cloud

Create your own secure, scalable private cloud for efficient data management and tailored IT services.

Education

Enhance educational experiences with practical, hands-on tech learning, facilitating innovation and computing skills.

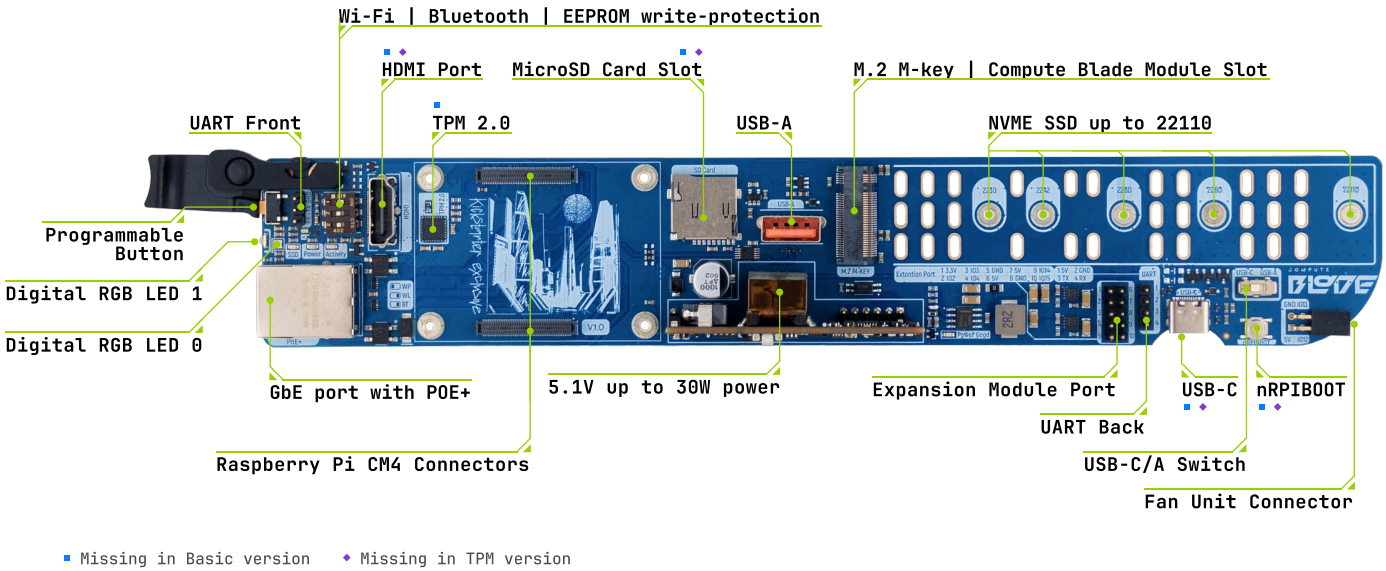
Scalable ARM Blade Server

Designed to work 24/7. Developed by listening and understanding the desires of real users. Fit up to 20 Compute Blades into a 1U rack space. Up to 80 ARM cores, 160GB RAM, and 10TB of NVMe flash storage in 1U 19-inch rack space.

Unlike conventional blade servers, our system eliminates a single point of failure as it doesn't rely on a server platform. While it still uses a PoE network switch (also necessary for blade servers), switches are simpler to replace or keep as spares compared to entire server platforms. Network equipment typically boasts high reliability.

Individual blades can be rebooted or power-cycled by momentarily disabling their switch port power. Thanks to the CM4's network boot feature, re-provisioning and system rescue are straightforward. Each blade is compact, devoid of moving parts, and can be easily shipped without special handling.

