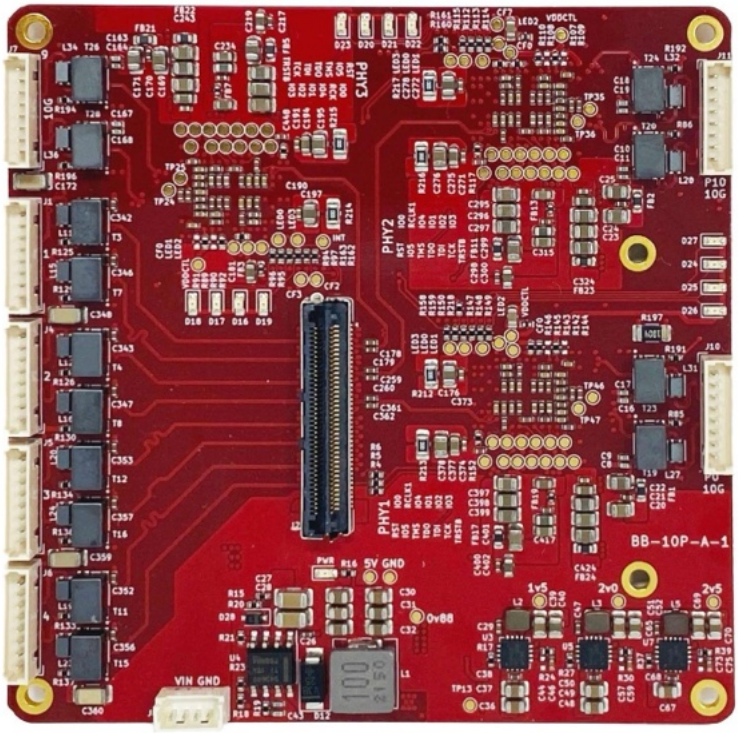
BotBlox



10GBlox BASE-T PHY

10GBASE-T PicoBlade Breakout Board

MPN: BB-10P-A-1

Datasheet

September 2022

Board revision A

BotBlox

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1 General Information

1.1 Functionality and Features of 10GBlox

The BotBlox 10GBlox BASE-T PHY is a breakout system designed for use with the 10GBlox Switch, providing 3 x 10Gbps and 4 x 1Gbps ethernet ports on Molex PicoBlade headers.

10GBlox BASE-T PHY itself does not contain any ethernet switching silicon, rather it simply contains three 10GBASE-T physical layer transceivers, and seven Molex PicoBlade headers for direct connection to an external system. The switching silicon is instead housed on the 10GBlox SWITCH which is designed to stack onto 10GBlox BASE-T PHY through a Samtec RazorBeam header.

Despite the apparent architectural simplicity of 10GBlox BASE-T PHY, the complexity of the 10GBASE-T transceivers on the board necessitates a reasonable amount of supporting circuitry and the existence of a datasheet dedicated purely to explaining how to use this board.

When used with 10GBlox SWITCH, 10GBlox BASE-T PHY will automatically begin autonegotiation with any connected devices and begin receiving and forwarding frames as an unmanaged ethernet switch. The configuration of the board is static and contained within the onboard flash memory.

10GBlox BASE-T PHY runs from a wide input voltage range of 8V to 60V allowing integration into a wide range of applications.

1.1.1 Features

The features described below apply when the board is used with 10GBlox Switch.

- 3 x 10/100/1000/2.5/5/10GBASE-T ethernet ports
- 4 x 10/100/1000BASE-T ethernet ports
- Input voltage range from 8V to 60V
- 77mm x 77mm board size
- Molex Picoblade connectors for power and Ethernet ports
- Automatic MDI-X crossover and polarity correction
- Auto-negotiation with connected devices to achieve maximum speed
- Out-the-box functionality, requiring zero user configuration to operate as an unmanaged device.

