

UbiSwitch

Compact 11 Port Module with
1Gbps and 10Gbps Ethernet

Datasheet

Applies to:

MPN: BB-UBS-B-1

MPN: BB-UBS-B-1-NDAA

May 2024

Board revision B

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1 General Information

1.1 Functionality and Features of UbiSwitch

The BotBlox UbiSwitch is a compact embeddable ethernet switch module that houses 8 x 1GBASE-T ports and 3 10G MAC ports, designed for challenging environments.

UbiSwitch is a modular board and has to be mated with a baseboard to provide power supply and connector breakout. This allows UbiSwitch to form the heart of any flexible ethernet system through a custom baseboard design. UbiSwitch can be used immediately with the [BotBlox UbiConn](#) board, which provides a plug-and-play ethernet switch solution with 8 x 1Gbps PHY ports and 3 x 10Gbps SFP+ ports.

When used with UbiConn, UbiSwitch does not require any configuration or software to function. When used with a custom baseboard that uses different ethernet hardware on the 10G MAC ports (eg, 10GBASE-T copper PHYs), UbiSwitch requires modification to its firmware to run correctly. BotBlox can provide this via a static firmware configuration, or it can be configured dynamically over serial using BotBlox's upcoming Switch Management software.

1.1.1 Features

- 3 x 10GBASE-R/XGMII ethernet ports (universal 10Gbps media connectivity)
- 8 x 10/100/1000BASE-T ethernet ports
- Input voltage range from 5V to 60V
- 42mm x 42mm board size
- Samtec EDGE RATE® rugged modular connector for interconnection to baseboard
- Automatic MDI-X crossover and polarity correction on the 8 10/100/1000BASE-T ports
- Auto-negotiation on all ports with connected devices to achieve maximum speed
- Onboard STM32 microcontroller for static firmware configuration
- Onboard STM32 microcontroller for dynamic serial configuration (coming Q3 2023)
- Less than 5 Watts maximum power draw
- Three onboard solder jumpers for static (in-the-field) firmware configuration
- Plug and play functionality (no configuration necessary) when used with BotBlox UbiConn (or a functional equivalent to BotBlox UbiConn)

1.1.2 General Information

| | |
|------------------------------|--|
| Voltage Input | 5V to 60V DC (65V Absolute maximum) |
| Supported Protocols | 10BASE-T, 100BASE-TX, 1000BASE-T, 2.5GBASE-T, 5GBASE-T, 10GBASE-T, 10GBASE-R |
| Power Consumption | 4.6W maximum |
| Weight | 20 grams |
| Size | 42mm x 42mm x 9.8mm (without heatsink) |
| Operating Temperature | -70°C to +110°C |
| Storage Temperature | -70°C to +125°C |

Table 1: General Information

1.1.3 General Operating Instructions

UbiSwitch is designed for use in harsh environments, operating from a nominal supply voltage of 24V, but with the ability to operate from as low as 5V and as high as 60V.

A baseboard needs to be used with UbiSwitch to provide access to the ports and power on the board. To use UbiSwitch, first mate the board with a baseboard then apply an input voltage from 5 to 60V. If the BotBlox UbiConn baseboard is used (or any baseboard that incorporates SFPs on the 10G ports) then UbiSwitch will begin functioning as an unmanaged switch on all 11 ports without any configuration necessary. If a different baseboard is used (crucially, if it uses different 10G media on the 10G ports), then UbiSwitch will require configuration either via a static firmware update or a dynamic serial configuration (coming in Q3 2023).

1.2 Safety Information

- This device can operate on voltages near and above 60V. Please read this manual before operating.
- This device is fully functionally tested prior to shipment however in-application testing prior to integration is recommended.
- This device is provided as an electronic circuit board, and requires integration into chassis for full ingress protection.
- Do not use this product in wet environments without integrating into a chassis.
- Do not operate this product beyond the rated temperature and voltages.

1.3 Block Diagram

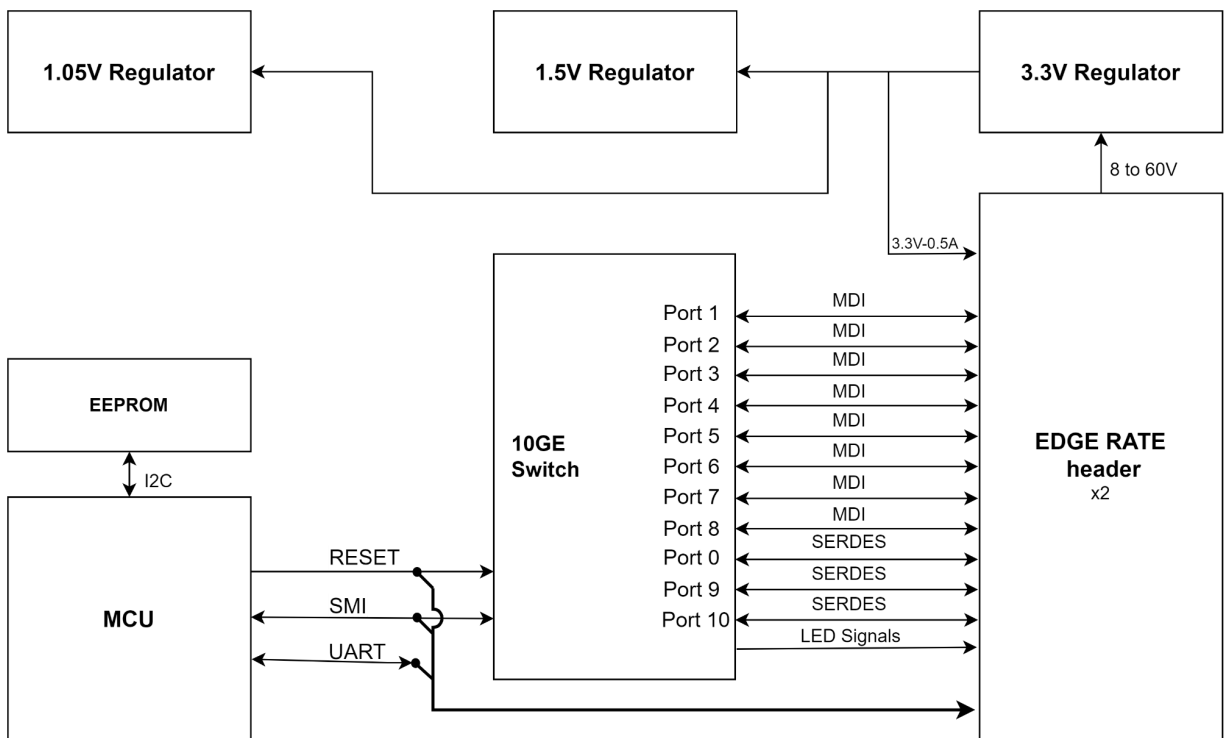


Figure 1: UbiSwitch Block Diagram

1.4 Included Equipment

The product includes the following:

- 1 x UbiSwitch Module
- 1 x UbiSwitch Heatsink

1.5 RoHS Compliance

The BotBlox UbiSwitch complies with the RoHS (Restriction of Hazardous Substances Directive) Certificate of Compliance.

