

# SwitchBlox Rugged

## Small Rugged 5 port 10/100Mbps Ethernet Switch

MPN: BB-SWR-A-1-1

## Datasheet

May 2021

Board revision A/B/C

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# 1 General Information

## 1.1 Functionality and Features of SwitchBlox Rugged

SwitchBlox Rugged is a rugged form factor 5 port 10/100Mbps (10BASE-T/100BASE-TX) Layer 2 unmanaged and managed ethernet switch. It has a non-blocking fabric meaning that 100Mbps speed can be achieved simultaneously on all ports. It is a very small form factor Ethernet Switch designed for the harshest applications, which can operate from -40°C to 105°C.

It runs from a wide input voltage range of 5 to 60V, features PoE injection onboard, and houses a microcontroller for custom firmware upload.

The board is stackable so that two boards can be combined to create a 10 port switch.

### 1.1.1 Features

- 5 x 10/100M (10BASE-T/100BASE-TX) ethernet ports
- Input voltage range from 4.5 to 60V
- Reverse protected voltage input
- Transient protected voltage input
- -40°C to 105°C Operation Range
- Stackable header to allow 10 ports total
- 44.5mm x 44.5mm board size
- Molex PicoBlade (rev A) Pico-Clasp (rev B/C) connectors for power and ports
- 15W PoE injection IEEE 802.3af on each port
- Automatic MDI-X crossover
- Unmanaged (out-the-box) functionality
- Embedded STM32L011D4P7 onboard for firmware to implement managed switch functions (VLANs, QoS, Port Mirroring)
- Port Activity Indicators
- Programmable RGB LED (via STM32L011D4P7 for managed applications)

### 1.1.2 General Information

<b>Voltage Input</b>	4.5V to 60V DC (65V absolute max)
<b>PoE Maximum Power Output</b>	15W (IEEE 802.3af)
<b>Supported Protocols</b>	10BASE-T, 100BASE-TX
<b>Power Consumption</b>	600mW (idle) to 1200mW (full switching)
<b>Weight</b>	16 grams
<b>Size</b>	44.5 mm x 44.5 mm x 9.95 mm
<b>Operating Temperature</b>	-40°C to +105°C
<b>Storage Temperature</b>	-55°C to +125°C

*Table 1: General Information*

### 1.1.3 General Operating Instructions

SwitchBlox Rugged 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.

In the simplest case of an unmanaged switch application, SwitchBlox Rugged can be operated immediately by following the following steps.

- 1) Apply a voltage between 5V to 60V to the voltage input terminals.
- 2) Connect external devices to the ethernet ports using RJ45 to Pico-Clasp cables.
- 3) SwitchBlox Rugged will automatically begin auto negotiation with connected devices and begin receiving and forwarding packets to/from all connected devices.

In managed mode SwitchBlox Rugged can implement VLAN setup, port mirroring and QoS.

*Other methods of operation are possible by uploading firmware to the STM32L011D4P7 on SwitchBlox Rugged.*

*By default, SwitchBlox Rugged ships without any firmware.*

## 1.2 Safety Information

- This device can operate on voltages near and above 60V. Please read this manual before operating.
- This device is provided “as is”. 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

