



Radiation-Tolerant PolarFire Development Kit User Guide

Introduction [\(Ask a Question\)](#)

The RT PolarFire® Development Kit is an RoHS-compliant, cost-optimized kit with general purpose interfaces that enables you to evaluate features of the RT PolarFire family of FPGAs.

The RT PolarFire Development Kit supports the following interfaces:

- DDR3 x72 Dual Inline Memory Module (DIMM) connector
- High-pin Count (HPC) FMC1, HPC FMC2
- QSPI Flash
- Reduced Gigabit Media-Independent Interface (RGMII)
- USB – UART
- I²C-PowerMonitor
- SPI Flash
- DIP Switches
- Push buttons
- User defined LEDs
- JTAG Programming through external header
- Programming using an on-board programmer
- Programming through JTAG external header

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

Table of Contents

Introduction.....	1
1. Getting Started.....	3
1.1. Kit Contents.....	3
1.2. Block Diagram.....	3
1.3. Board Overview.....	4
1.4. Board Components.....	6
1.5. Handling the Board.....	7
1.6. Operating Temperature.....	7
1.7. Powering Up the Board.....	7
2. Installation and Settings.....	9
2.1. Software Settings.....	9
2.2. Hardware Settings.....	9
2.3. Power Sources.....	11
3. Board Components and Operation.....	14
3.1. SPI Serial Flash.....	14
3.2. High-Speed Transceivers Configuration.....	14
3.3. Communication Interfaces.....	15
3.4. Memory Interface.....	15
3.5. QSPI Serial Flash.....	15
3.6. Expansion Capabilities.....	16
3.7. Voltage and Current Monitoring.....	16
3.8. User I/Os.....	17
3.9. USB to UART Interface.....	17
3.10. Programming Scheme.....	17
3.11. System Reset.....	18
3.12. 50 MHz Oscillator.....	18
3.13. Pin List.....	19
3.14. Board Component Placement.....	19
4. Appendix: Programming the RT PolarFire Device Using On-Board Programmer.....	21
5. Revision History.....	22
Microchip FPGA Support.....	23
Microchip Information.....	23
The Microchip Website.....	23
Product Change Notification Service.....	23
Customer Support.....	23
Microchip Devices Code Protection Feature.....	23
Legal Notice.....	24
Trademarks.....	24
Quality Management System.....	25
Worldwide Sales and Service.....	26

1. Getting Started [\(Ask a Question\)](#)

This section provides information about kit contents, board components, and other high-level information about the kit.

1.1 Kit Contents [\(Ask a Question\)](#)

The following table lists the RT PolarFire kit contents.

Table 1-1. Kit Contents

Item	Quantity
RT PolarFire® Development Kit (PROTO). For more information about the kit variants, see Table 1-2 .	1
12V, 5A power adapter	1
Ethernet cable	1
USB 2.0 micro A to Mini-B connector for UART interface to PC	1
Quickstart card	1

Table 1-2. Kit Variants

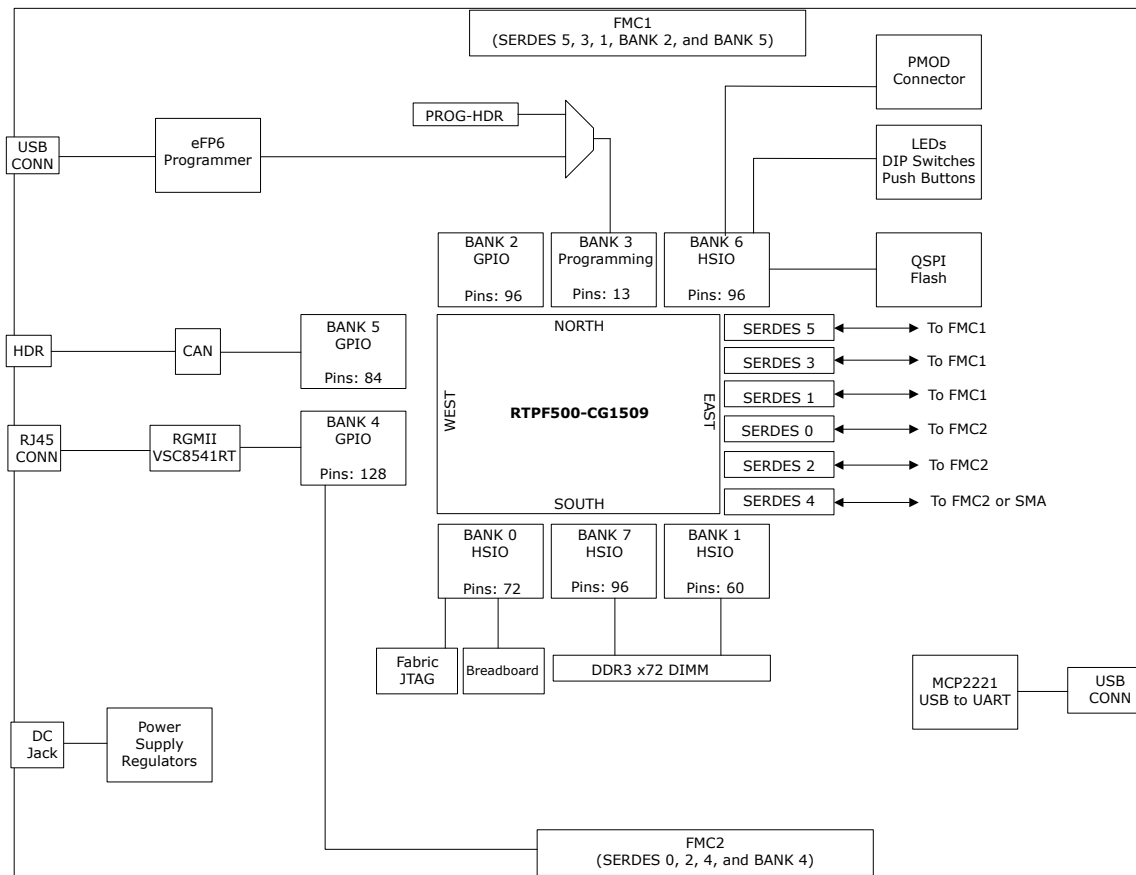
Kit Name	Silicon Part Number
RTPF-DEV-KIT-CB	RTPF500T-CB1509PROTO
RTPF-DEV-KIT-CB-1	RTPF500T-1CB1509PROTO
RTPF-DEV-KIT-CG	RTPF500T-CG1509PROTO
RTPF-DEV-KIT-CG-1	RTPF500T-1CG1509PROTO

You can order any of the above variants of the RT PolarFire development kit.

1.2 Block Diagram [\(Ask a Question\)](#)

The following block diagram shows the key components of the RT PolarFire Development kit.

