Titanium Ti180 M484 Development Kit User Guide

Ti180M484-DK-UG-v1.0
October 2022
www.efinixinc.com

Contents

Introduction

Thank you for choosing the Titanium Ti180 M484 Development Kit (part number: Ti180M484-DK), which allows you to explore the features of the Ti180 FPGA.

The Titanium Ti180 M484 Development Kit has everything you need to develop and prototype designs for the Ti180 FPGA. This kit showcases the Ti180's hardened MIPI D-PHY, supporting up to 2.5 Gbps per lane, and hardened LPDDR4 and LPDDR4x controllers. Use the Raspberry Pi v2 camera module to stream video and store data in the development board's 256-MBit, 1.6 Gbps LPDDR4 or 2.0 Gbps LPDDR4x SDRAM. Two IMX477 Camera Connector Daughter Cards let you process video data from 12.3 megapixel IMX477 camera modules.[1] The development board also has two Macronix high-performance 256 Mb SPI NOR flash chips so you can store additional user data such as RISC-V software.

This kit includes an FPGA Mezzanine Card (FMC) with additional multi-purpose QSE connectors to expand the development kit's connection capabilities. Additionally, Ethernet and HDMI connector daughter cards are also included in the kit so you can process data in the FPGA and send it to a display or another system.

⚠️ **Warning:** The board can be damaged without proper anti-static handling.

What's in the Box?

The Titanium Ti180 M484 Development Kit includes:

- Titanium Ti180 M484 Development Board
- 1 Raspberry Pi v2 camera module
- 1 Dual Raspberry Pi Camera Connector Daughter Card
- 2 IMX477 Camera Connector Daughter Cards
- 1 FMC-to-QSE Adapter Card
- 1 HDMI Connector Daughter Card
- 1 Ethernet Connector Daughter Card
- 1 MIPI and LVDS Expansion Daughter Card
- 1 15-pin flat cable
- 2 22-pin flat cables (100 mm and 200 mm)
- 1 USB type-C cable
- 12 V, 5 A universal power adapter
- Heat sink
- 14 standoffs, 10 screws, and 14 nuts

Register Your Kit

When you purchase an Efinix development kit, you also receive a license for the Efinity® software plus one year of software upgrades and patches. The Efinity® software is available for download from the Support Center on the Efinix web site.

To download the software, first register for our Support Center (**https://www.efinixinc.com/register**) and then register your development kit.

---

[1] IMX477 camera modules are not included in the kit.

Download the Efinity® Software

To develop your own designs for the Ti180 FPGA on the board, you must install the Efinity® software. You can obtain the software from the Efinix Support Center under Efinity Software (**www.efinixinc.com/support/**).

The Efinity® software includes tools to program the device on the board. Refer to the Efinity® Software User Guide for information about how to program the device.

Learn more: Efinity® documentation is installed with the software (see **Help** > **Documentation**) and is also available in the Support Center under Documentation (**www.efinixinc.com/support/**).

Installing the Linux USB Driver

The following instructions explain how to install a USB driver for Linux operating systems.

1. Disconnect your board from your computer.
2. In a terminal, use these commands:

```
> sudo <installation directory>/bin/install_usb_driver.sh
> sudo udevadm control --reload-rules
```

Note: If your board was connected to your computer before you executed these commands, you need to disconnect and re-connect it.

Installing the Windows USB Drivers

The Titanium Ti180 M484 Development Board development board has an FTDI FT2232H chip to communicate with the USB port.

Note: If you have another Efinix board and are using the Titanium Ti180 M484 Development Board, you must manage drivers accordingly. Refer to **AN 050: Managing Windows Drivers** for more information.

On Windows, you use software from Zadig to install drivers. Download the Zadig software (version 2.7 or later) from **zadig.akeo.ie**. (You do not need to install it; simply run the downloaded executable.)

To install the driver:

1. Connect the board to your computer with the appropriate cable and power it up.
2. Run the Zadig software.
3. Choose **Options > List All Devices**.
4. Select Ti180 M484 Development kit (Interface 1).

   Note: You do not need to install driver for Interface 0 because when you connect the Titanium Ti180 M484 Development Board to your computer, Windows automatically installs a driver for them.

5. Select **libusb-win32** in the **Driver** drop-down list.
6. Click **Replace Driver**.
7. Close the Zadig software.

Board Functional Description

The Titanium Ti180 M484 Development Board contains a variety of components to help you build designs for the Titanium Ti180 FPGA.

Figure 1: Titanium Ti180 M484 Development Board Block Diagram
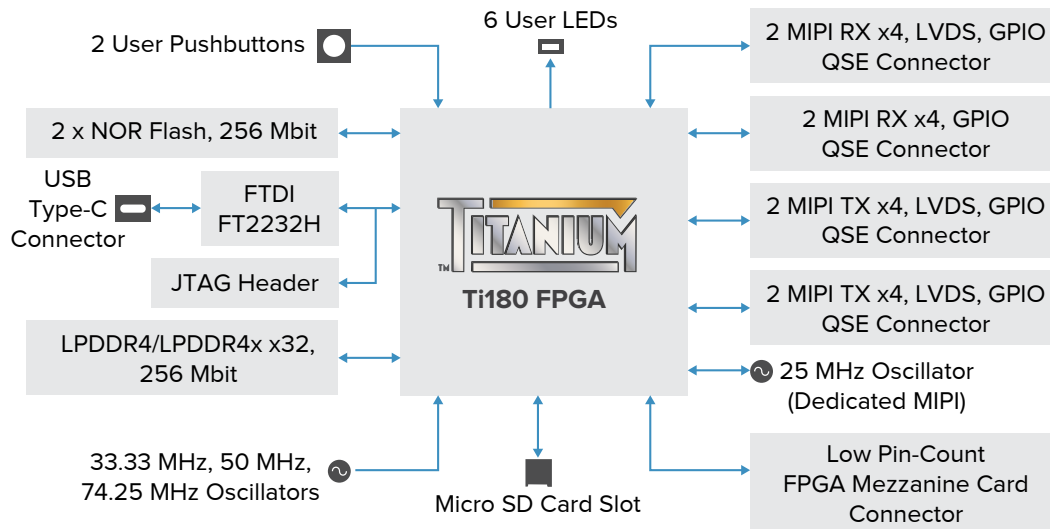
Features

