

SwitchBlox Nano

Tiny 3 port 10/100Mbps Ethernet Switch

MPN: BB-SWN-C-1

Datasheet

October 2023
Board revision C

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1 General Information

1.1 Functionality and Features of SwitchBlox Nano

The BotBlox SwitchBlox Nano is a tiny form factor 3 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 runs from a wide input voltage range of 5.1 to 40V, and provides a 5A, 0.5A power output. It also features PoE injection onboard, and houses a microcontroller for custom firmware upload.

1.1.1 Features

- 3 x 10/100M (10BASE-T/100BASE-TX) ethernet ports
- Input voltage range from 5.1 to 40V
- Transient protected voltage input
- 25.5 mm x 25.5 mm board size
- Molex Picoblade connectors for power and ports
- Automatic MDI-X crossover
- Unmanaged (out-the-box) functionality
- Embedded STM32L011F4U6 onboard for firmware to implement managed switch functions (VLANs, QoS, Port Mirroring)

1.1.2 General Information

| | |
|------------------------------|--|
| Voltage Input | 5V to 45V DC (45V absolute max) |
| Voltage Output | 5V \pm 5%, 0.5A |
| Supported Protocols | 10BASE-T, 100BASE-TX |
| Power Consumption | 220mW (idle) to 400mW (full switching) |
| Weight | 10 grams |
| Size | 25.5mm x 25.5mm x 7.23mm |
| Operating Temperature | 0°C to +70°C |
| Storage Temperature | -40°C to +85°C |

Table 1: General Information

1.1.3 General Operating Instructions

SwitchBlox Nano is designed for use in commercial and industrial environments, operating from a nominal supply voltage of 24V, but with the ability to operate from as low as 5.1V and as high as 40V.

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

- 1) Apply a voltage between 5.1V to 40V to the voltage input terminals.
- 2) Connect external devices to the ethernet ports using RJ45 to Picoblade cables.
- 3) SwitchBlox Nano will automatically begin auto negotiation with connected devices and begin receiving and forwarding packets to/from all connected devices.

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

Other methods of operation are possible by uploading firmware to the STM32L011F4U6 on SwitchBlox Nano.

By default SwitchBlox Nano ships without any firmware.

1.2 Safety Information

- This device can operate on voltages near and above 40V. 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.
- The board temperature can reach 60°C when 0.5A is drawn from the 5V output. In such cases, passive air cooling or heat sinking should be considered.