Specifications

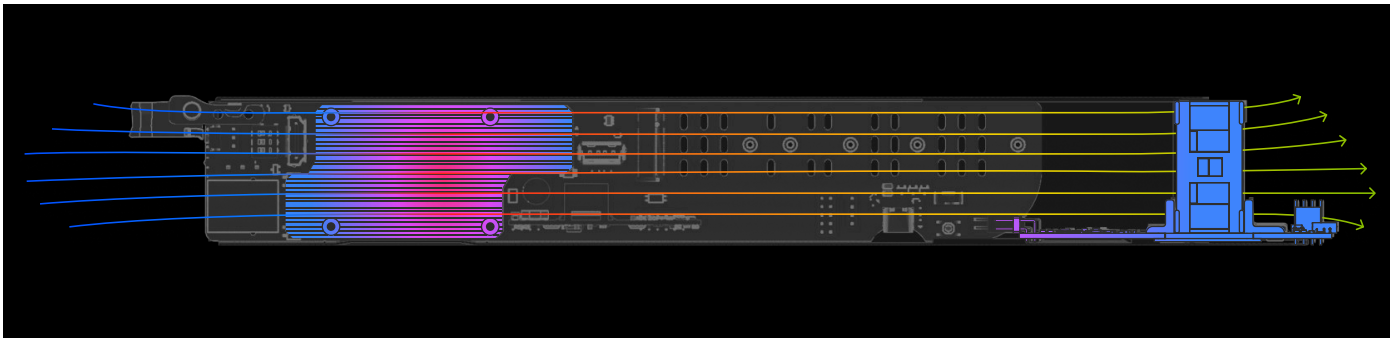


Compability	Raspberry Pi Compute Module 4 / 4 Lite
	Raspberry Pi Compute Module 4 Compatible Boards
Storage	M.2 NVMe up to 22110
	Micro SD
Networking	Gigabit Ethernet
	(Wi-Fi on some CM4 models, not recommended in rack usage)
GPIO	2 x UART
	7 x User Controllable GPIO including I2C
	Fan Unit Connector
	Programmable Button
	2 x Controllable RGB LEDs
Operating Voltage	5V - USB C
	5.1V - Power over Ethernet IEEE 802.3at (PoE+) up to 30W @5.1V
Input Power (Normal Operation)	2 - 8W
Ports	HDMI (4K60)
	USB A
	USB C
Security	TPM 2.0
	Hardware switchable Wi-Fi, Bluetooth and EEPROM write-protection
	Support for ZYMKEY 4i, Security Keys
Dimensions	42.5mm x 250mm x 17.5mm

Thermal Configuration

The Compute Blade is designed for deployment in enclosures, supporting configurations from a single pair in desktop enclosures to up to 10 pairs in a 19" BladeRunner rack-mounted chassis. Each pair is cooled using a specifically designed Fan Unit equipped with a single 40x40x20mm fan.

The design of the Fan Units provides robustness and reliability: in the event of one Compute Blade being disconnected or failing, the Fan Unit will continue to operate, maintaining effective cooling for the remaining blade.



Cooling Configuration

Paired Blades: Pairs of Compute Blades are physically separated and each pair is cooled by its dedicated Fan Unit.

Fan Unit Design: The Fan Units are designed for easy replacement without interrupting operation. Each Fan Unit receives power from both Compute Blades in the pair, ensuring that the fan continues to run even if one of the blades is powered off.

Thermal Dissipation Capacity

This cooling configuration can dissipate up to 60W of heat per slot, which represents the maximum power consumption of two blades. This level of thermal dissipation corresponds to an extreme case scenario. On average, measured thermal dissipation for a pair of Compute Blades rarely exceeds 20W.

Versions

Compute Blade Dev

Mostly used as master node and in development and homelab environments.

