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## PolarFire® SoC Icicle Kit

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### Introduction

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The PolarFire® SoC FPGA Icicle Kit (MPFS250T-FCVG484EES) is an RoHS-compliant, cost-optimized kit with general-purpose interfaces that enables you to evaluate features of the PolarFire SoC family of FPGAs.

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# Table of Contents

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|                                                                                |    |
|--------------------------------------------------------------------------------|----|
| Introduction.....                                                              | 1  |
| 1. Getting Started.....                                                        | 4  |
| 1.1. Kit Contents.....                                                         | 4  |
| 1.2. Block Diagram.....                                                        | 4  |
| 1.3. Web Resources.....                                                        | 5  |
| 1.4. Board Overview.....                                                       | 5  |
| 1.5. Handling the Board.....                                                   | 8  |
| 1.6. Operating Temperature.....                                                | 8  |
| 1.7. Powering Up the Board.....                                                | 8  |
| 2. Installation and Settings.....                                              | 10 |
| 2.1. Software Settings.....                                                    | 10 |
| 2.2. Hardware Settings.....                                                    | 10 |
| 2.3. Power Sources.....                                                        | 12 |
| 3. Board Components and Operations.....                                        | 15 |
| 3.1. LDDR4 Memory Interface.....                                               | 15 |
| 3.2. SPI Serial Flash.....                                                     | 15 |
| 3.3. eMMC and SDIO Interface.....                                              | 15 |
| 3.4. High Speed Transceivers Configuration.....                                | 16 |
| 3.5. Communication Interfaces.....                                             | 16 |
| 3.6. Expansion Capabilities.....                                               | 16 |
| 3.7. Voltage and Current Monitoring.....                                       | 17 |
| 3.8. GPIO.....                                                                 | 17 |
| 3.9. User Interface.....                                                       | 17 |
| 3.10. Mux for JTAG Selection.....                                              | 18 |
| 3.11. Programming Scheme.....                                                  | 18 |
| 3.12. System Reset.....                                                        | 18 |
| 3.13. 50 MHz Oscillator.....                                                   | 18 |
| 4. Pin List.....                                                               | 20 |
| 5. Board Component Placement.....                                              | 21 |
| 6. Demo Design.....                                                            | 23 |
| 7. Appendix: Programming PolarFire SoC FPGA Using the On-Board Programmer..... | 24 |
| 8. Revision History.....                                                       | 25 |
| The Microchip Website.....                                                     | 26 |
| Product Change Notification Service.....                                       | 26 |
| Customer Support.....                                                          | 26 |
| Microchip Devices Code Protection Feature.....                                 | 26 |
| Legal Notice.....                                                              | 27 |

|                                  |    |
|----------------------------------|----|
| Trademarks.....                  | 27 |
| Quality Management System.....   | 28 |
| Worldwide Sales and Service..... | 29 |

## 1. Getting Started

The PolarFire SoC Icicle Kit supports the following interfaces:

- PCI Express Root Port
- eMMC (DDR Mode/HS200/HS400)
- SD card
- LPDDR4
- SGMII
- I<sup>2</sup>C-Power Monitor
- USB
- UART
- CAN
- mikroBUS
- 40 pin Raspberry Pi 4 interface connector

The PolarFire SoC device available on Icicle Kit is programmed using the on-board FlashPro6 programmer. The on-board FlashPro6 programmer is used to develop and debug embedded applications using SoftConsole, Identify, or SmartDebug.

**Note:** Embedded FlashPro6 is enabled only for the production kits. For PROTO kits, the device can be programmed using an external FlashPro 4, 5, or 6 programmer.

### 1.1 Kit Contents

The following table lists the contents of the PolarFire SoC Icicle Kit.

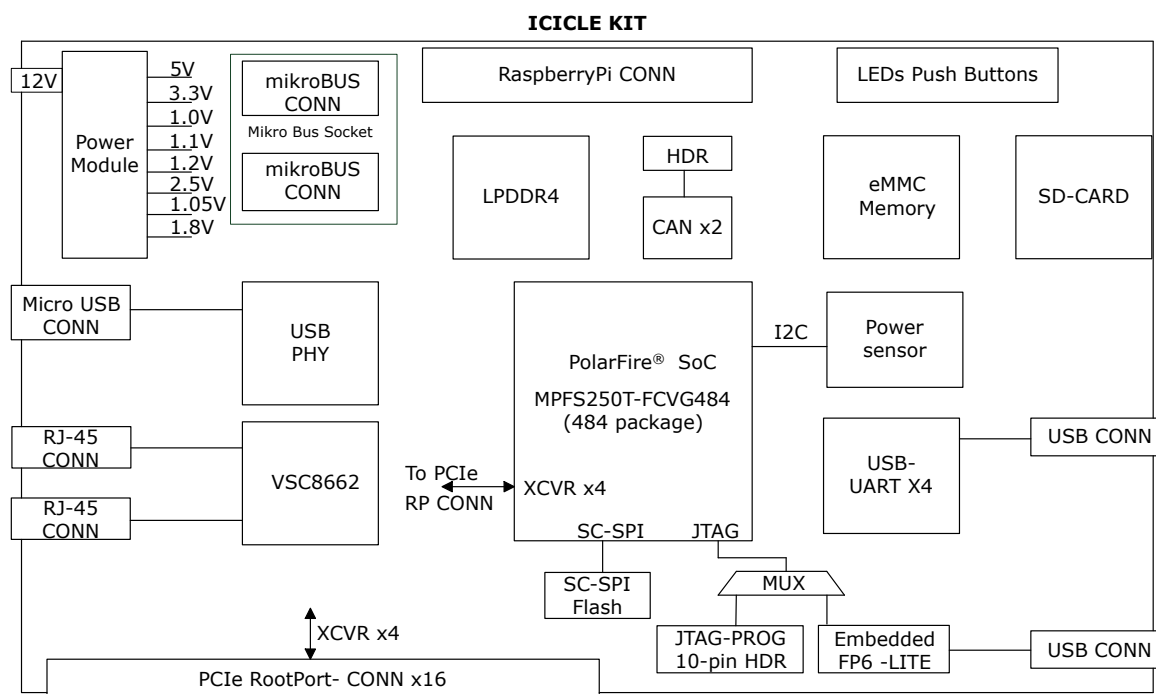
**Table 1-1. Kit Contents**

| Item                                                                                                   | Quantity |
|--------------------------------------------------------------------------------------------------------|----------|
| PolarFire SoC FPGA Icicle Kit ES featuring the MPFS250T-FCVG484EESEES device with 254 K logic elements | 1        |
| 12 V/5 A wall-mounted power adapter                                                                    | 1        |
| Ethernet cable                                                                                         | 1        |
| USB 2.0 micro AB connector for UART interface to PC                                                    | 1        |
| Quickstart card                                                                                        | 1        |

### 1.2 Block Diagram

The following block diagram shows the key components of the PolarFire SoC Icicle Kit.