1.1.2 General Information

Voltage Input	8V to 60V DC
Supported Protocols	10BASE-T, 100BASE-TX, 1000BASE-T, 2.5GBASE-T,5GBASE-T, 10GBASE-T
Power Consumption	7.2W (idle) to 24W (full switching) (when used with 10GBlox Switch)
Weight	60 grams (without heatsink)
Size	77 mm x 77 mm x 10 mm (without heatsink)
Operating Temperature	-40°C to +85°C (board requires thermal solution)
Storage Temperature	-40°C to +125°C

Table 1: General Information

1.1.3 General Operating Instructions

10GBlox BASE-T PHY 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 8V and as high as 60V. 10GBlox BASE-T PHY must be used with 10GBlox Switch to create a full ethernet switch system.

To use 10GBlox BASE-T PHY, first mate the board with 10GBlox Switch then apply an input voltage from 8 to 60V. Then connect external devices and the 10GBlox system will begin functioning as an unmanaged switch with up to 3 x 10GBASE-T capable ports and 4 x 1GBASE-T ports.

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

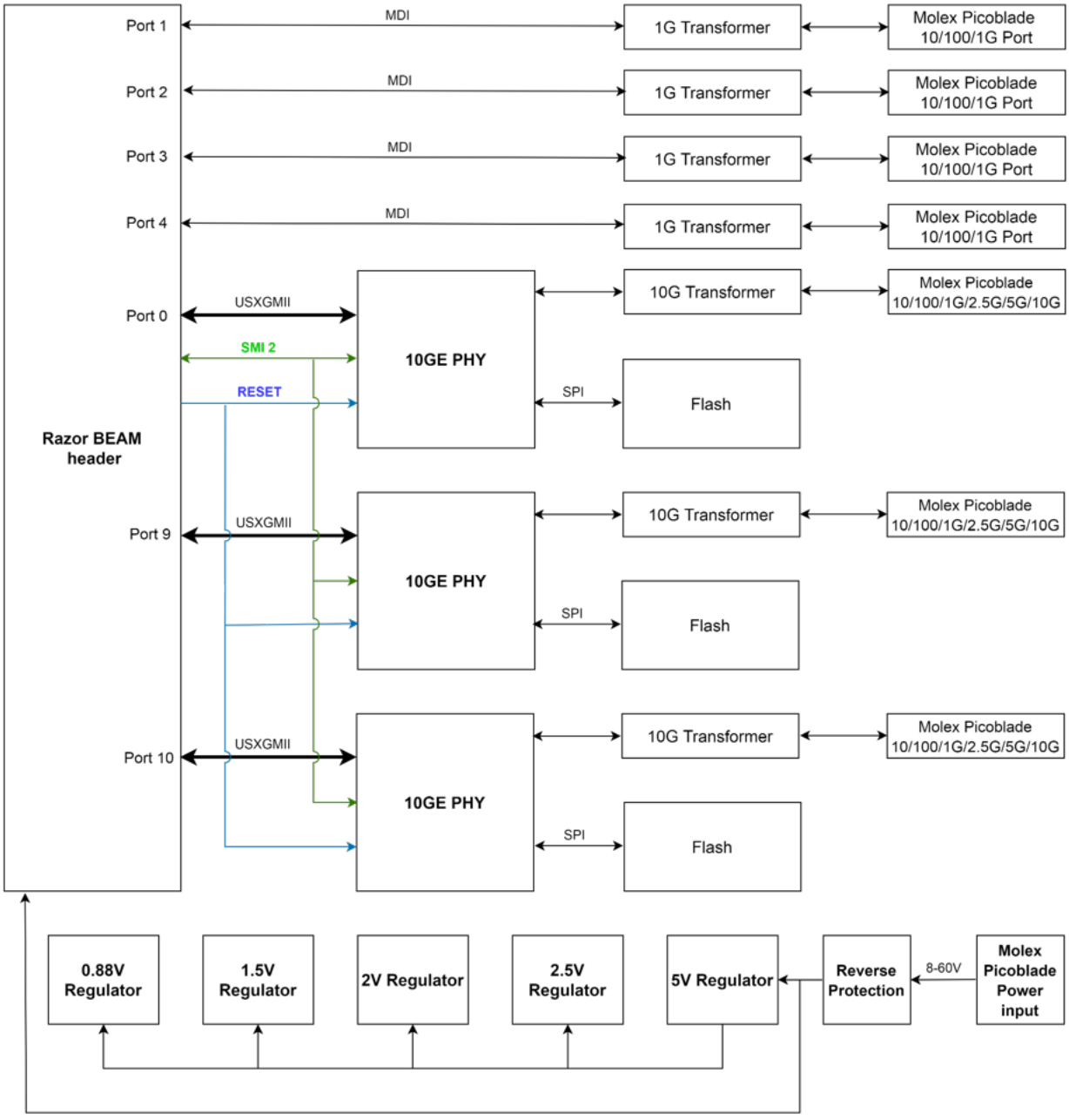

Figure 1: 10GBlox BASE-T PHY Block Diagram

1.3.1 System Design

To understand the design of 10GBlox it is necessary to understand the 10GBlox Switch design. While the 10GBlox Switch has its own datasheet, a brief explanation is provided here.

10GBlox Switch contains the main ethernet switch IC on the 10GBlox system. This IC provides four 1GBASE-T ethernet ports and three 10Gbps USXGMII ports. These seven ports are routed directly to a Samtec RazorBeam connector on 10GBlox Switch, along with a number of other power and control lines. Figure 2 below shows the signals carried on the 10GBlox Switch board.

