

# USBblox

Embedded USB3.1 to GigaBit Ethernet  
Converter  
*Revision A*

## Datasheet

Applies to:  
MPN: BB-UBB-A-1-NDAA

April 2024

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# 1 General Information

## 1.1 Functionality and Features of USBBlox

USBbloX is a compact USB 3.1 to 10/100/1000 Ethernet converter providing reliable and robust USB to ethernet conversion for harsh applications where Size, Weight and Power are limited (SWaP). Unlike the majority of USB to Ethernet conversion devices, USBbloX uses industrially rated chipsets and focuses on shielding of the USB 3.1 signals through extensive grounding and shielding. This is all achieved in an extremely compact form factor (19mm x 37mm), using vibration tolerant connectors.

These features allow USBbloX to achieve an extended operating temperature range, suitable for use in high vibration and noisy environments where size and weight are limited, such as drones, robots and other compact industrial applications.

USBbloX is powered through its USB port and contains a single USB 3.1 port and 10/100/1000 Ethernet port. The chipset on USBbloX is programmable via the USB port using [MPLAB® Connect Configurator](#) and configurations can be stored between power cycles thanks to the onboard EEPROM memory. This allows all of the registers on the main chip to be written to which can allow for more advanced configurations of the USB and ethernet ports to be achieved.

### 1.1.1 Features

- 1 x USB 3.1 SuperSpeed port (backwards compatible with USB 2.0)
- 1 x 1000BASE-T Ethernet port (compatible with 10BASE-T and 100BASE-TX)
- USB powered, no external other power input required
- -40°C to +85°C operating temperature range
- 19 mm x 37 mm x 9.4 mm board size (not including cables)
- Vibration tolerant, positive-locking Molex PicoClasp connectors for USB/Ethernet ports
- Auto-MDIX, auto-negotiation, auto polarity correction on ethernet port
- Automatic USB detach functionality when ethernet port is removed
- Extended EMI shielding
- Plug and play functionality (no configuration needed)
- Advanced configuration possible over USB port
- Ethernet activity LED onboard
- All cables included

### 1.1.2 General Information

<b>Voltage Input</b>	5V (from USB port)
<b>Supported Protocols</b>	10BASE-T, 100BASE-TX, 1000BASE-T, USB 3.1, USB 3.1, USB 2.0
<b>Power Consumption</b>	200mW (idle) to 1,076mW (1Gbps throughput)
<b>Weight</b>	6 grams (board only), 28 grams (board and cables)
<b>Size</b>	19 mm x 37 mm x 9.4 mm
<b>Operating Temperature</b>	-40°C to +85°C
<b>Storage Temperature</b>	-65°C to +150°C

*Table 1: General Information*

## 1.2 Device Bringup

In the simplest case of an unmanaged media conversion application, USBBlox can be operated immediately by following the following steps.

- 1) Connect USBBlox to a USB host using the included USB A to Molex PicoClasp cable.
- 2) Connect USBBlox to an ethernet device using the included RJ-45 to Molex PicoClasp cable.
- 3) The device connected to the USB port on USBBlox will now show an additional network interface present.