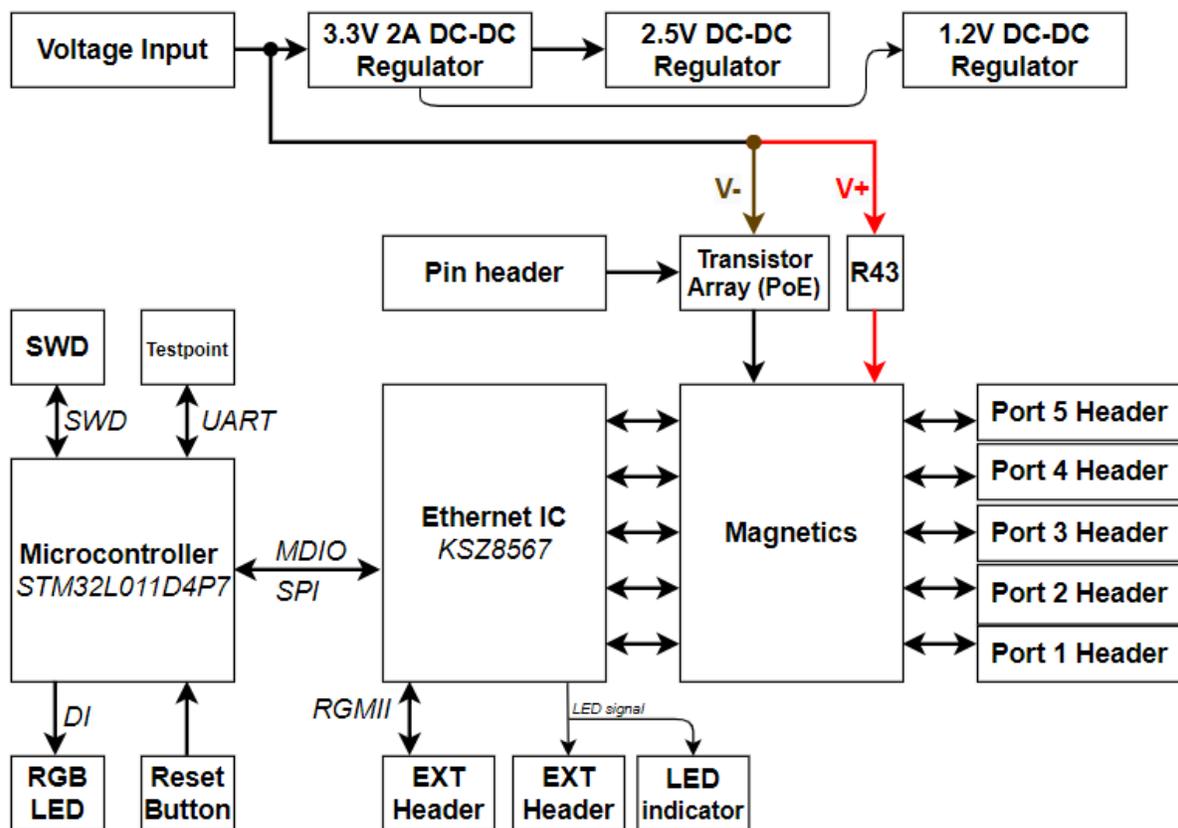


Figure 1: SwitchBlox Rugged Block Diagram

## 1.4 Included Equipment

The product includes the following:

1 x SwitchBlox Rugged board

5 x Molex Pico-Clasp to RJ45 5-way Shielded Twisted Pair cables (400mm)

1 x Molex Pico-Clasp to bare, tinned leads (400mm)

