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FPGA PolarFire
Ethernet Sensor
Bridge



MICROCHIP FPGA PolarFire Ethernet Sensor Bridge User Guide

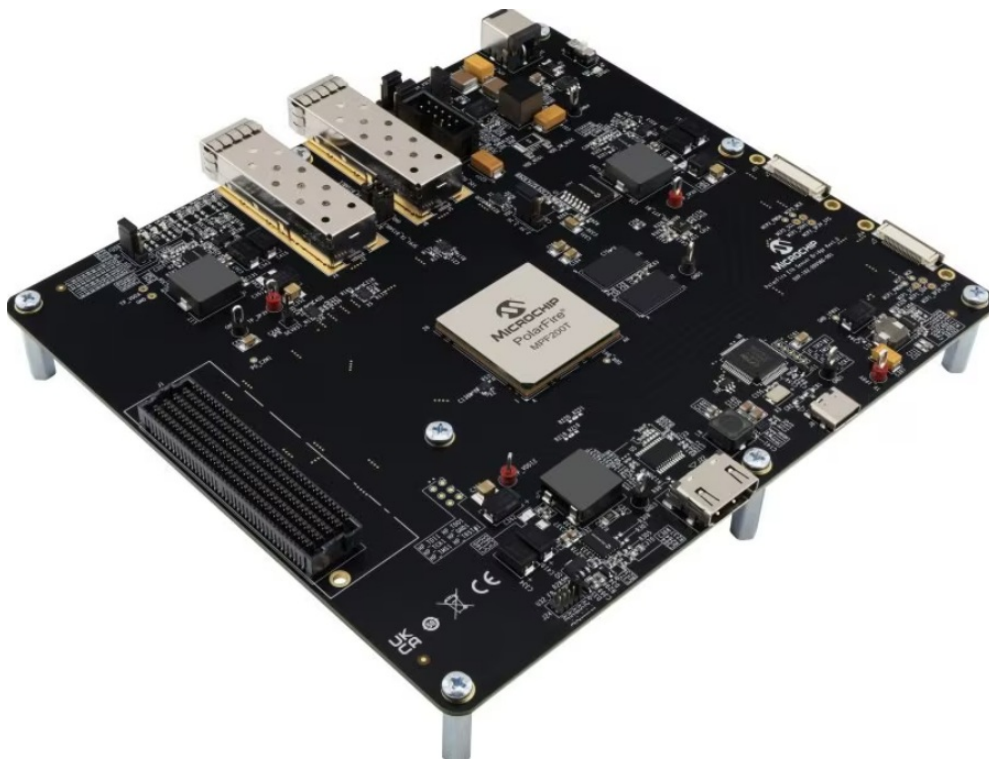
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MICROCHIP FPGA PolarFire Ethernet Sensor Bridge



Specifications

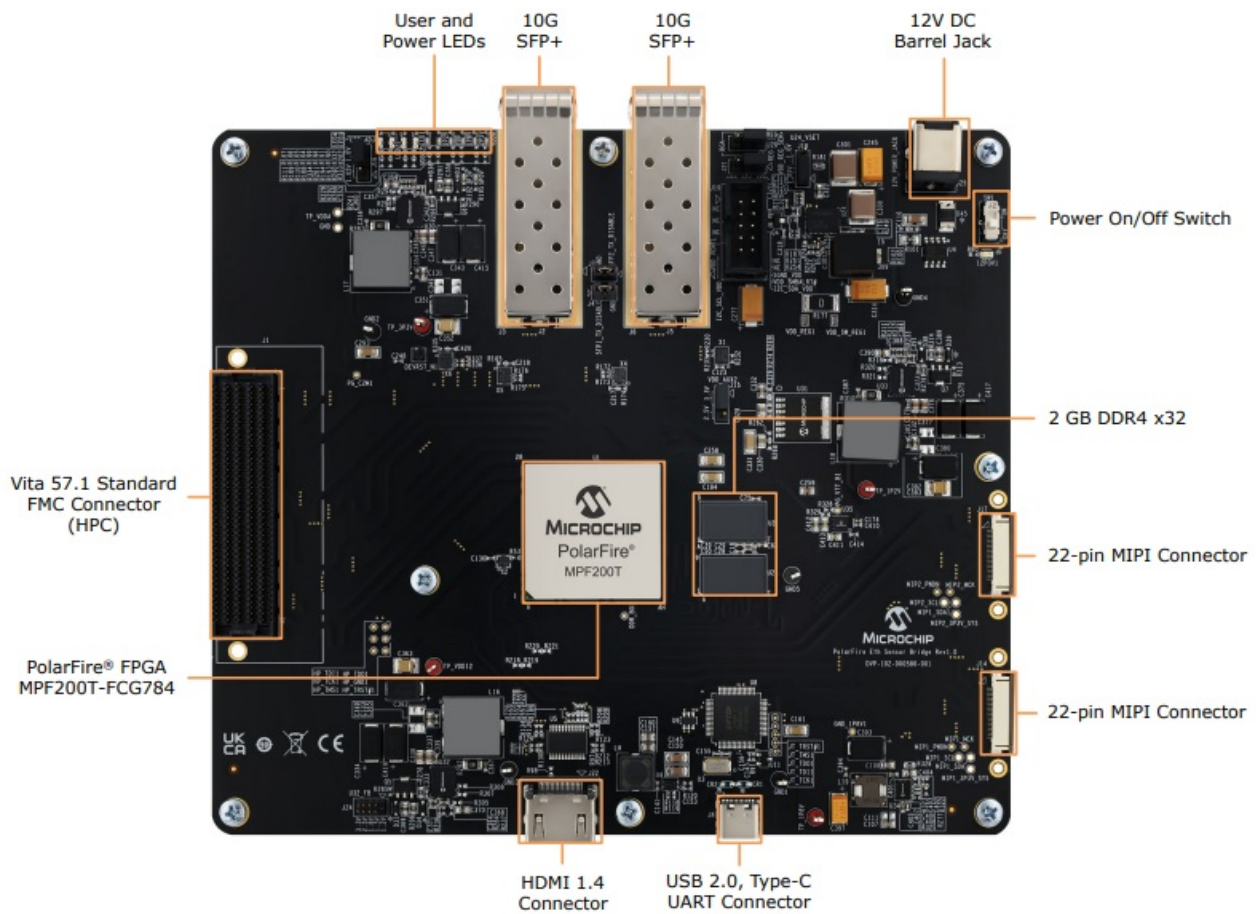
- Supports interfaces: 10G SFP+, HDMI 1.4, USB 2.0, Type-C UART, 2 GB DDR4 x32, MIPI Connector
- Programming: On-board FlashPro5 (FP5) programmer for PolarFire FPGA development