1.3 Block Diagram

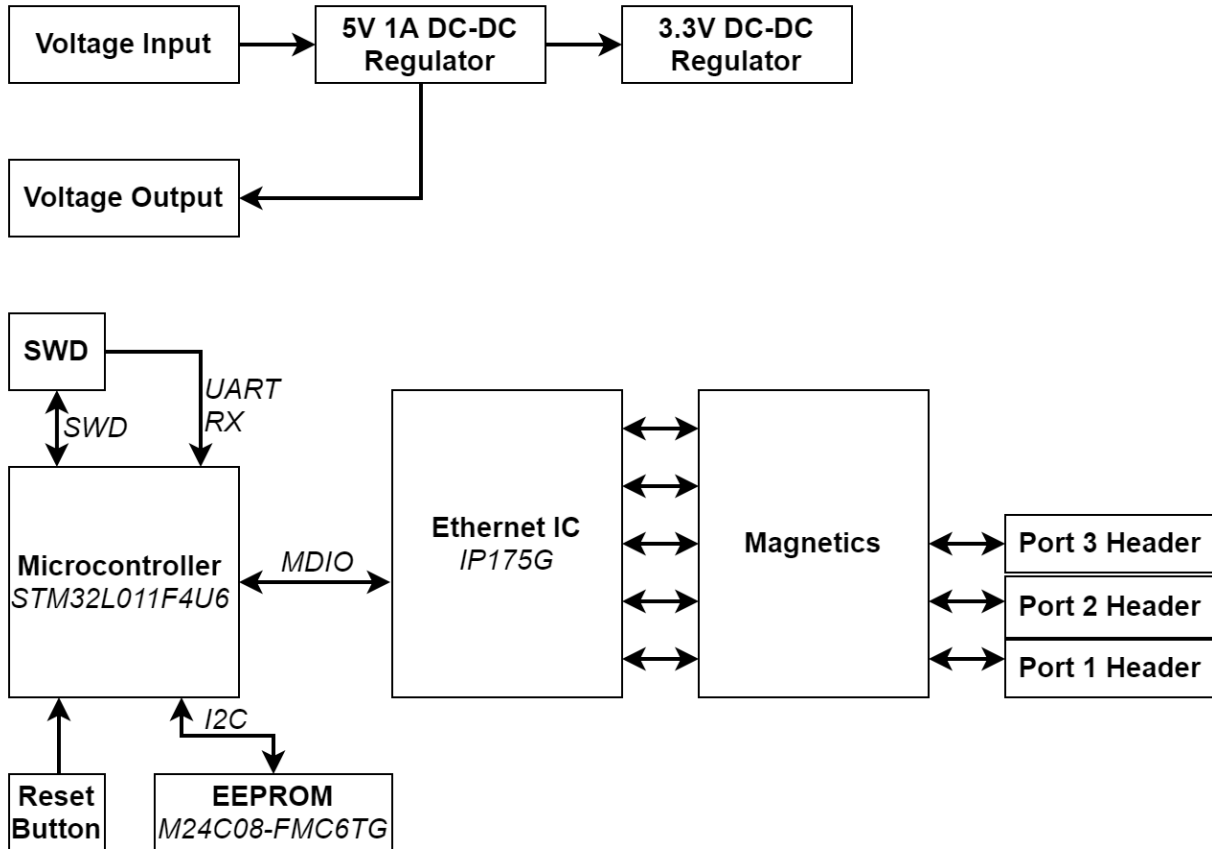


Figure 1: SwitchBlox Nano Block Diagram

1.4 Included Equipment

The product includes the following:

- 1 x SwitchBlox Nano board
- 3 x Molex Picoblade to RJ45 4-way Unshielded Twisted Pair cables (300mm)
- 2 x Molex Picoblade to bare, tinned leads (300mm)

1.5 RoHS Certification of Compliance

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

2 Hardware Interfaces

2.1 Board Map

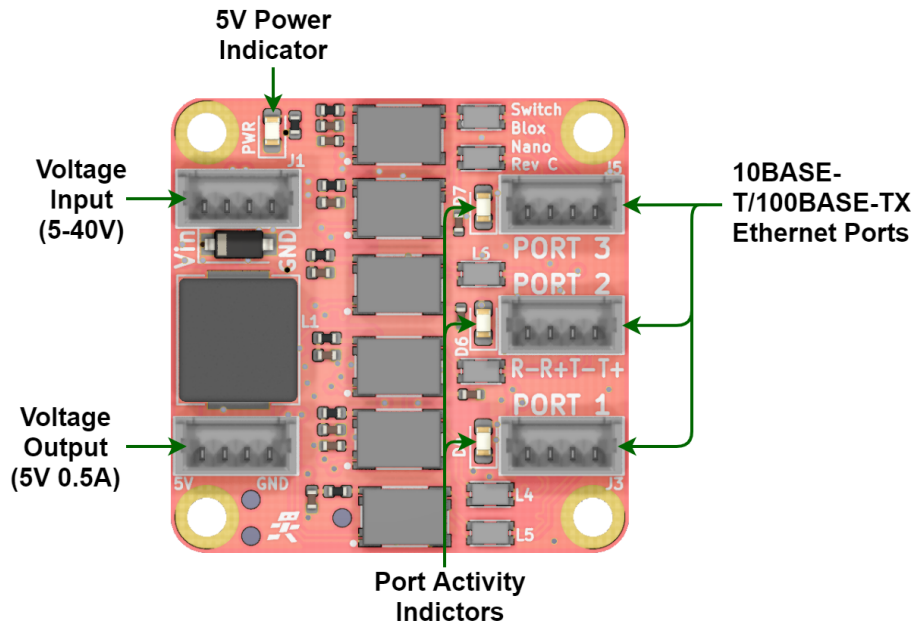


Figure 2: SwitchBlox Nano Board Map (front)