## 1.5 RoHS Certification of Compliance

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

# 2 Hardware Interfaces

## 2.1 Board Map

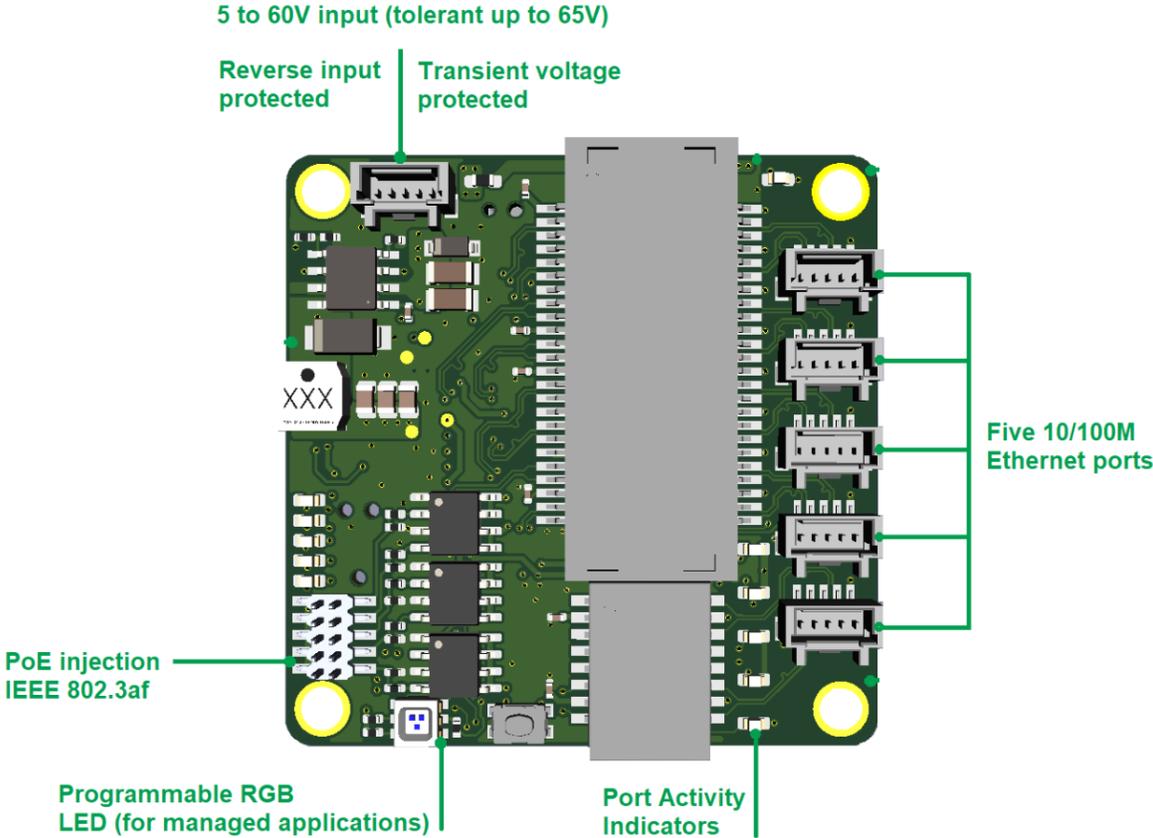


Figure 2: SwitchBlox Rugged Board Map (front)

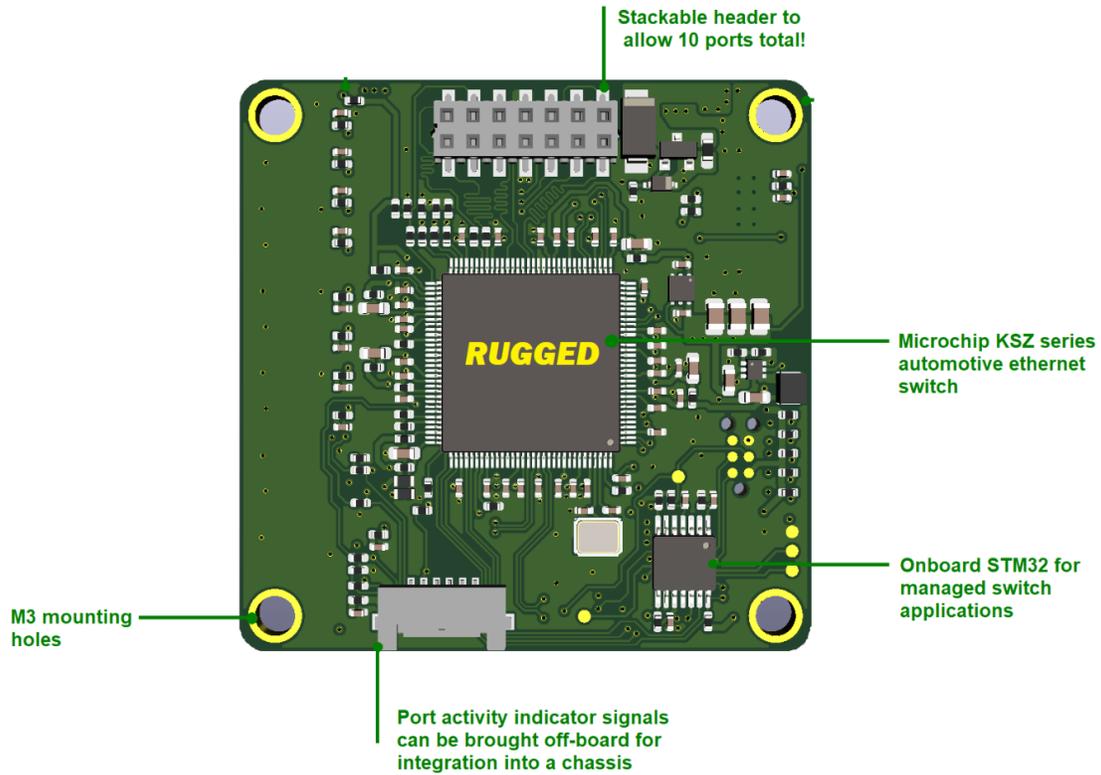


Figure 3: SwitchBlox Rugged Board Map (back)