Compute Blade TPM

Basic Blade + advanced security

Compute Blade Basic

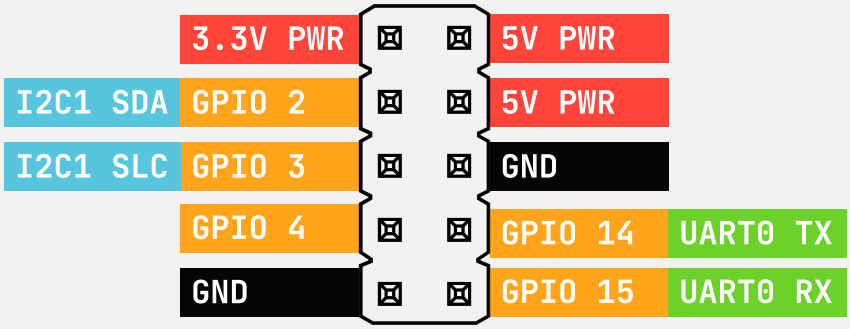
Mostly use for scaling your cluster environment. Contains only the necessary components for a enterprise grade worker node.

	Compute Blade Dev	Compute Blade TPM	Compute Blade Basic
Raspberry Pi CM4 port	✓	✓	✓
M.2 Key M up to 22110 for NVMe disks or high-speed modules	✓	✓	✓
1Gbit Ethernet with PoE up to 30W	✓	✓	✓
UART Front	✓	✓	✓
UART Back	✓	✓	✓
Expansion Module Port	✓	✓	✓
Compute Blade headers port	✓	✓	✓
Programmable Button	✓	✓	✓
Stealth mode	✓	✓	✓
Two digital LEDs	✓	✓	✓
USB-A	✓	✓	✓
TPM 2.0 onboard	✓	✓	✗
HDMI port	✓	✗	✗
USB-C for bootloader update	✓	✗	✗
MicroSD card slot	✓	✗	✗
Wi-Fi, BT, nRPIBOOT	SWITCHABLE	LOCKED	LOCKED

GPIO

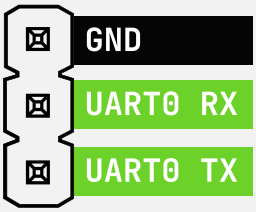
Expansion Module Port

This is the top part of the Raspberry Pi's GPIO connector. On the Compute Blade, PIN 1 corresponds to 3.3V, while on the Raspberry Pi's standard connector, it is labeled as 3.3V PWR.

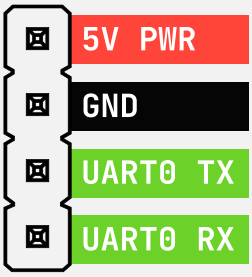


⚠ Short-circuiting the 3.3V and 5V supply will almost certainly destroy the CM4.