- Efinix Ti180M484I3 FPGA in a 484-ball FineLine BGA package
- LPDDR4 or LPDDR4x x32 bits memory:
  - 256 Mb
  - Up to 2.0 Gbps double-data rate (LPDDR4x)
  - Up to 1.6 Gbps double-data rate (LPDDR4)
- 2 x 256 Mbit SPI NOR flash memories
- 4 x MIPI, LVDS, and GPIO high-speed QSE connectors to attach the daughter cards included in the kit or your own custom daughter cards
- Micro-SD card slot
- FPGA mezzanine card (FMC) with low pin-count connector (LPC)
- USB Type-C connector to configure the development board
- 33.33, 50, and 74.25 MHz oscillators for Ti180 PLL input
- User LEDs and switches:
  - 6 LEDs
  - 2 pushbutton switches
- Power:
  - 12.0 V power supply connector
  - On-board regulator sources: 0.62 V, 0.85 V, 0.95 V, 1.1 V, 1.2 V, 1.8 V, 3.3 V, 5.0 V
- Power good and Ti180 configuration done LEDs

Overview

The board features the Efinix Ti180 FPGA in a 484-ball FBGA package, which is fabricated using Efinix Quantum™ technology. The Quantum™-accelerated programmable logic and routing fabric is wrapped with an I/O interface in a small footprint package. Ti180 FPGAs also include embedded memory blocks and DSP blocks. You create designs for the Ti180 FPGA in the Efinity® software, and then download the resulting configuration bitstream to the board using the USB connection.

Learn more: For more information on Ti180 FPGAs, refer to the **Ti180 Data Sheet**.

Figure 2: Titanium Ti180 M484 Development Board Components (Top)
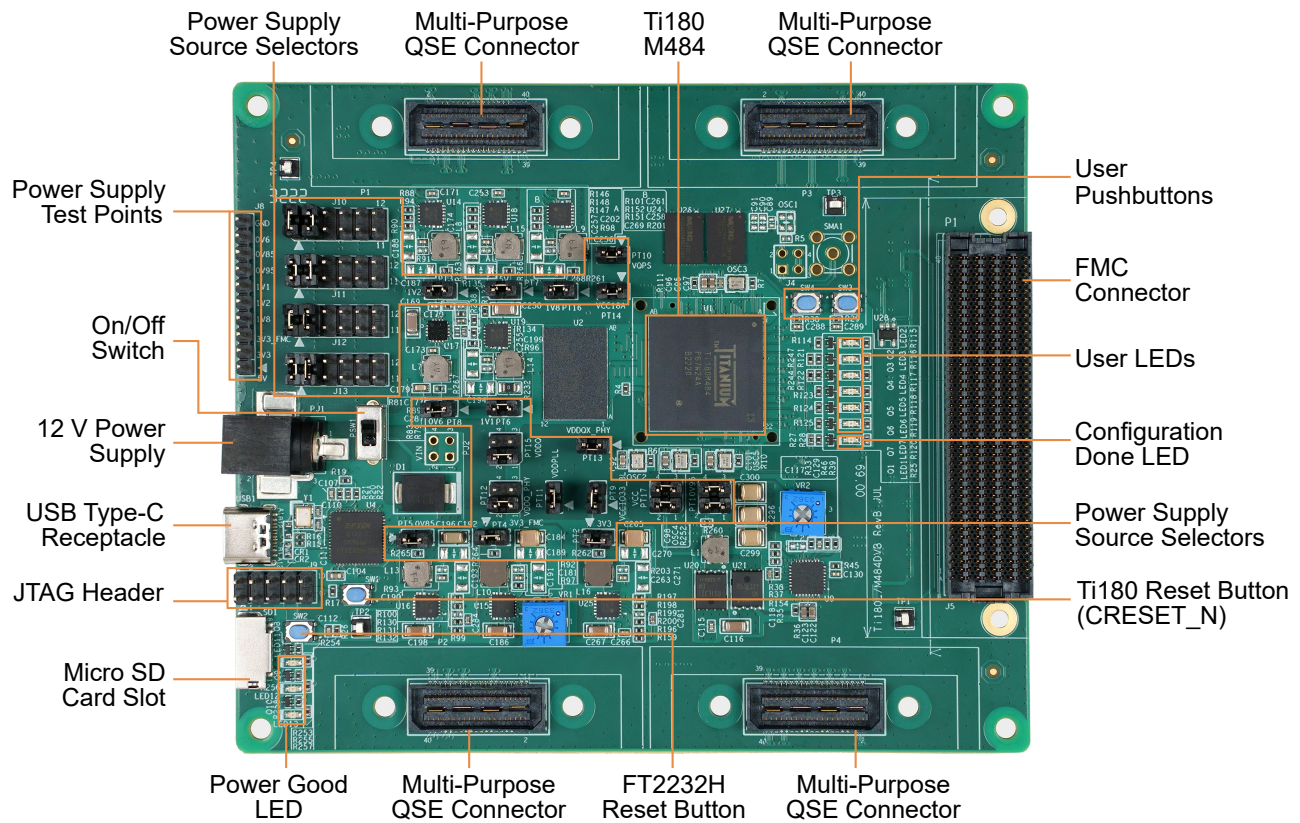
The Titanium Ti180 M484 Development Board provides four multi-purpose 0.8 mm high-speed ground plane sockets. These sockets can be used for GPIO, MIPI CSI-2 TX/RX, and LVDS TX/RX. The board includes a USB type-C port for the FTDI interface.