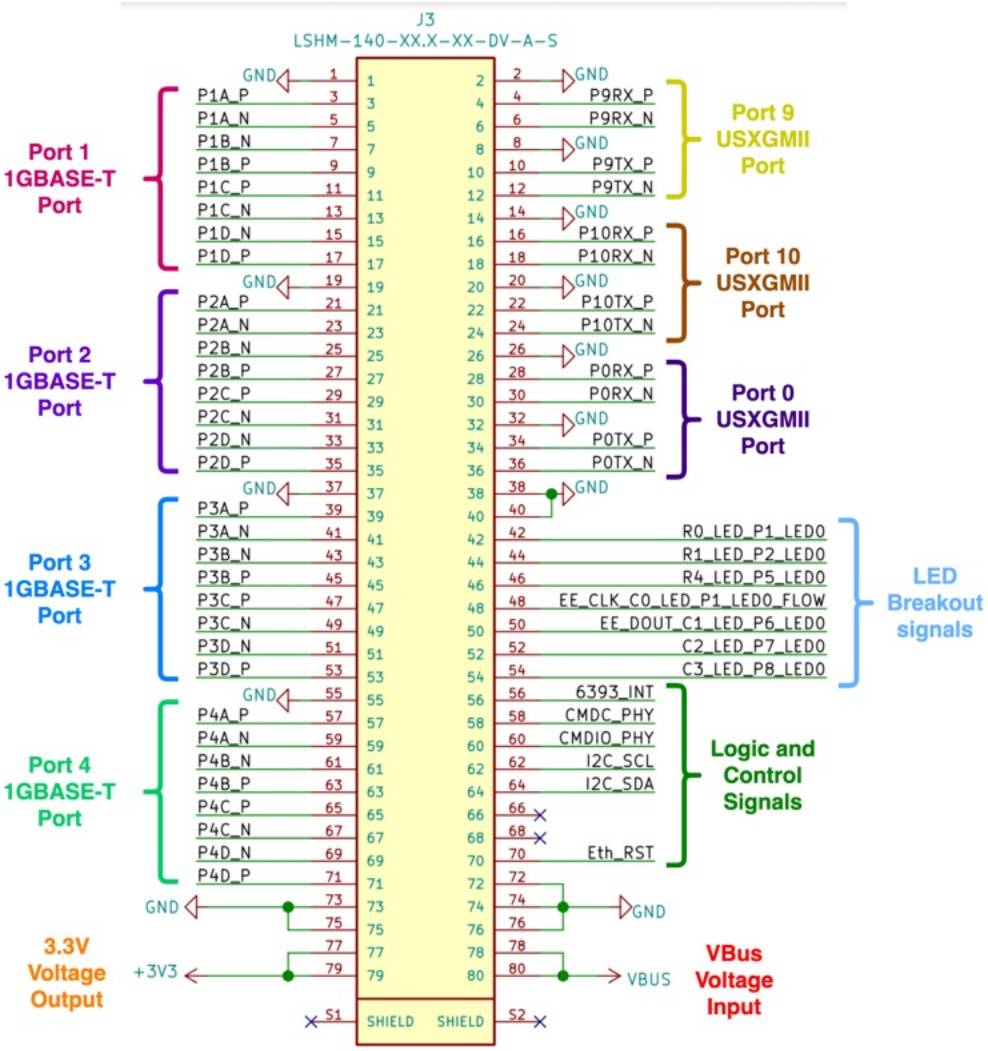

Figure 2: Signals on the 10GBlox Switch carried on the Samtec Razord Beam header

The signals shown in Figure 2 enter 10GBlox BASE-T PHY through its corresponding Samtec RazorBeam header. 10GBlox BASE-T PHY then routes these signals in the following ways.

- Ports 1-4 (the 10/100/1GBASE-T ports) are routed to Molex PicoBlade headers through ethernet magnetics.
- Ports 0, 9 and 10 (the USXGMII ports) are each routed to one of three 10GBASE-T ethernet physical layer transceivers (PHYs). The output of these PHYs are then routed to Molex PicoBlade headers through ethernet magnetics.
- 10GBlox BASE-T PHY houses a Molex PicoBlade header for 8-60V power input (VBus). This is then routed to the Samtec RazorBeam header to power the 10GBlox Switch.

In this way 10GBlox BASE-T PHY allows physical access to the 1GBASE-T ports from 10GBlox Switch, while also converting the USXGMII ports from 10GBlox Switch into copper ethernet ports.

The reason for splitting up the design in this way was to allow different PHY boards to be developed in the future, where some or all USXGMII ports could be converted to fiber or another media.

1.3.2 Autonegotiation

All ports on the 10GBlox system support auto negotiation, auto-MDI/MDIX and polarity correction. Each port will auto negotiate with the connected device to achieve the fastest possible speed. The fastest possible speed will depend on what the connected device is capable of, and the quality of the cabling between 10GBlox and the connected device. This simplifies system connectivity, meaning four of the ports on 10GBlox BASE-T PHY are compatible with any 10/100/1G device and three ports are compatible with any 10/100/1G/2.5G/5G/10G device.

1.4 Included Equipment

The product includes the following:
1 x 10Blox-PHY board
7 x Molex PicoBlade to RJ45 4-way Shielded Twisted Pair cables (300mm)
1 x Molex PicoBlade Power Cable to bare, tinned leads (300mm)

1.5 RoHS Certification of Compliance

The BotBlox 10GBlox-PHY complies with the RoHS (Restriction of Hazardous Substances Directive) Certificate of Compliance.