Introduction

The PolarFire® Ethernet Sensor Bridge (PFSB) kit is an RoHS-compliant board that has two MIPI camera interface, two 10G SFP ports, and an HDMI interface.

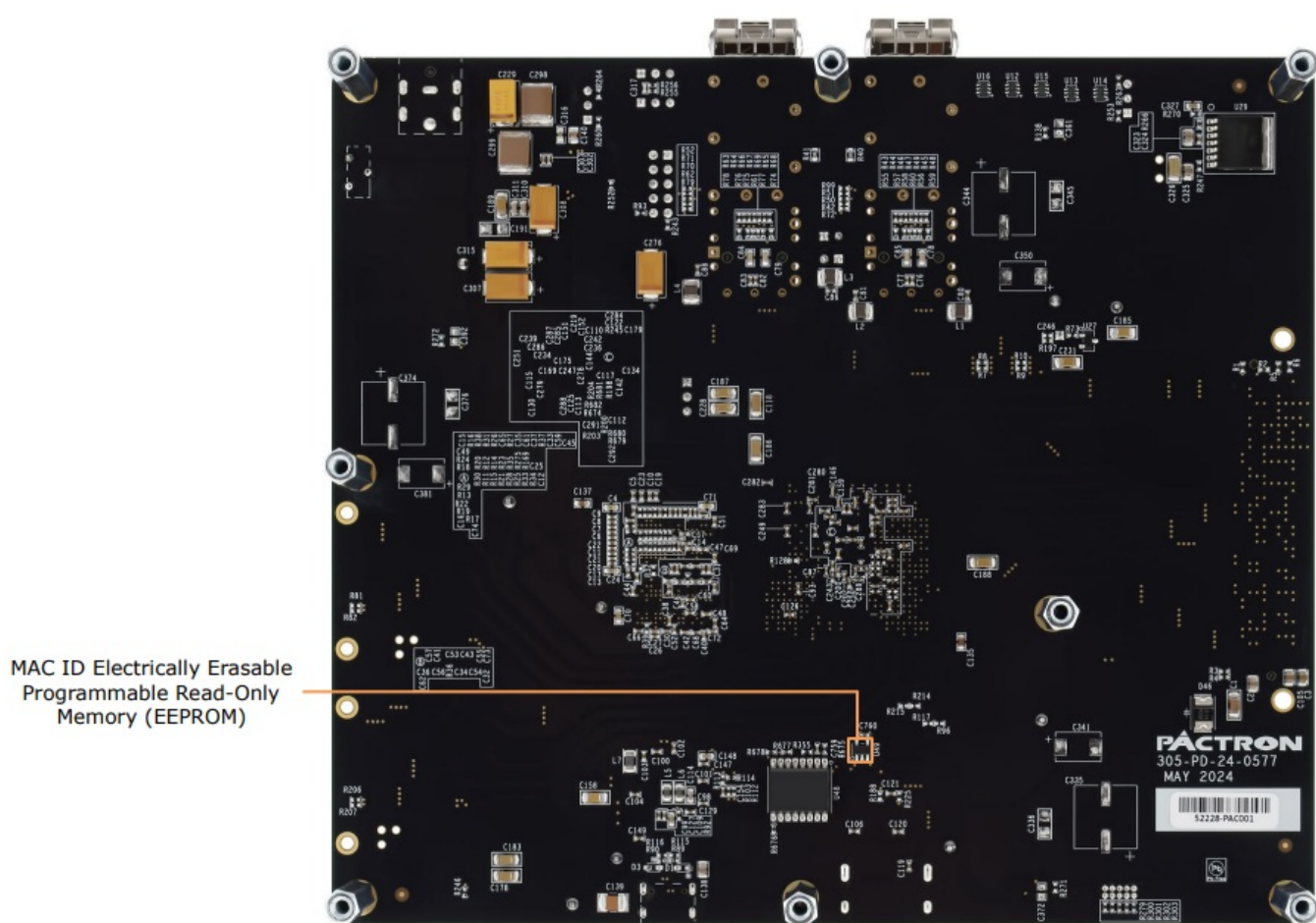
The following image highlights the top-view of the PFSB kit.

Figure 1. Board Callout (Top-View)



The following image highlights the bottom-view of the PFSB kit.

Figure 2. Board Callout (Bottom-View)



For more information about the PFSB kit, see the MPF200-ETH-SENSOR-BRIDGE page.

Getting Started

The PolarFire Ethernet Sensor Bridge board supports the following interfaces:

- 10G SPF+ Ports
- X32 DDR4
- HDMI 1.4
- USB-UART
- 2x MIPI camera interface
- FMC connector

The PolarFire device is programmed using the on-board FlashPro5 (FP5) programmer. The on-board FP5 programmer is also used to develop and debug embedded applications using SoftConsole, Identify, or SmartDebug.

Kit Contents (Ask a Question)

The following table lists the contents of the PolarFire Ethernet Sensor Bridge.