### 1.3 Block Diagram

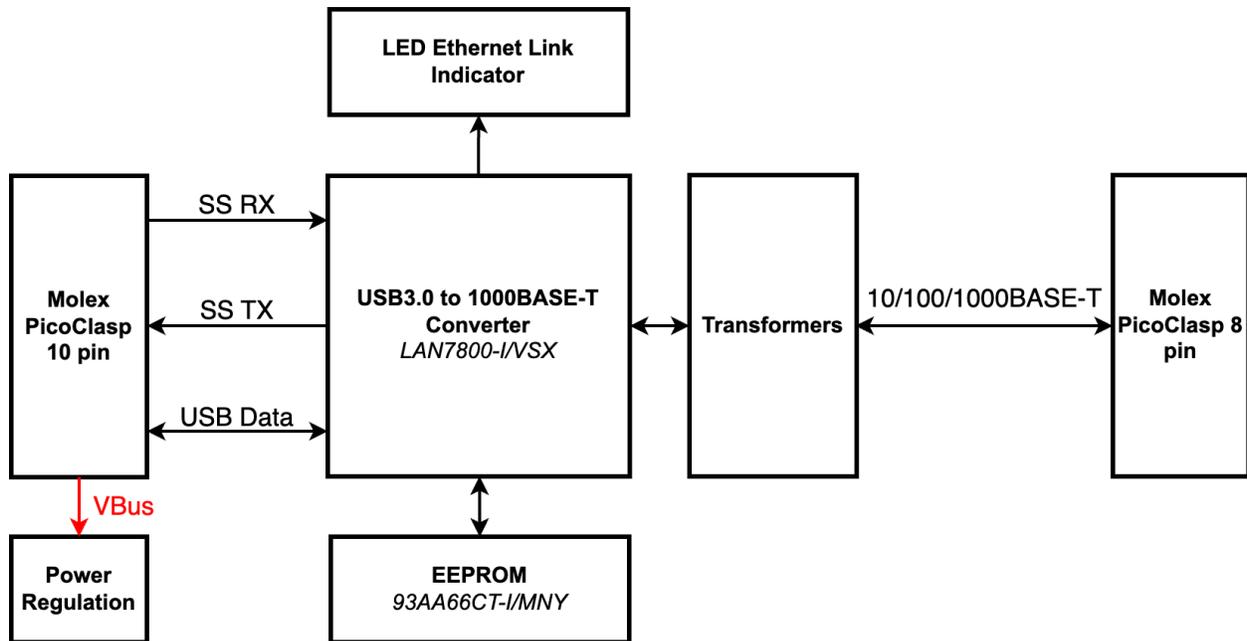


Figure 1: USBBlOX Block Diagram

### 1.4 Included Equipment

The product includes the following:

- 1 x USBBlOX
- 1 x Molex PicoClasp to USB C, (Shielded, USB3.1, 400mm, 10 way)
- 2 x Molex PicoClasp to RJ-45, (Unshielded, Ethernet, 300mm, 8 way)

### 1.5 RoHS Certification of Compliance

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

## 2 Hardware Interfaces

### 2.1 Board Map

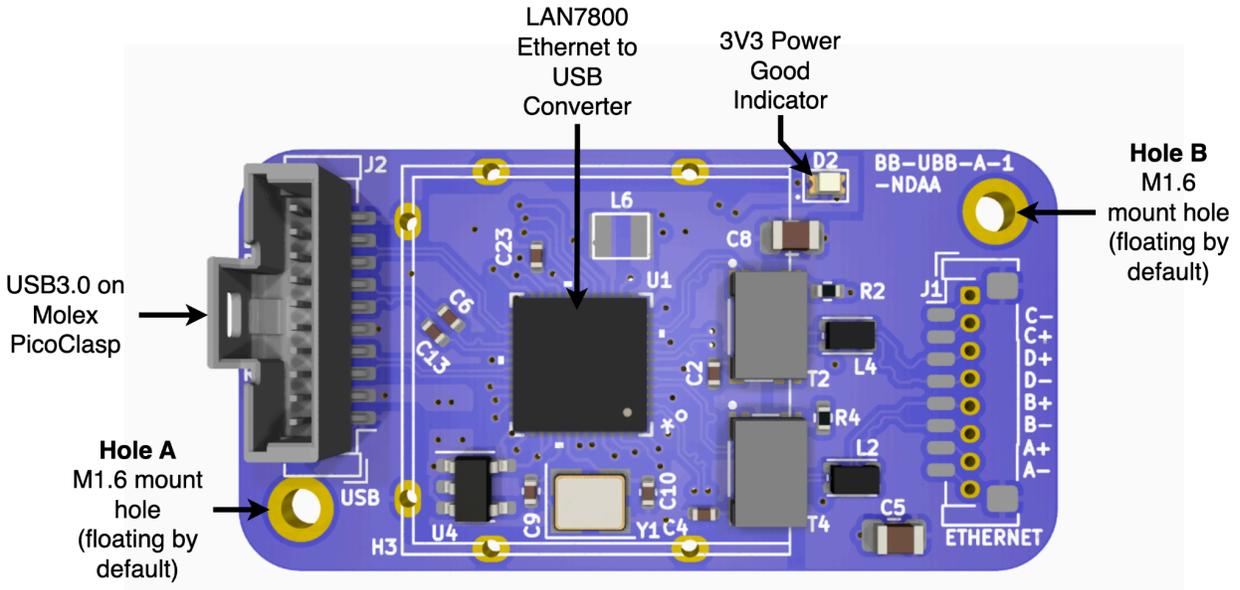


Figure 2: USBBlox Board Map (front) (EMI shield not shown)