The FTDI FT2232H module has two channels to support the following interfaces:
- *FTDI interface 0*—FPGA UART
- *FTDI interface 1*—FPGA JTAG and SPI

The FTDI module receives the Ti180 configuration bitstream from a USB host and writes to the Ti180 FPGA in SPI active configuration. You can write a configuration bitstream to the on-board SPI NOR flash memory through JTAG with the JTAG SPI Flash Loader Core. Additionally, it supports a UART interface to the Ti180.

The SPI NOR flash memory stores the configuration bitstream. The Ti180 FPGA accesses this configuration bitstream when it is in active configuration mode (default).

Learn more: Refer to the Titanium Ti180 M484 Development Board Schematics and BOM for more information about the components used.

Power On

To turn on the development board, turn on switch PSW1. The 12 V DC power is input to the on-board regulators to generate the required 5.0 V, 3.3 V, 1.8 V, 1.2 V, 1.1 V, 0.95 V, 0.85 V, and 0.62 V for components on the board. When these voltages are up and stable, the power-good LEDs, LED11, LED12, and LED13 illuminate, giving you a visual confirmation of the status.

Reset

The Ti180 FPGA is typically brought out of reset with the `CRESET_N` signal. Upon power up, the Ti180 FPGA is held in reset until `CRESET_N` toggles high-low-high.

Note: You can manually assert the high-low-high transition with pushbutton switch SW1.

`CRESET_N` has a pull-up resistor. When you press SW1, the board drives `CRESET_N` low; when you release SW1, the board drives `CRESET_N` high. Thus, a single press of SW1 provides the required high-low-high transition.

After toggling `CRESET_N`, the Ti180 FPGA goes into configuration mode and reads the configuration bitstream from the flash memory. When configuration completes successfully, the FPGA drives the `CDONE` signal high. `CDONE` is connected to a LED (LED1), which turns on when the Ti180 FPGA enters user mode.

FTDI Reset

Pushbutton SW2 is the FTDI FT2232H chip reset button. All board communications through the FTDI FT2232H chip disconnect when you press pushbutton SW2, and reconnect when you release it.

Configuration

You can configure the Ti180 FPGA using the following configuration modes:
- JTAG
- SPI Active
- SPI Active x8

You must use JTAG Bridge when programming the flash because the SPI Active signals are not routed directly to FT2232H on the Titanium Ti180 M484 Development Board. When generating bitstream for you own design, ensure that you select the **Active** option in the **Bitstream Generation** tab of the Efinity **Project Editor**. Refer to **Programming the Development Board** on page 34 for instructions to program for SPI Active mode.

Note: Before a JTAG reconfiguration, you need to erase the SPI flash and press pushbutton SW1 (CRESET_N) on the Titanium Ti180 M484 Development Board.

To erase the SPI flash then configure using the JTAG mode:

1. In the Efinity Programmer, select the **SPI Active using JTAG Bridge** Programming Mode.
2. Under **Auto configure JTAG Bridge Image**, click the **Select Image File** button and select the **jtag_spi_flash_loaded_dual.bit** file.
3. Under **SPI Active Options**, click the **Erase** button.
4. In the **Erase Flash** pop-up window:
   - Set the **Starting Flash Address** to **0x000000**.
   - Set the **Erase Length** to **0x10000**.
   - Click the **Erase Flash** button.
5. Under **Image**, click the **Select Image File** button to load your design bitstream.
6. Change to **JTAG** Programming Mode.
7. Press pushbutton SW1 to toggle the CRESET_N high-low-high then click the **Start Program** button.

For subsequent JTAG configuration, you only need to perform steps 5 to 7.

The Titanium Ti180 M484 Development Board does not support internal reconfiguration for remote updates.

Clock Sources

Three on-board oscillators (33.33, 50, and 74.25 MHz) are available to drive the Ti180 PLL input pin and clock input. Additionally, there is a dedicated 25 MHz on-board oscillator as the MIPI clock source.

Table 1: Oscillator and Clock Generator Sources

Clock Source	Ti180 Pin Name	PLL Resource
33.33 MHz oscillator	GPIOL_32_PLLIN1	PLL_TL2
50 MHz oscillator	GPIOB_P_11_PLLIN0	PLL_BL1
74.25 MHz oscillator	GPIOL_26_PLLIN1	PLL_TL0
25 MHz oscillator	GPIOL_06_CLK27_P	MIPI0 dedicated PLL
	GPIOL_07	MIPI1 dedicated PLL
	GPIOL_27_CLK28_P	MIPI2 dedicated PLL
	GPIOL_28_CLK29_P	MIPI3 dedicated PLL

Note: The Efinity Interface Designer issues an unrouted clkmux input error if more than 8 GCLK resources are used on the left side of Ti180 FPGA. To solve this, assign one of the clocks, for example MIPI clock TX0, to use the RCLK instead of the GCLK. For more information, refer to the Clock and Control Network section of the Ti180 Data Sheet.

Headers

The board contains a variety of headers to provide power, inputs, and outputs, and to communicate with external devices or boards.