Figure 1-1. PolarFire SoC Icicle Kit Block Diagram



### 1.3 Web Resources

For more information about the PolarFire SoC Icicle Kit, refer to [PolarFire SoC Page](#).

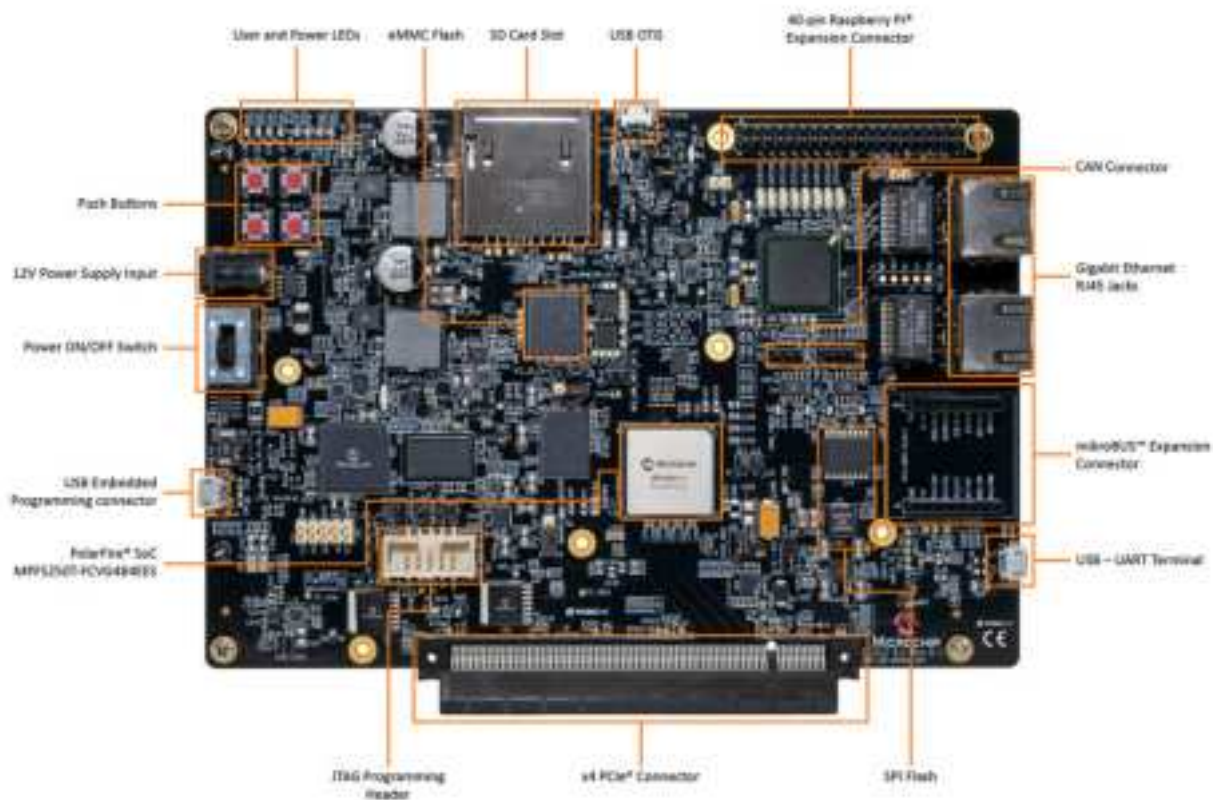
### 1.4 Board Overview

The PolarFire SoC Icicle Kit features a MPFS250T-FCVG484EES FPGA with the following capabilities:

- VSC8662 with two RJ45 connectors for 10/100/1000 Mbps Ethernet
- LPDDR4 memory
- Power monitor module
- PCIe root port
- One SPI flash device
- 40 pin raspberry Pi 4 interface connector
- mikroBUS expansion port

The following illustration highlights various components of the PolarFire SoC Icicle Kit.

Figure 1-2. PolarFire SoC Icicle Kit



#### 1.4.1 Form Factor

The following are the dimensions of PolarFire SoC Icicle Kit.

- Form factor is 7.2 x 4.95 inches.
- Maximum height of the component at the top side: 0.59 inches.
- Maximum height of the component at the bottom side: 0.51 inches.

#### 1.4.2 FPGA Bank IO Assignment for Individual Interfaces

Table 1-2. FPGA Bank Assignment

| Interfaces    | FPGA Bank Allocation |
|---------------|----------------------|
| LPDDR4        | B6                   |
| SGMII         | B5, B1, B9, and B2   |
| PCI           | XCVRO, B1, B9        |
| mikroBUS      | B1, B9, and B2       |
| USB-UART (x4) | B1, B9               |
| USB interface | B2                   |
| SC-SPI_FLASH  | B3                   |
| JTAG Header   | B3                   |

.....continued

| Interfaces                         | FPGA Bank Allocation |
|------------------------------------|----------------------|
| eMMC/SDIO                          | B4                   |
| CAN                                | B2, B1               |
| Raspberry Pi 4 interface connector | B1                   |
| User defined LEDs/Switches         | B0                   |

The following table lists the important components of the PolarFire SoC Icicle Kit.