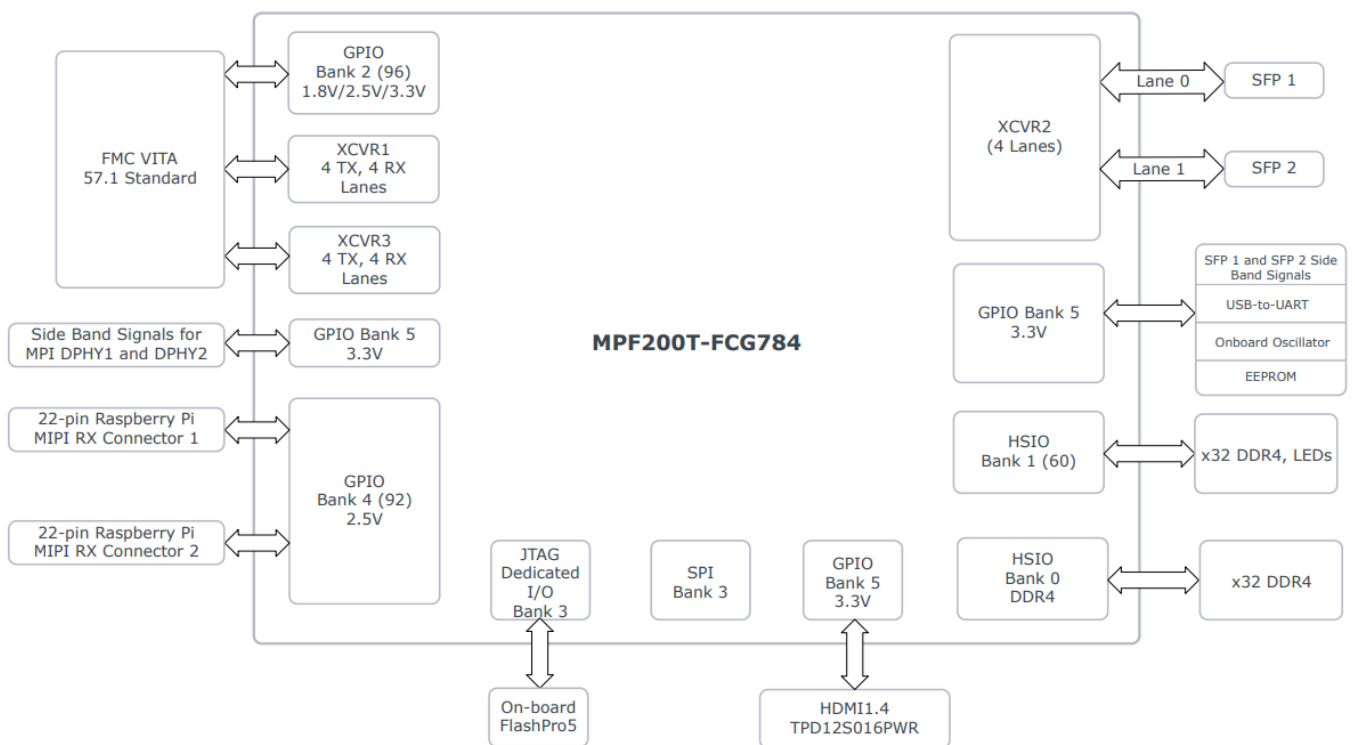
Table 1-1. Kit Contents

Item	Quantity
PolarFire Ethernet Sensor Bridge Board	1
PolarFire Ethernet Sensor Bridge Quickstart Card	1
12.3 MP 477M HQ Camera Module for Raspberry Pi with 135°(D) M12 Wide Angle Lens	1
10GBase-T SFP + RJ45 30 cm	1
4Ft Cat7 Shielded (SSTP) 600 MHz Cable	1
12V AC Adapter	1
12V Power Cord	1
USB C TO USB C, USB 2.0 – 2 MET	1

Block Diagram

The following block diagram shows all the components of the board.

Figure 1-1. Block Diagram



Board Overview

The following table lists the key components of the PolarFire Ethernet Sensor Bridge.

Table 1-2. Board Components

Component	Label on Board	Description
Featured Device		
PolarFire® FPGA MPF200T-FCG784	U1	See PolarFire FPGA Datasheet.
Power Supply		
12V external supply	J25	The board is powered by using a 12V adapter.
Clocks		
50 MHz clock oscillator	X2	50 MHz clock oscillator with single-ended output
OSC	X4	148.5 MHz oscillator (differential LVDS output), which is the input to the XCVR1
OSC	X6	125 MHz oscillator (differential LVDS output), which is the input to the XCVR1
OSC	X5	125 MHz oscillator (differential LVDS output), which is the input to the XCVR3
OSC	X1	156.25 MHz oscillator (differential LVDS output), which is the input to the XCVR2

Component	Label on Board	Description
FPGA Programming and Debugging		
Programming using on-board embedded FlashPro5 (eFP5)	U8	On-board eFP5 to program or debug the silicon through USB to JTAG channel
Communication Interfaces		
SFP+ Ethernet	J2 and J5	SFP+ connector for 10G Ethernet
FMC connector	J1	Expansion connector
HDMI	J22	HDMI 1.4 connector
USB-UART	U8	FT4232HL is a USB-to-quad UART bridge controller. This device is used to support 3 UART interfaces on the board.
Memory Chips		
DDR4	U2 and U3	MT40A512M16TB-062E:R is used for DDR4 interface
microSD Card	J17	microSD connector
General Purpose I/O		
Debug push-buttons	SW1 to SW2	For debugging
Dip Switches	SW8	Eight dip switches for debugging
Light-Emitting Diodes (LEDs)	LED1 to LED8	Eight active-high LEDs connected for debugging
Expansion Interfaces		
FMC	J1	FMC connector
Raspberry Pi MIPI RX Connector	J14 and J17	Facilitates the use of the CSI-2 camera module

Handling the Board (Ask a Question)

To avoid possible damage or malfunction, pay attention to the following points while handling or operating the board:

- Handle the board with Electrostatic Discharge (ESD) precautions to avoid damage. For information about the ESD precautions, see Understanding Product Handling and ESD Precautions.
- Turn off the board by unplugging the USB Type-C cable.