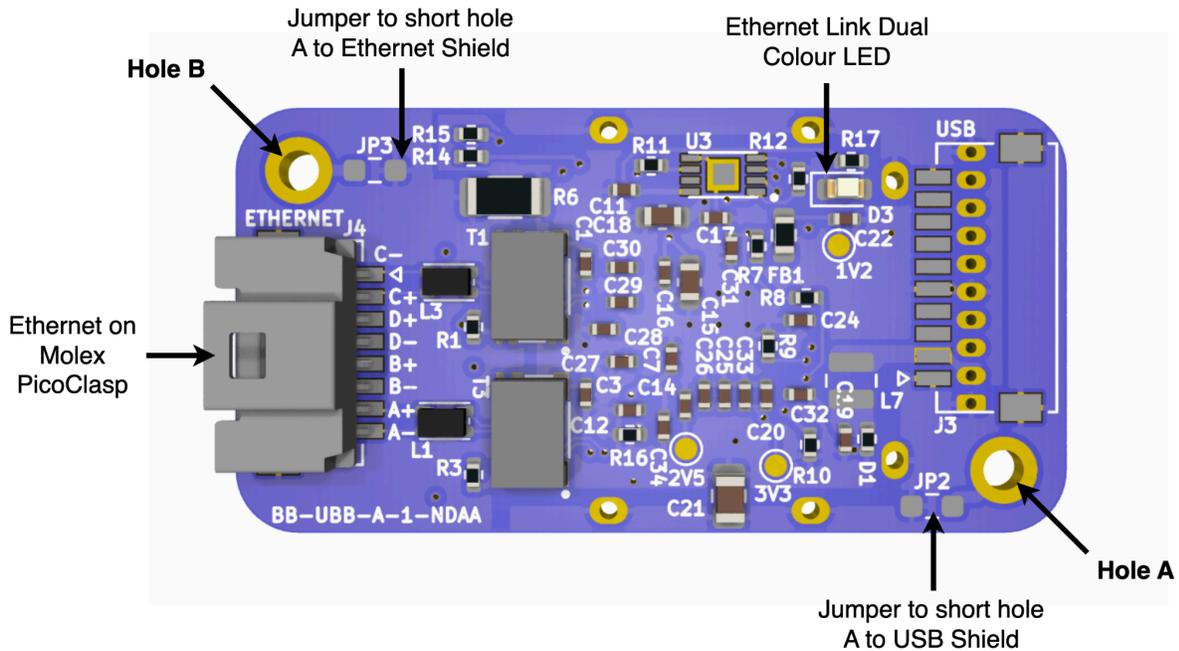
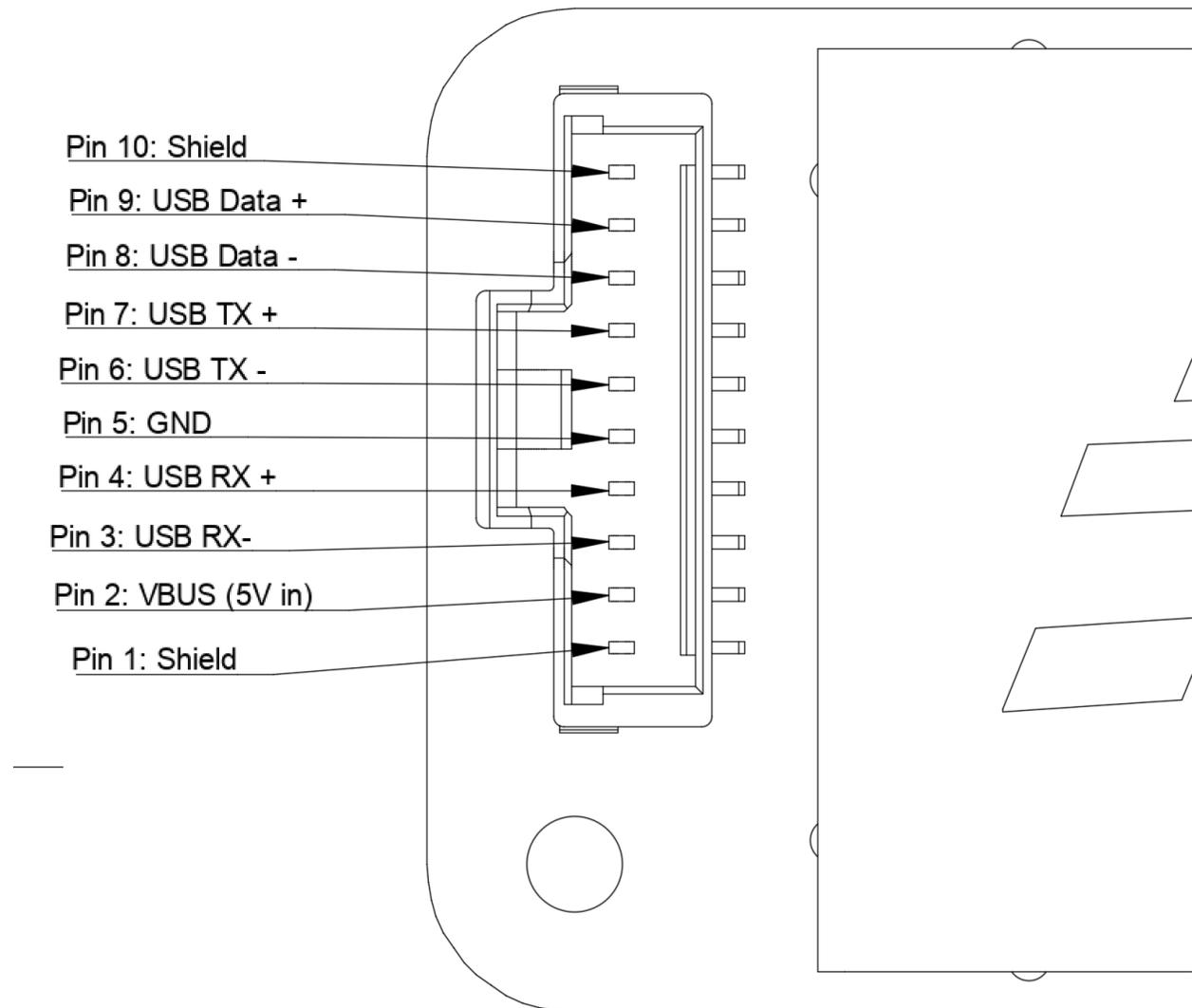


Figure 3: USBBlox Board Map (back)

## 2.2 USB Port

### 2.2.1 Connector Pinout

Figure 4 below shows the pinout on the 10 pin Molex PicoClasp connector that carries USB 3.1 signals.