2 Hardware Interfaces

2.1 Board Map

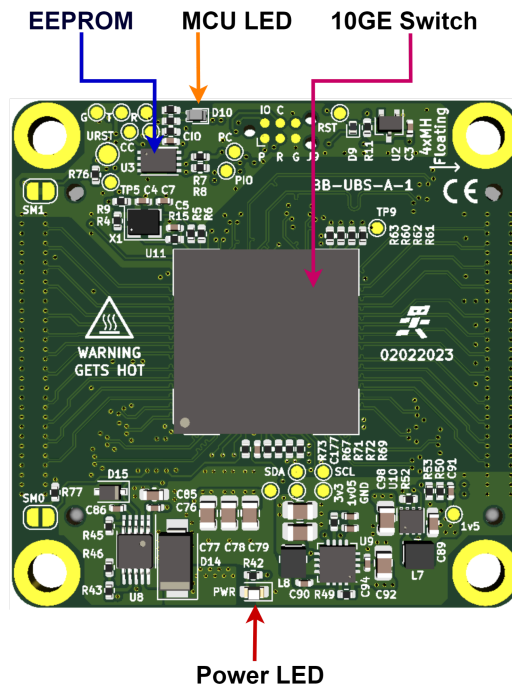


Figure 2: UbiSwitch Board Map (front)

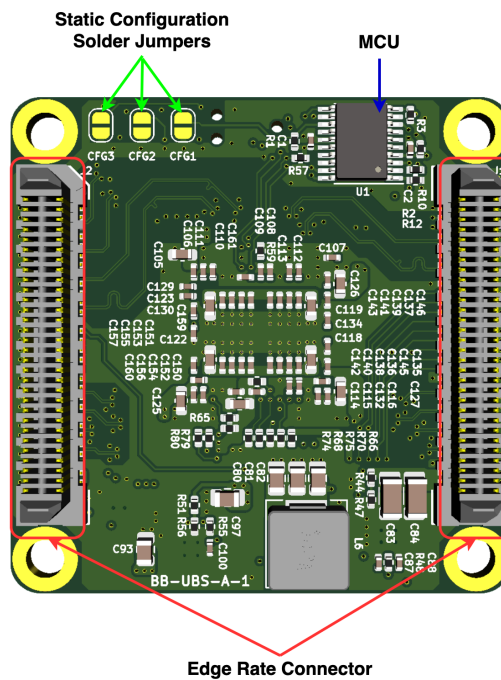


Figure 3: UbiSwitch Board Map (back)

2.2 Connectors and Pinouts

2.2.1 Edge Rate connector

The 8 ports, 3 SerDES, SMI, LED signals, UART, input voltage and output voltage are placed onto two Samtec Edge Rate™ (MPN: [ERM8-030-02.0-S-DV-TR](#)) stackable headers. The Edge Rate connector on the UbiSwitch Board is shown in figure 4 below. The Edge Rate connector provides a high quality connection optimized for signal integrity and a 0.8mm spacing for isolation protection.

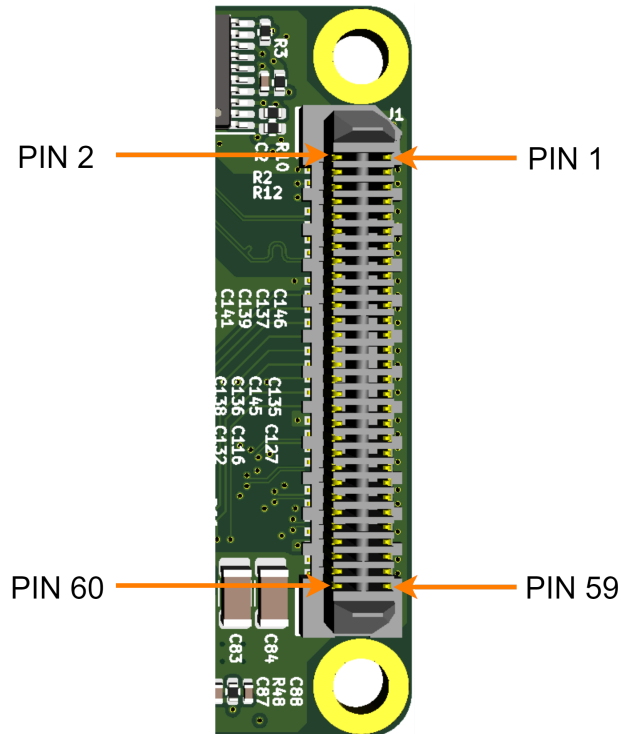


Figure 4: Edge Rate connector on UbiSwitch

Mating part: [ERF8-030-05.0-S-DV-K-TR](#) (used on UbiConn board)

The mating method is shown in figure 5 below.

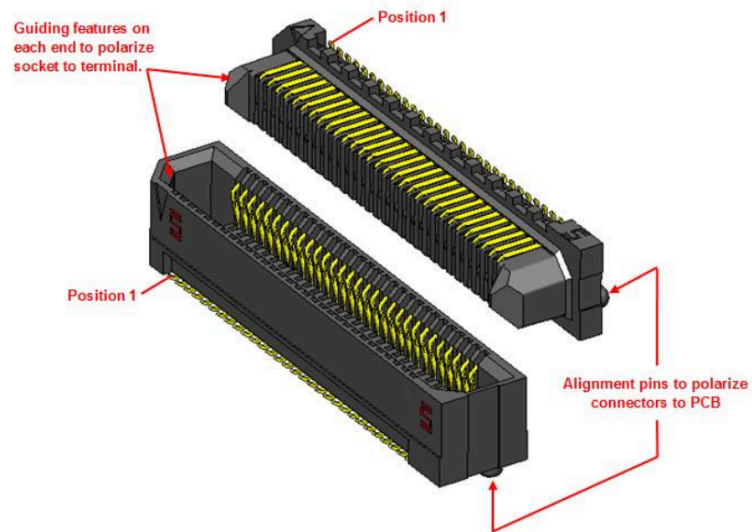


Figure 5: Edge Rate connector mating

The signal to pin assignments used on UbiSwitch is detailed in table 3 and table 4 below.

| Connector | Pin name | Pin number | Description |
|-----------|----------|------------|---------------------------------|
| J1 | GND | 1 | Ground |
| | GND | 2 | Ground |
| | GND | 6 | Ground |
| | GND | 12 | Ground |
| | GND | 18 | Ground |
| | GND | 19 | Ground |
| | GND | 37 | Ground |
| | GND | 38 | Ground |
| | GND | 55 | Ground |
| | GND | 56 | Ground |
| | GND | 57 | Ground |
| | GND | 59 | Ground |
| | VBUS | 58 | Input supply voltage, 5V to 60V |

| | | | |
|--|-------|----|---|
| | VBUS | 60 | Input supply voltage, 5V to 60V |
| | P1A_P | 3 | Port 1 1000BASE-T Differential Data Pair A ~ D Note: 100BASE-TX and 10BASE-Te are also supported on the A and B pairs. |
| | P1A_N | 5 | |
| | P1B_P | 9 | |
| | P1B_N | 7 | |
| | P1C_P | 11 | |
| | P1C_N | 13 | |
| | P1D_P | 17 | |
| | P1D_N | 15 | |
| | P2A_P | 21 | Port 2 1000BASE-T Differential Data Pair A ~ D Note: 100BASE-TX and 10BASE-Te are also supported on the A and B pairs. |
| | P2A_N | 23 | |
| | P2B_P | 27 | |
| | P2B_N | 25 | |
| | P2C_P | 29 | |
| | P2C_N | 31 | |
| | P2D_P | 35 | |
| | P2D_N | 33 | |
| | P3A_P | 39 | Port 3 1000BASE-T Differential Data Pair A ~ D Note: 100BASE-TX and 10BASE-Te are also supported on the A and B pairs. |
| | P3A_N | 41 | |
| | P3B_P | 45 | |
| | P3B_N | 43 | |
| | P3C_P | 47 | |
| | P3C_N | 49 | |
| | P3D_P | 53 | |
| | P3D_N | 51 | |
| | P4A_P | 40 | Port 4 1000BASE-T Differential Data Pair A ~ D |