Operating Temperature (Ask a Question)

To be updated in a future revision.

Powering Up the Board (Ask a Question)

The PolarFire Ethernet Sensor Bridge board is powered by the 12V Jack (J25). To turn on the board, connect a 12V adapter to the 12V Jack (J25). Power status LEDs, VDD, VDDA, 1P2V, 1P8V, and 2P5V start glowing to indicate that the board is turned on.

The following table lists the probing points for power rails.

Table 1-3. Voltage Measurement

S. No	Regulator/Power Rail	Jumper	Rail	Probing Point	Expected Voltage/Supply	Tolerance
1	U24/VDD	J18 (2 and 3)	VDD	VDD and GND (C308)	1.0V	±3%
2		J18 (2 and 1)			1.05V	±3%
3	U30/3P3V	—	3P3V	TP_3P3V and GND (C351)	3.3V	±5%
4	U29/VDDA	J16 (2 and 3)	VDDA	TP_VDDA and GND (C326)	1.0V	±3%
5		J16 (2 and 1)			1.05V	±3%
6	U6/5P0V	—	5P0V	5P0V and GND (C160)	5.0V	±5%

S. No	Regulator/Power Rail	Jumper	Rail	Probing Point	Expected Voltage/Supply	Tolerance
7	U31/2P5V	—	2P5V	2P5V and GND (C331)	2.5V	±5%
8	U33/VDDI0_1	—	1P2V	TP_1P2V and GND (C382)	1.2V	±5%
9	U32/VDDI2	J24 (9 and 10)	VDDI2	TP_VDDI2 and GND (C363)	3.3V	±5%
10		J24 (7 and 8)			2.5V	±5%
11		J24 (5 and 6)			1.8V	±5%
12		J24 (3 and 4)			1.5V	±5%
13		J24 (1 and 2)			1.2V	±5%
14	U34/1P8V	—	1P8V	TP_1P8V and GND (C397)	1.8V	±5%
15	U35/DDR4_VREF	—	0P6V_VTT_DDR4	0P6V_VTT_DDR4 and GND (C413)	0.6V	±5%

Installation and Settings

This section provides information about the software and hardware settings required to run the pre-programmed demo design on the PolarFire Ethernet Sensor Bridge.

Software Settings (Ask a Question)

Download and install the latest release of Microchip’s Libero® SoC and generate your free Silver license at Microchip Portal. The Libero SoC installer includes the required device programmerdrivers. See the following references:

- For more information about licensing and installing Libero SoC, see the Libero SoC Documentation.
- For more information about installing SoftConsole, see the SoftConsole page.
- For more information about downloading and installing Microchip’s DirectCores on the Host PC, where Libero SoC is installed, see the IP Core Tools.
- For more information about downloading and installing Microchip’s firmware drivers on the Host PC, where Libero SoC is installed, see the Firmware Catalog Documentation.

Hardware Settings (Ask a Question)

This section provides information about jumper settings, test points, and Power LEDs on the PFSB board.

Jumper Settings (Ask a Question)

Connect the jumpers according to the settings specified in the following table.

Table 2-1. Jumper Settings

Jumper	Description	Pin	Default Setting
J15	Jumper to select the VDDAUX voltage for Bank 2	Close pins 1 and 2 for setting VDDAUX to 2.5V.	Pins 1 and 2 are closed.
J24	Jumper to select the bank voltage for GPIO Bank 2	Close pins as follows: • 1 and 2 = 1.2V	Pins 9 and 10 are closed.
		• 3 and 4 = 1.5V	
		• 5 and 6 = 1.8V	
		• 7 and 8 = 2.5V	
		• 9 and 10 = 3.3V	

Power Supply LEDs (Ask a Question)

The following table lists the power supply LEDs on the PFSB kit.

Table 2-2. Power Supply LEDs

LED	Description
VDD	1V rail (core voltage)
1P8V	1.8V rail
VDDA	1V analog
2P5V	2.5V
1P2V	1.2V
5P0V	5V rail

Test Points (Ask a Question)

The following test points are available on the PFSB kit.

Table 2-3. Test Points

Test Point	Description
GND1	Test point for GND
GND4	Test point for GND
GND5	Test point for GND
TP_VDDA	Test point for VDDA
TP_1P2V	Test point for 1.2V
TP_2P5V	Test point for 2.5V
TP_VDD	Test point for 1V (core voltage rail)
TP_1P8V	Test point for 1.8V

Power Sources (Ask a Question)