## 2.2 Connectors and Pinouts

### 2.2.1 Voltage Input

The top left connector is the voltage input terminal. A five pin connector is used to allow the input voltage to be easily daisy chained between boards (two wires per power rail).

The voltage input has the following features:

- Voltage input can range from 4.5 to 60V
- Maximum allowable voltage of 65V
- Transient voltage protection above 66.3V
- Reverse polarity protection

The pinout of the voltage input connector is shown in figure 4 below.

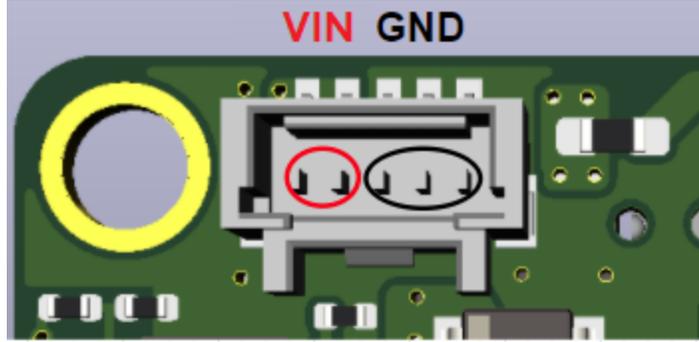


Figure 4: Voltage input header pinout

Connector part numbers

Connector on board	Mating header	Crimp used	Wire used
<a href="#">5019400503</a>	<a href="#">5019390500</a>	<a href="#">5013340100</a>	UL1061, 28AWG

Table 2: Voltage input connector pinout and part numbers

Cable pinout

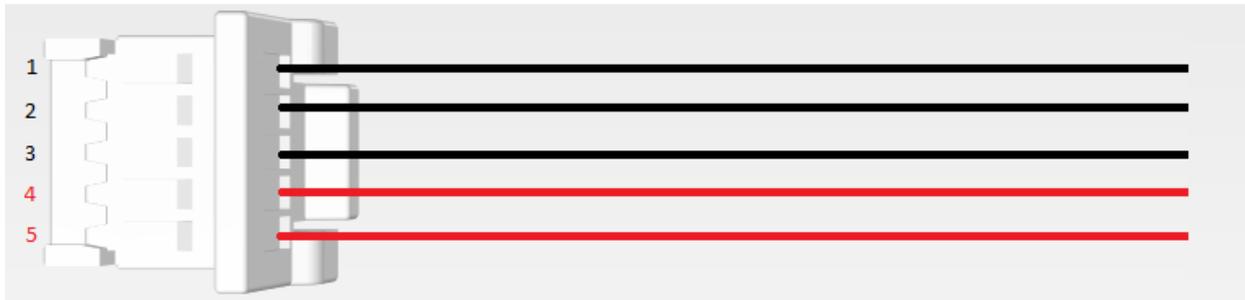


Figure 5: Voltage input cable pinout (red = V+, black = GND)

## 2.2.2 Ethernet Ports

There are five ethernet connectors on SwitchBlox Rugged. Each connector has five pins corresponding to the four signals required for 100BASE-TX and GND which are R-, R+, T-, T+ and GND. The pin mapping of all five connectors is identical.