2 Hardware Interfaces

2.1 Board Map

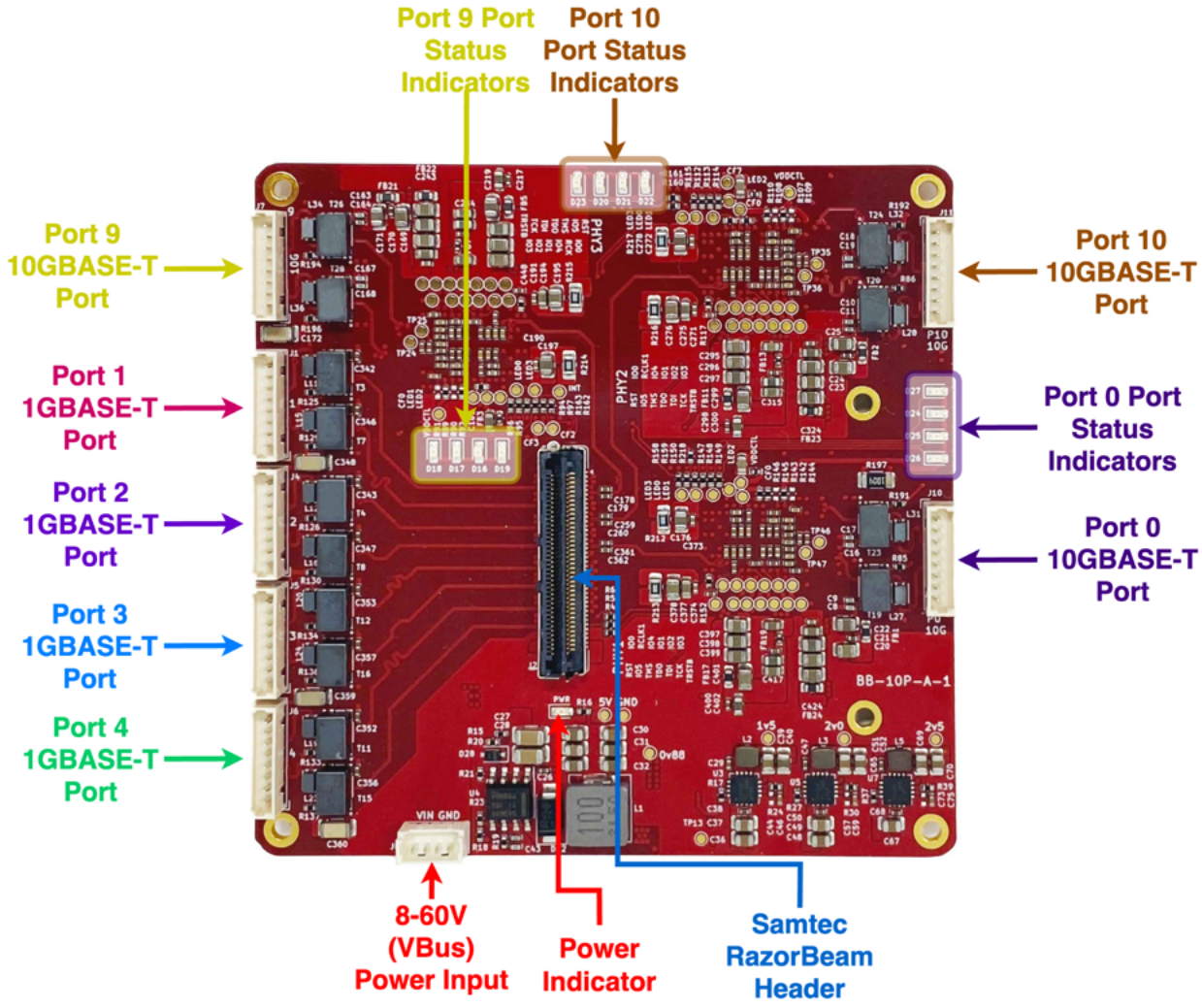

Figure 3: 10GBlox-PHY Board Map (front)