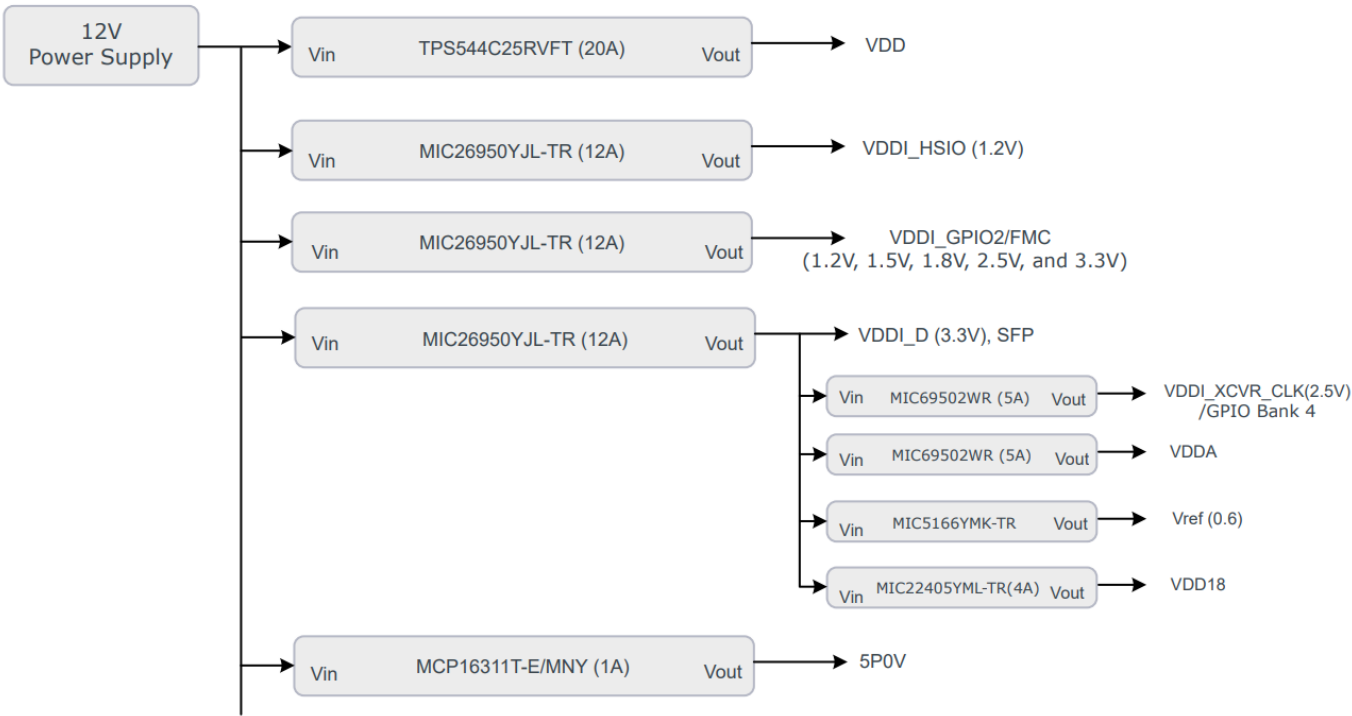
The PFSB uses Microchip power supply devices. For more information about these power supply devices, see Microchip's Power Management Devices. The following table lists the key voltage rails required for a normal operation of the PFSB board.

Table 2-4. I/O Voltage Rails

Bank	I/O Rail	Voltage
Bank 0 and 1 (HSIO)	1P2V	1.2V
Bank 2 (GPIO)	VDDI2	1.8V, 2.5V, and 3.3V
Bank 4 (GPIO)	2P5V	2.5V
Bank 3 (JTAG)	3P3V	3.3V
Bank 5 (GPIO)	1P8V	1.8V

The following figure shows voltage rails 5V, 3.3V, 2.5V, 1.8V, 1.2V, and 1.0V (VDD) that are available on the PFSB kit.

Figure 2-1. Voltage Rails



The following table lists the power regulators recommended for the PFSB kit voltage rails.

Table 2-5. Power Regulators

Voltage Rail	Part Number	Description	Current
VDD (1V)	TPS544C25RVFT	IC REG BUCK ADJUSTABLE 20A	20A

Voltage Rail	Part Number	Description	Current
VDDA	MIC69502WR	IC REG LINEAR POS ADJ 5A	5A
VDDI0_1	MIC26950YJL-TR	IC REG BUCK ADJUSTABLE 12A	12A
VDDI2	MIC26950YJL-TR	IC REG BUCK ADJUSTABLE 12A	12A
1P8V	MIC22405YML-TR	IC REG BUCK ADJUSTABLE 3A	4A
2P5V	MIC69502WR	IC REG LINEAR POS ADJ 5A	5A
3P3V	MIC26950YJL-TR	IC REG BUCK ADJUSTABLE 12A	12A
VTT/VREF	MIC5166YML-TR	IC PWR SUP 3A HS DDR TERM 10MLF	3A
5P0V	MCP16311T-E/MNY	IC REG BUCK ADJUSTABLE 1A	1A

Board Components and Operation

This section describes the key components of the PFSB board and provides information about important board operations. For device datasheet, see the PolarFire FPGAs documentation page.

DDR4 Memory Interface (Ask a Question)

The DDR4 memory is connected to HSIO Bank 0 and 1. The following list provides the DDR4 memory specifications:

- Part number: MT40A512M16TB-062E:R
- Manufacturer: Micron
- X32

SPI Flash (Ask a Question)

SPI Flash is connected to the dedicated SPI interface of Bank 3. The following list provides the SPI Flash specifications:

- Part number: MT25QL01GBBB8ESF-0SIT
- Manufacturer: Micron

MAC ID EEPROM (Ask a Question)

The I2C-based Electrically Erasable Programmable Read-Only Memory (EEPROM) is connected to the GPIO Bank for storing dual MAC ID. The following list provides the EEPROM specifications:

- Part number: AT24MAC402-STUM-T
- Manufacturer: Microchip

Communication Interfaces (Ask a Question)

The PFSB kit supports the following interfaces for communication:

- Ethernet-XCVR: The PFSB kit supports two 10G SFP+ connectors. XCVR2 is connected to the SFP+ connectors. A 156.25 MHz clock is provided on the board.
- USB-to-UART Interface: The PFSB kit supports a USB-to-quad UART bridge controller device, which supports two UART interfaces. The following are the specifications:
 - Part number: FT4232HL
 - Manufacturer: FTDI
 - UART_C and UART_D interfaces are connected to GPIO Bank 5

Expansion Capabilities (Ask a Question)

The PFSB kit has the following expansion capabilities.

- Raspberry Pi 22-Pin MIPI Connector
- HDMI Connector
- FMC Interface

Raspberry Pi 22-Pin MIPI Connector (Ask a Question)

The PFSB kit has two 22-pin Raspberry Pi MIPI camera interfaces. MIPI Camera signals are connected to GPIO Bank 4. It has four data lanes, one clock pair, and side band signals connected to Bank 5.

- Part number: 0524372271
- Manufacturer: Molex

HDMI Connector (Ask a Question)

The PFSB kit has an HDMI 1.4 interface connector. TPD12S016PWR is used for ESD protection and overcurrent protection. The following list provides the HDMI connector specifications:

- Part number: RAHHD19TR
- Manufacturer: Switchcraft Inc.