Figure 1-1. Block Diagram



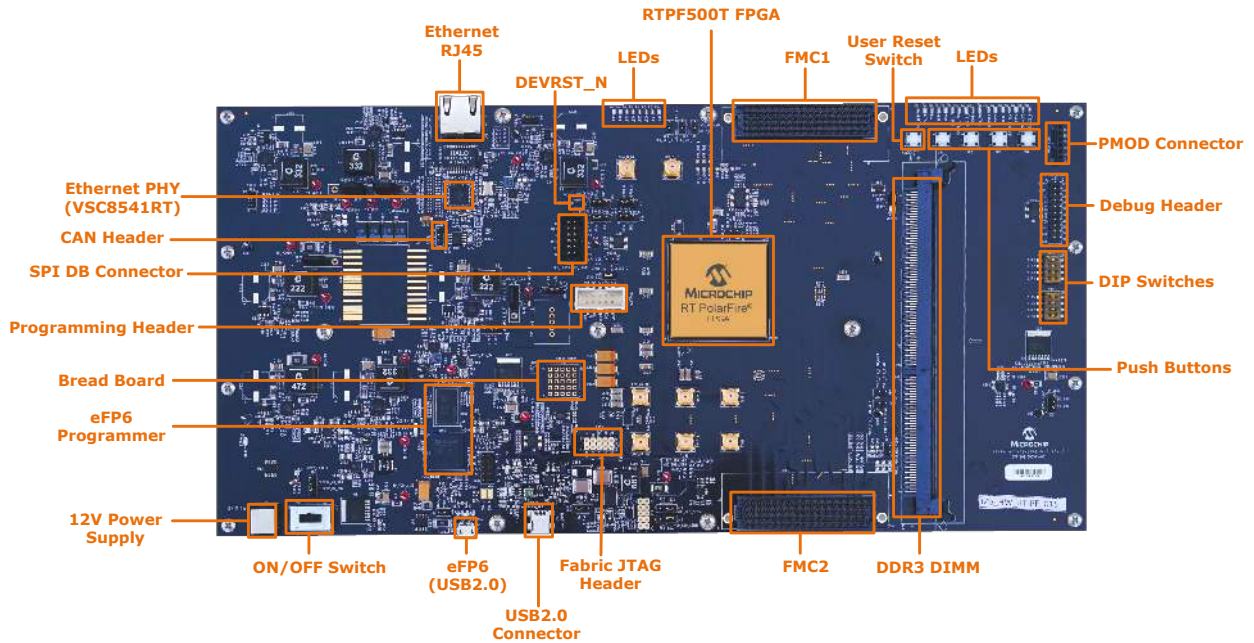
1.3 Board Overview [\(Ask a Question\)](#)

The RT PolarFire Development kit features the RTPF500T device with the following capabilities.

- VSC8541RT with an RJ45 connector for 10/100/1000 Mbps Ethernet
- DDR3 x 72 DIMM connector
- Power monitor module
- QSPI Flash device
- USB-UART device
- Bread board
- Fabric JTAG Header
- Push buttons/LEDs/DIP switches
- Debug header
- PMOD Type 1 connector
- FMC1 (HPC) and FMC2 connectors
- On-board programmer
- External JTAG header
- 50 MHz clock oscillator

The following illustration highlights various components of the RT PolarFire Development Kit.

Figure 1-2. Board Callout



1.3.1 Form Factor [\(Ask a Question\)](#)

The RT PolarFire Development Kit has the following dimensions:

- Form factor (X-Y axis):
 - X-axis (14 inch)
 - Y-axis (6.95 inch)
- The maximum height of the component at the top side is 835 mils
- The maximum height of the component at the bottom side is 413.39 mils

1.3.2 Assignment of FPGA I/O Banks [\(Ask a Question\)](#)

The following table lists the assignment of FPGA I/O Banks to on-board interfaces.

Table 1-3. FPGA I/O Bank Assignments

On-Board Interface	Assigned FPGA I/O BANK
DDR3 DIMM	BANK 1, BANK 7
FMC1 connector	BANK 2, BANK 5
CAN	BANK 5
FMC2 connector	BANK 4
RGMI interface	BANK 4
QSPI Flash	BANK 6
User defined LEDs	BANK 6
DIP Switches and Push buttons	BANK 6
Debug header	BANK 6

.....continued

On-Board Interface	Assigned FPGA I/O BANK
PMOD (Type 1) connector	BANK 6
Bread board	BANK 0
Fabric JTAG Header	BANK 0
USB-UART	BANK 0
External Programming header	BANK 3
External SPI Flash	BANK 3

1.4 Board Components [\(Ask a Question\)](#)

The following table lists the important components of the RT PolarFire Development Kit.

Component	Label on Board	Description
Featured Device		
RT PolarFire® FPGA	U1	For silicon part number, see Table 1-2 .
Power Supply and Monitoring		
12V power supply input	J19	The board is powered by a 12V power source using an external +12V/5 A DC jack.
ON/OFF switch	SW7	Power ON/OFF switch from +12V external DC jack
Clocks		
On-board 50 MHz clock oscillator	X3	50 MHz clock oscillator with single-ended output
FPGA Programming and Debugging		
SPI Flash	U55	1 Gb Micron MT25QU01GBBB8ESF-0SIT QSPI Flash memory device connected to SPI pins on BANK 3 of the RT PolarFire device.
QSPI Flash	U38	1 Gb Micron MT25QL01GBBB8ESF-0SIT SPI Flash memory device connected to HSIO pins on BANK 6 of the RT PolarFire device.
JTAG programming MUX	U56	MUX to select the programmer for RT PolarFire device It is used to select on-board programmer or external programmer
SPI programming MUX	U58	MUX to select SPI Programming MUX to select SPI Flash device or SPI DB
External programming header	J3	External programming header to program and debug the RT PolarFire device using FlashPro. The appropriate programmer must be selected in the FlashPro software. Note: For PROTOTYPE kits, the device can be programmed using an external FlashPro 4, 5, or 6 programmer.
On board programmer	U59	On-board programming
Expansion Interfaces		
PMOD	J14	PMOD Type 1 connector
Bread board	J33	Bread board connector

.....continued

Component	Label on Board	Description
Communication Interfaces		
Ethernet PHY	U12	VSC8541XMVRT
1000Base-X Gigabit Ethernet Transceiver RJ45 conn-1	J68	Ethernet (RJ45) jack with external magnetics interfacing with VSC8541RT in RGMII mode
USB-UART	U7	MCP2221
USB connector	J24	USB Micro A to B connector
CAN	J20	CAN Header
Memory Chips		
DDR3 DIMM	J17	DDR3 DIMM connector x72 for North NE anchor point (HSIO BANK 1 and 7)
General Purpose I/O		
Debug Switches	SW1 to SW4	For debug
Light-emitting diodes (LEDs)	LED1 to LED8	Eight Active-High LEDs connected to some of the user I/Os for debugging.
DIP Switches	DIP1 to DIP8	Eight DIP switches connected to some of the user I/Os for debugging.

1.5 Handling the Board [\(Ask a Question\)](#)

Handle the board with electrostatic discharge (ESD) precautions to avoid any possible damage or malfunction. For more information about using the board with ESD precautions, see [Understanding Product Handling and ESD Precautions \(for Hybrid Devices\)](#).

1.6 Operating Temperature [\(Ask a Question\)](#)

The extended commercial operating temperature range is 0 °C to 100 °C.

1.7 Powering Up the Board [\(Ask a Question\)](#)

To Power-Up the board, perform the following steps:

1. Connect 12V, 5A power supply brick to J19.
2. Connect the USB mini cable to J24 and another end to the test PC.
3. Slide Switch SW7 to the **ON** position.
4. Power status LEDs 12P0V, 5P0V, 3P3V, VDDAUX4, VDD_A_25, VDD_XCVR_CLK, 2P5V, VDDAUX2_5, VDD, 1P8V, VDDA, VDDI1_7, VDDIO_6_1P8V, VDDI2_5, VDDI4, 1P0V_PHY_VSC8541, FP6_DDR3_1P5V, 1P2V_FP.
5. Install the software required for developing designs and set the jumpers for the pre-programmed design. See [2. Installation and Settings](#).