Table 2: Titanium Ti180 M484 Development Board Headers

Reference Designator	Description
P1	40-pin multi-purpose high-speed QSE connector for MIPI TX/RX, LVDS, or GPIO
P2	40-pin multi-purpose high-speed QSE connector for MIPI TX/RX, or GPIO
P3	40-pin multi-purpose high-speed QSE connector for MIPI TX/RX, LVDS, or GPIO
P4	40-pin multi-purpose high-speed QSE connector for MIPI TX/RX, LVDS, or GPIO
PJ1	12 V DC power supply input jack
PT1	0.95 V power supply source selector
PT2	3.3 V power supply source selector
PT3	1.2 V power supply source selector
PT4	3.3 V power (FMC) supply source selector
PT5	0.85 V power supply source selector
PT6	1.1 V power supply source selector
PT7	5 V power supply source selector
PT8	0.62 V power supply source selector
PT9	VCCIO selector for banks BL, BR, TL, and TR (3.3 V)
PT10	VQPS selector (1.8 V)
PT11	VDDPLL/VDD_PHY selector (0.85 V)
PT12	User selectable VDDQ_PHY (0.62 V or 1.1 V)
PT13	VDDQX_PHY selector (1.1 V)
PT14	MIPI selector (1.8 V)
PT15	User selectable VDDQ (0.62 V or 1.1 V)
PT16	1.8 V power supply source selector
PT17	VCCA selector (0.95 V)
J5	FMC connector
J8	Power supply test point
J9	JTAG header
J10	User selectable VCCIO for bank 2A_2B_2C (1.2 V, 1.8 V, or 3.3 V)
J11	User selectable VCCIO for bank 3B_3C (1.2 V, 1.8 V, or 3.3 V)
J12	User selectable VCCIO for bank 3A (1.2 V, 1.8 V, or 3.3 V)
J13	User selectable VCCIO for bank 4A (1.2 V, 1.8 V, or 3.3 V)
USB1	USB type-C receptacle (FTDI FT2232H)
TP1 - TP4	Ground test points
SD1	Micro-SD card slot

Headers P1, P2, P3, and P4 (Multi-Purpose)

P1, P2, P3, and P4 are multi-purpose high-speed QSE interface connectors for either MIPI TX/RX, LVDS, or GPIO that support 2 clock lanes and 8 data lanes. You can use these connectors to attach:

- **Dual Raspberry Pi Camera Connector Daughter Card**
- **IMX477 Camera Connector Daughter Card**
- **MIPI and LVDS Expansion Daughter Card**

Table 3: P1 Pin Assignments

Pin Number	Signal Name	Pin Number	Signal Name
1	3V3	2	MIPI1_RXDP0
3	5V	4	MIPI1_RXDN0
5	GND	6	GND
7	MIPI0_RXDP0	8	MIPI1_RXDP1
9	MIPI0_RXDN0	10	MIPI1_RXDN1
11	GND	12	GND
13	MIPI0_RXDP1	14	MIPI1_RXDP2
15	MIPI0_RXDN1	16	MIPI1_RXDN2
17	GND	18	GND
19	MIPI0_RXDP2	20	MIPI1_RXDP3
21	MIPI0_RXDN2	22	MIPI1_RXDN3
23	GND	24	GND
25	MIPI0_RXDP3	26	MIPI1_RXDP4
27	MIPI0_RXDN3	28	MIPI1_RXDN4
29	GND	30	GND
31	MIPI0_RXDP4	32	GPIOL_29_CLK30_P
33	MIPI0_RXDN4	34	GPIOL_03_CLK24_P
35	GND	36	GND
37	GPIOR_66	38	QSE_GPIOT_P_14_CLK17_P
39	GPIOR_65	40	QSE_GPIOT_N_14_CLK17_N

Table 4: P2 Pin Assignments

Pin Number	Signal Name	Pin Number	Signal Name
1	3V3	2	MIPI3_RXDP0
3	5V	4	MIPI3_RXDN0
5	GND	6	GND
7	MIPI2_RXDP0	8	MIPI3_RXDP1
9	MIPI2_RXDN0	10	MIPI3_RXDN1
11	GND	12	GND
13	MIPI2_RXDP1	14	MIPI3_RXDP2
15	MIPI2_RXDN1	16	MIPI3_RXDN2
17	GND	18	GND
19	MIPI2_RXDP2	20	MIPI3_RXDP3
21	MIPI2_RXDN2	22	MIPI3_RXDN3
23	GND	24	GND
25	MIPI2_RXDP3	26	MIPI3_RXDP4
27	MIPI2_RXDN3	28	MIPI3_RXDN4
29	GND	30	GND
31	MIPI2_RXDP4	32	GPIOL_04_CLK25_P
33	MIPI2_RXDN4	34	GPIOL_05_CLK26_P
35	GND	36	GND
37	GPIOR_69	38	GPIOB_P_01_EXTFB
39	GPIOR_70	40	GPIOB_P_00_PLLIN0

Table 5: P3 Pin Assignments

Pin Number	Signal Name	Pin Number	Signal Name
1	3V3	2	MIPI1_TXDP0
3	5V	4	MIPI1_TXDN0
5	GND	6	GND
7	MIPI0_TXDP0	8	MIPI1_TXDP1
9	MIPI0_TXDN0	10	MIPI1_TXDN1
11	GND	12	GND
13	MIPI0_TXDP1	14	MIPI1_TXDP2
15	MIPI0_TXDN1	16	MIPI1_TXDN2
17	GND	18	GND
19	MIPI0_TXDP2	20	MIPI1_TXDP3
21	MIPI0_TXDN2	22	MIPI1_TXDN3
23	GND	24	GND
25	MIPI0_TXDP3	26	MIPI1_TXDP4
27	MIPI0_TXDN3	28	MIPI1_TXDN4
29	GND	30	GND
31	MIPI0_TXDP4	32	QSE_GPIOT_P_15_CLK18_P
33	MIPI0_TXDN4	34	QSE_GPIOT_N_15_CLK18_N
35	GND	36	GND
37	QSE_GPIOT_P_16_CLK19_P	38	QSE_GPIOT_P_17_CLK20_P
39	QSE_GPIOT_N_16_CLK19_N	40	QSE_GPIOT_N_17_CLK20_N