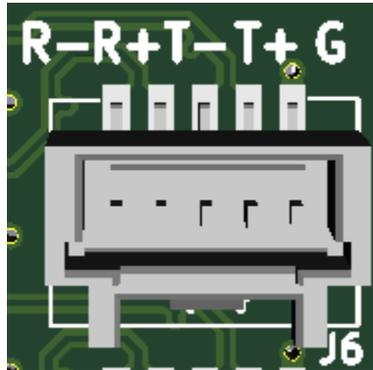


Figure 6: Ethernet port pinout

Connector on board	Mating header	Crimp used	Wire used
<a href="#">5019400503</a>	<a href="#">5019390500</a>	<a href="#">5013340100</a>	UL1061, 28AWG

Table 4: Ethernet connector pinout and part numbers

### Cable pinout

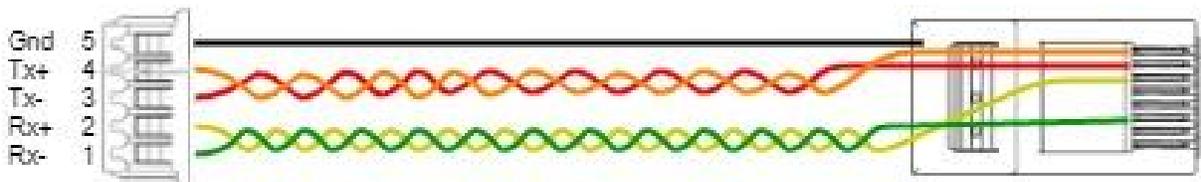


Figure 7: Ethernet cable pinout

### 2.2.3 Extension RGMII header

SwitchBlox Rugged exposes RGMII on a stackable header, for board stacking purposes. This connection allows two boards to be stacked to form a 10 port switch. This requires no additional configuration, however some minor additional mounting hardware is required:

- 1 x 14 position pin header (MPN: M22-2520705)
- 4 x 8mm hex standoffs (MPN: 24382)
- 4 x M2.5 machines screws (MPN: 29300)

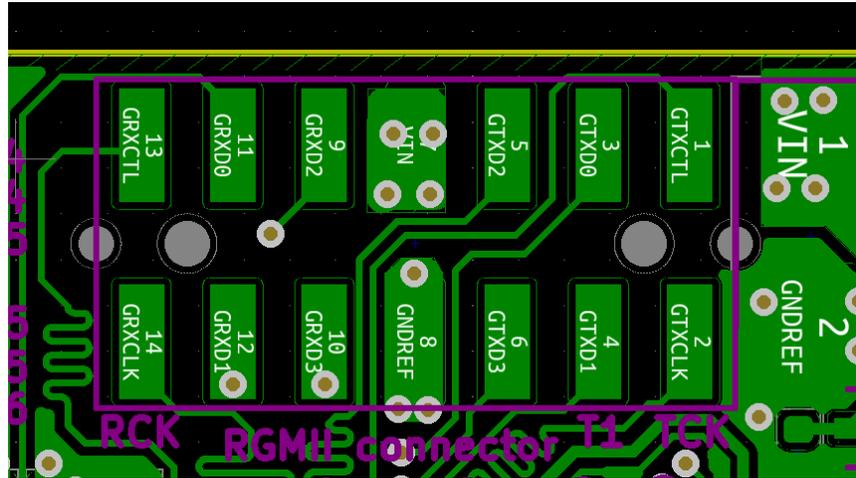


Figure 8: Extension RGMII header pinout, Rx in this case refers to the received data from the switch, therefore is an output from this board. Tx is an input to this board. This is consistent with the PHY side of the RGMII



Figure 9: Stackable board

## 2.2.4 SWD Programming Header

A programming header on the back of the board allows the STM32L011D4P7 on SwitchBlox Rugged to be programmed over SWD.