**Table 1-3. PolarFire SoC Icicle Kit Components**

| Component                                           | Label on Board | Description                                                                                                                                                                                                                                               |
|-----------------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Featured Device</b>                              |                |                                                                                                                                                                                                                                                           |
| PolarFire SoC FPGA                                  |                | MPFS250T-FCVG484EES<br>Extended Commercial (0 °C to 100 °C) temperature support.                                                                                                                                                                          |
| <b>Power Supply and Monitoring</b>                  |                |                                                                                                                                                                                                                                                           |
| 12 V power supply input                             | J29            | The board is powered by a 12 V power source using an external +12 V/5 A DC jack.                                                                                                                                                                          |
| ON/OFF switch                                       | SW6            | Power ON/OFF switch from +12 V external DC jack.                                                                                                                                                                                                          |
| <b>Clocks</b>                                       |                |                                                                                                                                                                                                                                                           |
| On-board 50 MHz clock oscillator                    | X5             | 50 MHz clock oscillator with single-ended output.                                                                                                                                                                                                         |
| OSC                                                 | X2             | 125 MHz oscillator (differential LVDS output) which is the input to the MSS Reference clk.                                                                                                                                                                |
| <b>FPGA Programming and Debugging</b>               |                |                                                                                                                                                                                                                                                           |
| SPI flash                                           | U43            | 1 Gb Micron MT25QL01GBBB8ESF-0SIT SPI flash memory device connected to SPI pins on bank3 of the PolarFire SoC device.                                                                                                                                     |
| JTAG programming header                             | J23            | Header to program and debug the PolarFire SoC device using FlashPro. The appropriate programmer must be selected in the FlashPro software.<br><b>Note:</b> For PROTO kits, the device can be programmed using an external FlashPro 4, 5, or 6 programmer. |
| Embedded FlashPro 6                                 | U26            | On-board programming.                                                                                                                                                                                                                                     |
| <b>Expansion Interfaces</b>                         |                |                                                                                                                                                                                                                                                           |
| mikroBUS                                            | J44, J8        | mikrobus connector.                                                                                                                                                                                                                                       |
| Raspberry Pi 4                                      | J26            | Raspberry Pi 4 interface connector.                                                                                                                                                                                                                       |
| PCIe X 16                                           | J6             | PCI Express Root port connector.                                                                                                                                                                                                                          |
| <b>Communication Interfaces</b>                     |                |                                                                                                                                                                                                                                                           |
| 1000Base-X Gigabit Ethernet Transceiver RJ45 conn-2 | J1, J2         | Ethernet (RJ45) jack with external magnetics interfacing with VSC8662 in SGMII mode.                                                                                                                                                                      |
| USB-UART                                            | J11            | USB Micro AB connector.                                                                                                                                                                                                                                   |
| CAN                                                 | J25, J27       | CAN Headers.                                                                                                                                                                                                                                              |

.....continued

| Component                    | Label on Board | Description                                                                   |
|------------------------------|----------------|-------------------------------------------------------------------------------|
| USB-ULPI                     | J16            | USB Micro AB connector.                                                       |
| <b>Memory Chips</b>          |                |                                                                               |
| LPDDR4                       | U2             | MT53D512M32D2DS-053 WT:D TR is used for LPDDR4 interface. Memory size: 16 Gb. |
| eMMC                         | U45            | SDINBDG4-8G eMMC is used for this interface. Memory size: 8 GB.               |
| SD card                      | J30            | SD connector.                                                                 |
| <b>General Purpose I/O</b>   |                |                                                                               |
| Debug Switches               | SW1 to SW4     | For debug.                                                                    |
| Light-emitting diodes (LEDs) | LED1 to LED4   | Four active-high LEDs connected to some of the user I/Os for debugging.       |

## 1.5 Handling the Board

Pay attention to the following points while handling or operating the board to avoid possible damage or malfunction:

- Handle the board with electrostatic discharge (ESD) precautions to avoid damage. For more information about using the board with ESD precautions, refer to [Understanding Product Handling and ESD Precautions \(for Hybrid Devices\)](#).
- Power down the board to switch between the programming headers J17 and PCIe CONN (CON1).

## 1.6 Operating Temperature

Extended commercial temperature range (0 °C to 100 °C).

## 1.7 Powering Up the Board

To power up the board, do the following:

1. Connect 12 V/5 A power supply brick to J29.
2. Slide switch SW6 to ON position.
3. Power status LEDs 12P0, 5P0, 2P5V, VDDAUX4, 3P3V, VDD, 1P8, 1P1V\_LPDDR4, and VDDA will glow.
4. Install the software required for developing designs and set the jumpers for the pre-programmed design. For more information, refer to [2. Installation and Settings](#).

The following table provides the probing points for power rails.

**Table 1-4. Power Measurements**

| # | Power Rail | Probing Point | Tolerance Allowed | Expected Voltage (in Volt) |
|---|------------|---------------|-------------------|----------------------------|
| 1 | 12P0V      | C476          | ±5%               | 12 V                       |
| 2 | 5P0V       | C482          | ±5%               | 5 V                        |
| 3 | 1P8V       | C542          | ±5%               | 1.8 V                      |

.....continued

| #  | Power Rail       | Probing Point | Tolerance Allowed | Expected Voltage (in Volt) |
|----|------------------|---------------|-------------------|----------------------------|
| 4  | 2P5V             | C786          | ±5%               | 2.5 V                      |
| 5  | 1P5V_DDR3        | C602          | ±5%               | 1.5 V                      |
| 6  | 0P75V_VTT_DDR3   | C514          | ±5%               | 0.75 V                     |
| 7  | VDD              | C499          | ±3%               | 1 V                        |
| 8  | 1P1V_LPDDR4      | C574          | ±5%               | 1.1 V                      |
| 9  | 1P2V_PHY_VSC_FP6 | C587          | ±5%               | 1.2 V                      |
| 10 | 3P3V             | C527          | ±5%               | 3.3 V                      |
| 11 | VDDA             | C556          | ±3%               | 1.05 V                     |

## 2. Installation and Settings

This section provides information about the software and hardware settings required to run the pre-programmed demo design on the PolarFire SoC Icicle Kit.

### 2.1 Software Settings

1. Download and install the latest release of Libero<sup>®</sup> SoC software from the Microsemi website.
2. Generate a [free silver license](#) for your software. The Libero SoC installer includes FlashPro5 drivers.

For instructions about installing Libero SoC, refer to [Libero Software Installation and Licensing Guide](#). For instructions about how to download and install DirectCores and driver firmware cores on the PC where Libero SoC is installed, refer to [Installing IP Cores and Drivers User's Guide](#).

### 2.2 Hardware Settings

This section provides information about jumper settings, switches, and LEDs on the PolarFire SoC Icicle Kit.

#### 2.2.1 Jumper Settings

The following table lists the default jumper settings on board.

**Table 2-1. Jumper Settings**

| Jumper | Description                                                                                | Pin           | Default Setting |
|--------|--------------------------------------------------------------------------------------------|---------------|-----------------|
| J31    | To select LPDDR4 Vref                                                                      | —             | Open            |
| J9     | Select pin for programming FPGA with external FlashPro header or with on-board programmer. | —             | Open            |
| J21    | To select PolarFire SoC JTAG reset.                                                        | —             | Open            |
| J46    | To select 3.3 V for RPI connector from the Icicle Kit                                      | —             | Open            |
| J47    | To select 5 V for RPI connector from the Icicle Kit                                        | —             | Open            |
| J15    | To select USB ID                                                                           | Short pin 1-2 | —               |
| J17    | 5 V for VBUS switch for USB3340                                                            | Short pin 1-2 | —               |
| J43    | To select 1.8 V or 3.3 V for eMMC modes                                                    | Short pin 1-2 | —               |
| J28    | Jumper for PolarFire SoC Serdes Vref                                                       | Short pin 1-2 | —               |
| J24    | 5 V for VBUS switch for USB3320                                                            | Short pin 1-2 | —               |
| J34    | To select 1.8 V or 3.3 V for BANK4 voltage                                                 | Short pin 1-2 | —               |
| J35    | To select 2.5 V or 3.3 V for BANK4 Aux voltage                                             | Short pin 1-2 | —               |
| J45    | To select 1 V or 1.05 V for VDD core voltage                                               | Short pin 1-2 | —               |

#### 2.2.2 Power Supply LEDs

The following table lists the power supply LEDs on the PolarFire SoC Icicle Kit.