FMC Interface (Ask a Question)

The PFSB kit supports an FMC connector that allows the use of external daughter boards. ADC and DAC boards from Analog Devices are supported. XCVR1 and XCVR3 are connected to the FMC. Sideband signals are connected to GPIO Bank 2. The following daughter boards are supported:

- DAC38RF8xEVM_RevE
- LI-IMX530-SLVS-FMC_V1.01
- DC079C_AFE77xxEVM

Debug Circuitry (Ask a Question)

The PolarFire Ethernet Sensor Bridge has four Debug LEDs (LED1 to LED4), which are connected to HSIO Bank 1. The following table lists the Debug LED to FPGA pin connection.

Table 3-1. Debug LED Connection

LED Number	Pin
LED1	AD18
LED2	AE18
LED3	AB19
LED4	AC18

Programming Scheme (Ask a Question)

The PolarFire Ethernet Sensor Bridge has an on-board FlashPro5 to program or debug the silicon through USB to JTAG channel. For more information about how to program the device, see Programming PolarFire FPGA Using the On-board FlashPro5.

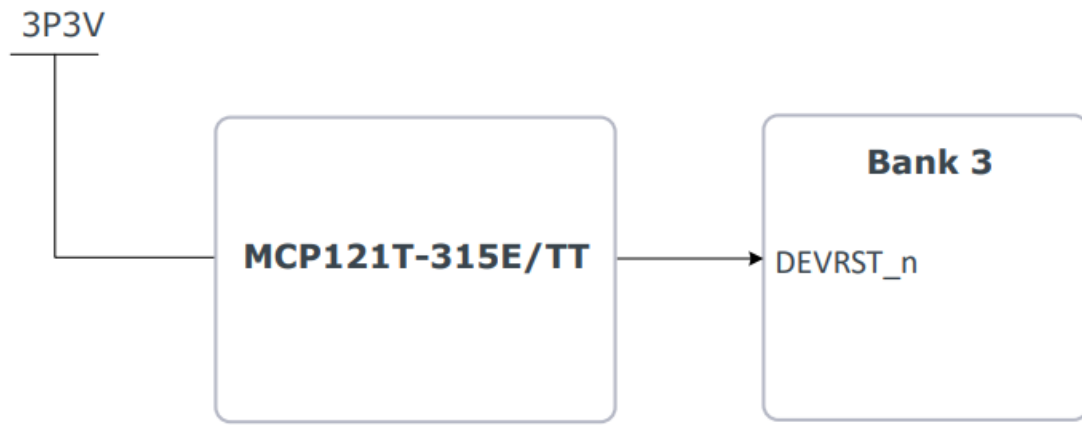
Form Factor (Ask a Question)

The form factor of the PFSB kit is 6.8" × 6", approximately.

System Reset (Ask a Question)

DEVRST_N is an input-only reset pad that allows a full reset of the chip to be asserted. The following figure shows a sample reset circuit that uses a Microchip MCP121T-315E/TT device.

Figure 3-1. Reset Circuit

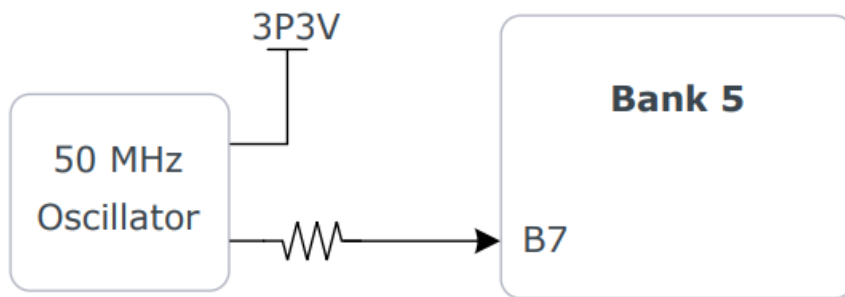


50 MHz Oscillator (Ask a Question)

A 50 MHz clock oscillator, with an accuracy of ± 10 ppm, is available on board. This clock oscillator is connected to the FPGA fabric to provide a system reference clock. The 50 MHz oscillator is connected to the B7 pin number of the FPGA device.

The following figure shows the 50 MHz clock oscillator interface.