*Figure 4: Connector pinout of the USB port on USBBlox*

Table 2 below shows the connectors and associated mating header and crimp used for the USB port.

Connector on board	Mating header	Crimp used	Wire used
<a href="#">5013311007</a>	<a href="#">5013301000</a>	<a href="#">5011937000</a>	UL1061, 28AWG

*Table 2: USB connector pinout and part numbers*

Pin number	Signal Name	Direction with respect to USBBlox	Description
1	Shield	Not applicable	Connects to the cable shield of the USB cable. Not connected to the USB power ground.
2	VBUS	Input	5V power rail from USB Host; this powers USBBlox
3	USB RX-	Input	USB 3.1 SuperSpeed receiver negative. Must connect to the USB host transmitter negative.
4	USB RX+	Input	USB 3.1 SuperSpeed receiver positive. Must connect to the USB host transmitter positive.
5	GND	Input	GND power rail from USB Host; this powers USBBlox
6	USB TX-	Output	USB 3.1 SuperSpeed transmitter negative. Must connect to the USB host receiver negative.
7	USB TX+	Output	USB 3.1 SuperSpeed transmitter positive. Must connect to the USB host receiver positive.
8	USB Data -	Bidirectional	USB 2.0 data negative. Must connect to USB host data negative.
9	USB Data +	Bidirectional	USB 2.0 data positive. Must connect to USB host data positive.
10	Shield	Not applicable	Connects to the cable shield of the USB cable. Not connected to the USB power ground.

*Table 3: USB connector signal descriptions*

## 2.2.2 Mating Cable Pinout

USBblox is supplied with a Molex PicoClasp (10 pin) to USB A cable to allow easy integration with typical USB 3.0 devices. The mapping for this cable is shown in figure 5 below.

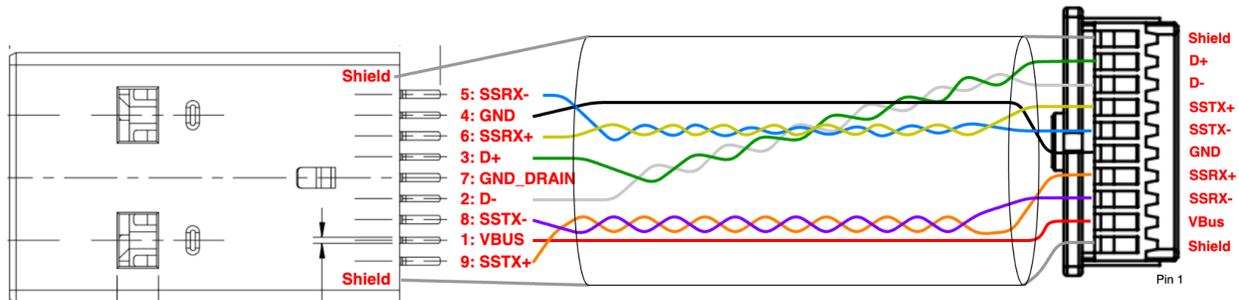


Figure 5: Cable diagram for the Molex PicoClasp to USB A 3.0 cable.

USB3.0 is very sensitive to signal integrity and EMI considerations. Therefore any cable used for the connection between the USB Host and USBblox must be as short as possible, with adequate shielding, and good quality internal twisted pairs.

## 2.3 USB Fabric

The USB fabric on USBblox is dictated by the capabilities of the onboard LAN7800 chip. This includes features such as:

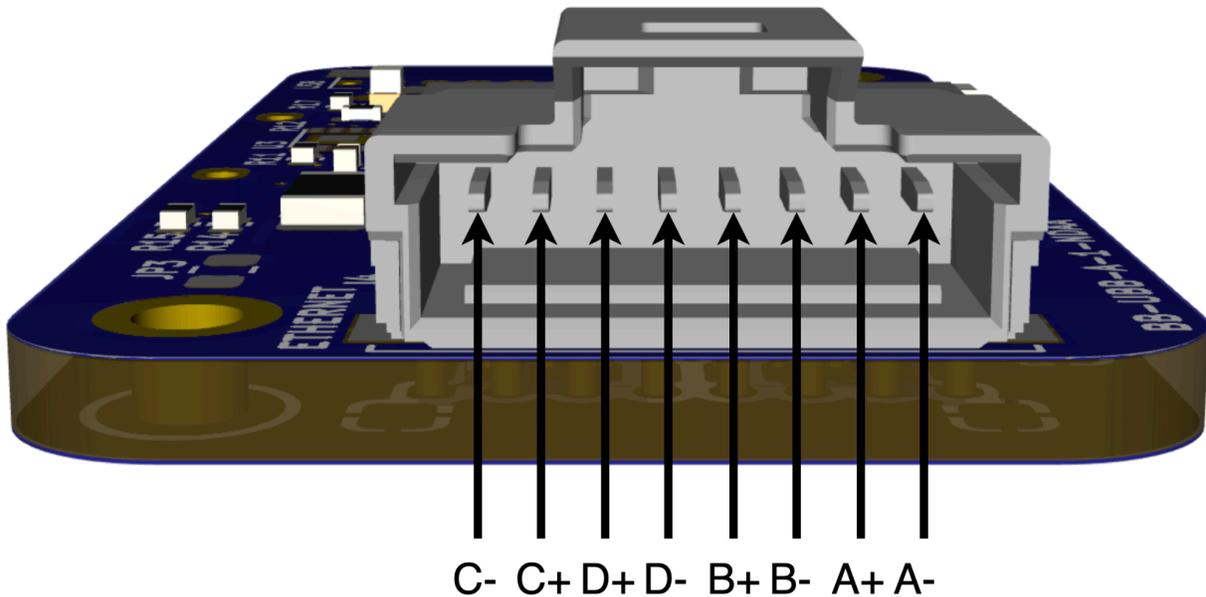
- SuperSpeed (SS), High Speed (HS) and Full Speed (FS) mode support
- Four USB Endpoints
- Driver support for Linux, Windows 7, 8, 8.1, and 10 drivers (Microsoft Certified), OS X and macOS driver

For more information on additional USB features, please refer to the [LAN7800 datasheet](#).

## 2.4 Ethernet Port

### 2.4.1 Connector Pinout

Figure 6 below shows the pinout on the 8 pin Molex PicoClasp connector for the ethernet port. This mapping is the same mapping as used on all of our other gigabit boards that use a Molex PicoClasp header. This allows easy integration of USBBlox with other BotBlox hardware through the use of a Molex PicoClasp to Molex PicoClasp 8 way cable.



*Figure 6: Connector pinout of the USB port on USBBlox*

Table 4 below shows the connectors and associated mating header and crimp used for the ethernet port.

Connector on board	Mating header	Crimp used	Wire used
<a href="#">5013310807</a>	<a href="#">5013300800</a>	<a href="#">5013340000</a>	UL1061, 28AWG

*Table 4: Ethernet connector pinout and part numbers*

### 2.4.2 Mating Cable Pinout

Figure 7 below shows the mapping of the Molex PicoClasp to RJ-45 cable used for the ethernet port on USBBlox. This cable is unshielded.

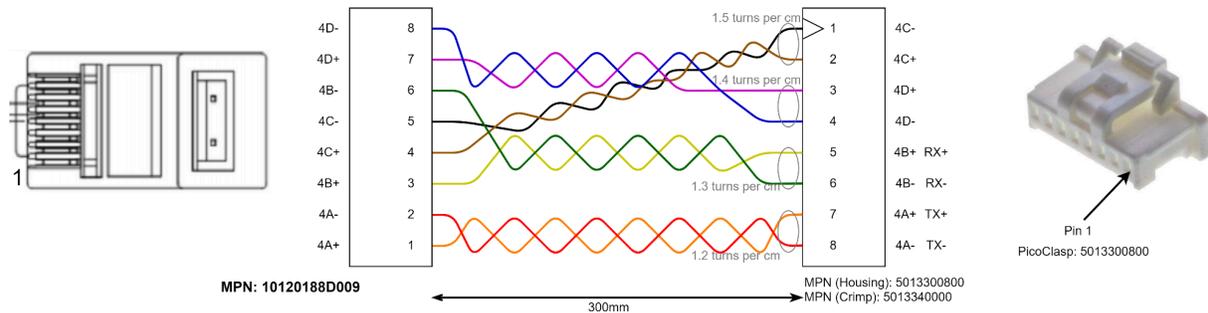


Figure 7: Ethernet cable pinout

### 2.4.3 LED Link Indication

A dual colour LED on USBBlox is used to communicate both link activity and link speed.

**Orange/Red** LED: 1000BASE-T link

**Green** LED: 100BASE-Tx or 10BASE-T link

## 2.5 Ethernet Fabric

### 2.5.1 Ethernet port characteristics

The ethernet port on USBBlox is a 10/100/1000 MAC and PHY that supports auto-negotiation, auto-polarity correction and auto-MDIX capability. This means the ethernet port will automatically detect polarity and TX/RX mismatches between itself and the connected ethernet device, and adjust itself accordingly to establish a link.

The auto negotiation functionality means that the port will automatically downshift from 1000BASE-T to 100BASE-Tx or 10BASE-T in the case of a degraded cable, or a link device that can only run at 100BASE-Tx/10BASE-T. This will also occur if a 2 pair cable is connected to the port, meaning USBBlox can interoperate with older network cabling that only uses two pairs of the cable.