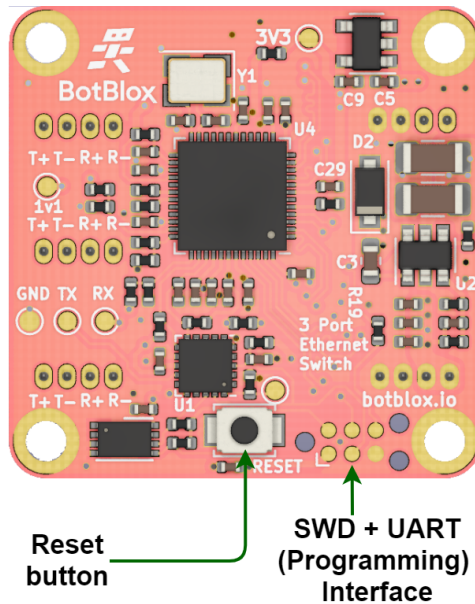


Figure 3: SwitchBlox Nano Board Map (back)

2.2 Connectors and Pinouts

2.1.1 Voltage Input

The top left connector is the voltage input terminal. A four 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 5 to 40V
- Maximum allowable voltage of 45V

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

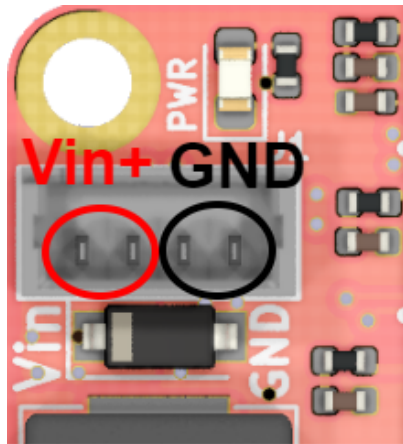


Figure 4: Voltage input header pinout

Connector part numbers

| Connector on board | Mating header | Crimp used | Wire used |
|---------------------------|----------------------------|---------------------------|---------------|
| 530470410 | 0510210400 | 500798000 | UL1061, 28AWG |

Table 2: Voltage input connector pinout and part numbers

Cable pinout



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

2.1.2 Voltage Output

The bottom left connector is the voltage output terminal. A four pin connector is used to increase the maximum output current.

The voltage output has the following features:

- Voltage output is nominally 5V with tolerance of $\pm 5\%$
- Up to 0.5A output current
- Around 30uF of capacitance on the 5V rail

The pinout of the voltage output connector is shown in figure 6 below.

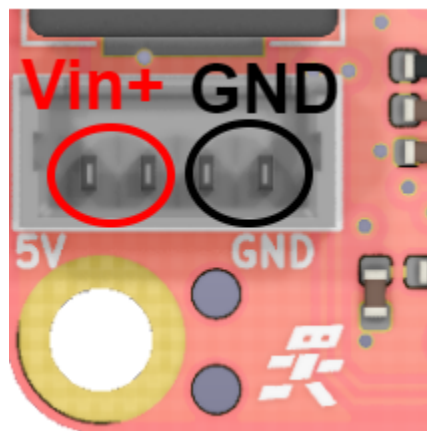


Figure 6: Voltage output header pinout

Cable pinout

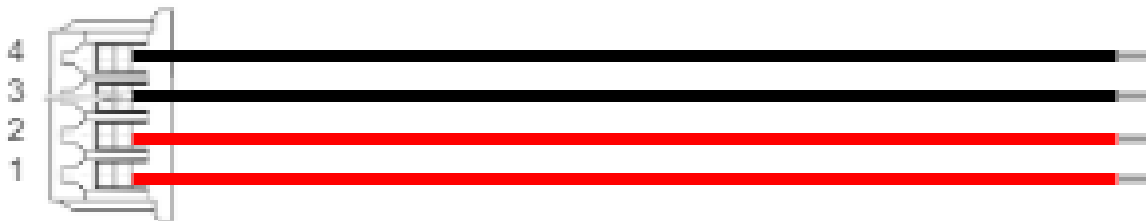


Figure 7: Voltage output cable pinout (red = 5V, black = GND)

Connector part numbers

| Connector on board | Mating header | Crimp used | Wire used |
|---------------------------|----------------------------|---------------------------|---------------|
| 530470410 | 0510210400 | 500798000 | UL1061, 28AWG |