| | | | |
|--|---------|----|--|
| | P4A_N | 42 | Note: 100BASE-TX and 10BASE-T are also supported on the A and B pairs. |
| | P4B_P | 46 | |
| | P4B_N | 44 | |
| | P4C_P | 48 | |
| | P4C_N | 50 | |
| | P4D_P | 54 | |
| | P4D_N | 52 | |
| | P0TX_P | 14 | SerDES Port 0 Transmit Data bus positive |
| | P0TX_N | 16 | SerDES Port 0 Transmit Data bus negative |
| | P0RX_P | 8 | SerDES Port 0 Receive Data bus positive |
| | P0RX_N | 10 | SerDES Port 0 Receive Data bus negative |
| | R0_LED | 20 | Parallel multiplexed LED outputs. These active low LED pins directly drive the port's LEDs supporting a range from 1 to 20 LEDs in a multiplexed fashion. In this mode the cathode of each LED connects to these pins through a series current limiting resistor. The anode of each LED connects to one of the Cx_LED pins below |
| | R1_LED | 22 | |
| | R2_LED | 24 | |
| | R3_LED | 26 | |
| | R4_LED | 28 | |
| | C0_LED | 30 | Connect to the anode of LED column 0 for each row |
| | C1_LED | 32 | Connect to the anode of LED column 1 for each row |
| | C2_LED | 24 | Connect to the anode of LED column 2 for each row |
| | C3_LED | 36 | Connect to the anode of LED column 3 for each row |
| | SE_SCLK | 4 | Synchronous Ethernet Source Clock. This is a 25 MHz reference clock which can be used as a synchronous clock input from the board or system. This signal must come from a high quality clock conditioning circuit or Synchronous Ethernet PLL. |

Table 2: UbiSwitch J1 connector pin assignments

| Connector | Pin name | Pin number | Description |
|-----------|----------|------------|---|
| J2 | GND | 1 | Ground |
| | GND | 2 | Ground |
| | GND | 7 | Ground |
| | GND | 13 | Ground |
| | GND | 19 | Ground |
| | GND | 20 | Ground |
| | GND | 25 | Ground |
| | GND | 37 | Ground |
| | GND | 38 | Ground |
| | GND | 55 | Ground |
| | GND | 56 | Ground |
| | GND | 58 | Ground |
| | GND | 60 | Ground |
| | +3V3 | 57 | Output 3.3V, maximum 0.5A |
| | +3V3 | 59 | Output 3.3V, maximum 0.5A |
| | P5A_P | 53 | Port 5 1000BASE-T Differential Data Pair A ~ D Note: 100BASE-TX and 10BASE-Te are also supported on the A and B pairs. |
| | P5A_N | 51 | |
| | P5B_P | 47 | |
| | P5B_N | 49 | |
| | P5C_P | 45 | |
| | P5C_N | 43 | |
| | P5D_P | 39 | |
| | P5D_N | 41 | |
| | P6A_P | 54 | Port 6 1000BASE-T Differential Data Pair A ~ D Note: 100BASE-TX and 10BASE-Te are also |
| | | | |

| | | | |
|--|--------|----|---|
| | P6A_N | 52 | supported on the A and B pairs. |
| | P6B_P | 48 | |
| | P6B_N | 50 | |
| | P6C_P | 46 | |
| | P6C_N | 44 | |
| | P6D_P | 40 | |
| | P6D_N | 42 | |
| | P7A_P | 36 | Port 7 1000BASE-T Differential Data Pair A ~ D Note: 100BASE-TX and 10BASE-Te are also supported on the A and B pairs. |
| | P7A_N | 34 | |
| | P7B_P | 30 | |
| | P7B_N | 32 | |
| | P7C_P | 28 | |
| | P7C_N | 26 | |
| | P7D_P | 22 | |
| | P7D_N | 24 | |
| | P8A_P | 18 | Port 8 1000BASE-T Differential Data Pair A ~ D Note: 100BASE-TX and 10BASE-Te are also supported on the A and B pairs. |
| | P8A_N | 16 | |
| | P8B_P | 12 | |
| | P8B_N | 14 | |
| | P8C_P | 10 | |
| | P8C_N | 8 | |
| | P8D_P | 4 | |
| | P8D_N | 6 | |
| | P9TX_P | 17 | SerDES Port 9 Transmit Data bus positive |
| | P9TX_N | 15 | SerDES Port 9 Transmit Data bus negative |
| | P9RX_P | 23 | SerDES Port 9 Receive Data bus positive |

| | | | |
|--|-----------|----|---|
| | P9RX_N | 21 | SerDES Port 9 Receive Data bus negative |
| | P10TX_P | 5 | SerDES Port 10 Transmit Data bus positive |
| | P10TX_N | 3 | SerDES Port 10 Transmit Data bus negative |
| | P10RX_P | 11 | SerDES Port 10 Receive Data bus positive |
| | P10RX_N | 9 | SerDES Port 10 Receive Data bus negative |
| | ETH_RST | 27 | Active low system reset, (internal pulled up). Will hardware reset the ethernet switch chip, but not the onboard microcontroller. |
| | MDC_CPU | 33 | Management Data Clock for the ethernet switch, Slave. MDC_CPU is the reference clock input for the serial management interface (SMI) that connects to an external SMI master, typically a CPU. A continuous clock stream is not expected. The maximum frequency supported is 20.0 MHz. The CPU's SMI interface is used to access the device's registers but it cannot be used until the device's INTn pin becomes active low. We do not recommend using this bus in your application for switch configuration, instead, the serial port should be used. |
| | MDIO_CPU | 35 | Management Data I/O, Slave. MDIO_CPU is used to transfer management data in and out of the device synchronously to MDC_CPU. We do not recommend using this bus in your application for switch configuration, instead, the serial port should be used. |
| | USART2_RX | 29 | Input Microcontroller UART RX line. This connects directly to the onboard microcontroller and is used to send serial commands to the board for switch configuration. |
| | USART2_TX | 31 | Output Microcontroller UART TX line. This connects directly to the onboard microcontroller and is used to receive serial commands from the board relating to switch configuration. |

Table 3: UbiSwitch J2 connector pin assignment

2.2.2 SWD Programming Header

A programming header on the front of the board allows the STM32 on UbiSwitch to be programmed over SWD.

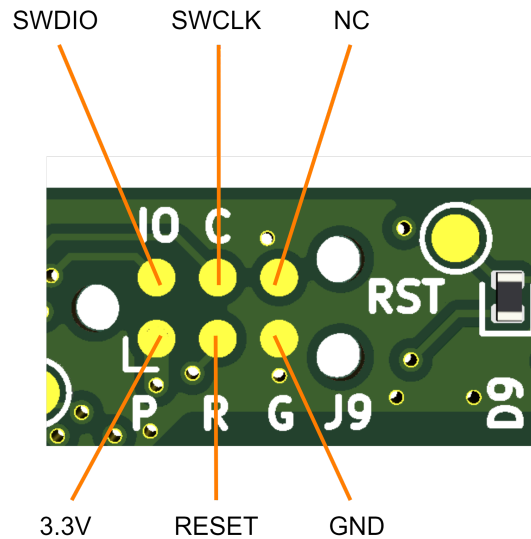


Figure 6: SWD programming header pinout

This header allows access to the SWD port on the onboard STM32 microcontroller, and requires the use of a 6-pin needle adapter such as the [J-Link 6-pin needle adapter](#) along with an in-circuit programmer such as the [J-Link](#).

In most cases, we do not recommend directly uploading firmware to UbiSwitch for switch configuration. Instead we recommend using our serial interface which can achieve switch configuration without needing to change or upload firmware.

2.3 System Information

UbiSwitch has the following capabilities.