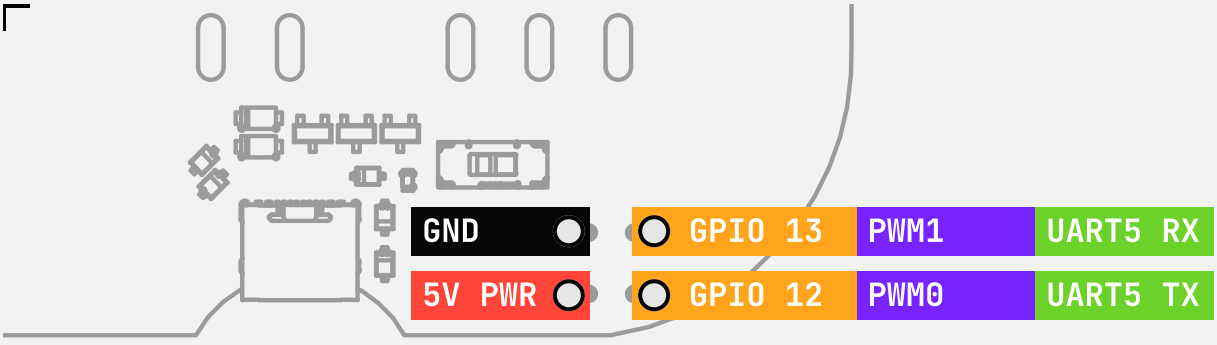
UART Front



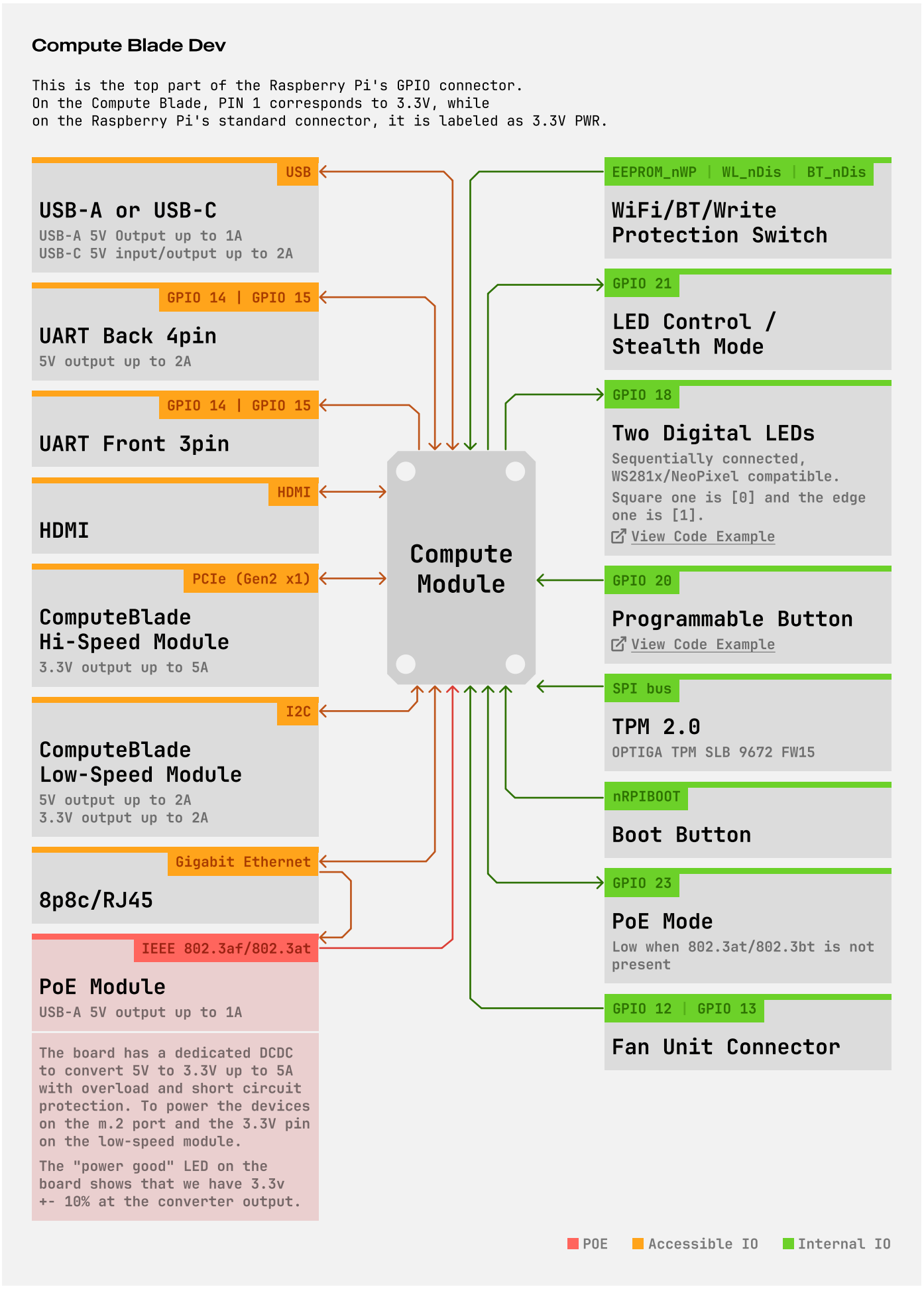
UART Back



Fan Unit Connector



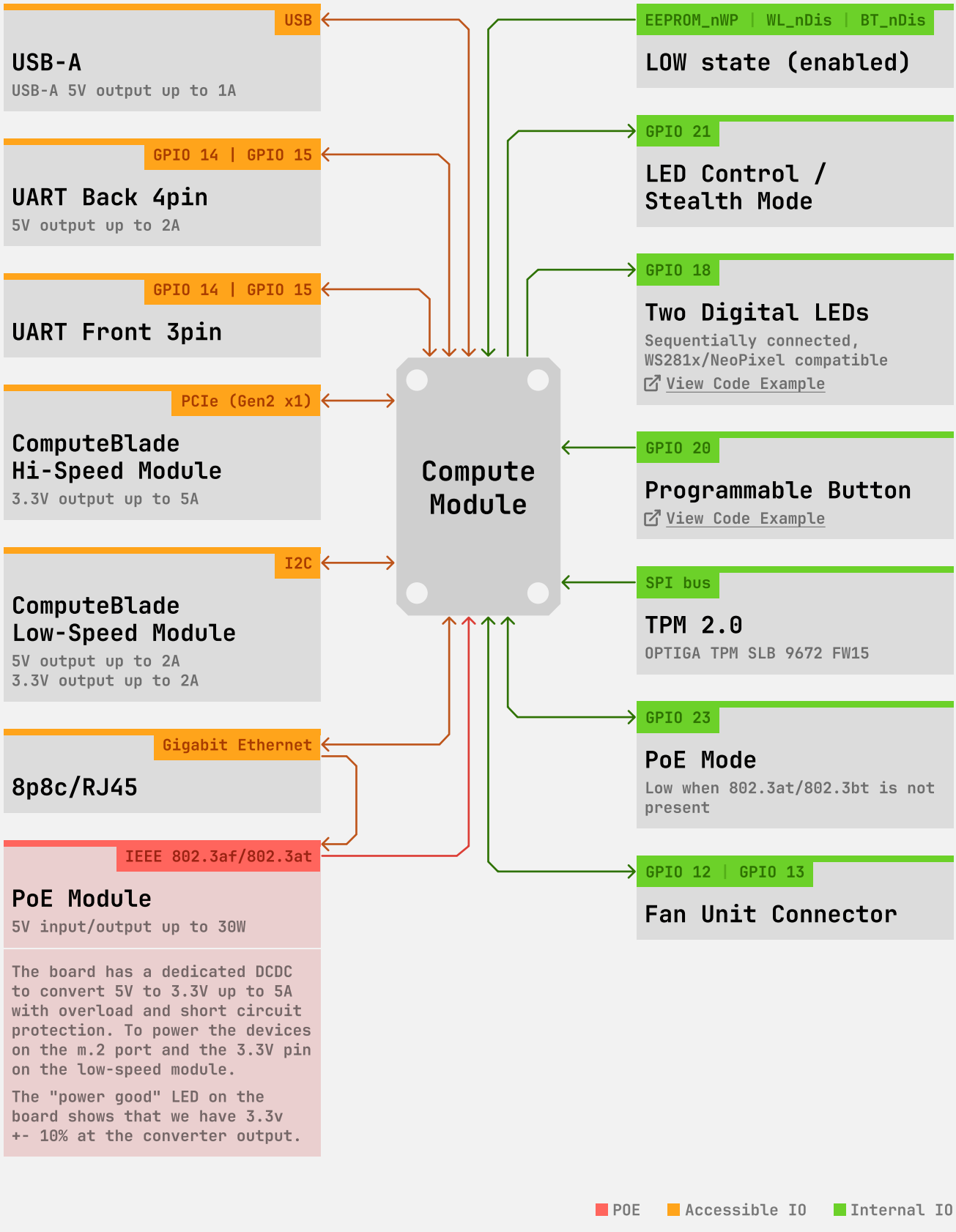