**Table 2-2. Power Supply LEDs**

| LED  | Description       |
|------|-------------------|
| 12P0 | 12 V power supply |
| 5P0  | 5 V power supply  |

| .....continued |                           |
|----------------|---------------------------|
| LED            | Description               |
| 2P5V           | 2.5 V power supply        |
| VDDAUX4        | Bank4 Aux voltage         |
| 3P3V           | 3.3 V power supply        |
| VDD            | Core voltage              |
| 1P8            | 1.8 V power supply        |
| 1P1V_LPDDR4    | LPDDR4 voltage            |
| VDDA           | Power for Serdes channels |

### 2.2.3 Test Points

The following test points are available on the PolarFire SoC Icicle Kit.

**Table 2-3. Test Points**

| Test Point                | Description                                 |
|---------------------------|---------------------------------------------|
| GND1TP_BLK to GND10TP_BLK | Test point for Ground                       |
| SD_D0                     | Test point for SD_DATA0/eMMCMC_DATA0 at Mux |
| SD_D1                     | Test point for SD_DATA1/eMMCMC_DATA1 at Mux |
| SD_D2                     | Test point for SD_DATA2/eMMCMC_DATA2 at Mux |
| SD_D3                     | Test point for SD_DATA3/eMMC_DATA3 at Mux   |
| SD_CLK                    | Test point for SD_CLK/eMMC_CLK at Mux       |
| SD_CMD                    | Test point for SD_CMD/eMMC_CMD at Mux       |
| eMMC_CLK                  | Test point for eMMCMC_CLK at eMMCMC device  |
| SDC_CLK                   | Test point for SD_CLK at SD connector       |
| SDC_CMD                   | Test point for SD_CMD at SD connector       |
| SDC_D3                    | Test point for SD_DATA3 at SD connector     |
| SDC_D2                    | Test point for SD_DATA2 at SD connector     |
| SDC_D1                    | Test point for SD_DATA1 at SD connector     |
| SDC_D0                    | Test point for SD_DATA0 at SD connector     |
| SD_CLK_FB_EM_D4           | Test point for SD_CLK_FB/eMMC_DATA4 at Mux  |
| SD_VSEL_EM_D5             | Test point for SD_VSEL/eMMC_DATA5 at Mux    |
| SD_CMD_DIR_EM_D7          | Test point for SD_CMD_DIR/eMMC_DATA7 at Mux |
| SD_WP#_EM_RSTN            | Test point for SD_WP#/eMMC_RSTN at Mux      |
| SD_CD#_EM_STB             | Test point for SD_CD#/eMMC_STB at Mux       |
| TP19-UART0 TX Togg        | Test point for UART0 TX Togg                |
| TP17-UART0 RX Togg        | Test point for UART0 RX Togg                |
| TP16-UART1 TX Togg        | Test point for UART1 TX Togg                |
| TP15-UART1 RX Togg        | Test point for UART1 RX Togg                |
| TP12-UART2 TX Togg        | Test point for UART2 TX Togg                |

| .....continued     |                                                   |
|--------------------|---------------------------------------------------|
| Test Point         | Description                                       |
| TP13-UART2 RX Togg | Test point for UART2 RX Togg                      |
| TP14-UART3 TX Togg | Test point for UART3 TX Togg                      |
| TP18-UART3 RX Togg | Test point for UART3 RX Togg                      |
| XTAL2_VSC          | Test point for XTAL2 for Phy                      |
| RCLK1_VSC          | Test point for Phy recovered clk1                 |
| RCLK2_VSC          | Test point for Phy recovered clk2                 |
| CKO_VSC            | Test point for Phy clkout                         |
| THMDA1             | Test point for THMDA1                             |
| FIBR_DIP_1         | Test point for PHY_Serdes receiver input pair     |
| FIBR_DIN_1         | Test point for PHY_Serdes receiver input pair     |
| FIBR_DOP_1         | Test point for PHY_Serdes transmitter output pair |
| FIBR_DON_1         | Test point for PHY_Serdes transmitter output pair |
| FIBR_DIP_0         | Test point for PHY_Serdes receiver input pair     |
| FIBR_DIN_0         | Test point for PHY_Serdes receiver input pair     |
| FIBR_DOP_0         | Test point for PHY_Serdes transmitter output pair |
| FIBR_DON_0         | Test point for PHY_Serdes transmitter output pair |
| TP1 to TP6 -       | Test points for PCIe reserved pins                |
| TP_VDD             | Test point for VDD_core voltage                   |
| TP_1P1V            | Test point for 1.1 V                              |
| GND_1P1V           | Test point for 1.1V_Ground                        |
| TP_1P2V            | Test point for 1.2 V                              |
| GND_1P2V           | Test point for 1.2V_Ground                        |
| TP_3P3V            | Test point for 3.3 V                              |
| TP_VDDA            | Test point for VDDA voltage                       |
| TP_2P5V            | Test point for 2.5 V                              |
| TP_1P8V            | Test point for 1.8 V                              |
| TP_5P0V            | Test point for 5 V                                |
| GND_1P8V           | Test point for 1.8V_Ground                        |

## 2.3 Power Sources

The PolarFire SoC Icicle Kit uses power supply devices. For more information about these power supply devices, refer to [Power Management web page](#).

The following table lists the key power supplies required for normal operation of the PolarFire SoC Icicle Kit.