Table 6: P4 Pin Assignments

Pin Number	Signal Name	Pin Number	Signal Name
1	3V3	2	MIPI3_TXDP0
3	5V	4	MIPI3_TXDN0
5	GND	6	GND
7	MIPI2_TXDP0	8	MIPI3_TXDP1
9	MIPI2_TXDN0	10	MIPI3_TXDN1
11	GND	12	GND
13	MIPI2_TXDP1	14	MIPI3_TXDP2
15	MIPI2_TXDN1	16	MIPI3_TXDN2
17	GND	18	GND
19	MIPI2_TXDP2	20	MIPI3_TXDP3
21	MIPI2_TXDN2	22	MIPI3_TXDN3
23	GND	24	GND
25	MIPI2_TXDP3	26	MIPI3_TXDP4
27	MIPI2_TXDN3	28	MIPI3_TXDN4
29	GND	30	GND
31	MIPI2_TXDP4	32	QSE_GPIOT_P_18_CLK21_P
33	MIPI2_TXDN4	34	QSE_GPIOT_N_18_CLK21_N
35	GND	36	GND
37	QSE_GPIOB_P_21_CDI9	38	QSE_GPIOB_P_18_CLK5_P
39	QSE_GPIOB_N_21_CDI8	40	QSE_GPIOB_N_18_CLK5_N

Header PJ1 (Power Supply)

PJ1 is a 12V DC power supply input jack. PJ1 supplies power to regulators on the board that power the Ti180. The maximum current supply to this input jack is 5 A.

Header J5 (FMC)

J5 is a 400-pin FMC LPC interface connector for connecting the FMC-to-QSE Adapter Card. You can use this connector to attach the **FMC-to-QSE Adapter Card.**

Note: Only sub-headers J5-1, J5-2, and J5-3 are connected to I/O pins in the Ti180. Sub-headers J5-4 and J5-4 are not connected to any I/O pins in the Ti180

Table 7: J5-1 Pin Assignments

Pin Number	Signal Name	Pin Number	Signal Name
C1	GND	D1	GND
C2	N.C.	D2	GND
C3	N.C.	D3	GND
C4	GND	D4	N.C.
C5	GND	D5	N.C.
C6	N.C.	D6	GND
C7	N.C.	D7	GND
C8	GND	D8	GPIOR_P_31_PLLIN1
C9	GND	D9	GPIOR_N_31
C10	GPIOR_P_22_CLK13_P	D10	GND
C11	GPIOR_N_22_CLK13_N	D11	GPIOR_P_27_CLK8_P
C12	GND	D12	GPIOR_N_27_CLK8_N
C13	GND	D13	GND
C14	GPIOR_P_20_CLK15_P	D14	GPIOR_P_25_CLK10_P
C15	GPIOR_N_20_CLK15_N	D15	GPIOR_N_25_CLK10_N
C16	GND	D16	GND
C17	GND	D17	GPIOB_P_16_EXTSPICLK_CLK3_P
C18	GPIOR_P_18	D18	GPIOB_N_16_CLK3_N
C19	GPIOR_N_18	D19	GND
C20	GND	D20	GPIOR_P_45_PLLIN0
C21	GND	D21	GPIOR_N_45
C22	GPIOB_P_23_PLLIN0	D22	GND
C23	GPIOB_N_23_CDI12	D23	GPIOR_P_42
C24	GND	D24	GPIOR_N_42
C25	GND	D25	GND
C26	GPIOB_P_24_EXTFB	D26	GPIOB_P_25_CDI15
C27	GPIOB_N_24_CDI13	D27	GPIOB_N_25_CDI14
C28	GND	D28	GND
C29	GND	D29	TCK
C30	GPIOL_00_PLLIN1	D30	FMC_TDI
C31	GPIOL_36_PLLIN1	D31	FMC_TDO

Pin Number	Signal Name	Pin Number	Signal Name
C32	GND	D32	3V3
C33	GND	D33	FMC_TMS
C34	N.C.	D34	N.C.
C35	12 V	D35	N.C.
C36	GND	D36	3V3
C37	12 V	D37	GND
C38	GND	D38	3V3
C39	3V3	D39	GND
C40	GND	D40	3V3

Table 8: J5-2 Pin Assignments

Pin Number	Signal Name	Pin Number	Signal Name
E1	GND	F1	N.C.
E2	FMC_GPIOT_P_14_CLK17_P	F2	GND
E3	FMC_GPIOT_N_14_CLK17_N	F3	GND
E4	GND	F4	N.C.
E5	GND	F5	N.C.
E6	FMC_GPIOT_P_15_CLK18_P	F6	GND
E7	FMC_GPIOT_N_15_CLK18_N	F7	N.C.
E8	GND	F8	N.C.
E9	FMC_GPIOT_P_16_CLK19_P	F9	GND
E10	FMC_GPIOT_N_16_CLK19_N	F10	N.C.
E11	GND	F11	N.C.
E12	FMC_GPIOT_P_17_CLK20_P	F12	GND
E13	FMC_GPIOT_N_17_CLK20_N	F13	N.C.
E14	GND	F14	N.C.
E15	FMC_GPIOT_P_18_CLK21_P	F15	GND
E16	FMC_GPIOT_N_18_CLK21_N	F16	N.C.
E17	GND	F17	N.C.
E18	GPIOT_P_19_CLK22_P	F18	GND
E19	GPIOT_N_19_CLK22_N	F19	N.C.
E20	GND	F20	N.C.
E21	GPIOB_P_17_CLK4_P	F21	GND
E22	GPIOB_N_17_CLK4_N	F22	N.C.
E23	GND	F23	N.C.
E24	GPIOB_P_22_CDI11	F24	GND
E25	GPIOB_N_22_CDI10	F25	N.C.
E26	GND	F26	N.C.