Table 3: Voltage output connector pinout and part numbers

2.1.3 Ethernet Ports

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

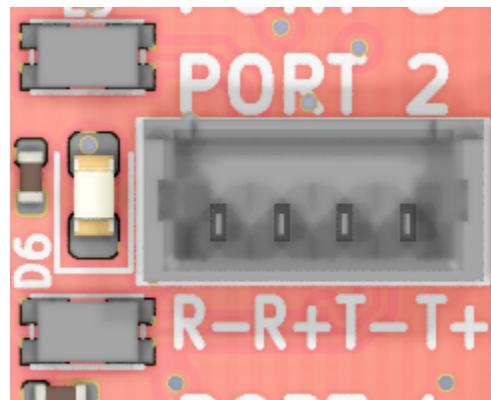


Figure 8: Ethernet port pinout

| Connector on board | Mating header | Crimp used | Wire used |
|---------------------------|----------------------------|---------------------------|---------------|
| 530470410 | 0510210400 | 500798000 | UL1061, 28AWG |

Table 4: Ethernet connector pinout and part numbers

Cable pinout

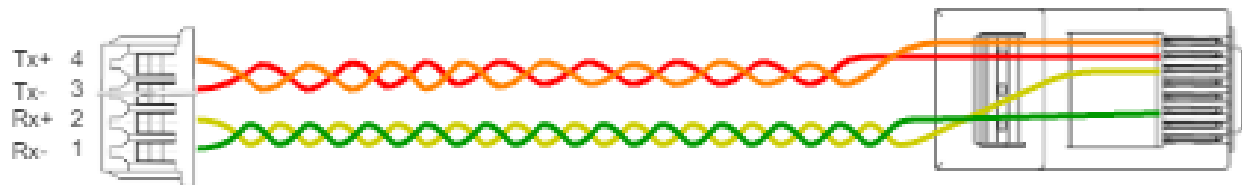


Figure 9: Ethernet cable pinout

2.1.4 SWD Programming and UART RX Header

A programming header on the back of the board allows the STM32L011F4U6 on SwitchBlox Nano to be programmed over SWD.