2.3.1 Switch Fabric

| | |
|-----------------------------------|---|
| Packet Buffer Memory | 2Mbit |
| Jumbo Frame Support | 10K Bytes (enabled by default) |
| # of MAC Addresses | 16K |
| Ports 1-8 Capability | 10/100/1000BASE-T (Triple speed, autonegotiation) |
| Port 0 Capability | RGMII, RMII, MII, SGMII, 5GBASE-X, SFI, USXGMII |
| Port 9 & 10 Capability | SGMII, 5GBASE-X, SFI, USXGMII |

Table 4: UbiSwitch switch fabric capabilities

2.3.2 Switch Management

The following switch management features are available and will be enabled once the BotBlox Switch Management software is released.

| | |
|---|-----------------|
| Link Aggregation (LAG/Port Trunking) | Yes |
| 802.1p, TOS/DS/ IPv6 TC, MAC | Yes |
| Programmable Weighting | Yes |
| Port-based VLANs | Yes |
| 802.1Q VLANs | Yes, 4096 total |
| Double Tagging (Q in Q) | Yes |
| LMP Entries | 256 |
| 802.1BR ECID | 4K |
| Wake on LAN/ Wake On Frame | Yes |
| Remote Mgmt/Ethertype DSA | Yes |
| TCAM | Yes |
| 802.1D/s/w Spanning Tree | Yes |

| | |
|---|-----|
| 802.1X Port & MAC Authentication | Yes |
| Port Mirroring | Yes |
| IGMP/MLD Snooping | No |
| 802.1AS / Qat / Qav / 1588v2 | Yes |
| 802.1Qbv | Yes |
| Synchronous Ethernet | Yes |
| Cut Through Switch Fabric | Yes |

Table 5: UbiSwitch switch management features

2.3.3 Fundamental Frequencies

The main board level frequencies on UbiSwitch are listed below.

- 25MHz - Main MEMS oscillator
- 403KHz - 3.3V Regulator
- 3MHz - 1.5V Regulator
- 1.29MHz - 1.05V Regulator
- 597KHz - 3.3V Regulator (for SFP)

2.4 Interfaces

2.4.1 8 x 10/100/1000BASE-T Ethernet Ports

There are 8 copper ethernet ports on UbiSwitch that can operate in 10BASE-T, 100BASE-TX and 1000BASE-T modes of operation.

2.4.1.1 Auto negotiation

These 8 ports support auto negotiation and will automatically negotiate with any connected device to achieve the highest possible link speed based on the connected device's capabilities. This is the default configuration of these ports on UbiSwitch. Auto negotiation can be disabled through switch configuration, and the port can be fixed to a particular speed. In most cases it is not advisable to do this since it is simpler to just let the auto negotiation protocol handle any differences in port capabilities.

2.4.1.2 Auto-MDI/X

The 8 ports support Auto-MDI/X by default, meaning the ports will automatically determine whether or not they need to cross over between its pairs as shown in table 6. This means that an external crossover cable is not required when using these ports.

If a connected device cannot automatically correct for crossover the ports on UbiSwitch will make the necessary adjustments prior to commencing auto negotiation. If a connected device

can automatically correct for crossover, UbiSwitch will implement a random algorithm as described in IEEE 802.3 clause 40.4.4 to determine which device performs the crossover. This feature can be disabled through switch configuration, however this is not advised.

| Pin | MDI | | | MDIX | | |
|-----------|------------|------------|----------|------------|------------|----------|
| | 1000BASE-T | 100BASE-TX | 10BASE-T | 1000BASE-T | 100BASE-TX | 10BASE-T |
| MDIP/N[0] | BI_DA± | TX± | TX± | BI_DB± | RX± | RX± |
| MDIP/N[1] | BI_DB± | RX± | RX± | BI_DA± | TX± | TX± |
| MDIP/N[2] | BI_DC± | Unused | Unused | BI_DD± | Unused | Unused |
| MDIP/N[3] | BI_DD± | Unused | Unused | BI_DC± | Unused | Unused |

Table 6: MDI/MDIX Pin Mapping

2.4.1.3 Polarity Correction

UbiSwitch will automatically correct polarity (+ and - wiring mistakes) errors in the receive connections in 1000BASE-T and 10BASE-T. In 100BASE-TX, the polarity does not matter. This allows UbiSwitch to compensate for an incorrect polarity.

2.4.2 3 x 10G MAC ports

Ports 0, 9 and 10 on UbiSwitch are SERDES interfaces that implement MAC ports on the switch. These are different to the 8 x 1G ports described above, because they are not capable of being directly connected to an external system by themselves. They require a physical layer transceiver (PHY) to be converted from a MAC level interface to a field level interface such as 10GBASE-T (10Gbps on four copper pairs) or 10GBASE-R (10Gbps backplane for connection to SFP). While this may seem like a limitation, this allows flexibility on these ports, as any type of PHY can be connected to them to achieve any type of ethernet media connection.

Ports 9 and 10 can support SGMII, 5GBASE-X, SFI and USXGMII while port 0 can support RGMII, RMII, MII, SGMII, 5GBASE-X, SFI and USXGMII. By default, UbiSwitch configures all these ports to operate in SFI mode as 10GBASE-R, which is the required mode when connecting to an external SFP, as is the case on the UbiConn breakout board.

When using these ports to connect to an SFP cage on a baseboard, no configuration is necessary and the ports will work immediately. When using a different PHY on the baseboard, these ports will need specific configuration.

The 10G ports MAC port can integrate with copper PHYs using 100BASE-Tx, 1000BASE-T, 2.5GBASE-T, 5GBASE-T and 10GBASE-T. When integrating with SFPs (as is the case when

using UbiSwitch with UbiConn), these ports can also run at 100M, 1G, 2.5G, 5G and 10G, assuming the SFP that is plugged in can also support these speeds.

2.4.3 Serial Port

UbiSwitch contains a serial port that allows the user to send and receive commands to/from the device. This serial port is connected directly to the STM32 microcontroller and does not connect to the main ethernet switch chip on the board. This allows the STM32 to run custom parser firmware that can receive human-readable serial commands and parse them to low level SMI commands to configure the switch.

The onboard STM32 can also store serial commands on an EEPROM on UbiSwitch, allowing for non-volatile configurations to be written to the device over serial. At present this firmware is un-implemented, however it will be released with the BotBlox Switch Management Software.

Note that both RX and TX are 3.3V level signals and do not require any external pull ups. For external connections, ensure that GND is common between UbiSwitch and the connected device.

2.4.4 SMI port

The SMI port connects directly to the SMI port on the ethernet switch chip and the STM32 microcontroller. It is not recommended to use this for switch configuration as the interface is not human readable, nor are commands able to be stored after a power cycle. This port is broken out mainly for debugging and for cases where the management device for the switch is intended to reside on the baseboard rather than on UbiSwitch.

Note that both MDIO and MDC are 3.3V level signals and do not require any external pullups. For external connections, ensure that GND is common between UbiSwitch and the connected device.

2.4.5 Power supply

UbiSwitch contains its own power supply circuitry and can run from any voltage between 5 - 60V. This input voltage is not isolated on the UbiSwitch Module.

2.4.6 LED port indicator signals

UbiSwitch breaks out nine LED signals which, when multiplexed correctly, allow the link and activity from each port to be indicated on LEDs. These signals are available on the stackable header, allowing the baseboard to contain these port LEDs, or allowing an external connector to be added to break-out the LEDs further. On UbiConn, the LED signals are connected to port activity LEDs on the board and also broken out to an LED signal breakout header for convenience. To understand how the LED signals need to be connected, please refer to section 2.2.5 of the UbiConn datasheet.