The following table provides the probe points for power rails.

Table 1-4. Power Measurements

Serial Number	Power Rail	Probe point	Allowed Tolerance	Expected Voltage (Volts)
1	12P0V	C61	±5%	12V
2	VDD	C522	±5%	1V
3	5P0V	C114	±5%	5V
4	3P3V	C397	±5%	3.3V
5	1P8V	C325	±5%	1.8V
6	2P5V	C341	±5%	2.5V
7	VDDI1_7	C309	±5%	1.5V
8	VDDI2_5	C373	±5%	3.3V
9	VDDI4	C412	±5%	3.3V
10	VDDA	C609	±5%	1V
11	VDDA25	C663	±5%	2.5V
12	VDD_XCVR_CLK	C673	±5%	2.5V
13	1P2_FP6	C691	±5%	1.2V
14	FP6_DDR3_1P5V	C719	±5%	1.5V
15	1P0V_VSC8541	C194	±5%	1V
16	VTT_B17_DIMM	C363	±5%	0.75V
17	VREF_B17_DIMM	C364	±5%	0.75V
18	VTT_FP6_DDR3	C711	±5%	0.75V
19	VREF_FP6_DDR3	C712	±5%	0.75V
19	1P8V_RT	C384	±5%	1.8V
20	VDDI1_7_RT	C379	±5%	1.5V
21	VDDAUX_2_5	C392	±5%	2.5V
22	VDDAUX4	C445	±5%	2.5V
23	VDD18	C578	±5%	1.8V

2. Installation and Settings [\(Ask a Question\)](#)

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

2.1 Software Settings [\(Ask a Question\)](#)

For setting the software, perform the following steps:

1. Download and install the latest release of Libero® SoC software from the [Libero SoC Software Download](#) web page.
2. Generate a [free silver license](#) for your software. The Libero SoC installer includes FlashPro5 drivers.
3. For instructions about installing Libero SoC, see [Libero Software Installation and License Installation Quick Start Guide](#).
4. For instructions about purchasing, downloading, and installing Direct Cores and driver firmware cores on the PC where Libero SoC is installed, see [Libero Software Installation and License Installation Quick Start Guide](#).

2.2 Hardware Settings [\(Ask a Question\)](#)

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

2.2.1 Jumper Settings [\(Ask a Question\)](#)

The following table lists the default jumper settings on the RT PolarFire Development Kit.

Table 2-1. Jumper Settings

Jumper	Description	Pin	Default Setting
J60	BANK 1 VREF for DIMM connector	—	Open
J2	BANK 7 VREF for DIMM connector	—	Open
J41	FMC1 connector HB BANK voltage	—	Open
J42	FMC2 connector HB BANK voltage	—	Open
J27	CLK_SEL1 pin for SerDes Mux	—	Open
J29	CLK_SEL0 pin for SerDes Mux	—	Open
J31	Mux select pin for RTPF silicon programming	—	Open
J62	Mux select pin for SPI Flash or SPI DB	—	Open
J5	XCVR_Vref pin	—	Open
J48	Jumper to select VDD voltage to 1.0V and 1.05V	2 and 3	—
J45	Jumper to select VDD_REG_SENSE-	2 and 3	—
J46	Jumper to select VDD_REG_SENSE+	2 and 3	—
J30	Jumper to select VDDI1_7 voltage for MHP8565ASC RT regulator	2 and 3	—
J16	VDDI1_7 voltage select jumper	2 and 3	—
J32	VDDSPD voltage select jumper for DDR3 or DDR4	1 and 2	—
J1	LPRB_A or LPRB_B select jumper	1 and 2	—
J6	Reserved pin for BANK3 pullup/pull down option	1 and 2	—
J7	IO_CFG_INTF select jumper	1 and 2	—

.....continued

Jumper	Description	Pin	Default Setting
J8	SPI_Enable select jumper	1 and 2	—
J64	USB3320_VBUS	1 and 2	—
J34	12PV enable select jumper	1 and 2	—
J28	Jumper to select MHP50601A (RT regulator) or MIC2690 for VDD18 and VDDI0_6	1 and 2	—
J26	Jumper to select MHP8565ASC (RT regulator) or MIC2690 for VDD11_7	1 and 2	—
J4	Jumper to select VDDA voltage	1 and 2	—
J22	Jumper to select VDDAUX2_5 voltage	1 and 2	—
J23	Jumper to select VDDAUX4 voltage	1 and 2	—
J18	Jumper to select VDDI2_5_Vadj_FMC1 voltage	9 and 10	—
J15	Jumper to select VDDI4_Vadj_FMC2 voltage	9 and 10	—

2.2.2 Power Supply LEDs [\(Ask a Question\)](#)

The following table lists the power supply LEDs on the RT PolarFire Development Kit.

Table 2-2. Power Supply LEDs

LED	Description
12P0V	12V power supply
5P0V	5V power supply
3P3V	3.3V power supply
VDD_A_25	VDDA25 voltage
1P8V	1.8V power supply
VDD	Core voltage
VDDI1_7	BANK 1 & 7 voltage
1P0V_PHY	VSC8541_Phy_1V
VDDI4	BANK 4 voltage
VDDI2_5	BANK 2, 5 voltage
VDDI0_6_1P8V	BANK 0, 6 voltage
FP6_1P5V	FlashPro6 1.5V voltage
1P2V_FP	FlashPro6 1.2V voltage
VDDAUX4	BANK 4 auxiliary voltage
VDD_XCVR_CLK	Transceiver reference clock supply
2P5V	2.5V
VDDAUX2_5	BANK 2, 5 auxiliary voltages

2.2.3 Test Points [\(Ask a Question\)](#)

The following table lists all the test points available on the RT PolarFire Development Kit.

Test Point	Description
GND1TP_BLK to GND18TP_BLK	Test point for Ground
ETH_CLKOUT	Test point for VSC8541_CLK out
8541_MDC	Test point for VSC8541_MDC
8541_MDIO	Test point for VSC8541_MDIO
TP_5P0V	Test point for 5V supply
TP_3P3V	Test point for 3.3V supply
TP_1P8V1	Test point for 1.8V supply
TP_VDDI0_6	Test point for BANK voltage 0 and 6
TP_2P5V	Test point for 2.5V supply
TP_VDD	Test point for VDD core supply
PG_VDD	Test point for power good for VDD regulator
TP_VDDI1_7	Test point for BANK voltage 1 and 7
TP_VDDI2_5	Test point for BANK voltage 2 and 5
TP_VDDI4	Test point for BANK 4 voltage
TP_VDDAUX2_5	Test point for BANK 2 and 5 Aux voltage
TP_VDDAUX4	Test point for SD_CLK_FB/eMMC_DATA4 at Mux
TP_VDDA1	Test point for VDDA
TP_VDD_A_25	Test point for VDDA25 and VDD25
TP_VDD_XCVR_CLK	Test point for VDD_XCVR_CLK
TP_1P2V	Test point for VDD core voltage for FP6
TP_FP6_1P5V	Test point for 1.5V_eFP6 DDR3
TP_1P0V_PHY	Test point for PHY 1V voltage

2.3 Power Sources (Ask a Question)

RT PolarFire Development Kit uses Microchip power regulators. For more information about these power supply devices, see [Power Management](#). RT PolarFire devices have multiple I/O banks that require power supplies. The following table lists these key power supplies required for normal operation of the RT PolarFire Development Kit.