Pin Number	Signal Name	Pin Number	Signal Name
E27	FMC_GPIOB_P_21_CDI9	F27	GND
E28	FMC_GPIOB_N_21_CDI8	F28	N.C.
E29	GND	F29	N.C.
E30	FMC_GPIOB_P_20_CDI6_CLK7_P	F30	GND
E31	FMC_GPIOB_N_20_CDI7_CLK7_N	F31	N.C.
E32	GND	F32	N.C.
E33	FMC_GPIOB_P_19_CDI5_CLK6_P	F33	GND
E34	FMC_GPIOB_N_19_CDI4_CLK6_N	F34	N.C.
E35	GND	F35	N.C.
E36	FMC_GPIOB_P_18_CLK5_P	F36	GND
E37	FMC_GPIOB_N_18_CLK5_N	F37	N.C.
E38	GND	F38	GND
E39	3V3_FMC	F39	GND
E40	GND	F40	3V3_FMC

Table 9: J5-3 Pin Assignments

Pin Number	Signal Name	Pin Number	Signal Name
G1	GND	H1	N.C.
G2	GPIOT_P_20_CLK23_P	H2	GND
G3	GPIOT_N_20_CLK23_N	H3	GND
G4	GND	H4	GPIOT_P_13_CLK16_P
G5	GND	H5	GPIOT_N_13_CLK16_N
G6	GPIOR_P_16_PLLIN1	H6	GND
G7	GPIOR_N_16	H7	GPIOR_P_24_CLK11_P
G8	GND	H8	GPIOR_N_24_CLK11_N
G9	GPIOR_P_28	H9	GND
G10	GPIOR_N_28	H10	GPIOR_P_23_CLK12_P
G11	GND	H11	GPIOR_N_23_CLK12_N
G12	GPIOR_P_21_CLK14_P	H12	GND
G13	GPIOR_N_21_CLK14_N	H13	GPIOR_P_26_CLK9_P
G14	GND	H14	GPIOR_N_26_CLK9_N
G15	GPIOR_P_19	H15	GND
G16	GPIOR_N_19	H16	GPIOT_P_12_EXTFB
G17	GND	H17	GPIOT_N_12
G18	GPIOR_P_17	H18	GND
G19	GPIOR_N_17	H19	GPIOB_P_15_CLK2_P
G20	GND	H20	GPIOB_N_15_CLK2_N
G21	GPIOB_P_28_CDI21	H21	GND

Pin Number	Signal Name	Pin Number	Signal Name
G22	GPIOB_N_28_CDI20	H22	GPIOR_P_44_EXTFB
G23	GND	H23	GPIOR_N_44
G24	GPIOB_P_27_CDI19	H24	GND
G25	GPIOB_N_27_CDI19	H25	GPIOR_P_43
G26	GND	H26	GPIOR_N_43
G27	GPIOR_P_41	H27	GND
G28	GPIOR_N_41	H28	GPIOB_P_26_CDI16
G29	GND	H29	GPIOB_N_26_CDI17
G30	GPIOB_P_34	H30	GND
G31	GPIOB_N_34	H31	GPIOB_P_33_CDI31
G32	GND	H32	GPIOB_N_33_CDI30
G33	GPIOB_P_32_CDI28	H33	GND
G34	GPIOB_N_32_CDI29	H34	GPIOB_P_31_CDI27
G35	GND	H35	GPIOB_N_31_CDI26
G36	GPIOB_P_30_CDI25	H36	GND
G37	GPIOB_N_30_CDI24	H37	GPIOB_P_29_CDI22
G38	GND	H38	GPIOB_N_29_CDI23
G39	3V3_FMC	H39	GND
G40	GND	H40	3V3_FMC

Headers PT1, PT2, PT3, PT4, PT5, PT6, PT7, PT8, and PT16 (Power Supply Source Selector)

PT1, PT2, PT3, PT4, PT5, PT6, PT7, PT8, and PT16 are 2-pin or 4-pin (PT1 only) headers reserved to ease power measurements. Refer to the **Titanium Ti180 M484 Development Board Schematics** for more information.

By default, the jumpers connect pins 1 and 2 (and 3 and 4 for PT1), which sources the power from on-board regulators.

Table 10: PT1, PT2, PT3, PT4, PT5, PT6, PT7, PT8, and PT16 (Power Supply Source Selector)

Header	Description
PT1	0.95 V power supply source selector (adjustable with VR2 potentiometer)
PT2	3.3 V power supply source selector
PT3	1.2 V power supply source selector
PT4	3.3 V (FMC) power supply source selector (adjustable with VR1 potentiometer)
PT5	0.85 V power supply source selector
PT6	1.1 V power supply source selector
PT7	5 V power supply source selector
PT8	0.62 V power supply source selector
PT16	1.8 V power supply source selector

Headers PT9, PT10, PT11, PT13, PT14, and PT17 (Functional Power Supply Selector)

PT9, PT10, PT11, PT13, PT14, and PT17 are 2-pin or 4-pin (PT17 only) headers used to select whether to source a power supply from the on-board regulator or an external supply. Each header connects to different functions.

By default, the jumpers connect pins 1 and 2 (and 3 and 4 for PT17), which sources the power from on-board regulators. You can disconnect the jumper and connect an external supply to pin 2.