### 2.5.2 MAC Address

The default MAC address of USBBlox is 00:80:0F:78:00:00. This can be modified using MPLAB® Connect Configurator, as described in section 3 Device Configuration.

### 2.5.3 NetDetach function

NetDetach is a mode of operation where the device detaches from the USB bus after the Ethernet cable is disconnected. This prevents a situation where a link still appears as present even when the ethernet device is disconnected. This feature is similar to Link Fault Pass-Through, a common feature in media converters.

## 2.5.4 VLAN setup

The LAN7800 supports:

- IEEE 802.1q VLAN tagging
- VLAN tag based packet filtering (all 4096 tags)
- Add and stripping IEEE 802.1q VLAN tags

Setting up these features requires studying the LAN7800 and using the MPLAB® Connect Configurator software. This is beyond the scope of this datasheet, please refer to the LAN7800 datasheet and MPLAB® Connect Configurator software.

## 2.5.5 Jumbo Frames

By default, USBBlox does not support jumbo frames, however this can be modified by using the MPLAB® Connect Configurator software to overwrite the preset non-volatile configuration. To modify this requires changing the maximum Jumbo Packet FIFO Configuration register from 1518 bytes to 9000 bytes. This is register 0d24, bits 5:4, as shown in excerpt from the LAN7800 datasheet in figure 8 below. Refer to 3 Device Configuration for basic information on how to configure USBBlox.

### 15.3.1.23 Ethernet PHY Extended PHY Control 2 Register

Index (In Decimal): 24                      Size:            16 bits  
Page: 0

BITS	DESCRIPTION	TYPE	DEFAULT
15:13	<b>100BASE-TX Edge Rate Control</b> 011 = +3 edge rate (slowest) 010 = +2 edge rate 001 = +1 Default edge rate 000 = Default edge rate 111 = -1 edge rate 110 = -2 edge rate 101 = -3 edge rate 100 = -4 edge rate (fastest)	R/W	000b
12:6	<b>RESERVED</b>	RO	-
5:4	<b>Jumbo Packet FIFO Configuration</b> 00 = Normal IEEE 1518-byte packet length 01 = 9000-byte jumbo packet length 10 = 12000-byte jumbo packet length 11 = RESERVED	R/W	00b
3:1	<b>RESERVED</b>	RO	-
0	<b>Cable Loopback Mode Enable</b>	R/W	0b

Figure 8: An excerpt from page 252 of the LAN7800 show the frame size register

## 3 Device Configuration

### 3.1 MPLAB® Connect Configurator

USBBlOX uses the LAN7800 from Microchip to achieve the USB to ethernet conversion, and has an onboard 512 byte EEPROM for storing a non-volatile configuration of the chip. This configuration can be modified to a customer's specific needs using the [MPLAB® Connect Configurator](#). This software is a freely available GUI from Microchip, and configuration is done solely over the USB port on USBBlOX. The steps below illustrate how to use MPLAB® Connect Configurator to generate a flashable configuration file for USBBlOX.

USBBlOX is a plug and play device, you do not need to do any configuration unless you have specific requirements.

1. Install [MPLAB® Connect Configurator](#), the software is only available for Windows.
2. Using the supplied cables plug USBBlOX into a USB 3.1 host port on your computer and plug the ethernet port on USBBlOX into a spare ethernet port on your device.
3. Open up device manager and confirm the device shows up as a Network Adapter as in figure 9 below.