Figure 3-2. 50 MHz Oscillator



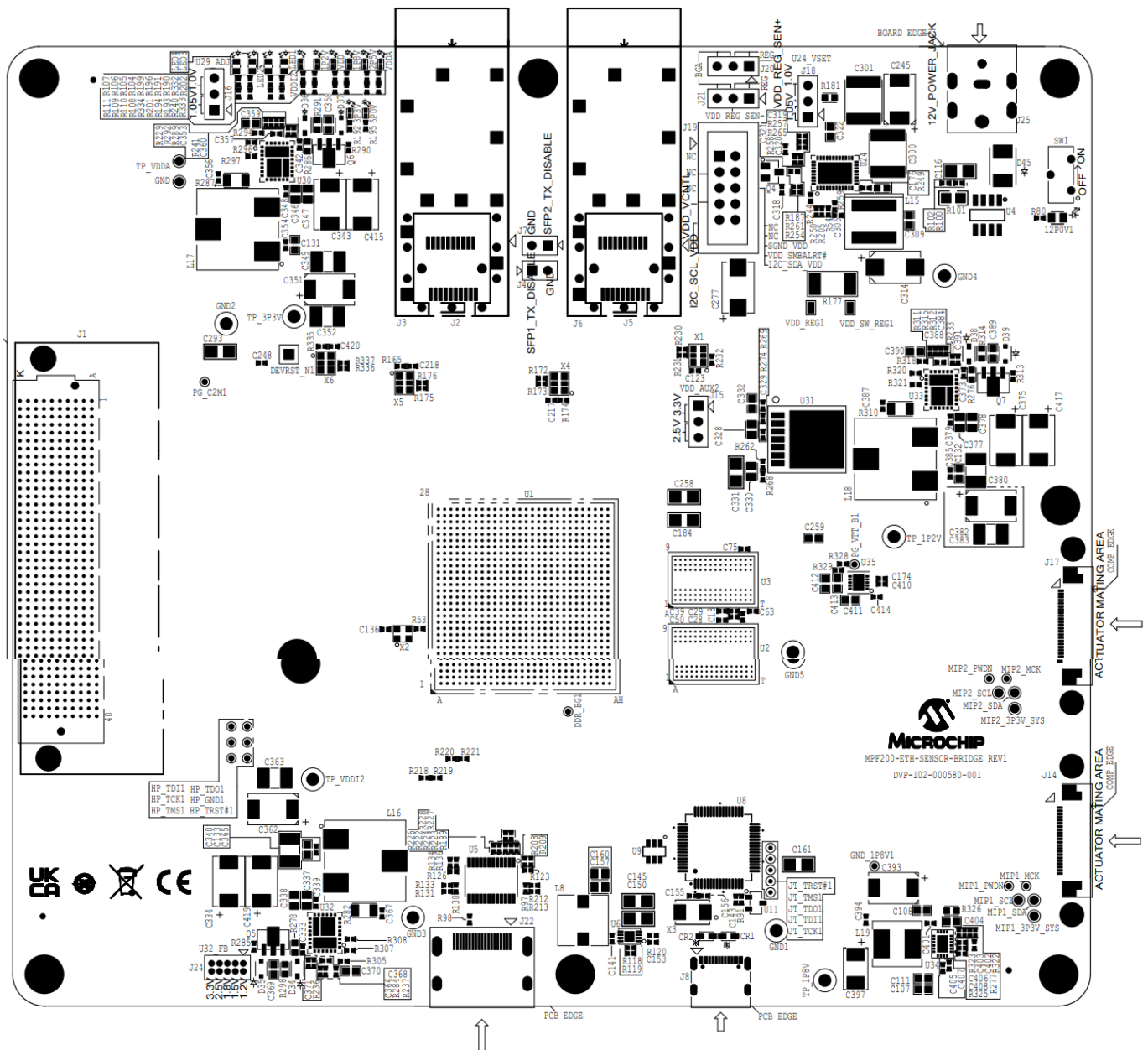
Pin List (Ask a Question)

For more information about all package pins on the PolarFire FPGA device, see the Package Pin Assignment Table (PPAT).

Board Components Placement (Ask a Question)

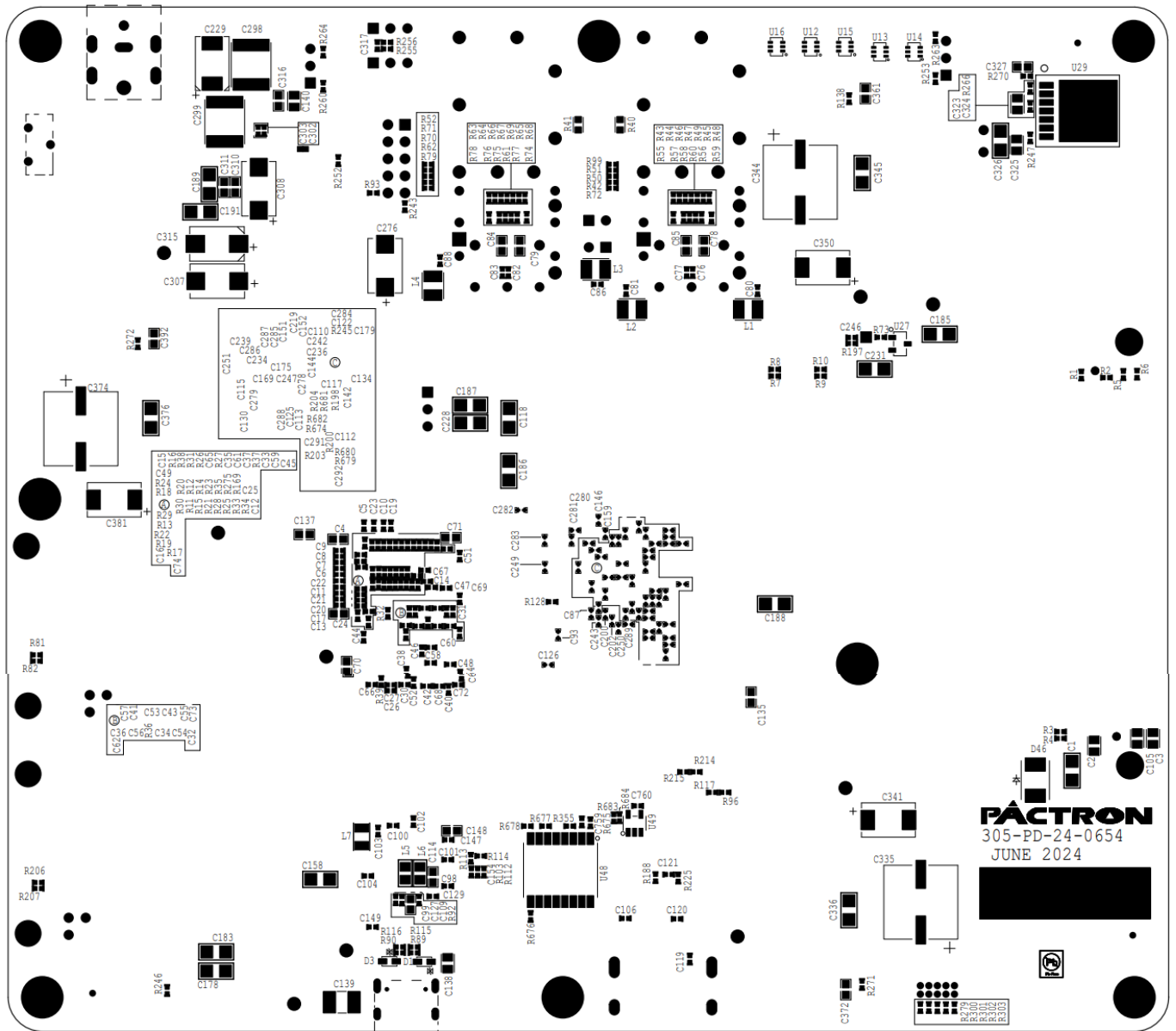
The following silkscreen shows the top-view of the placement of various components on the board.