Table 11: PT9, PT10, PT11, PT13, PT14, and PT17 (Functional Power Supply Selector)

Header	Description
PT9	VCCIO selector for banks BL, BR, TL and TR (3.3 V)
PT10	VQPS selector (1.8 V)
PT11	VDDPLL/VDD_PHY selector (0.85 V)
PT13	VDDQX_PHY selector (1.1 V)
PT14	MIPI selector (1.8 V)
PT17	VCCA selector (0.95 V)

Headers PT12 and PT15 (VDDQ_PHY and VDDQ Selector)

PT12 and PT15 are 4-pin headers used to select the voltage supplies for VDDQ_PHY and VDDQ. Select these voltage supplies based on the DDR mode you use. By default, the jumper connects pin 1 and 2. You can disconnect the jumpers, and connect an external source to pins 2 and 4.

Table 12: PT12 and PT15 Pin Assignments

Jumper	VDDQ_PHY and VDDQ Voltage	DDR Mode
Connect Pins 1 and 2	0.62 V (default)	LPDDR4x
Connect Pins 3 and 4	1.1 V	LPDDR4

Header J8 (Supply Test Points)

J8 is a 10-pin header connected to the available Titanium Ti180 M484 Development Board power supplies. Connect to the following pins to evaluate the corresponding power supply.

Table 13: J8 Pin Assignments

Pin Number	Voltage
1	5 V
2	3.3 V
3	3.3 V (FMC)
4	1.8 V
5	1.2 V
6	1.1 V
7	0.95 V
8	0.85 V
9	0.62 V
10	GND

Header J9 (JTAG)

J9 is a 10-pin JTAG interface. You can access the Ti180 JTAG pins through this header.

Table 14: J9 Pin Assignments

Pin Number	Signal Name
1	TDO
2	3.3 V
3	TCK
4	TDI
5	TMS
6	FTDI_RST
7	N.C.
8	CRESET_N
9	GND
10	GND

Headers J10, J11, J12, and J13 (Bank VCCIO Selector)

J10, J11, J12, and J13 are 12-pin headers used to select the VCCIO supply for banks 2A, 2B, 2C, 3A, 3B, 3C, and 4A. By default, the jumpers connect pins 1 and 2, and pins 3 and 4 which is 1.8 V. Connect the jumpers as shown in the following table to change the voltages.

Table 15: J10, J11, J12, and J13 Pin Assignments

Jumper	Header			
	J10 **Banks 2A, 2B, 2C**	**J11** **Bank 3B_3C**	**J12** **Bank 3A**	**J13** **Banks 4A**
Connect Pins 1 and 2	1.8 V (default)			
Connect Pins 3 and 4				
Connect Pins 5 and 6	1.2 V			
Connect Pins 7 and 8				
Connect Pins 9 and 10	3.3 V (FMC)			
Connect Pins 11 and 12				

Header USB1 (USB FTDI FT2232H)

USB1, a type-C USB receptacle, is the interface between the board and your computer for communication through the FTDI FT2232H chip. Connect the type-C USB cable for configuring Ti180 the FPGA and NOR flash. The board supports three different configuration modes: SPI passive mode, SPI active mode, and JTAG mode.

Test Points TP1, TP2, TP3, and TP4 (Ground)

Test points TP1, TP2, TP3, and TP4 are test points connected to ground. You can use any of the test points to get a ground reference on the Titanium Ti180 M484 Development Board.

SD1 (Micro-SD Card Slot)

The Titanium Ti180 M484 Development Board includes a micro-SD card slot, SD1. SD1 connects to GPIO pins in bank TR.

Table 16: SD1 Pin Assignments

Pin Name	Signal Name	Ti180 Pin Name
DATA2	SD_DATA2	GPIOR_58
DATA3	SD_DATA3	GPIOR_59
CMD	SD_CMD	GPIOR_60
VDD	3V3	–
CLK	SD_CLK	GPIOR_62
GND	GND	–
DATA0	SD_DATA0	GPIOR_61
DATA1	SD_DATA1	GPIOR_63
GND	GND	–
GND	GND	–

User Outputs

The board has 6 user LEDs that are connected to I/O pins in Ti180 banks 4B and 4C. By default, the Ti180 I/O connected to these LEDs are set as active high. To turn a given LED on, pull the corresponding I/O signal high.

Note: When adding these GPIO in the Efinity® Interface Designer, configure them as output pins.

Table 17: User Outputs

Reference Designator	Ti180 Pin Name	Active
LED2	GPIOB_N_02_CSO	High
LED3	GPIOB_P_02_CSI	High
LED4	GPIOB_P_13_CBSEL0_CLK0_P	High
LED5	GPIOB_P_14_NSTATUS_CLK1_P	High
LED6	GPIOB_N_11	High
LED7	GPIOB_P_12_EXTFB	High

User Inputs

The board has 2 pushbutton switches that you can use as inputs to the Ti180 FPGA. The pushbuttons are connected to I/O pins in Ti180 bank 4B. When building designs using these switches, turn on an internal pull up for these pins in the Interface Designer.

When you press the pushbutton switches the signal drives low, indicating user input.

Table 18: User Pushbuttons

Reference Designator	Ti180 Pin Name	Active
SW3	GPIOB_N_13_CBSEL1_CLK0_N	Low
SW4	GPIOB_N_14_TEST_N_CLK1_N	Low

Installing Standoffs

Before using the board, attach the standoffs with the screws and nuts provided in the kit. The following table lists the standoffs, screws, and nuts required for standoffs installation.

Table 19: Standoffs, Screws, and Nuts for Standoff Installation

Daughter card/adapter to Development Board Connection Type	Standoff			Screw			Nut	
	Size	Length	Qty	Size	Length	Qty	Size	Qty
FMC Connector	M2.5	10 mm	2	M2.5	5 mm	2	M2.5	2
QSE Connector	M3	5 mm	8	M3	4 mm	8	M3	8
Development Board Only	M3	12 mm	4	–	–	0	M3	4

(i) Note: Always power off the development board before attaching the standoffs.