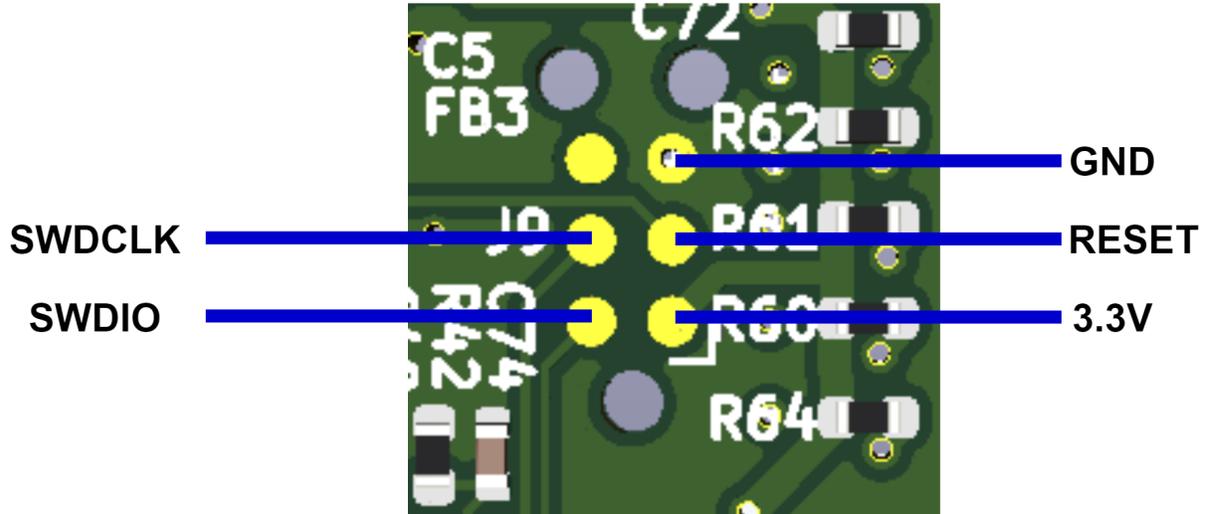


Figure 10: SWD programming header pinout

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](#).

## 2.2.5 External LED header

An External LED header on the back of the board allows port activity indicator signals can be brought off - board for integration into a chassis. The LED signals are provided in a common anode configuration. The anode of all external LEDs should connect to the 3.3V on the External LED header, and the cathode of the external LED should connect to the corresponding “Px” connection on the header.

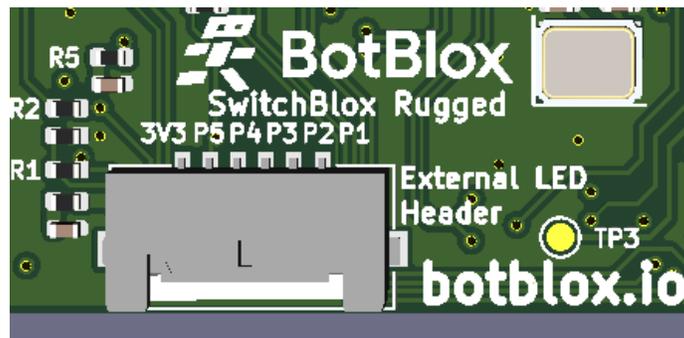


Figure 11: External LED header

The connector used on the board is 5037630691, which mates with 5037640601.

## 2.3 Other Interfaces

### 2.3.1 PoE Injector On Board

A 15W PoE injector onboard (IEEE 802.3af) on the front of SwitchBlox Rugged allows the input voltage to be injected onto any of the ports.

To achieve IEEE 802.3af compliant PoE on the port, an input voltage between 44V to 48V is needed. Once active, each PoE port can deliver a maximum of 300mW. PoE is not enabled by default on Rev B/C. To enable, R43 needs to be populated with a 0603 0 ohm resistor.

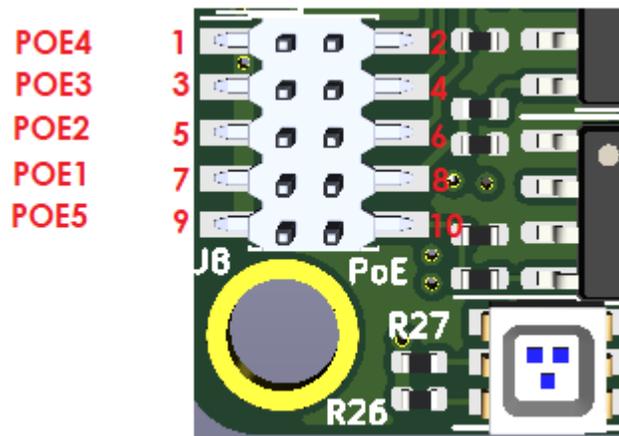


Figure 12: PoE select header

When the 2 pins in each row are connected together, an input voltage is applied to the selected port and the ethernet ports are PoE enabled, the corresponding PoE port LED comes on to indicate the PoE voltage on the board.