Block Scheme – Dev Compute Blade



Block Scheme – TMP Compute Blade

Compute Blade TMP

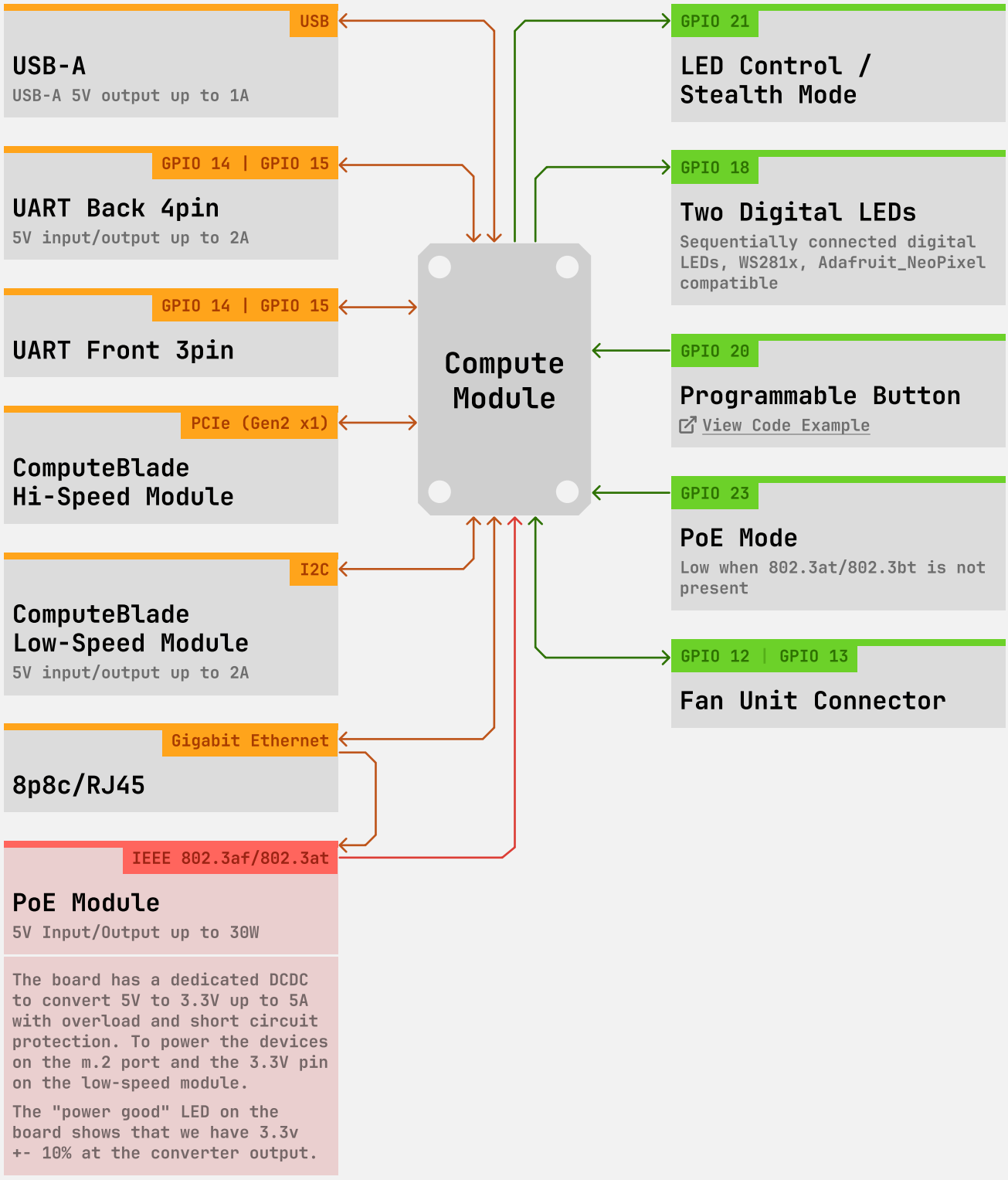
This is the top part of the Raspberry Pi's GPIO connector.
On the Compute Blade, PIN 1 corresponds to 3.3V, while
on the Raspberry Pi's standard connector, it is labeled as 3.3V PWR.