Table 2-3. I/O Voltage Rails

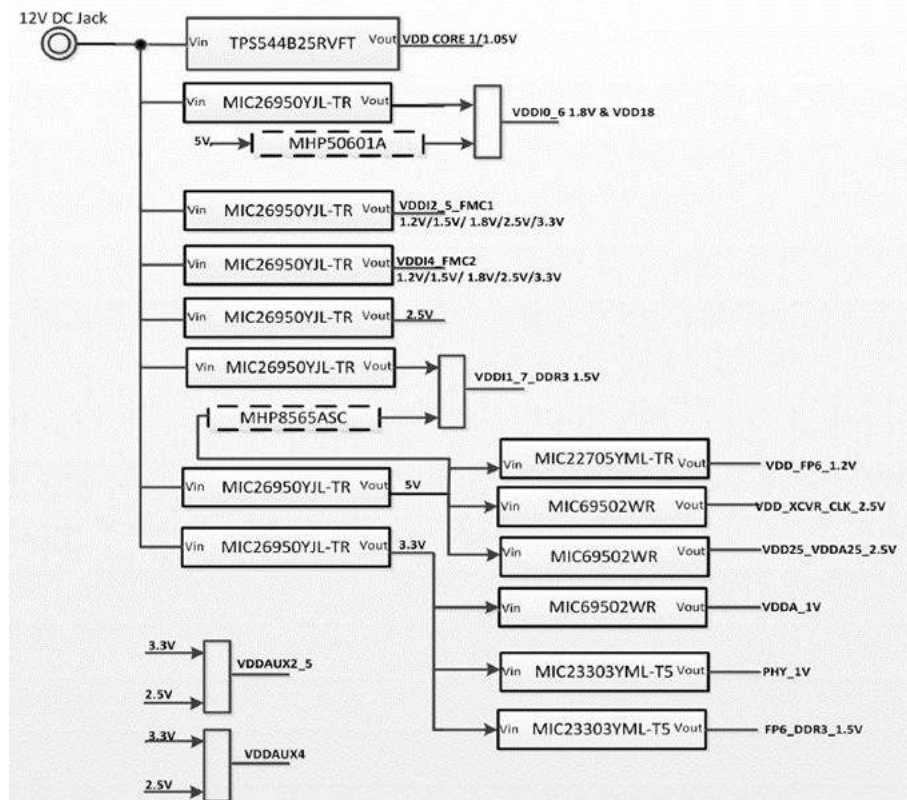
Name	Description	Operating Voltage	Unused Condition
V _{DDIx}	Supply for I/O circuits in a bank	For JTAG bank—1.8V/ 2.5V/3.3V For GPIO bank —1.2V/1.5V/ 1.8V/2.5V/ 3.3V For HSIO bank— 1.2V/1.5V/1.8V	The bank supply is not allowed to be left floating for any unused bank. It must be powered down to ground by direct connection.
V _{DD25}	Power for corner PLLs and PNVM	2.5V	Must connect to 2.5V
V _{DD18}	Power for programming and HSIO receiver	1.8V	Must connect to 1.8V

.....continued

Name	Description	Operating Voltage	Unused Condition
V _{DDAUXx}	Auxiliary supply for I/O circuitsAuxiliary supply voltage must be set to 2.5V or 3.3V and must always be equal to or higher than V _{DDIx} . For information about legal V _{DDI} and V _{DDAUX} combinations, see RT PolarFire FPGA User I/O User Guide .	Greater than or equal to V _{DDI} In cases where V _{DDI} and V _{DDAUX} in a given GPIO bank are both 2.5V or 3.3V, they must be tied together to same supply.	Must connect to greater than or equal to V _{DDI}
V _{REF}	Supply reference voltage for reference receiversEach bank can have only one V _{REF} value. V _{REF} can be externally supplied or internally generated. For more information, see RT PolarFire FPGA User I/O User Guide .	Depends on the I/O standards	The regular I/Os are used as V _{REF} supply. Libero® SoC configures unused user I/Os as the input buffer is disabled and the output buffer is tri-stated with weak pull-up.

The following figure shows the power scheme of the RT PolarFire Development kit.

Figure 2-1. RT PolarFire Power Scheme



The following table lists the power regulators used on the RT PolarFire Development kit.

Table 2-4. Power Regulators

Voltage Rail	Part Number	Description	Current
5V	MIC26950JL-TR	IC REG BUCK ADJUSTABLE	12A
VDD (1.2V) 1P2_FP6, VDD (1V)	MIC22705YML	IC REG BUCK ADJUSTABLE	7A
VSC_PHY(1.2V)	MIC23303YML-T5	IC REG BUCK ADJUSTABLE	3A
1.1V_LPDDR4	MIC23303YML-T5	IC REG BUCK ADJUSTABLE	3A
1P8V	MIC23303YML-T5	IC REG BUCK ADJUSTABLE	3A
VDD_XCVR_CLK (2P5V)	MIC69502WR	IC REG LINEAR POS ADJUSTABLE	5A
3P3V	MIC26950JL-TR	IC REG BUCK ADJUSTABLE	12A
VDDA	MIC69502WR	IC REG LINEAR POS ADJUSTABLE	5A
1P5V_DDR3	MIC23303YML-T5	IC REG BUCK ADJUSTABLE	3A
VTT and VREF	MIC5166YML-TR	IC PWR SUP 3 A HS DDR TERM 10MLF	3A
VDD18 and VDDI0_6	MIC26950YJL-TR	IC REG BUCK ADJUSTABLE	12A
VDD (1V/1.05V)	TPS544B25RVFT	IC REG BUCK ADJUSTABLE	20A
VDDI1_7	MIC26950YJL-TR	IC REG BUCK ADJUSTABLE	12A
VDDI2_5	MIC26950YJL-TR	IC REG BUCK ADJUSTABLE	12A
VDDI4	MIC26950YJL-TR	IC REG BUCK ADJUSTABLE	12A
VDDA25	MIC69502WR	IC REG LINEAR POS ADJUSTABLE	5A

3. Board Components and Operation [\(Ask a Question\)](#)

This section describes the key components of the RT PolarFire Development Kit and provides information about the important board operations. For more information, see the board level schematics.

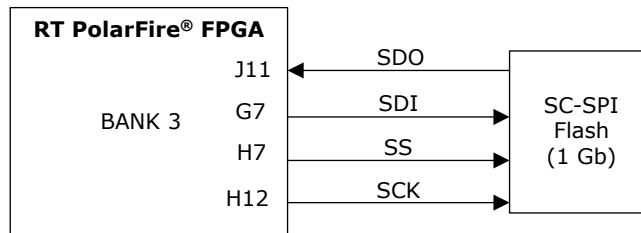
3.1 SPI Serial Flash [\(Ask a Question\)](#)

RT PolarFire Development Kit has a 1 Gb SPI Flash and SPI Flash daughter board connector. The SPI Flash is connected to BANK 3 SC-SPI pins to support IAP programming.

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

The following figure shows the SPI Flash interface on the RT PolarFire® Development kit.