To enable PoE, you will need 1.27 mm jumper shorting (MPN: [NPB02SVAN-RC](#))

	Pin 1	Pin 3	Pin 5	Pin 7	Pin 9
Pin 2	Port 4 POE				
Pin 4		Port 3 POE			
Pin 6			Port 2 POE		
Pin 8				Port 1 POE	
Pin 10					Port 5 POE

Table 2: Pin matching for PoE selection

*PoE injection is not a “hot-swappable feature”. Only toggle PoE on a port when no load is applied. If PoE is toggled while a load is connected, the PoE will be stuck on.*

*Drawing 300mW from all PoE ports at the same time can lead to the board overheating. It is best to test this in the application first.*

*On Rev C, resistor R43 must be populated with a 0 Ohm resistor to enable the PoE feature. This resistor is depopulated by default.*

The pinout of PoE on the port pins is TX+/TX- DC Voltage = 0V, RX+RX- DC Voltage = Vin.

### 2.3.2 LEDs

There are 12 LEDs on SwitchBlox Rugged in total. Five of the LED signals can be taken off 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.

Each Port Activity LED (**Green**) corresponds to a specific port. They indicate activity on each port and will blink when there is traffic on a port. They should be solid off when a port is not connected to any device, and they should blink under normal operation. A solid green LED indicates either constant traffic, or a fault with the port.

The PoE on Port Indicator LEDs (**Orange**) indicates which of the ports currently has PoE injected onto it. This can be toggled on a port-by-port basis using the PoE Select DIP switch.

The RGB LED is controlled entirely by the onboard microcontroller, therefore is only used in managed applications.

## 3 Software Interfaces

### 3.1 SPI

SwitchBlox Rugged uses the KSZ8567S to perform the ethernet switching. The KSZ8567S is an integrated 5 port ethernet switch, which also supports managed functions such as QoS, Port Mirroring and VLAN management (amongst other functions). By default the IC runs as an unmanaged switch. Managed functions need to be configured via SPI.

On SwitchBlox Rugged CS, MOSI, MISO and SCK connect to the STM32L011D4P7 pins. PA4 connects to CS, PA7 connects to MOSI, PA14 connects to MISO, PA13 connects to SCK. This allows the STM32 to programmatically control the KSZ8567S, and implement custom managed switch features. Custom firmware for this application will be available at <https://www.botblox.io/>.

### 3.2 UART

Pins PA0 (UART2\_RX) and PA9 (UART2\_TX) on the onboard STM32L011D4P7 are exposed on test points.

## 4 Device Configuration

### 4.1 Unmanaged Switch

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

### 4.2 Managed Switch

Running SwitchBlox in a managed switch application requires configuring the KSZ8567S onboard over SPI. This can be done via custom firmware on STM32

The KSZ8567S only has volatile memory, meaning configuration is only stored while power is active. This means it is necessary to write the configuration to the KSZ8567S on every startup. The STM32 onboard is able to circumvent this limitation by storing configuration variables in its internal EEPROM and then write this to the KSZ8567S at power on. This is how the BotBlox firmware works, and it allows configurations to be stored even after power off.

## 5 Device Characteristics

### 5.1 Operating Conditions

#### 5.1.1 Absolute Maximum Ratings

Operating in these ranges will reduce the lifetime of the device.

<b>Voltage Input Maximum</b>	65V
<b>PoE Current Delivery (per port)</b>	350mA
<b>Storage Temperature</b>	-55°C to +125°C
<b>Operating Temperature</b>	-40°C to +105°C

#### 5.1.2 Nominal (Test) Ratings

<b>Voltage Input</b>	65V
<b>PoE Power Delivery (per port)</b>	0mA

## 6 Datasheet Changelog

Date	Datasheet Version	Author	Notes
29/05/2021	ABC_A	Binh Ngyuen	Initial release
25/06/2021	ABC_B	Josh Elijah	Fixed the incorrect crimp terminal MPN stated for the connectors

## 7 Contact

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

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