2.4.7 Temperature Sensor

UbiSwitch contains an integrated temperature sensor that can be queried over serial. This allows for monitoring of the junction temperature inside the main switch chip. This feature will be active once the BotBlox Switch Management software is released.

2.4.8 Static configuration jumpers

In some production environments, it is desirable to have different static configurations enabled on UbiSwitch, that can be set up by field engineers without needing to use software. For these situations, UbiSwitch contains three static configuration jumpers that can be set/reset via soldering the jumpers, allowing up to eight different configurations to be selected on UbiSwitch without any software needed in the field. This feature is enabled by custom firmware provided by BotBlox. Figure 8 shows the location of these on the board.

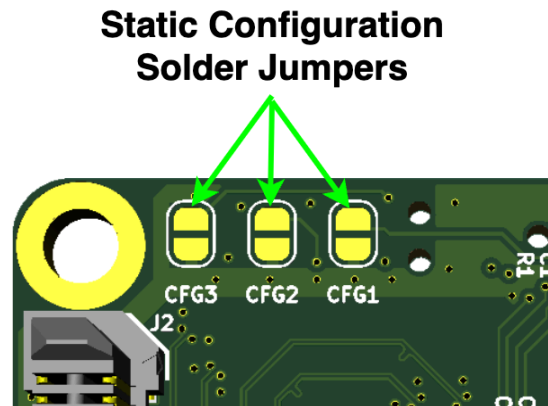


Figure 7 - The static configuration headers on UbiSwitch

These solder jumpers are housed on the bottom of UbiSwitch, so are not easily visible when UbiSwitch is plugged into a baseboard. However this can be mitigated through the use of the onboard microcontroller LED, which can be configured to flash a number of times to indicate the current configuration state based on these jumpers.

2.4.9 Onboard LEDs

There are two LEDs on UbiSwitch in total. One of these LEDs are dual color LEDs, meaning there are a total of three LED signals on this board.

The 3.3V Power Indicator LED (**Green**) indicates that voltage is present on the 3.3V line. It should be solid green in normal operation.

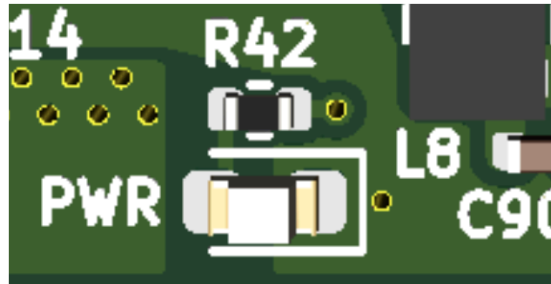


Figure 9: Power Indicator LED

Microcontroller LED is a **Red/Green** dual color LED that has a flexible use depending on the microcontroller firmware.

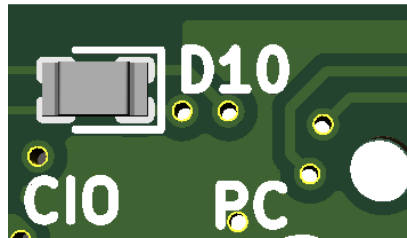


Figure 8: Microcontroller Dual Red/Green LED

2.5 Environmental Performance

UbiSwitch is designed with the following features to allow performance in harsh environments.

- Increased board thickness of 2mm to reduce susceptibility to high frequency vibration standing waves
- Automotive or higher rated components to enable an extended temperature range of -70°C to +110°C
- X5R or higher rated capacitors for reduced capacitor variability with temperature variation
- Molex PicoClasp positive locking connectors with increased contact area to resist vibration
- Solid state cooling to prevent mechanical failure of moving parts
- 0.8mm pitch stackable connector for increased clearance between signals

UbiSwitch will be tested to MIL-STD-810G, to ensure performance as listed below. These test results are not yet available.

| Test Name | Test Description |
|-------------------------------------|---|
| Low Pressure (Altitude) | MIL-STD-810G, Method 500.6 - Low Pressure (Altitude), Procedure II - Operation: 1 hour, <10m/s, 30,000 ft |
| Low Pressure (Decompression) | Method 500.6 – Low Pressure (Altitude), Procedure III – Rapid Decompression: 8,000ft to 40,000ft, 15 seconds |
| High Temperature | Method 501.6 – High Temperature, Procedure II – Operation, Constant Temperature Exposure: 100°C, 2 hours, <3°C/minute, uncontrolled humidity |
| Low Temperature | Method 502.6 – Low Temperature, Procedure II – Operation: -45°C, 2 hours, <3°C/minute, uncontrolled humidity |
| Temperature Shock | Method 503.6 – Temperature Shock, Procedure I-A – One-way Shock(s) from Constant Extreme Temperature: -45°C to 100°C, 1 minute |

| | |
|------------------|---|
| | 100°C to -45°C, 1 minute |
| Humidity | Method 507.6 – Humidity, Procedure I – Storage and Transit Cycles: 27°C, 95%, 2 hours |
| Vibration | Method 514.7 – Vibration, Procedure I – General Vibration, Category 13 – Fixed Wing Propeller Aircraft: Vibration Type: Broadband background with superimposed narrow band spikes Frequency Range: 15Hz – 2000Hz Orientation: In each of 3 mutually orthogonal axes, 1 hour per axis |

Table 7: MDI/MDIX Pin Mapping

3 Software Interfaces

At present, there is no software or firmware running UbiSwitch. However UbiSwitch's management features will be enabled in the future with the release of the BotBlox Switch Management software.

4 Device Configuration

4.1 Unmanaged Switch

To use UbiSwitch in an unmanaged application requires no configuration. Simply connect the daughter board and apply a voltage to the voltage input and connect downstream devices.