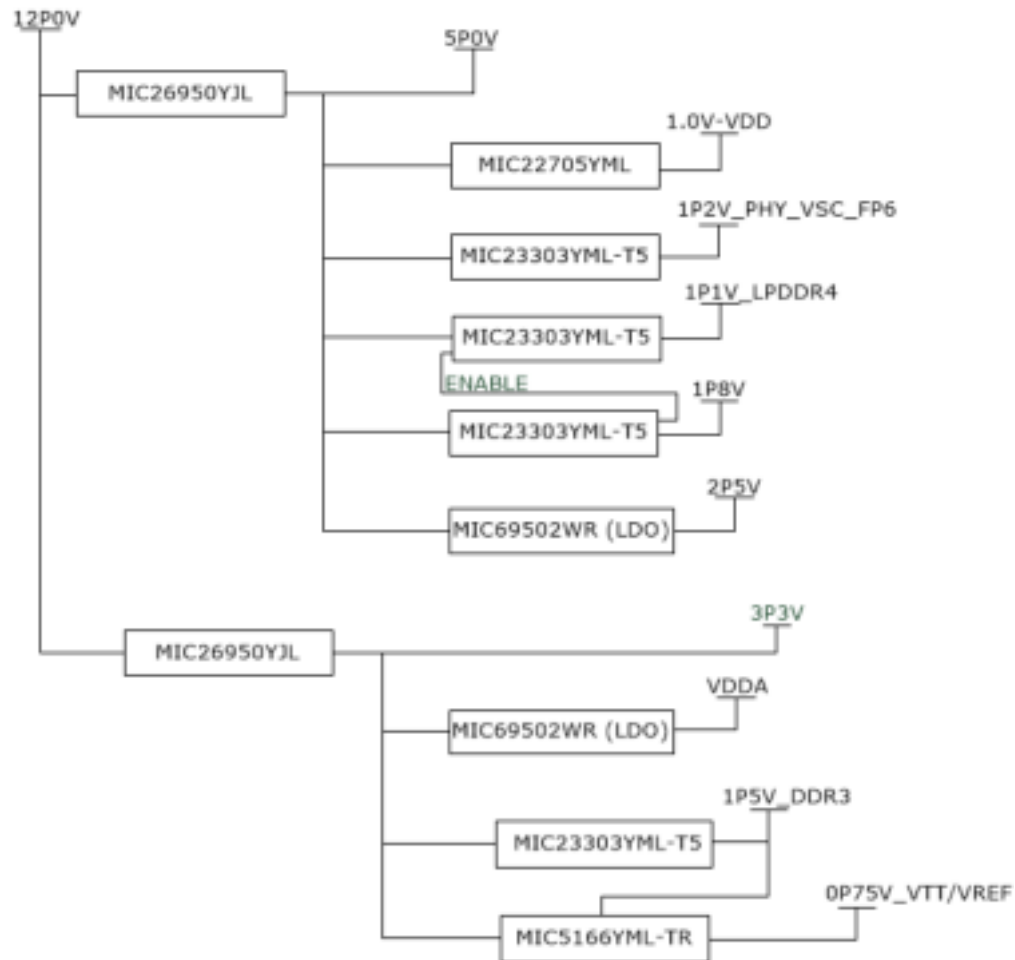
**Table 2-4. I/O Voltage Rails**

| Supply Name | Description                                                                                                                | Value (in Voltage)      |
|-------------|----------------------------------------------------------------------------------------------------------------------------|-------------------------|
| VDD         | Core Power                                                                                                                 | 1.0/1.05                |
| VDD25       | Power for PLL/ICB/Bank Controller/PNVM/Programming Analog block                                                            | 2.5                     |
| VDDA        | Power for SerDes RX Channels [3:0] Power for SerDes TX Channels [3:0]                                                      | 1.0/1.05                |
| VDDA25      | Power for SerDes PLLs                                                                                                      | 2.5                     |
| VDD18       | HSIO/MSS_DDR Receiver Input Power SE Corner Oscillator Power for programming blocks, analog block and SW Corner Oscillator | 1.8                     |
| VDDI0       | HSIO Bank Power                                                                                                            | 1.2, 1.5, 1.8           |
| VDDI1       | GPIO Bank Power                                                                                                            | 1.2, 1.5, 1.8, 2.5, 3.3 |
| VDDI2       | MSSIO Bank Power                                                                                                           | 1.2, 1.5, 1.8, 2.5, 3.3 |
| VDDI3       | Power for JTAG Ios                                                                                                         | 1.8, 2.5, 3.3           |
| VDDI4       | MSSIO Bank Power                                                                                                           | 1.2, 1.5, 1.8, 2.5, 3.3 |
| VDDI5       | MSS SGMII Bank Power and Pre-Driver                                                                                        | 2.5, 3.3                |
| VDDI6       | MSS DDR (HSIO) Bank Power                                                                                                  | 1.2, 1.5, 1.8           |
| VDDI7       | GPIO Bank Power                                                                                                            | 1.2, 1.5, 1.8, 2.5, 3.3 |
| VDDI8       | HSIO Bank Power                                                                                                            | 1.2, 1.5 1.8            |
| VDDI9       | GPIO Bank Power                                                                                                            | 1.2, 1.5, 1.8, 2.5, 3.3 |
| VDDAUX1     | GPIO Pre-Driver Bank Power                                                                                                 | 2.5, 3.3                |
| VDDAUX2     | MSSIO Pre-Driver Bank Power                                                                                                | 2.5, 3.3                |
| VDDAUX4     | MSSIO Pre-Driver Bank Power                                                                                                | 2.5, 3.3                |
| VDDAUX7     | GPIO Pre-Driver Bank Power                                                                                                 | 2.5, 3.3                |
| VDDAUX9     | GPIO Pre-Driver Bank Power                                                                                                 | 2.5, 3.3                |
| XCVR_VREF   | All SerDes RefClk receiver's voltage reference pin                                                                         | 0.9/1.25                |

**Note:** Bank 9 VDDI power pins are connected to Bank 1 VDDI power pins within the package substrate for pin migration compatibility.

The following figure shows voltage rails (12 V, 5 V, 3.3 V, 2.5 V, 1.8 V, 1.2 V, and 1.0 V) available on the PolarFire SoC Icicle Kit.

**Figure 2-1. Voltage Rails on PolarFire SoC Icicle Kit**



The following table lists the power regulators used for PolarFire SoC FPGA Icicle voltage rails.

**Table 2-5. Power Regulators**

| Voltage Rail   | Part Number    | Description                      | Current |
|----------------|----------------|----------------------------------|---------|
| 5 V            | MIC26950JL     | IC REG BUCK ADJ                  | 12 A    |
| VDD (1 V)      | MIC22705YML    | IC REG BUCK ADJUSTABLE           | 7 A     |
| VSC_PHY(1.2 V) | MIC23303YML-T5 | IC REG BUCK ADJUSTABLE           | 3 A     |
| 1.1V_LPDDR4    | MIC23303YML-T5 | IC REG BUCK ADJUSTABLE           | 3 A     |
| 1P8V           | MIC23303YML-T5 | IC REG BUCK ADJUSTABLE           | 3 A     |
| 2P5V           | MIC69502WR     | IC REG LINEAR POS ADJ            | 5 A     |
| 3P3V           | MIC26950JL     | IC REG BUCK ADJ                  | 12 A    |
| VDDA           | MIC69502WR     | IC REG LINEAR POS ADJ            | 5 A     |
| 1P5V_DDR3      | MIC23303YML-T5 | IC REG BUCK ADJUSTABLE           | 3 A     |
| VTT            | MIC5166YML-TR  | IC PWR SUP 3 A HS DDR TERM 10MLF | 3 A     |

### 3. Board Components and Operations

This section describes the key components of the PolarFire SoC Icicle Kit and provides information about important board operations. For device datasheets, refer to [PolarFire SoC Page](#).