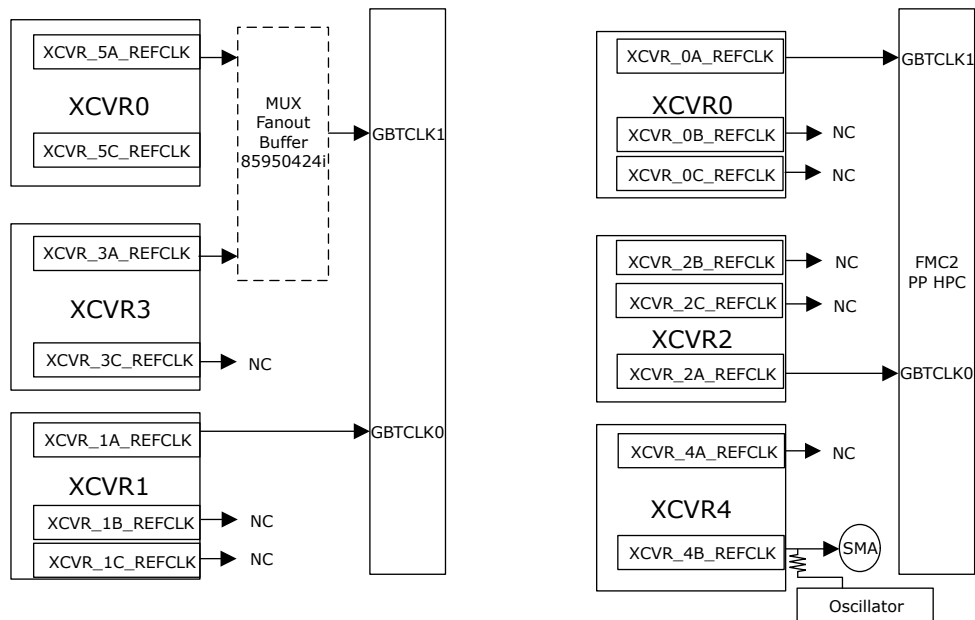
Figure 3-1. SPI Flash Interface



3.2 High-Speed Transceivers Configuration [\(Ask a Question\)](#)

The RTPF500T device includes six XCVR blocks and 24 SerDes lanes. The XCVR clocking scheme for driving the FMC connectors is shown in the following figure.

Figure 3-2. XCVR Clocking Scheme



As shown in the preceding figure, SerDes1, SerDes3, and SerDes5 lanes provide clocks to FMC1. SerDes0 and SerDes2 lanes provide clocks FMC2.

3.3 Communication Interfaces [\(Ask a Question\)](#)

This section describes the communication interfaces available on the kit.

3.3.1 Ethernet (RGMII Interface) [\(Ask a Question\)](#)

The RT PolarFire Development Kit includes Microchip's VSC8541RT device for Ethernet connectivity. The VSC8541RT device is a radiation tolerant single port Fast Ethernet copper PHY targeting space-constrained 10/100/1000BASE-T applications. The on-board VSC8541RT (GMII) is connected to I/O BANK 4 (GPIO) of the RT PolarFire FPGA.

3.3.2 CAN Interface [\(Ask a Question\)](#)

The RT PolarFire Development Kit does not support Controller Area Network (CAN) interface.

3.4 Memory Interface [\(Ask a Question\)](#)

The kit supports a standard DDR3 Dual Inline Memory Module (DIMM) socket for plugging in any standard DDR3 DIMM with variable density.

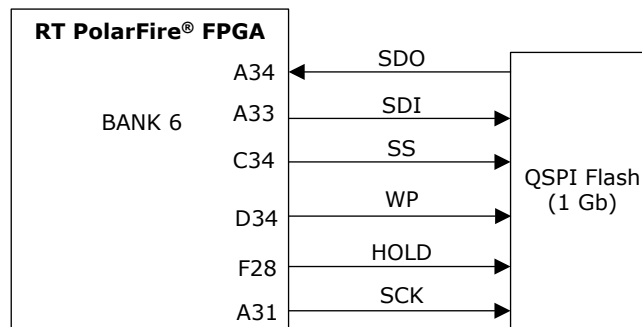
3.5 QSPI Serial Flash [\(Ask a Question\)](#)

RT PolarFire Development Kit has a 1 Gb QSPI Flash. The QSPI Flash is connected to BANK 6 to support application execution.

Part Number:	MT25QU01GBBB8ESF-0SIT
Manufacturer:	Micron
Flash Type:	NOR

The following figure shows the QSPI Flash interface on the RT PolarFire Development kit.

Figure 3-3. QSPI Flash Interface



3.6 Expansion Capabilities [\(Ask a Question\)](#)

The following sections explain the expansion connectors for the RT PolarFire Development Kit.

3.6.1 Pmod Type 1 Connector [\(Ask a Question\)](#)

The kit supports a Pmod (peripheral module interface) Type 1 connector (part number: PPPC061LFBN-RC). The I/O BANK 6 (HSIO) supports Pmod Type1 connections through a voltage-level translator.

3.6.2 Debug Header [\(Ask a Question\)](#)

The kit supports a debug header connected to I/O BANK 6 (HSIO). This header supports debug header connections through a voltage-level translator.

3.6.3 Bread Board [\(Ask a Question\)](#)

The kit supports a bread board. 20 pins of the I/O BANK 0 (HSIO) are connected to bread board connections.

3.6.4 Fabric JTAG Header [\(Ask a Question\)](#)

The kit supports a fabric JTAG header connected to I/O BANK 0 (HSIO) supports JTAG header through voltage-level translator.

3.7 Voltage and Current Monitoring [\(Ask a Question\)](#)

The kit has provision to measure current for the following power rails:

- VDD
- VDDI0_6_1P8V (1.8V for BANK 0 and 6)
- VDDA
- VDD_XCVR_CLK
- 3P3V
- 5P0V
- VDD_A_25
- VDDI1_7
- 2P5V
- VDDI4
- VDDI2_5
- 1P8V

Current sensing is done by PAC1934T-I/JQ. The I²C interface is available on digital values to read back values. Sensor's I²C interface is connected to the MCP2221 I²C interface.

3.8 User I/Os [\(Ask a Question\)](#)

The kit includes four push-buttons, eight DIP switches, and eight LED indicators connected to I/O BANK 6 (HSIO).

3.9 USB to UART Interface [\(Ask a Question\)](#)

The kit includes Microchip's MCP2221 device that is a USB to UART bridge controller to support UART interface on the board. UART I/Os are connected to the I/O BANK 0 (HSIO) of the RT PolarFire FPGA. I²C interface signals are connected to current measurement IC PCA9516APW,118.

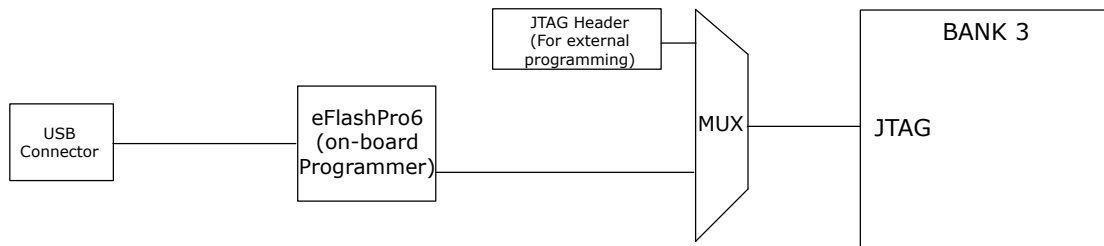
3.10 Programming Scheme [\(Ask a Question\)](#)

The on-board RT PolarFire FPGA can be programmed using [3.10.1. JTAG Programming Scheme](#) or [3.10.2. SPI Programming Scheme](#).