5 Mechanical drawing

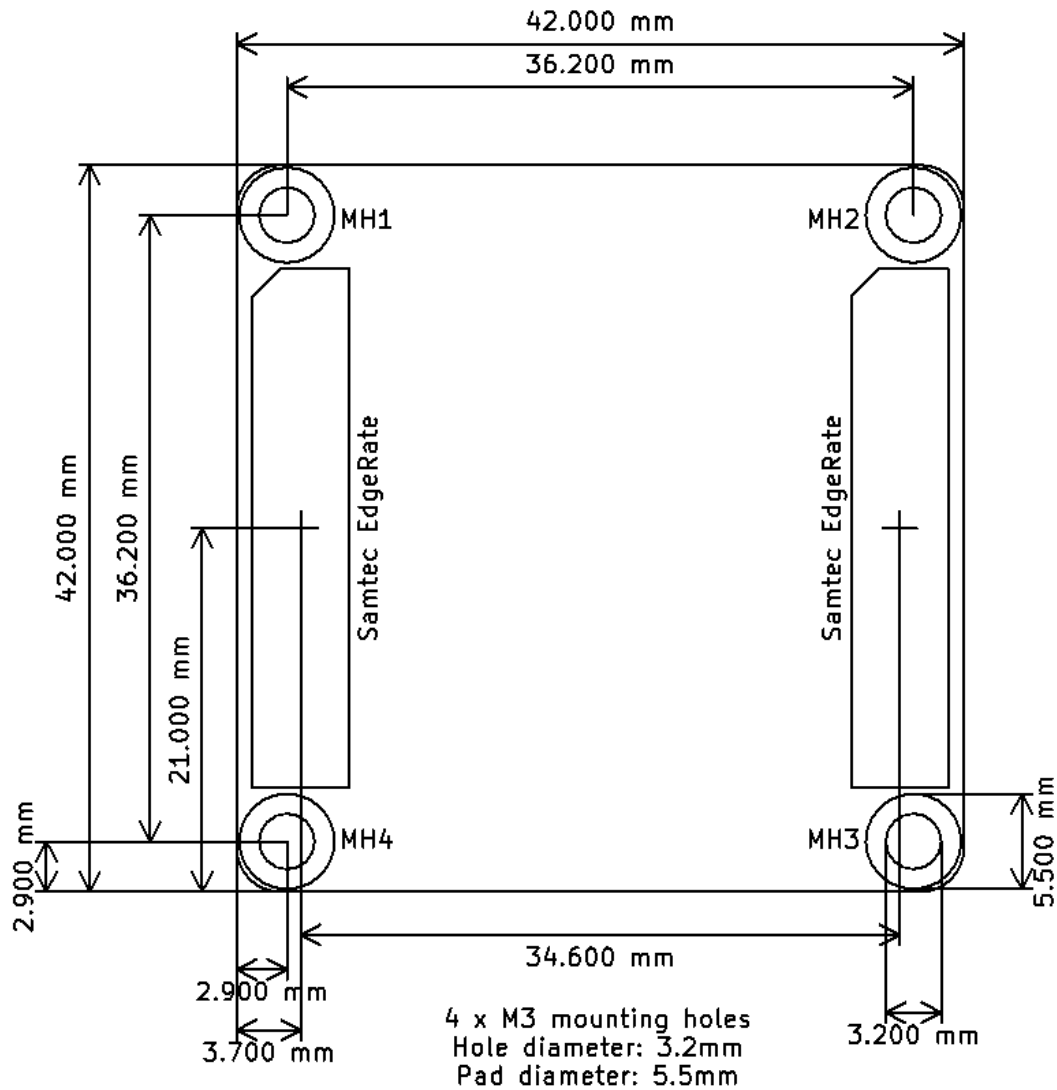


Figure 9. UbiSwitch mechanical drawing, viewed from top down

Full dimensional drawings and 3D CAD can be found in the links below.

<https://botblox.io/content/UbiSwitch%20Rev%20A%20Dim%20Drawing.pdf>

<https://botblox.io/content/UbiSwitch%20Rev%20A%20Dim%20Drawing.DXF>

<https://grabcad.com/library/ubiswitch-revision-a-1>

6 Thermal Considerations

The main switch chip on UbiSwitch dissipates significant power under full load conditions, hence it is recommended to run the device with a thermal heat sink solution.

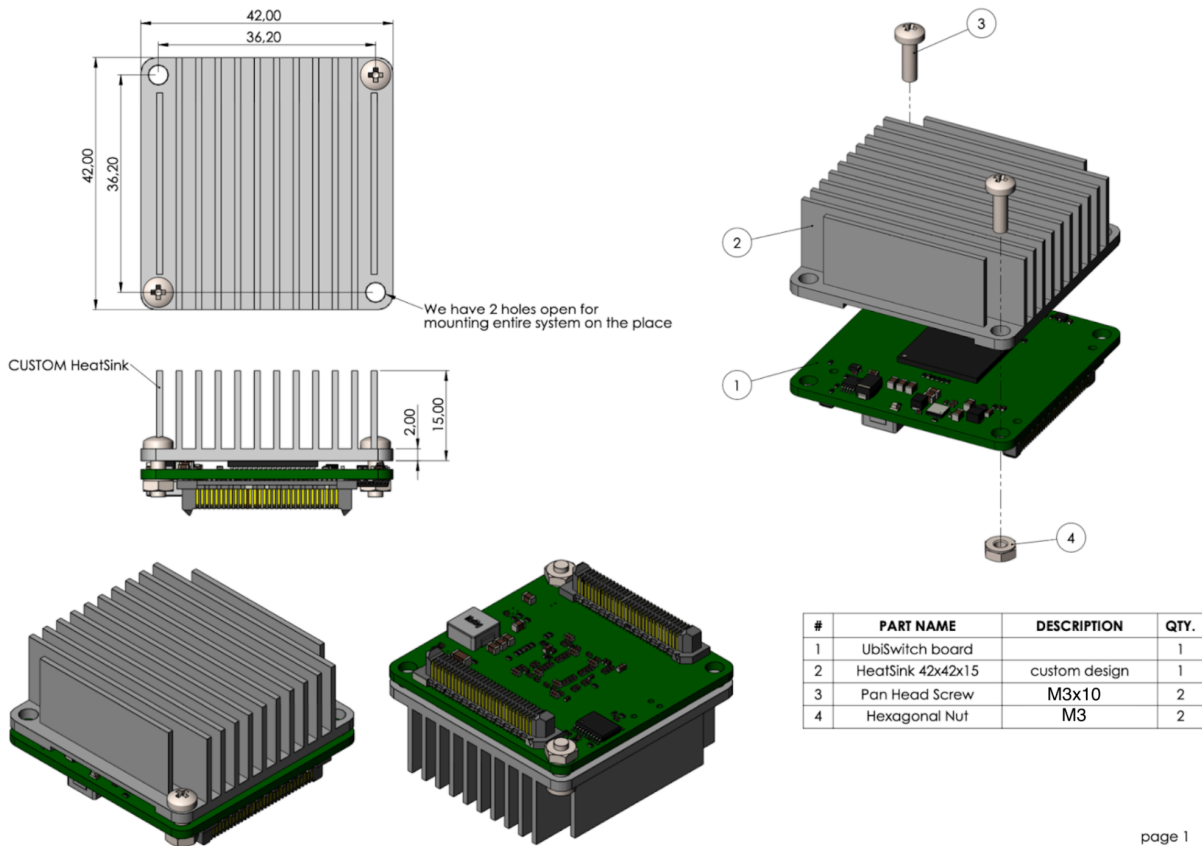
6.1 Thermal Characteristics

| Parameter | Condition | Typical Value |
|---|---|---------------|
| θ_{JA} - Thermal resistance, junction to ambient | JEDEC 3 in. x 4.5 in 4-layer PCB with no air flow | 22.28 °C/W |
| | JEDEC 3 in. x 4.5 in 4-layer PCB with 1m/s air flow | 20.13 °C/W |
| | JEDEC 3 in. x 4.5 in 4-layer PCB with 2m/s air flow | 19.38 °C/W |
| | JEDEC 3 in. x 4.5 in 4-layer PCB with 3m/s air flow | 18.92 °C/W |
| ψ_{JT} - Thermal characteristic parameter, junction to top-center of package | JEDEC 3 in. x 4.5 in 4-layer PCB with no air flow | 0.13 °C/W |
| | JEDEC 3 in. x 4.5 in 4-layer PCB with 1m/s air flow | 0.21 °C/W |
| | JEDEC 3 in. x 4.5 in 4-layer PCB with 2m/s air flow | 0.26 °C/W |
| | JEDEC 3 in. x 4.5 in 4-layer PCB with 3m/s air flow | 0.20 °C/W |
| θ_{JC} - Thermal resistance, junction to case | JEDEC with no air flow | 5.08 °C/W |
| θ_{JB} - Thermal resistance, junction to board | JEDEC with no air flow | 12.68 °C/W |

Table 8: Thermal characteristics of the main chip on UbiSwitch

6.2 Passive heat sinking

UbiSwitch is supplied with a heatsink that mounts to the top of the main chip.



page 1

Figure 10. Illustration showing the UbiSwitch heat spreader plate that is included with the board

The thermal resistance of the heatsink with zero air flow is around $1.82\text{ }^{\circ}\text{C/W}$. We suggest using thermal paste with around 79W/m-K (for example, [TC4-10G](#)) to achieve a paste thermal resistance of $0.675\text{ }^{\circ}\text{C/W}$ when used on the $15\text{mm} \times 15\text{mm}$ chip.

Figure 11 below shows more information on the thermal characteristics of heatsink supplied with UbiSwitch.