For more information, refer to [Board Level Schematics document](#).

#### 3.1 LDDR4 Memory Interface

LPDDR4 is connected to the MSS BANK 6.

- Part number: MT53D512M32D2DS-053 WT:D TR
- Manufacturer: Micron
- Frequency range: 800 MHz
- Memory size: 16 Gb

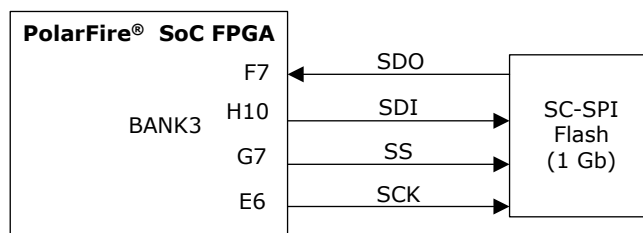
#### 3.2 SPI Serial Flash

PolarFire SoC Icicle Kit has one SPI flash 1 Gb. Flash is connected to BANK3 SC-SPI pins to support IAP programming.

- Part number: MT25QL01GBBB8ESF-0SIT
- Manufacturer: Micron
- Flash Type: NOR

The following figure shows the SPI Flash interface of the PolarFire SoC Icicle Kit.

**Figure 3-1. SPI Flash Interface**



#### 3.3 eMMC and SDIO Interface

PolarFire SoC MSS BANK4 has MUXed IOs for SDIO or eMMC interface. PolarFire SoC Icicle Kit uses on board MUX U44 and U29 to select interface between 8 GB eMMC device or SD card connector.

##### 3.3.1 eMMC

- Part number: SDINBDG4-8G
- Manufacturer: SanDisk
- eMMC 5.1
- Supports variable clock frequencies of 0-20 MHz, 0-26 MHz (default), 0-52 MHz (high-speed), 0-200 MHz SDR (HS200), and 0-200 MHz DDR (HS400)
- Dual power system: Core voltage (Vcc) 2.7 to 3.3 V, IO (VCCQ) voltage either: 1.7-1.95 V or 2.7-3.6 V

##### 3.3.2 SD Card

PolarFire SoC Icicle Kit has one SD card connector.

- Part number: 10067847-001RLF
- Manufacturer: Amphenol ICC (FCI)
- SD interface is connected using a voltage translator between SD card connector and MUX (eMMC/SD)
- Supported modes are default speed (25 MHz), high speed (50 MHz), UHS-I (SDR12, SDR25, SDR50, SDR14, and DDR50)

### 3.4 High Speed Transceivers Configuration

#### 3.4.1 Transceivers Block Allocations

- MPFS250T-FCVG484EES has one XCVR block and 4 SERDES LANES available.

#### 3.4.2 PC1x16 Connector

XCVR x4 lanes are mapped to PCIe CONN.

On board PC1x16 straddle Mount root port connector is available in PolarFire SoC Icicle Kit.

- Part number: 10025026-10103TLF
- Manufacturer: Amphenol ICC
- 4-TX/RX pairs are connected to SERDES block
- 100 MHz reference clock is provided to connector

### 3.5 Communication Interfaces

#### 3.5.1 Ethernet – SGMII Interface

VSC8662 device is a low-power, dual Gigabit Ethernet transceiver (1000BASE-X Gigabit Ethernet Transceiver PHY)

- Part number: VSC8662
- VSC8662 MAC interface dual port signals (Port 0 and Port1) RX/TX is connected on MSS SGMII Bank 5
- VSC8662 MDC and MDIO signals are connected MSS BANK 2

#### 3.5.2 CAN Interface

PolarFire SoC Icicle Kit has two CAN interfaces. One interface is from the MSS BANK 2 and another interface is from the GPIO BANK 1.

- Part number: MCP2562FDT-E/SN
- Manufacturer: Microchip

#### 3.5.3 USB OTG

USB3340 is a Hi-Speed USB 2.0 Transceiver that provides a physical layer (PHY) solution well-suited for portable electronic devices.

- Part number: USB3340-EZK-TR
- Manufacturer: Microchip
- USB interface uses MSS BANK 2
- 26 MHz on board crystal for reference clock

### 3.6 Expansion Capabilities

The following sections explain the expansion connectors for PolarFire SoC Icicle Kit.

#### 3.6.1 Raspberry Pi 4 Connector

PolarFire SoC Icicle Kit has 40 pin Raspberry pi connector.

- Part number: 61204021621
- Manufacturer: Wurth Electronics
- Raspberry pi signals use GPIO BANK 1 and BANK 9

### 3.6.2 mikroBUS Connector

PolarFire SoC Icicle Kit has 16 pin mikroBUS interface connector.

- UART, SPI, and I<sup>2</sup>C signals
- SPI signals use MSS BANK 2
- I<sup>2</sup>C, UART, and other GPIO signals use GPIO BANK 1 and BANK 9

## 3.7 Voltage and Current Monitoring

PolarFire SoC Icicle Kit has provision to measure current for four power rails.

- VDD
- VDD25
- VDDA25
- VDDA

Current sensing is done by PAC1934T-I/JQ. The I<sup>2</sup>C interface is available on digital values to read back values. Sensor's I<sup>2</sup>C interface is connected to the MSS I<sup>2</sup>C interface.

## 3.8 GPIO

### 3.8.1 Switches and LEDs

PolarFire SoC Icicle Kit is equipped with four tact switches and four LED indicators.

- Switches and LEDs are connected to HSIO BANK 0

### 3.8.2 LEDs

LED's to indicate:

- Power
- User defined LEDs (quantity – 4)

## 3.9 User Interface

The PolarFire SoC Icicle Kit has four user defined LEDs and four push-button switches.

### 3.9.1 USB to UART Interface

CP2108 is a USB to quad UART bridge controller to support 4 UART interface on board. UART IOs are connected to the Fabric IOs (Bank1) of PolarFire SoC.

- Part number: CP2108-B02-GM
- Manufacturer: Silicon Labs
- UART interface uses GPIO BANK 1 and BANK 9

**Note:**

The Silicon Labs CP2108 drivers are needed to see the COM ports through the J11 connector. The drivers can be downloaded from the following location:

[www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers](http://www.silabs.com/developers/usb-to-uart-bridge-vcp-drivers)

### 3.10 Mux for JTAG Selection

Multiplexer U22 is used for JTAG selection for External Flash Pro header and On board Programmer .