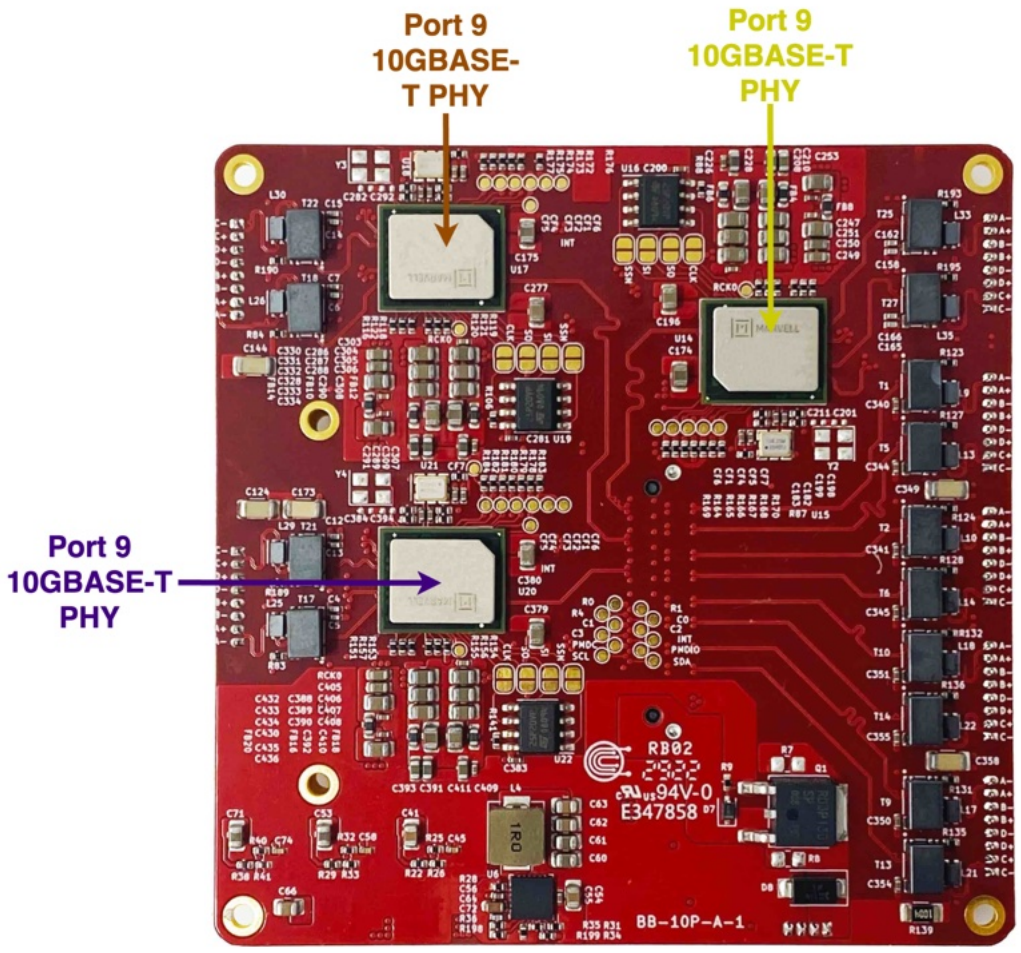

Figure 4: 10GBlox-PHY Board Map (back)

2.2 Connectors and Pinouts

2.2.1 Razor Beam connector

The 7 ports, USXGMII, SMI, LED signals, input voltage and output voltage are placed onto a Samtec Razor Beam™ (MPN: LSHM-140-03.0-L-DV-A-S-K-TR) stackable header. The Razor Beam connector on the 10GBlox-PHY Board is shown in figure 4 below.

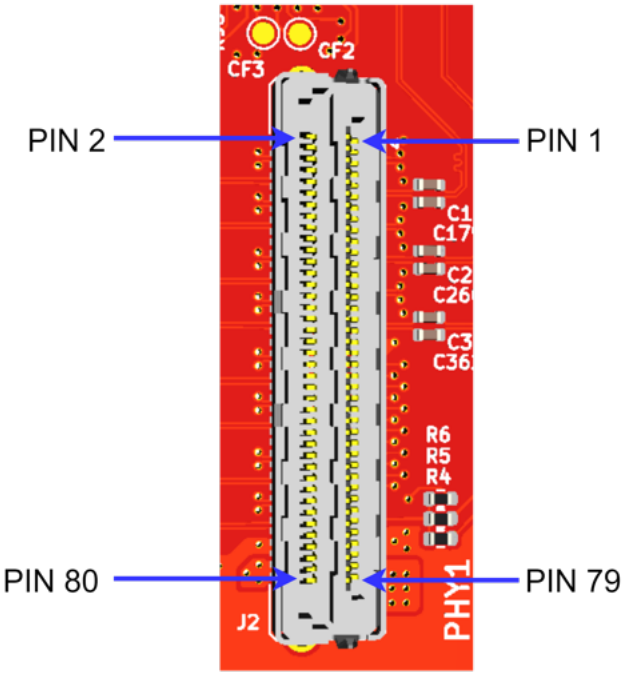

Figure 5: Razor Beam connector

The Razor Beam connector is a hermaphroditic (genderless) connector, meaning the same part is required on the daughtboard for mating. The mating method is shown in figure 5 below.

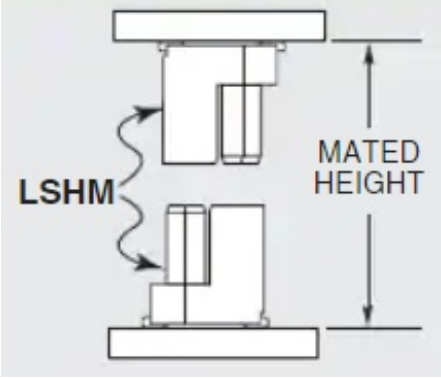

Figure 6: Razor Beam connector self-mating

The pin mapping between two mated LSHM-140-03.0-L-DV-A-S-K-TR Razor Beam connectors is shown in table 2 below.