Figure 4-1. Silkscreen (Top-View)



The following silkscreen shows the bottom-view of the placement of various components on the board.

Figure 4-2. Silkscreen (Bottom-View)



Demo Design (Ask a Question)

To be updated in a future revision.

Programming PolarFire FPGA Using the On-board FlashPro5 (Ask a Question)

The PolarFire Ethernet Sensor Bridge includes an on-board FlashPro5 programmer. Therefore, external programming hardware is not required to program the PolarFire device. The device is programmed with a programming .job file, using the FlashPro Express software installed on the host PC. As a prerequisite, ensure to download the latest version of FlashPro Express on the host PC.

Follow these steps to program an on-board PolarFire device:

1. Connect the 12V adapter to J25.

When the board is successfully set up, the power LEDs start glowing.

2. Launch Flash Pro Express (FPEXpress) software.

3. Create a new Job project by selecting Project > New Job Project from FlashPro Express Job.

4. In the New Job Project from FlashPro Express Job dialog box, complete the following steps:

- In Programming job file, click Browse and select the .job file.
- In FlashPro Express job project location, select a convenient path where the FlashPro Express project needs to be saved by clicking Browse.

A FlashPro Express project is created in the next window.

5. Program the device by clicking RUN.

The RUN PASSED message is displayed to confirm the successful programming of the device.

6. Power cycle the board by unplugging the USB Type-C cable and reconnecting it.

Revision History (Ask a Question)

The revision history describes the changes that were implemented in the document. The changes are listed by revision, starting with the most current publication.

Revision	Date	Description
A	10/2024	Initial revision

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Tel: 630-285-0071	Tel: 86-769-8702-9880	Tel: 81-6-6152-7160	Germany – Heilbronn
Fax: 630-285-0075	China – Guangzhou	Japan – Tokyo	Tel: 49-7131-72400
Dallas	Tel: 86-20-8755-8029	Tel: 81-3-6880- 3770	Germany – Karlsruhe
Addison, TX	China – Hangzhou	Korea – Daegu	Tel: 49-721-625370
Tel: 972-818-7423	Tel: 86-571-8792-8115	Tel: 82-53-744-4301	Germany – Munich
Fax: 972-818-2924	China – Hong Kong SAR	Korea – Seoul	Tel: 49-89-627-144-0
Detroit	Tel: 852-2943-5100	Tel: 82-2-554-7200	Fax: 49-89-627-144-44
Novi, MI	China – Nanjing	Malaysia – Kuala Lumpur	Germany – Rosenheim
Tel: 248-848-4000	Tel: 86-25-8473-2460	Tel: 60-3-7651-7906	Tel: 49-8031-354-560
Houston, TX	China – Qingdao	Malaysia – Penang	Israel – Hod Hasharon
Tel: 281-894-5983	Tel: 86-532-8502-7355	Tel: 60-4-227-8870	Tel: 972-9-775-5100
Indianapolis	China – Shanghai	Philippines – Manila	Italy – Milan
Noblesville, IN	Tel: 86-21-3326-8000	Tel: 63-2-634-9065	Tel: 39-0331-742611
	China – Shenyang	Singapore	Fax: 39-0331-466781
	Tel: 86-24-2334-2829	Tel: 65-6334-8870	Italy – Padova
	China – Shenzhen	Taiwan – Hsin Chu	Tel: 39-049-7625286
	Tel: 86-755-8864-2200	Tel: 886-3-577-8366	Netherlands – Drunen
	China – Suzhou	Taiwan – Kaohsiung	Tel: 31-416-690399
	Tel: 86-186-6233-1526	Tel: 886-7-213-7830	Fax: 31-416-690340
	China – Wuhan	Taiwan – Taipei	Norway – Trondheim
			Tel: 47-72884388

Tel: 317-773-8323	Tel: 86-27-5980-5300	Tel: 886-2-2508-8600	Poland – Warsaw
Fax: 317-773-5453	China – Xian	Thailand – Bangkok	Tel: 48-22-3325737
Tel: 317-536-2380	Tel: 86-29-8833-7252	Tel: 66-2-694-1351	Romania – Bucharest
Los Angeles	China – Xiamen	Vietnam – Ho Chi Minh	Tel: 40-21-407-87-50
Mission Viejo, CA	Tel: 86-592-2388138	Tel: 84-28-5448-2100	Spain – Madrid
Tel: 949-462-9523	China – Zhuhai		Tel: 34-91-708-08-90
Fax: 949-462-9608	Tel: 86-756-3210040		Fax: 34-91-708-08-91
Tel: 951-273-7800			Sweden – Gothenberg
Raleigh, NC			Tel: 46-31-704-60-40
Tel: 919-844-7510			Sweden – Stockholm
New York, NY			Tel: 46-8-5090-4654
Tel: 631-435-6000			UK – Wokingham
San Jose, CA			Tel: 44-118-921-5800
Tel: 408-735-9110			Fax: 44-118-921-5820
Tel: 408-436-4270			
Canada – Toronto			
Tel: 905-695-1980			
Fax: 905-695-2078			

FAQ

- Q: How do I program the PolarFire FPGA using the on-board FlashPro5?**

A: To program the FPGA, connect the board to a computer via USB and use the FlashPro5 programmer software to load the programming files.

- Q: What applications can be developed using SoftConsole, Identify, or SmartDebug?**

A: These tools can be used to develop and debug embedded applications for the PolarFire device.

Documents / Resources

	MICROCHIP FPGA PolarFire Ethernet Sensor Bridge [pdf] User Guide FPGA PolarFire Ethernet Sensor Bridge, FPGA, PolarFire Ethernet Sensor Bridge, Ethernet Sensor Bridge, Sensor Bridge
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