- Part number: 74CBTLV3257BQ,115
- Manufacturer: NXP

**Table 3-1. Mux for JTAG Selection**

| Jumper (J9) | JTAG Selection            |
|-------------|---------------------------|
| Open        | External Flash Pro header |
| Close       | On-board Programmer       |

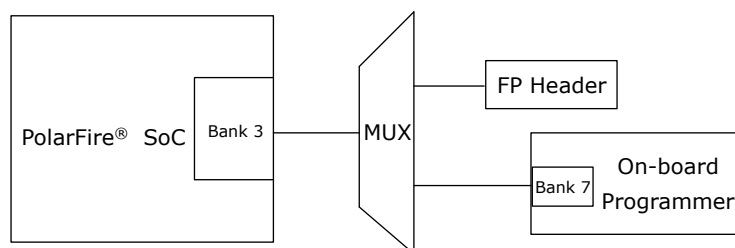
### 3.11 Programming Scheme

PolarFire SoC silicon is programmed in two ways:

- Using FlashPro header connected to BANK3 of PolarFire SoC
- On-board programmer (BANK 7)

The following is the block diagram for programming scheme of PolarFire SoC.

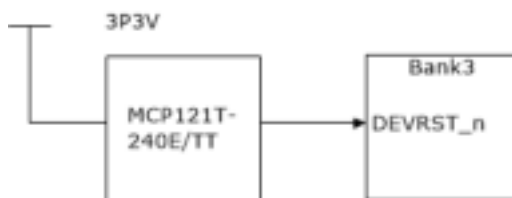
**Figure 3-2. PolarFire SoC Programming Scheme Block Diagram**



### 3.12 System Reset

DEVRST\_N is an input-only reset pad that allows a full reset of the chip to be asserted at any time. The following figure shows a sample reset circuit that uses a Microchip MCP121T-240E/TT device.

**Figure 3-3. Reset Circuit**



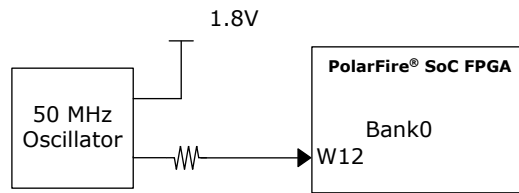
### 3.13 50 MHz Oscillator

A 50 MHz clock oscillator with an accuracy of  $\pm 10$  ppm is available on the board. This clock oscillator is connected to the FPGA fabric to provide a system reference clock.

The pin number of the 50 MHz oscillator is W12, and the pin name is HSIO92PB0/CLKIN\_N\_2/CCC\_NW\_CLKIN\_N\_2/CCC\_NW\_PLL1\_OUT0.

The following figure shows the 50 MHz clock oscillator interface.

**Figure 3-4. 50 MHz Clock Oscillator**



For more information, refer to Board-Level Schematics document (provided separately).

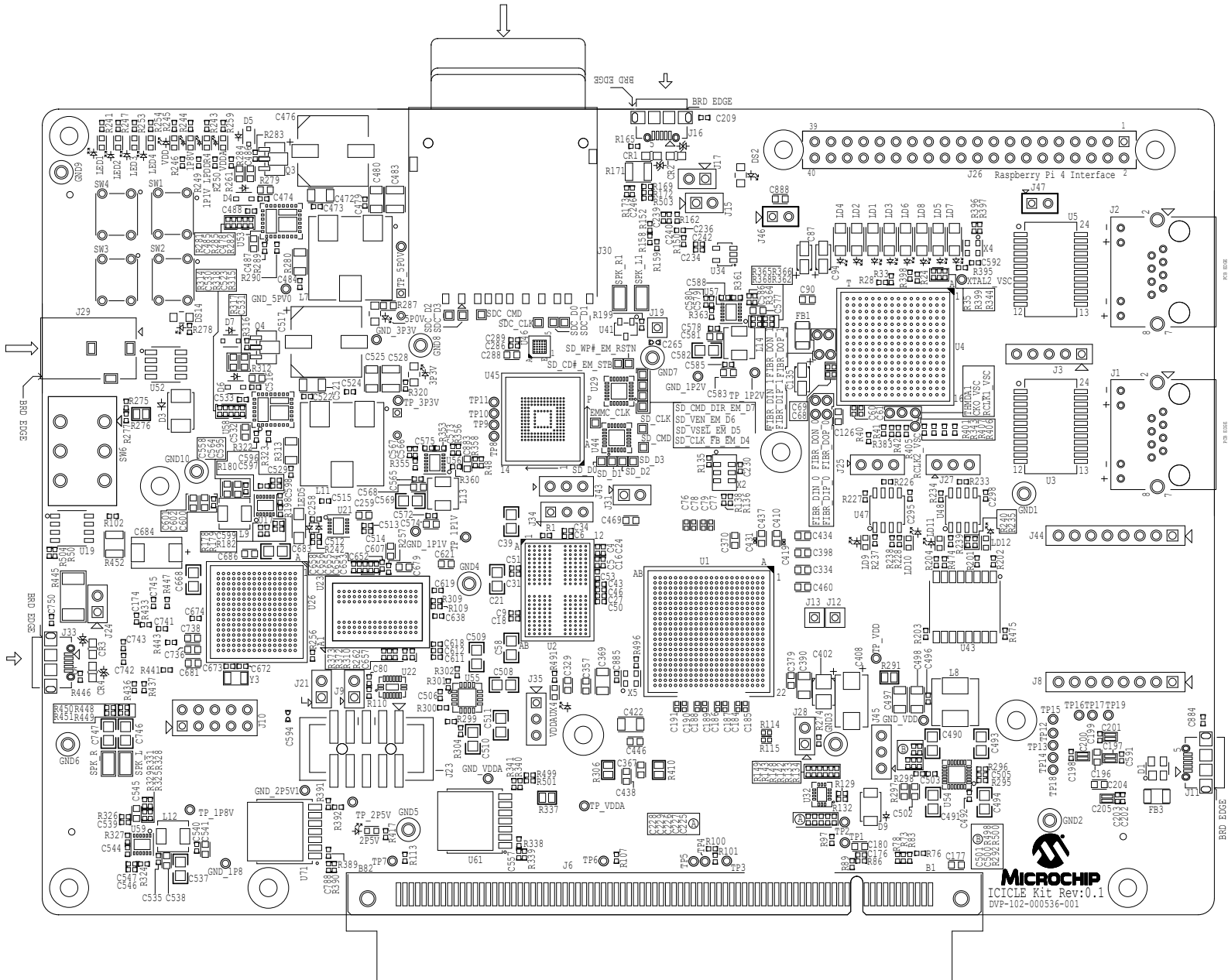
## 4. Pin List

For more information about all package pins on the PolarFire SoC, refer to [PolarFire SoC MPFS250T\\_MPFS250TS-FCVG484 Package Pin Assignment Table](#).