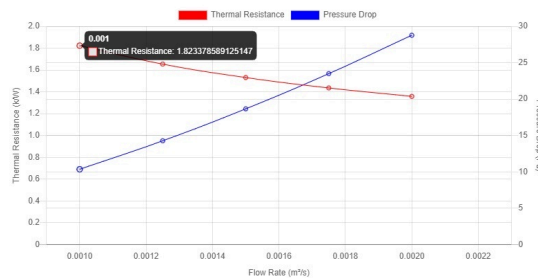
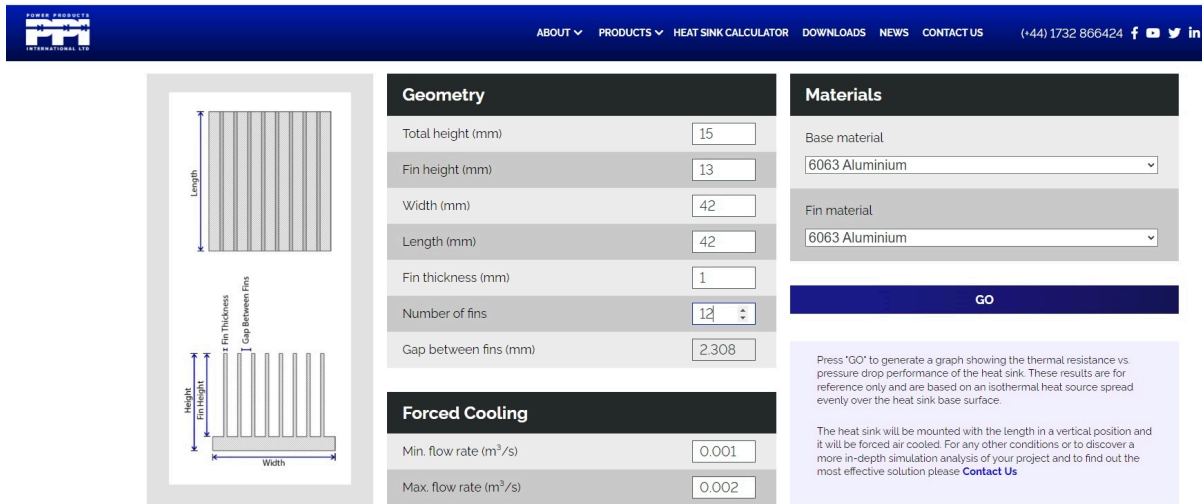


Figure 11. Thermal characteristics of the heatsink supplied with UbiSwitch

6.3 Temperature Calculations

6.3.1 No heat sink, 0 m/s air flow (not recommended)

Power dissipation, $P_d = 4.604 \text{ W}$

$\theta_{JA} = 22.28 \text{ }^\circ\text{C/W}$

$\psi_{JT} = 0.13 \text{ }^\circ\text{C}$

Ambient temperature = $25 \text{ }^\circ\text{C}$

Case temperature = $4.604 * 22.28 = 102.57 \text{ }^\circ\text{C}$ (above ambient)

Junction temperature = $(0.13 * 4.604) + 102.57 = 103.16 \text{ }^\circ\text{C}$ (above ambient)

Actual temperature of junction at ambient = $128.16 \text{ }^\circ\text{C}$

6.3.2 BotBlox Heatsink 0 m/s air flow

Power dissipation, $P_d = 4.604 \text{ W}$

$\theta_{JC} = 5.08 \text{ }^\circ\text{C/W}$

θ_{CH} (Case to heatsink) = $0.675 \text{ }^\circ\text{C/W}$ (Mainly thermal resistance of thermal paste)

θ_{HA} (Heatsink to ambient) = $1.82 \text{ }^\circ\text{C/W}$

$\psi_{JT} = 0.13 \text{ }^\circ\text{C}$

Ambient temperature = 25 °C

Heatsink temperature rise = $4.604 * (5.08 + 0.675 + 1.82) = 34.87$ °C (*above ambient*)

Estimated junction temperature = ~70°C

7 Assembly and Mounting Information

7.1 Required Hardware

- UbiSwitch Module
- UbiSwitch Heatsink (included with UbiSwitch Module)
- UbiSwitch BaseBoard
- Thermal Paste (we recommend [TC4-10G](#))
- 2 x M3 pan head machine screws, 10mm length ([example](#))
- 2 x M3 pan head machine screws, 20mm length ([example](#))
- 4 x M3 hex nuts ([example](#))
- 4 x 2mm nylon washer ([example](#))

7.2 Assembling the heatsink

The first step in assembling UbiSwitch is to mount the heatsink onto the UbiSwitch Module. The steps below assuming the use of the standard included heatsink (BB-UBH-A-1); steps may vary when using a custom heatsink.

Step 1: Add thermal paste

Add thermal paste to the top of the main chip on the UbiSwitch Module



Figure 12. Applying thermal paste to UbiSwitch

Step 2: Identify correct heatsink polarity

Some material is removed on the underside of the heatsink; this is to accommodate the taller circuitry on the UbiSwitch Module. It is important to ensure the heatsink is mounted as shown in figure 13 to ensure that this gap aligns with the taller circuitry on UbiSwitch.

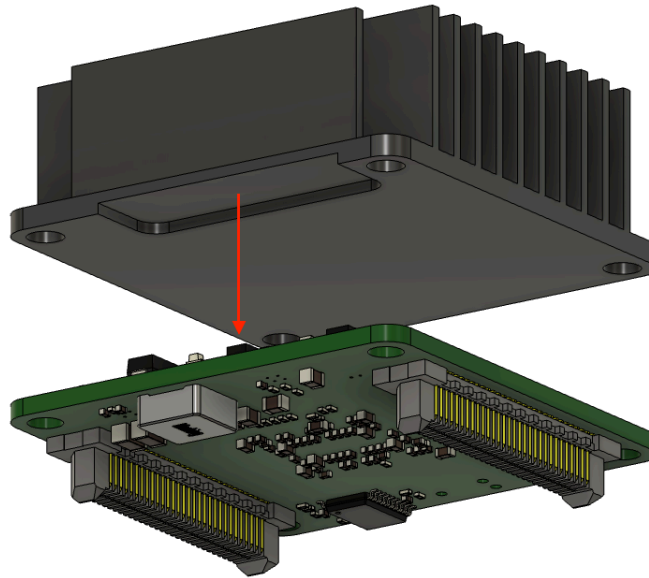


Figure 13. Applying thermal paste to UbiSwitch

Step 3: Place washers and screws

Once the correct heatsink alignment is achieved, place the two M3 12mm machine screws through two of the holes on the heatsink, and place two washers on these same holes. Figure 14 shows which holes to put the M3 12mm screws through; it is important that only these holes are used for mounting the heatsink.