Block Scheme – Basic Compute Blade

Compute Blade Basic

This is the top part of the Raspberry Pi's GPIO connector.
On the Compute Blade, PIN 1 corresponds to 3.3V, while
on the Raspberry Pi's standard connector, it is labeled as 3.3V PWR.

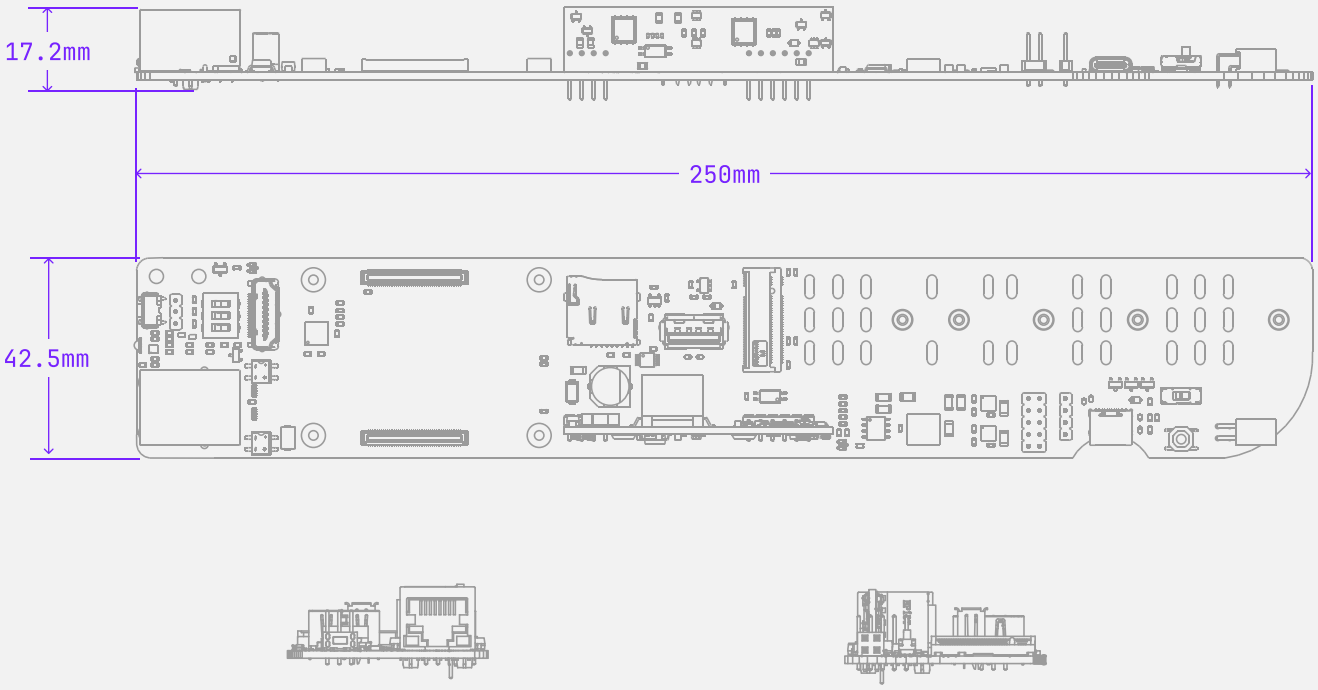


The board has a dedicated DCDC to convert 5V to 3.3V up to 5A with overload and short circuit protection. To power the devices on the m.2 port and the 3.3V pin on the low-speed module.

The "power good" LED on the board shows that we have 3.3v +- 10% at the converter output.

POE Accessible IO Internal IO

Mechanical



V0.9RC2, V1, V1 mk4, V1 mk4-k share the same dimensions

Documentation

DOCUMENTATION
docs.computeblade.com

GET STARTED
docs.computeblade.com/getting-started

DISCORD
uplab.pro/discord

GITHUB
github.com/uptime-industries

DATA SHEETS
https://docs.computeblade.com/data-sheets

3D MODELS
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