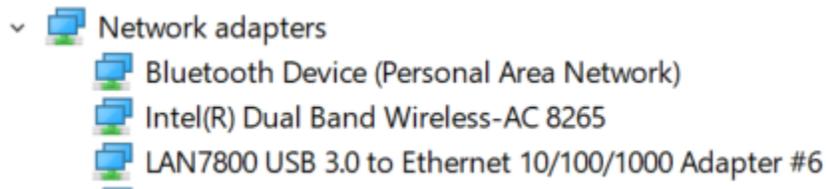


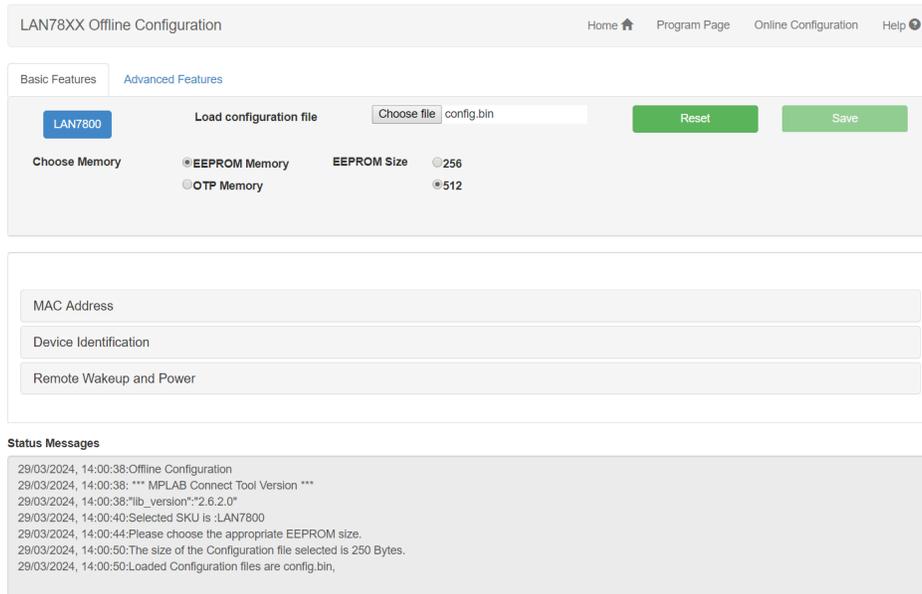
Figure 9: Device Manager showing the LAN7800 device

4. Open MPLAB® Connect Configurator and select LAN78XX Offline as shown in figure 10.



Figure 10: Device Manager showing the LAN7800 device

5. Click EEPROM and select 512 as the size. You will also need to load in a blank .bin file. You can do this by making a new text file then changing the extension to .bin, and using this as the config file. Figure 11 shows the option configuration menu.



*Figure 11: The offline configuration screen for LAN78XX*

- Using the Basic Features tab and the Advanced Features tab, you can access and configure all features of the LAN7800. Once ready, click “Save” to store the configuration to the selected binary file.

You can download the default binary that USBBlox is loaded with from the link below.  
<https://botblox.io/content/USBBLOX%20DEFAULT%20CONFIG.bin>

- Once you have saved your configuration, click “Program Page”.
- In the Program Page, select the LAN7800 device that should appear when USBBlox is connected to your PC. Then select the binary file you have just written to, and click “Program”, as shown in figure 12.