3.10.1 JTAG Programming Scheme [\(Ask a Question\)](#)

The on-board RT PolarFire device can be programmed using the on-board JTAG programmer or an external JTAG programmer as shown in the following figure.

Figure 3-4. JTAG Programming Scheme



The kit includes a multiplexer (U56) for selecting either the external programming JTAG header or the on-board programmer. The following are the multiplexer details:

Part Number	74CBTLV3257BQ,115
Manufacturer	NXP

The following table lists the J31 jumper setting for selecting the required JTAG programmer.

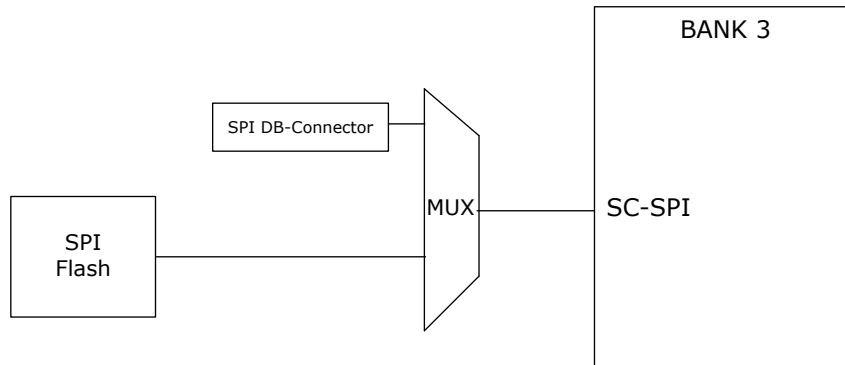
Table 3-1. J31 Jumper Setting

Jumper (J31)	JTAG Selection
Open	External Programming header
Close	On-board Programmer

3.10.2 SPI Programming Scheme [\(Ask a Question\)](#)

The on-board RT PolarFire device can be programmed using the on-board SPI interface or an external SPI interface as shown in the following figure.

Figure 3-5. SPI Programming Scheme



The kit includes a multiplexer (U58) for selecting either the external SPI DB-Connector header or the on-board SPI Flash. The following are the multiplexer details:

Part number	74CBTLV3257PW,118
Manufacturer	NXP

The following table lists the J62 jumper setting for selecting the required SPI programming.

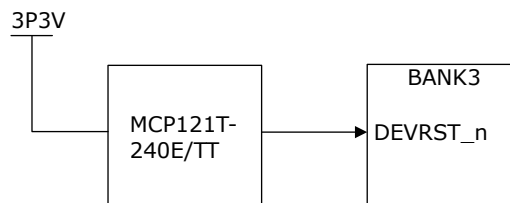
Table 3-2. J62 Jumper Setting

Jumper (J62)	SPI Selection
Open	On-board SPI
Close	SPI DB-Connector

3.11 System Reset [\(Ask a Question\)](#)

DEVRST_N is an input-only reset pad that asserts a full reset of the chip at any time. The following figure shows a sample reset circuit that uses a Microchip MCP121T-240E/TT device.

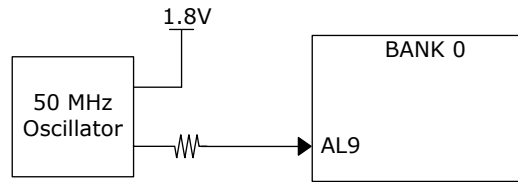
Figure 3-6. Reset Scheme



3.12 50 MHz Oscillator [\(Ask a Question\)](#)

A 50 MHz clock oscillator with an accuracy of ± 10 ppm is available on the board.

Figure 3-7. 50 MHz Clock Oscillator



The connection of this clock oscillator with the FPGA fabric is listed the following table.

Table 3-3. Clock Oscillator and the FPGA Fabric Connection

RT PolarFire® Package Pin Number	RT PolarFire Device Pin Name
AL9	HSIO194PB0/CLKIN_N_2/CCC_NW_CLKIN_N_2/CCC_NW_PLL1_OUT0

For more information, refer to board-level schematics (provided separately).

3.13 Pin List [\(Ask a Question\)](#)

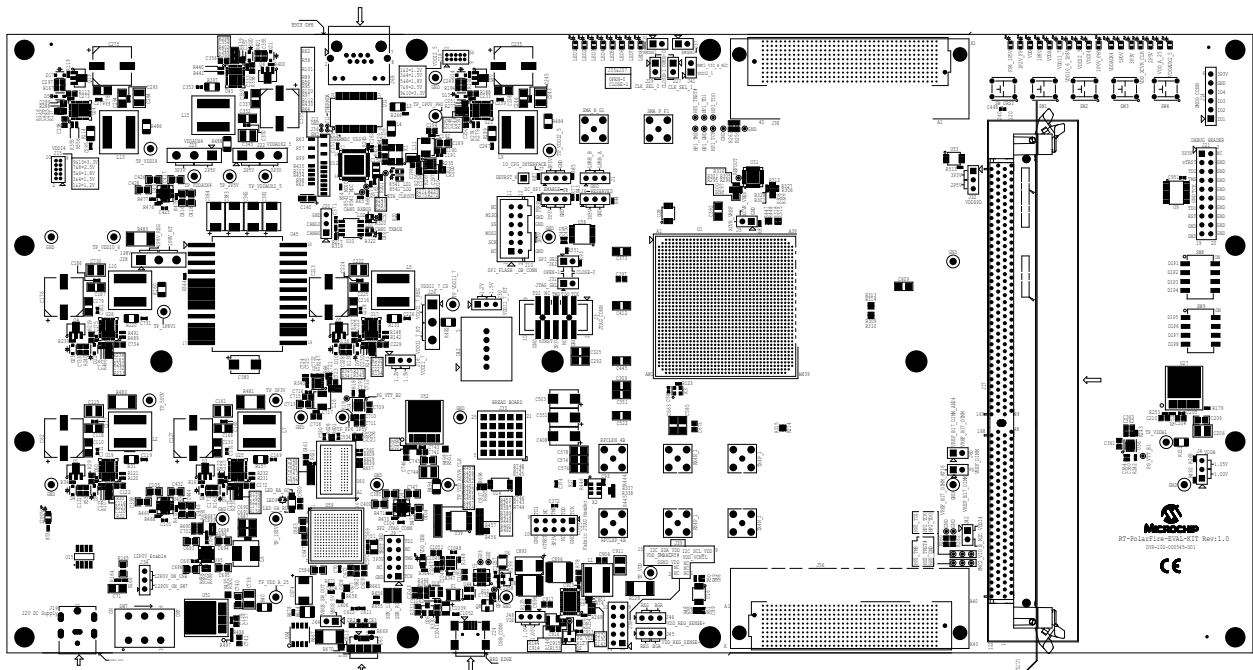
For more information about the package pins, see [PPAT](#).

3.14 Board Component Placement [\(Ask a Question\)](#)

This section provides PCB silkscreens to identify board components along with their reference designators.