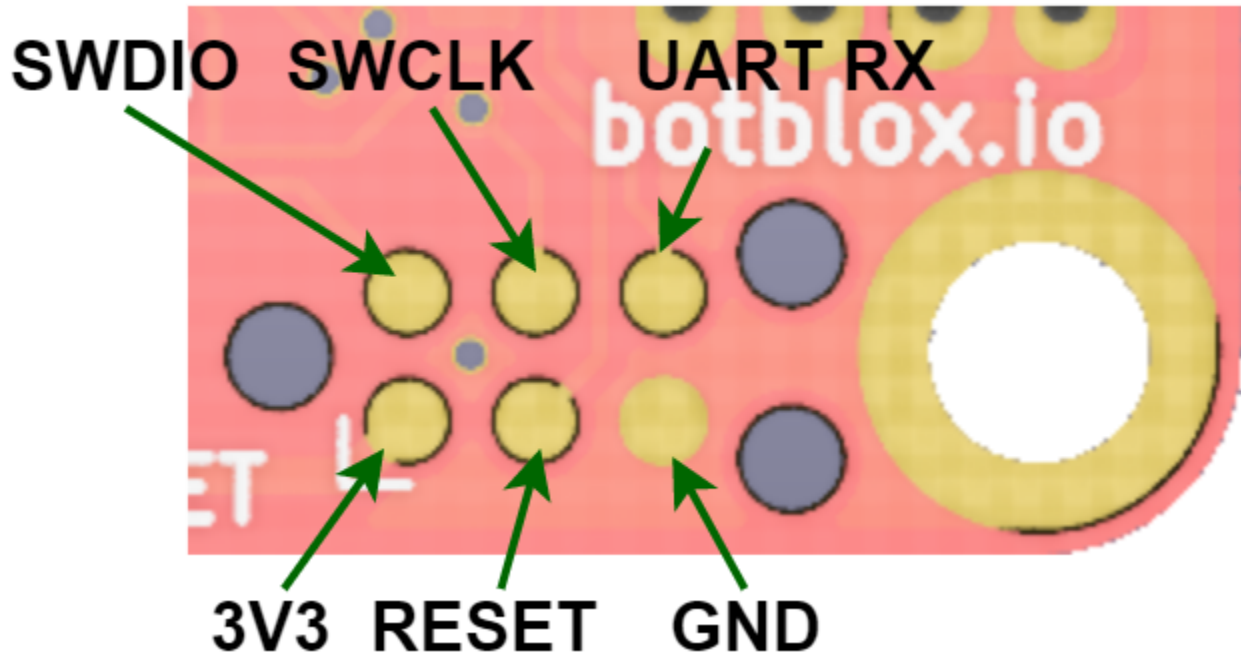


Figure 10: SWD programming and UART RX header pinout

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](#).

An unused pin on this header also connects to the UART RX (PA0) on the STM32. This approach allows at least unidirectional UART communication (from a host to SwitchBlox Nano) for uploading switch management configuration, without needing another connector on the board. The same 6-pin needle adapter is used to access this pin. The needle adapter should then connect to any USB to UART converter, using the GND and UART_RX pins.

2.2 Other Interfaces

2.2.1 LEDs

There are 4 LEDs on SwitchBlox Nano in total. None of the LED signals can be taken off board.

The 5V Power Indicator LED (**Green**) indicates that voltage is present on the 5V 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.

3 Software Interfaces

3.1 MDIO

SwitchBlox Nano uses the IP175G to perform the ethernet switching. The IP175G 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 MDIO.

MDIO (also known as SMI) is a board-level serial interface that is commonly used for configuring ethernet ICs. On a physical level it is very similar to I2C however it uses a slightly different data structure. For the purposes of this document, SCL (I2C serial clock) will be used interchangeably with MDC (management data clock) and SDA (I2C serial data) will be used interchangeably with MDIO (management data input/output). This is the case for the labelling on the breakout header too.

On SwitchBlox Nano MDC and MDIO connect to the STM32L011F4U6 pins. PA4 connects to MDC, PA10 connects to MDIO. This allows the STM32 to programmatically control the IP175G, and implement custom managed switch features. BotBlox have developed custom firmware for this application which can be found on <https://www.botblox.io/>.

3.2 UART

Pin PA0 (UART2_RX) on the onboard STM32L011D4P6 is exposed on the SWD/UART header. Given that the STM32 is also connected to the IP175G ethernet switch, this allows any external device to control the functionality of the onboard ethernet switch via custom parser software running on the STM32.

The mechanism for this communication is the same as on SwitchBlox, however the lack of a TX pin means SwitchBlox Nano can not send a configuration acknowledgement back to the host.

BotBlox have developed custom software for this application which can be found on <https://www.botblox.io/>.

4 Device Configuration

4.1 Unmanaged Switch

To use SwitchBlox Nano 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 Nano in a managed switch application requires configuring the IP175G onboard over MDIO. This can be done via custom firmware on STM32, or directly connecting an external device to SwitchBlox Nano over MDIO.

The IP175G only has volatile memory, meaning configuration is only stored while power is active. This means it is necessary to write the configuration to the IP175G 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 IP175G at power on. This is how the BotBlox firmware works, and it allows configurations to be stored even after power off.

You can find this firmware on <https://www.botblox.io/>.

Note - The embedded EEPROM on SwitchBlox Nano is currently not used because the configuration variables are small enough to fit in the STM32's internal EEPROM.

5 Device Characteristics

5.1 Operating Conditions

5.1.1 Absolute Maximum Ratings

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

| | |
|------------------------------|-------------|
| Voltage Input Maximum | 45V |
| Storage Temperature | -30°C +85°C |
| Operating Temperature | 0 to 70°C |
| 5V Output Current | 0.5A |

6 Datasheet Changelog

| Date | Datasheet Version | Author | Notes |
|------------|-------------------|-------------|---|
| 04/01/2021 | C_A | Josh Elijah | Initial release |
| 09/11/2021 | C_B | Josh Elijah | Fixed a typo on maximum input voltage |
| 24/10/2023 | C_C | Jaclyn Li | Table 1.1.2 General Information updated to be correct values. |

7 Contact

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

info@botblox.org
4 Pavilion Court 600 Pavilion Drive,
Northampton Business Park,
Northampton,
England
NN4 7SL

8 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/>