Connector A Pin	Connector B Pin	Connector A Pin	Connector B Pin	Connector A Pin	Connector B Pin
1	2	28	27	55	56
2	1	29	30	56	55
3	4	30	29	57	58
4	3	31	32	58	57
5	6	32	31	59	60
6	5	33	34	60	59
7	8	34	33	61	62
8	7	35	36	62	61
9	10	36	35	63	64
10	9	37	38	64	63
11	12	38	37	65	66
12	11	39	40	66	65
13	14	40	39	67	68
14	13	41	42	68	67
15	16	42	41	69	70
16	15	43	44	70	69
17	18	44	43	71	72
18	17	45	46	72	71
19	20	46	45	73	74
20	19	47	48	74	73
21	22	48	47	75	76
22	21	49	50	76	75

23	24	50	49	77	78
24	23	51	52	78	77
25	26	52	51	79	80
26	25	53	54	80	79
27	28	54	53		

Table 2: Pin matching for mating connector

The signal to pin assignments used on 10GBlox-PHY is detailed in table 3 below.

Pin name	Pin number	Description
GND	1	Ground
GND	2	Ground
GND	7	Ground
GND	13	Ground
GND	19	Ground
GND	20	Ground
GND	25	Ground
GND	31	Ground
GND	37	Ground
GND	38	Ground
GND	39	Ground
GND	56	Ground
GND	71	Ground
GND	73	Ground
GND	74	Ground
GND	75	Ground

GND	76	Ground
VBUS	77	Input supply voltage, 8V to 60V
VBUS	79	Input supply voltage, 8V to 60V
+3V3	77	**Output** 3.3V, maximum 0.5A
+3V3	79	**Output** 3.3V, maximum 0.5A
P1A_P	4	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	6	
P1B_P	10	
P1B_N	8	
P1C_P	12	
P1C_N	14	
P1D_P	18	
P1D_N	16	
P2A_P	22	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	24	
P2B_P	28	
P2B_N	26	
P2C_P	30	
P2C_N	32	
P2D_P	36	
P2D_N	34	
P3A_P	40	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	42	
P3B_P	46	
P3B_N	44	
P3C_P	48	

P3C_N	50	
P3D_P	54	
P3D_N	52	
P4A_P	58	Port 4 1000BASE-T Differential Data Pair A ~ D Note: 100BASE-TX and 10BASE-Te are also supported on the A and B pairs.
P4A_N	60	
P4B_P	64	
P4B_N	62	
P4C_P	66	
P4C_N	68	
P4D_P	72	
P4D_N	70	
P0TX_P	33	USXGMII Port 0 Transmit Data bus positive
P0TX_N	35	USXGMII Port 0 Transmit Data bus negative
P0RX_P	27	USXGMII Port 0 Receive Data bus positive
P0RX_N	29	USXGMII Port 0 Receive Data bus negative
P9TX_P	9	USXGMII Port 9 Transmit Data bus positive
P9TX_N	11	USXGMII Port 9 Transmit Data bus negative
P9RX_P	3	USXGMII Port 9 Receive Data bus positive
P9RX_N	5	USXGMII Port 9 Receive Data bus negative
P10TX_P	21	USXGMII Port 10 Transmit Data bus positive
P10TX_N	23	USXGMII Port 10 Transmit Data bus negative
P10RX_P	15	USXGMII Port 10 Receive Data bus positive
P10RX_N	17	USXGMII Port 10 Receive Data bus negative
I2C_SDA	63	I2C SDA Data In/Out
I2C_SCL	61	I2C SCL serial clock
ETH_RST	69	Active low system reset