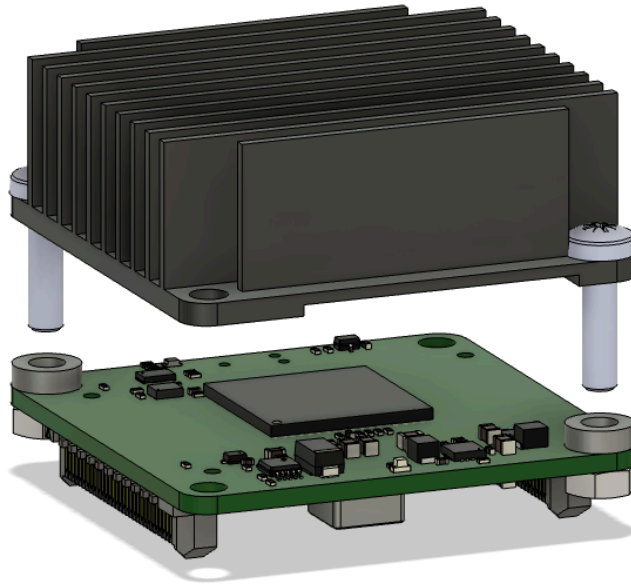


Figure 14. The machine screws and washers for mounting the heatsink

Step 4: Add hex nuts to the bottom

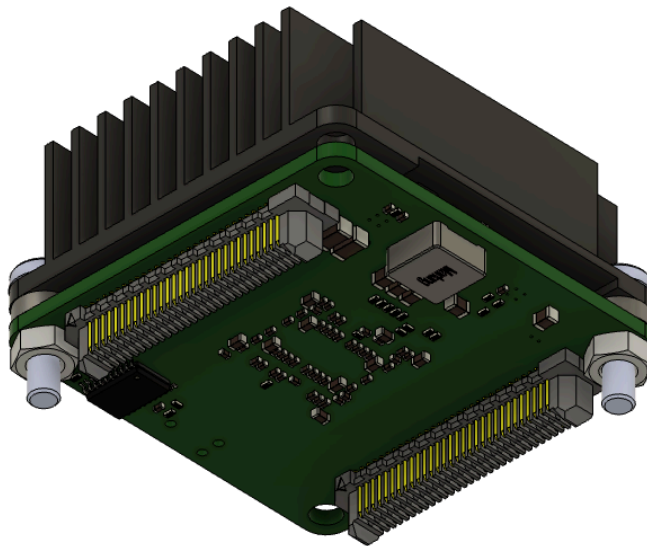


Figure 15. Adding the hex nuts to secure the heatsink

Step 5: Mount the UbiSwitch Module + Heatsink assembly onto UbiSwitch Baseboard

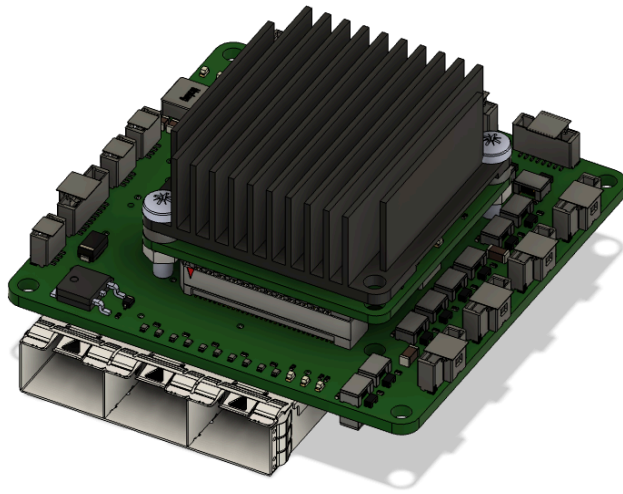


Figure 16. Mounting the UbiSwitch Module assembly onto the UbiSwitch BaseBoard

Step 6: Add washers and screws to the remaining mount holes

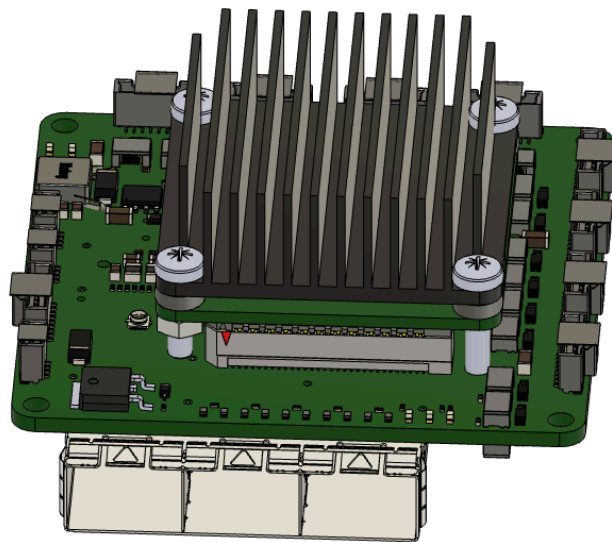


Figure 17. Mounting screws and washers added to the remaining mount holes

Step 7: Add hex nuts to the two remaining screws to secure the UbiSwitch Module to the UbiSwitch BaseBoard

These hex nuts fix the UbiSwitch Module to the UbiSwitch BaseBoard. This is necessary as the stacking header system on UbiSwitch is not locking. The arrow in figure 18 shows one of the hex nuts that is close to the onboard transformers; care should be taken to not damage the transformers when tightening this nut.

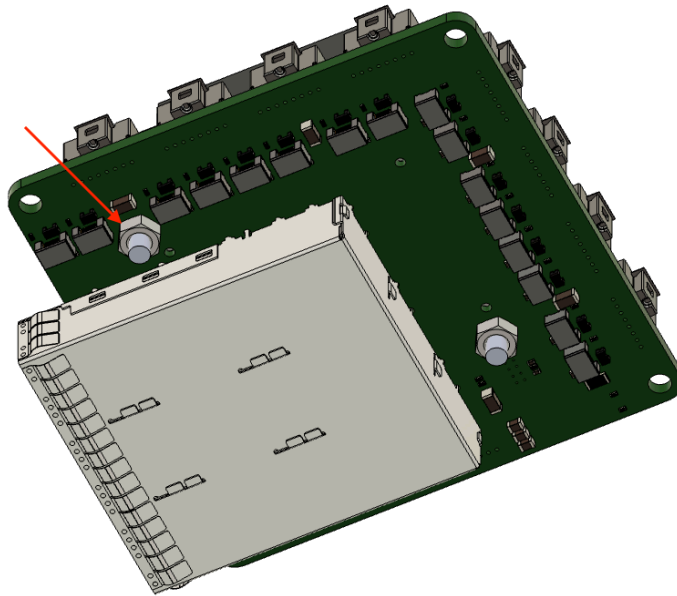


Figure 18. Hex screws added to secure the UbiSwitch Module to the UbiSwitch BaseBoard

8 Datasheet Changelog

| Date | Datasheet Version | Author | Notes |
|------------|-------------------|-------------|--|
| 5/2/2023 | A_A | Josh Elijah | Initial release |
| 9/2/2023 | A_B | Josh Elijah | Added new heatsink information and amended calculations with improved heatsink |
| 21/03/2023 | A_C | Josh Elijah | Added 7 Assembly and Mounting Information and updated heatsink calculations |
| 03/04/2023 | A_D | Josh Elijah | Changed M3 12mm bolt to M3 10mm to address the fact that the 12mm bolt was too long and hitting the board |
| 27/04/2023 | A_E | Josh Elijah | Changed wording of some sections |
| 29/06/2023 | A_F | Binh Nguyen | Fixed errors in pins, clk is on pin4 not pin2 and one of the diff pairs has a pin number of 23 which is also incorrect |
| 18/07/2023 | A_G | Josh Elijah | Changed input voltage range requirement from 8-60V to 5-60V, based on testing. |
| 01/08/2023 | A_H | Josh Elijah | Fixed reference to M2.5 screws in figure 10, updated them to M3 screws. |
| 25/10/2023 | A_I | Jaclyn Li | Table 1.1.2 General Information and Temperature range in 2.5 Environmental Performance updated to be correct values. |
| 09/01/2024 | A_J | Jaclyn Li | Updated to Revision B and updated IGMP/MLD Snooping information |
| 01/05/2024 | A_K | Jaclyn Li | Updated operating temperature range from “-40°C to +85°C” to “-70°C to +110°C”. Updated storage temperature range from “-40°C to +125°C” to “-70°C to +125°C”. |

9 Contact

If you have any questions regarding this product, please contact us:

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10 Certificate of Conformity

The full text of the Certificate of Conformity of this product is available at the following web address. <https://botblox.io/documentation/>