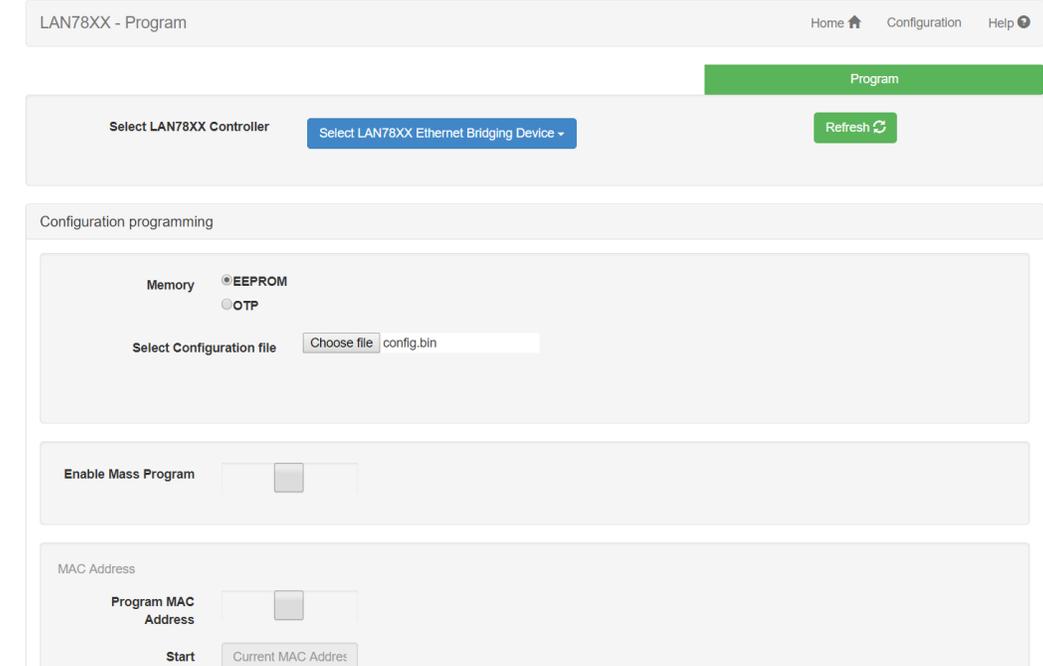


Figure 12: The Program Page

9. Once programmed, the device should show as in figure 13.

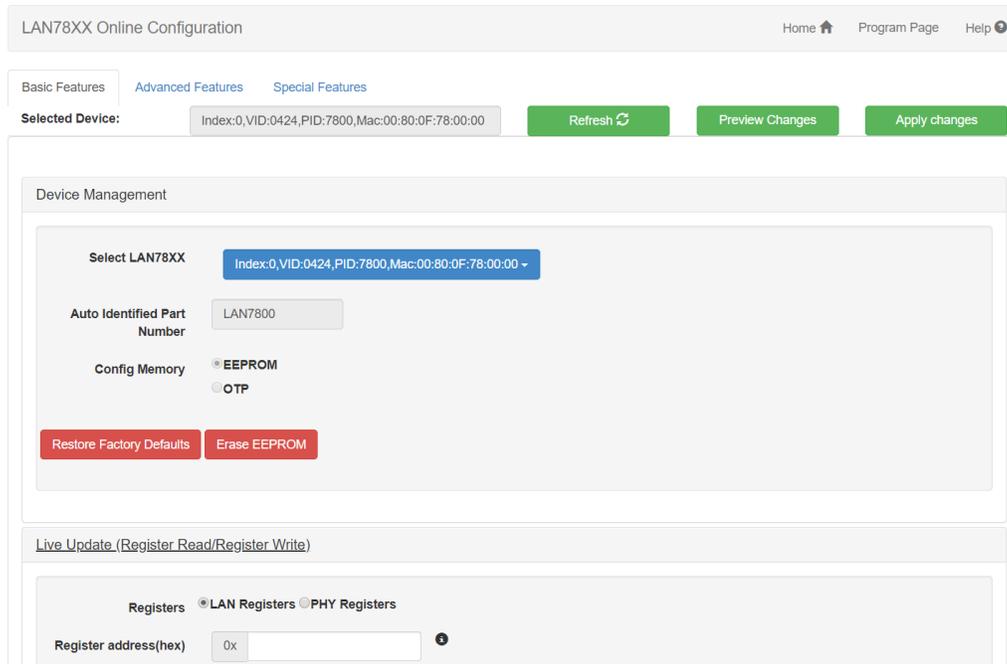


Figure 13: The Program Page after the device has been programmed.

10. You can now use USBBlox with the newly configured settings. More guidance can be found on the information page for [MPLAB® Connect Configurator](#).

## 4 Mechanical Drawing

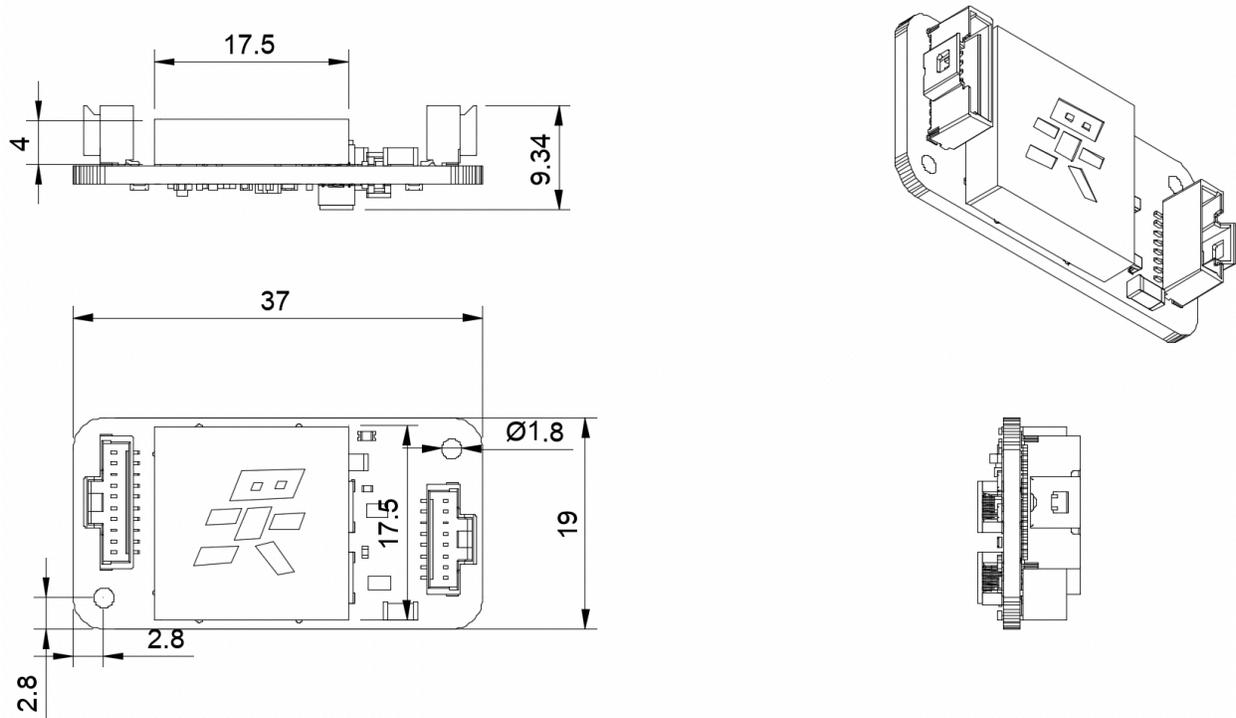


Figure 14: The basic mechanical dimensions of USBBloX

## 5 Datasheet Changelog

Date	Datasheet Version	Author	Notes
11/04/2024	A_A	Josh Elijah	Initial release

## 6 Contact

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

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## 7 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/>