INT	55	INTn is an active low, open drain pin that is asserted to indicate an unmasked interrupt event occurred. A single external pull-up resistor is required somewhere on this interrupt net for it to go high when it is inactive
MDC_PHY	57	As a Management Data Clock, in Master mode, this pin is the reference clock output for the serial management interface (SMI) that connects to an external SMI slave device, typically external PHYs.
MDIO_PHY	59	As a Management Data Clock, in Master mode, this pin is used to transfer management data in and out of the device synchronously to MDC_PHY
R0_LED	41	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	43	
R4_LED	45	
C0_LED	47	connect to the anode of LED column 0 for each row
C1_LED	49	connect to the anode of LED column 1 for each row
C2_LED	51	connect to the anode of LED column 2 for each row
C3_LED	53	connect to the anode of LED column 3 for each row
NC	65	Not connected
NC	67	Not connected

Table 3: 10GBlox-PHY connector pin assignments

2.3 Other Interfaces

2.3.1 LEDs

There are 13 LEDs on 10GBlox-PHY in total.
The 5V Power Indicator LED (**Green**) indicates that voltage is present on the 5V line. It should be solid green in normal operation.

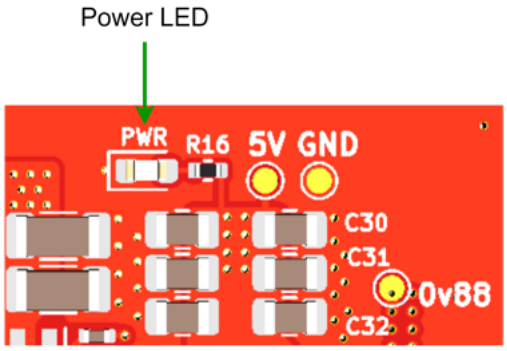

Figure 7: Power Indicator LED

There are 4 LEDs on each port of 10GBlox BASE-T PHY. None of the LED signals can be taken off board. The LED indicators for the 1G ports are housed on 10GBlox Switch.

LED 1 (Labelled Link/ACT in figure 8) is solid **Green** for a link 10M/100M/1G/2.5G/5G/10G and blinks for activity.
LED 2, 3, 4 are solid **Green** to indicate whether the link is 10G, 1G, 100M speed. All LEDs are off in 10M mode. The activity LEDs indicator is allocated identically as bellow:

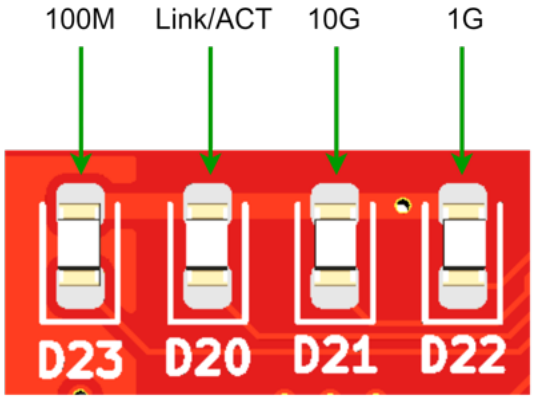

Figure 8: Port Activity Green LEDs

3 Software Interfaces

In the default configuration, there are no software interfaces on 10GBlox; it functions solely as an unmanaged switch. It is possible to configure 10GBlox to implement managed switch features including VLAN, PTP (IEEE1588), IMGP and numerous other capabilities. Achieving this requires custom firmware to be uploaded to the STM32 on 10GBlox Switch. Please get in touch to support this functionality.

4 Device Configuration

4.1 Unmanaged Applications

To use 10GBlox-PHY in an unmanaged application requires no configuration. Simply connect the daughter board and apply a voltage to the voltage input and connect downstream devices.

4.2 Managed Applications

Managed applications can be achieved using the onboard STM32 for MDIO access to the registers on the PHYs on 10GBlox-PHY. Currently this is not implemented however full customisation of the PHYs is supported with custom firmware.

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	65V
Storage Temperature	-40°C to +125°C
Operating Temperature	-40°C to +85°C

5.2 Thermal Considerations

10GBlox BASE-T PHY is not suitable for use without some

6 Datasheet Changelog

Date	Datasheet Version	Author	Notes
1/10/2022	A_A	Josh Elijah	Initial release

7 Contact

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

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