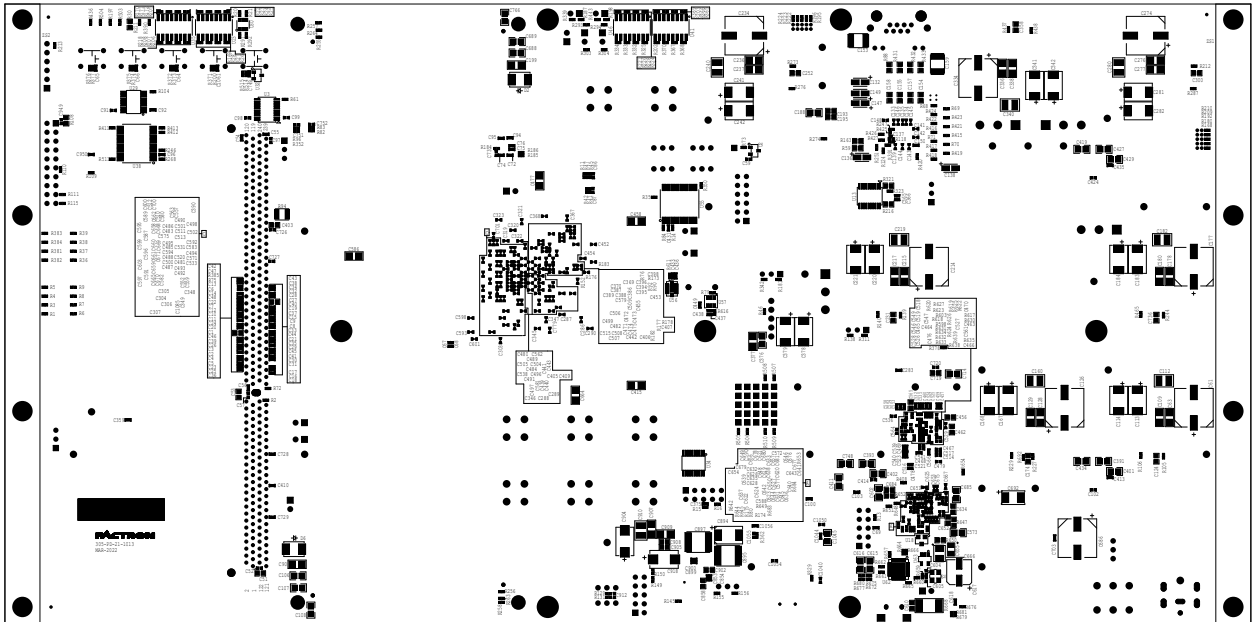
The following silkscreen shows the top view of the board.

Figure 3-8. Top View



The following silkscreen shows the bottom view of the board.

Figure 3-9. Bottom View



4. Appendix: Programming the RT PolarFire Device Using On-Board Programmer [\(Ask a Question\)](#)

The RT PolarFire Development Kit includes an on-board programmer. Therefore, an external programmer hardware is not required to program the RT PolarFire device. The device can be programmed using the FlashPro Express software installed on the host PC.



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

To program the on-board RT PolarFire device using the on-board programmer, perform the following steps:

1. Connect the power supply cable to the **J19** connector on the board.
2. Close Jumper **J31** for MUX U56.
3. Power on the board using the **SW7** slide switch.
4. When the board is successfully set up, the power LEDs start glowing.
5. Download FlashPro Express from [Programming and Debug Tools Downloads](#).
6. On the host PC, launch the FlashPro Express software.
7. Click **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, the `Run Program PASSED` status is displayed.

5. 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.

Table 5-1. Revision History

Revision	Date	Description
B	04/2023	<ul style="list-style-type: none">• Made the silkscreen figures searchable, see Figure 3-8 and Figure 3-9.• Updated Table 2-2.
A	09/2022	Initial revision

Microchip FPGA Support [\(Ask a Question\)](#)

Microchip FPGA products group backs its products with various support services, including Customer Service, Customer Technical Support Center, a website, and worldwide sales offices. Customers are suggested to visit Microchip online resources prior to contacting support as it is very likely that their queries have been already answered.

Contact Technical Support Center through the website at www.microchip.com/support. Mention the FPGA Device Part number, select appropriate case category, and upload design files while creating a technical support case.

Contact Customer Service for non-technical product support, such as product pricing, product upgrades, update information, order status, and authorization.

- From North America, call **800.262.1060**
- From the rest of the world, call **650.318.4460**
- Fax, from anywhere in the world, **650.318.8044**

Microchip Information [\(Ask a Question\)](#)

The Microchip Website [\(Ask a Question\)](#)

Microchip provides online support via our website at www.microchip.com/. This website is used to make files and information easily available to customers. Some of the content available includes:

- **Product Support** – Data sheets and errata, application notes and sample programs, design resources, user's guides and hardware support documents, latest software releases and archived software
- **General Technical Support** – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip design partner program member listing
- **Business of Microchip** – Product selector and ordering guides, latest Microchip press releases, listing of seminars and events, listings of Microchip sales offices, distributors and factory representatives

Product Change Notification Service [\(Ask a Question\)](#)

Microchip's product change notification service helps keep customers current on Microchip products. Subscribers will receive email notification whenever there are changes, updates, revisions or errata related to a specified product family or development tool of interest.

To register, go to www.microchip.com/pcn and follow the registration instructions.

Customer Support [\(Ask a Question\)](#)

Users of Microchip products can receive assistance through several channels:

- Distributor or Representative
- Local Sales Office
- Embedded Solutions Engineer (ESE)
- Technical Support

Customers should contact their distributor, representative or ESE for support. Local sales offices are also available to help customers. A listing of sales offices and locations is included in this document.

Technical support is available through the website at: www.microchip.com/support

Microchip Devices Code Protection Feature [\(Ask a Question\)](#)

Note the following details of the code protection feature on Microchip products:

-
- Microchip products meet the specifications contained in their particular Microchip Data Sheet.
 - Microchip believes that its family of products is secure when used in the intended manner, within operating specifications, and under normal conditions.
 - Microchip values and aggressively protects its intellectual property rights. Attempts to breach the code protection features of Microchip product is strictly prohibited and may violate the Digital Millennium Copyright Act.
 - Neither Microchip nor any other semiconductor manufacturer can guarantee the security of its code. Code protection does not mean that we are guaranteeing the product is “unbreakable”. Code protection is constantly evolving. Microchip is committed to continuously improving the code protection features of our products.

Legal Notice [\(Ask a Question\)](#)

This publication and the information herein may be used only with Microchip products, including to design, test, and integrate Microchip products with your application. Use of this information in any other manner violates these terms. Information regarding device applications is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. Contact your local Microchip sales office for additional support or, obtain additional support at www.microchip.com/en-us/support/design-help/client-support-services.

THIS INFORMATION IS PROVIDED BY MICROCHIP "AS IS". MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION INCLUDING BUT NOT LIMITED TO ANY IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY, AND FITNESS FOR A PARTICULAR PURPOSE, OR WARRANTIES RELATED TO ITS CONDITION, QUALITY, OR PERFORMANCE.

IN NO EVENT WILL MICROCHIP BE LIABLE FOR ANY INDIRECT, SPECIAL, PUNITIVE, INCIDENTAL, OR CONSEQUENTIAL LOSS, DAMAGE, COST, OR EXPENSE OF ANY KIND WHATSOEVER RELATED TO THE INFORMATION OR ITS USE, HOWEVER CAUSED, EVEN IF MICROCHIP HAS BEEN ADVISED OF THE POSSIBILITY OR THE DAMAGES ARE FORESEEABLE. TO THE FULLEST EXTENT ALLOWED BY LAW, MICROCHIP'S TOTAL LIABILITY ON ALL CLAIMS IN ANY WAY RELATED TO THE INFORMATION OR ITS USE WILL NOT EXCEED THE AMOUNT OF FEES, IF ANY, THAT YOU HAVE PAID DIRECTLY TO MICROCHIP FOR THE INFORMATION.

Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Trademarks [\(Ask a Question\)](#)

The Microchip name and logo, the Microchip logo, Adaptec, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, CryptoMemory, CryptoRF, dsPIC, flexPWR, HELDO, IGLOO, JukeBlox, KeeLoq, Kleer, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

AgileSwitch, APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, Flashtec, Hyper Speed Control, HyperLight Load, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet-Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, TrueTime, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, Augmented Switching, BlueSky, BodyCom, Clockstudio, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, Espresso T1S, EtherGREEN, GridTime, IdealBridge, In-Circuit Serial Programming, ICSP, INICnet, Intelligent Paralleling, IntelliMOS, Inter-Chip Connectivity, JitterBlocker, Knob-on-Display, KoD, maxCrypto, maxView, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICkit, PICTail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, RTAX, RTG4, SAM-

ICE, Serial Quad I/O, simpleMAP, SimpliPHY, SmartBuffer, SmartHLS, SMART-I.S., storClad, SQI, SuperSwitcher, SuperSwitcher II, Switchtec, SynchroPHY, Total Endurance, Trusted Time, TSHARC, USBCheck, VariSense, VectorBlox, VeriPHY, ViewSpan, WiperLock, XpressConnect, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, and Symmcom are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2023, Microchip Technology Incorporated and its subsidiaries. All Rights Reserved.

ISBN: 978-1-6683-2275-8

Quality Management System [\(Ask a Question\)](#)

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

Worldwide Sales and Service

AMERICAS	ASIA/PACIFIC	ASIA/PACIFIC	EUROPE
<p>Corporate Office 2355 West Chandler Blvd. Chandler, AZ 85224-6199 Tel: 480-792-7200 Tel: 480-792-7277 Technical Support: www.microchip.com/support Web Address: www.microchip.com</p> <p>Atlanta Duluth, GA Tel: 678-957-9614 Fax: 678-957-1455</p> <p>Austin, TX Tel: 512-257-3370</p> <p>Boston Westborough, MA Tel: 774-760-0087 Fax: 774-760-0088</p> <p>Chicago Itasca, IL Tel: 630-285-0071 Fax: 630-285-0075</p> <p>Dallas Addison, TX Tel: 972-818-7423 Fax: 972-818-2924</p> <p>Detroit Novi, MI Tel: 248-848-4000</p> <p>Houston, TX Tel: 281-894-5983</p> <p>Indianapolis Noblesville, IN Tel: 317-773-8323 Fax: 317-773-5453 Tel: 317-536-2380</p> <p>Los Angeles Mission Viejo, CA Tel: 949-462-9523 Fax: 949-462-9608 Tel: 951-273-7800</p> <p>Raleigh, NC Tel: 919-844-7510</p> <p>New York, NY Tel: 631-435-6000</p> <p>San Jose, CA Tel: 408-735-9110 Tel: 408-436-4270</p> <p>Canada - Toronto Tel: 905-695-1980 Fax: 905-695-2078</p>	<p>Australia - Sydney Tel: 61-2-9868-6733</p> <p>China - Beijing Tel: 86-10-8569-7000</p> <p>China - Chengdu Tel: 86-28-8665-5511</p> <p>China - Chongqing Tel: 86-23-8980-9588</p> <p>China - Dongguan Tel: 86-769-8702-9880</p> <p>China - Guangzhou Tel: 86-20-8755-8029</p> <p>China - Hangzhou Tel: 86-571-8792-8115</p> <p>China - Hong Kong SAR Tel: 852-2943-5100</p> <p>China - Nanjing Tel: 86-25-8473-2460</p> <p>China - Qingdao Tel: 86-532-8502-7355</p> <p>China - Shanghai Tel: 86-21-3326-8000</p> <p>China - Shenyang Tel: 86-24-2334-2829</p> <p>China - Shenzhen Tel: 86-755-8864-2200</p> <p>China - Suzhou Tel: 86-186-6233-1526</p> <p>China - Wuhan Tel: 86-27-5980-5300</p> <p>China - Xian Tel: 86-29-8833-7252</p> <p>China - Xiamen Tel: 86-592-2388138</p> <p>China - Zhuhai Tel: 86-756-3210040</p>	<p>India - Bangalore Tel: 91-80-3090-4444</p> <p>India - New Delhi Tel: 91-11-4160-8631</p> <p>India - Pune Tel: 91-20-4121-0141</p> <p>Japan - Osaka Tel: 81-6-6152-7160</p> <p>Japan - Tokyo Tel: 81-3-6880-3770</p> <p>Korea - Daegu Tel: 82-53-744-4301</p> <p>Korea - Seoul Tel: 82-2-554-7200</p> <p>Malaysia - Kuala Lumpur Tel: 60-3-7651-7906</p> <p>Malaysia - Penang Tel: 60-4-227-8870</p> <p>Philippines - Manila Tel: 63-2-634-9065</p> <p>Singapore Tel: 65-6334-8870</p> <p>Taiwan - Hsin Chu Tel: 886-3-577-8366</p> <p>Taiwan - Kaohsiung Tel: 886-7-213-7830</p> <p>Taiwan - Taipei Tel: 886-2-2508-8600</p> <p>Thailand - Bangkok Tel: 66-2-694-1351</p> <p>Vietnam - Ho Chi Minh Tel: 84-28-5448-2100</p>	<p>Austria - Wels Tel: 43-7242-2244-39 Fax: 43-7242-2244-393</p> <p>Denmark - Copenhagen Tel: 45-4485-5910 Fax: 45-4485-2829</p> <p>Finland - Espoo Tel: 358-9-4520-820</p> <p>France - Paris Tel: 33-1-69-53-63-20 Fax: 33-1-69-30-90-79</p> <p>Germany - Garching Tel: 49-8931-9700</p> <p>Germany - Haan Tel: 49-2129-3766400</p> <p>Germany - Heilbronn Tel: 49-7131-72400</p> <p>Germany - Karlsruhe Tel: 49-721-625370</p> <p>Germany - Munich Tel: 49-89-627-144-0 Fax: 49-89-627-144-44</p> <p>Germany - Rosenheim Tel: 49-8031-354-560</p> <p>Israel - Ra'anana Tel: 972-9-744-7705</p> <p>Italy - Milan Tel: 39-0331-742611 Fax: 39-0331-466781</p> <p>Italy - Padova Tel: 39-049-7625286</p> <p>Netherlands - Drunen Tel: 31-416-690399 Fax: 31-416-690340</p> <p>Norway - Trondheim Tel: 47-72884388</p> <p>Poland - Warsaw Tel: 48-22-3325737</p> <p>Romania - Bucharest Tel: 40-21-407-87-50</p> <p>Spain - Madrid Tel: 34-91-708-08-90 Fax: 34-91-708-08-91</p> <p>Sweden - Gothenberg Tel: 46-31-704-60-40</p> <p>Sweden - Stockholm Tel: 46-8-5090-4654</p> <p>UK - Wokingham Tel: 44-118-921-5800 Fax: 44-118-921-5820</p>