## 5. Board Component Placement

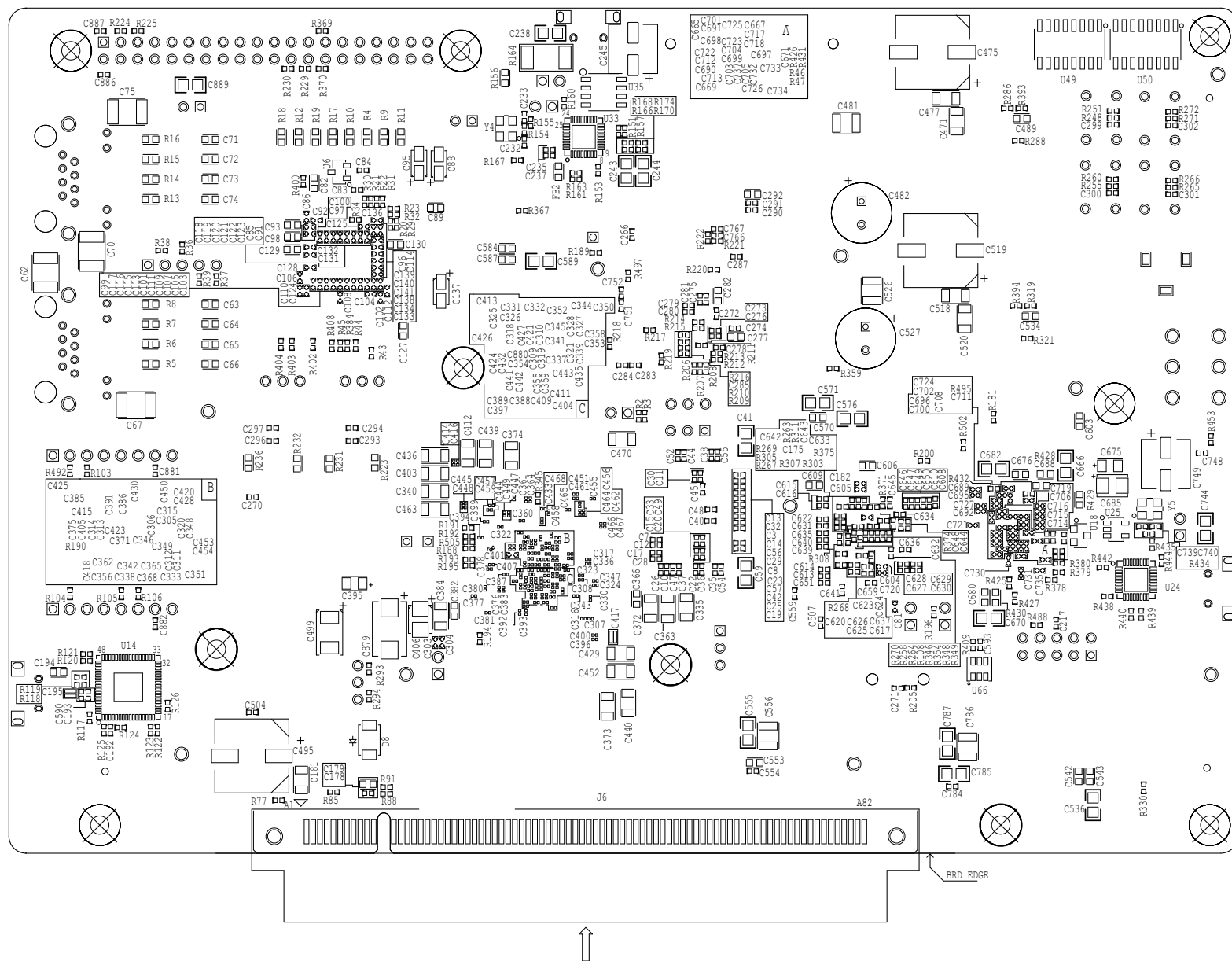
The following figure shows the placement of various components on the PolarFire SoC Icicle Kit silkscreen.

Figure 5-1. Silkscreen Top View



The following figure shows the bottom view of the PolarFire SoC Icicle Kit silkscreen.

### Figure 5-2. Silkscreen Bottom View



## 6. Demo Design

For the Icicle kit reference design, refer to the documentation provided on [GitHub](#).

### 7. Appendix: Programming PolarFire SoC FPGA Using the On-Board Programmer

The PolarFire SoC Icicle Kit includes an on-board programmer. An external programmer hardware is, therefore, not required to program the PolarFire SoC device. The device can be programmed using the FlashPro software installed on the host PC.

Follow these steps to program an on-board PolarFire SoC device using the on-board programmer.

**Notes:** The programming file will be available in a future release.

1. Connect the power supply cable to the **J23** connector on the board.
2. Close Jumper **J9** for mux U22.
3. Power on the board using the **SW6** slide switch.
4. When the board is successfully set up, the power LEDs start glowing.
5. Download FlashPro Express from the following location: <https://www.microsemi.com/product-directory/programming/4977-flashpro#software>
6. On the host PC, start the **FlashPro Express** software.
7. Click **New Project** to create a new project.
8. In the **New Project** window, do the following, and click **OK**.
  - Enter a project name.
  - Select **Single device** as the programming mode
9. Click **Configure Device**.
10. Click **Program** to program the device.
11. From the **View Programmer** pane, select the on-board FlashPro6 programmer.
12. Click **Browse**, and select the .stp file from the **Load Programming File** window.

The **Programmer List** window in the FlashPro Express software shows the programmer name, programmer type, port, programmer status, and information about whether the programmer is enabled.

When the device is programmed successfully, a Run Program PASSED status is displayed.

## 8. Revision History

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                                                                                                                                                                                                                                                                                                                         |
|----------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| B        | 05/2021 | Updated <a href="#">3.9.1 USB to UART Interface</a> section with a note.                                                                                                                                                                                                                                                            |
| A        | 01/2021 | Following is a list of changes made in this release: <ul style="list-style-type: none"><li>• Converted this document from Microsemi format to Microchip format. Document number is changed from 50200882 to DS60001679A.</li><li>• Information about <a href="#">1.4.1 Form Factor</a> has been updated in this revision.</li></ul> |
| 2.0      | —       | The following is a summary of the changes made in this revision. <ul style="list-style-type: none"><li>• Updated Table 10.</li><li>• Updated the <a href="#">Appendix: Programming PolarFire SoC FPGA Using the On-Board Programmer</a>.</li></ul>                                                                                  |
| 1.0      | —       | This is the first publication of this document.                                                                                                                                                                                                                                                                                     |

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