Figure 3: Installing Standoffs
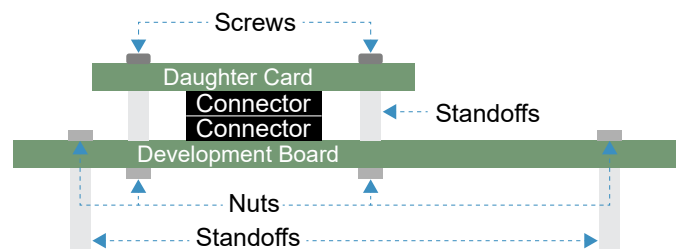
To install standoffs:

1. Attach four 12 mm standoffs to the Titanium Ti180 M484 Development Board with nuts.
2. Attach two 10 mm standoffs to the FMC-to-QSE Adapter Card with screws.
3. Attach two 5 mm standoffs to a daughter card with screws.
4. Attach the flat cable to the FPC header, if applicable.
5. Attach the daughter card with installed standoffs to the connector and tighten the standoffs with nuts.

Once the standoffs are installed securely, you can make the connections to the development board or daughter cards, for example, connecting the USB cable or Ethernet cable.

⚠ Warning: You can damage the board if you over tighten the screws. Tighten all screws to a torque between 4 ± 0.5 kgf/cm and 5 ± 0.5 kgf/cm.

Titanium Ti180 M484 Development Board Example Design

Efinix preloads the Titanium Ti180 M484 Development Board with an example design that demonstrates the following functions:

- Multi-Input Video Stream
- Read SD Card Information

Figure 4: Example Design Block Diagram Overview
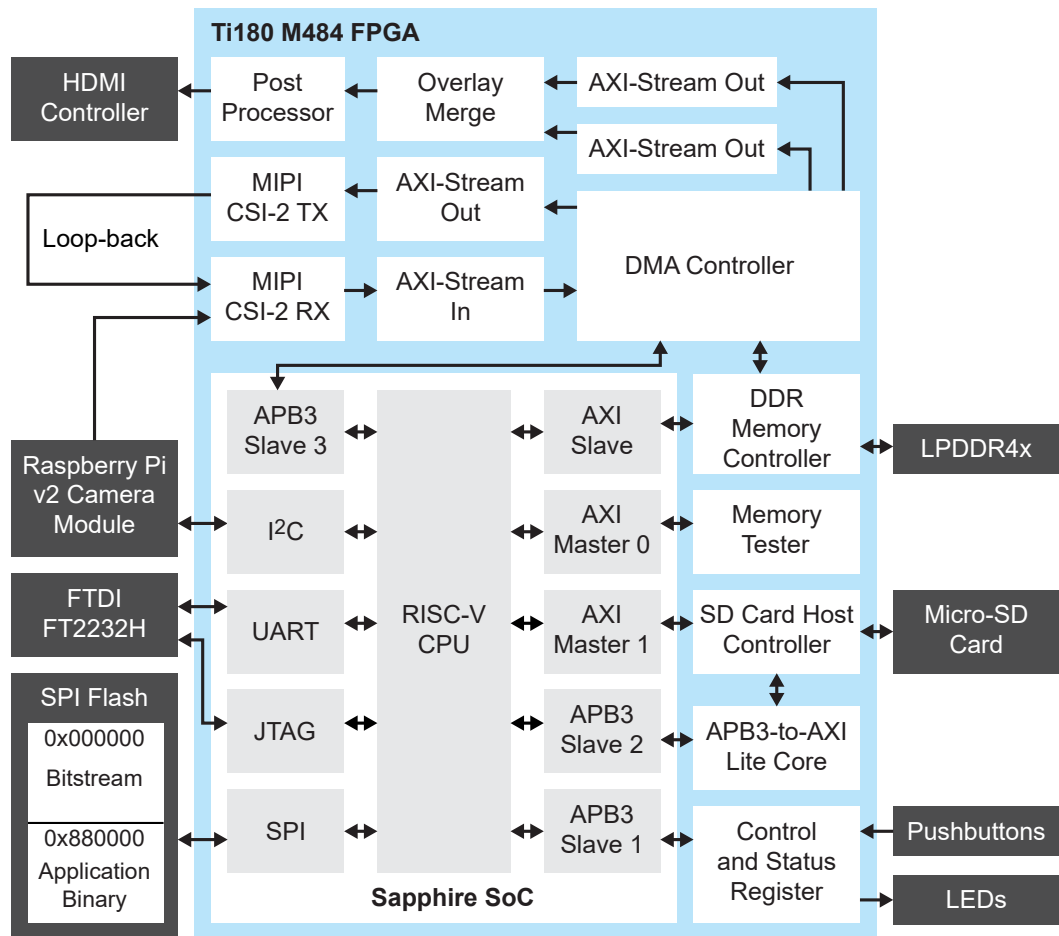
Multi-Input Video Stream

The design receives a video stream from the Raspberry Pi v2 camera module through a MIPI CSI-2 RX block, then displays the video through the HDMI output. A Sapphire RISC-V SoC controls the operation flow of the design and assigns the DMA controller to stream video frame data to and from the LPDDR4 memory.

The design can display up to four Raspberry Pi v2 camera module video streams simultaneously. The Titanium Ti180 M484 Development Kit only includes one Raspberry Pi v2 camera module. You need to provide three additional camera modules to use this feature. To simulate a multi-input stream in a single-camera setup, the example design generates a video output, loop-back the data through the MIPI CSI-2 TX and RX, then displays the video as one of the video outputs.

Read SD Card Information

The design includes an SD host controller block that initializes the SD card and accesses the SD card information. You can retrieve the SD card information such as card size, speed, and blocks using a terminal software on your computer. The card reading design supports SD specification V2.0 with 4 bits mode.

Set Up the Hardware

The following figure shows the hardware setup steps:

Figure 5: Hardware Setup
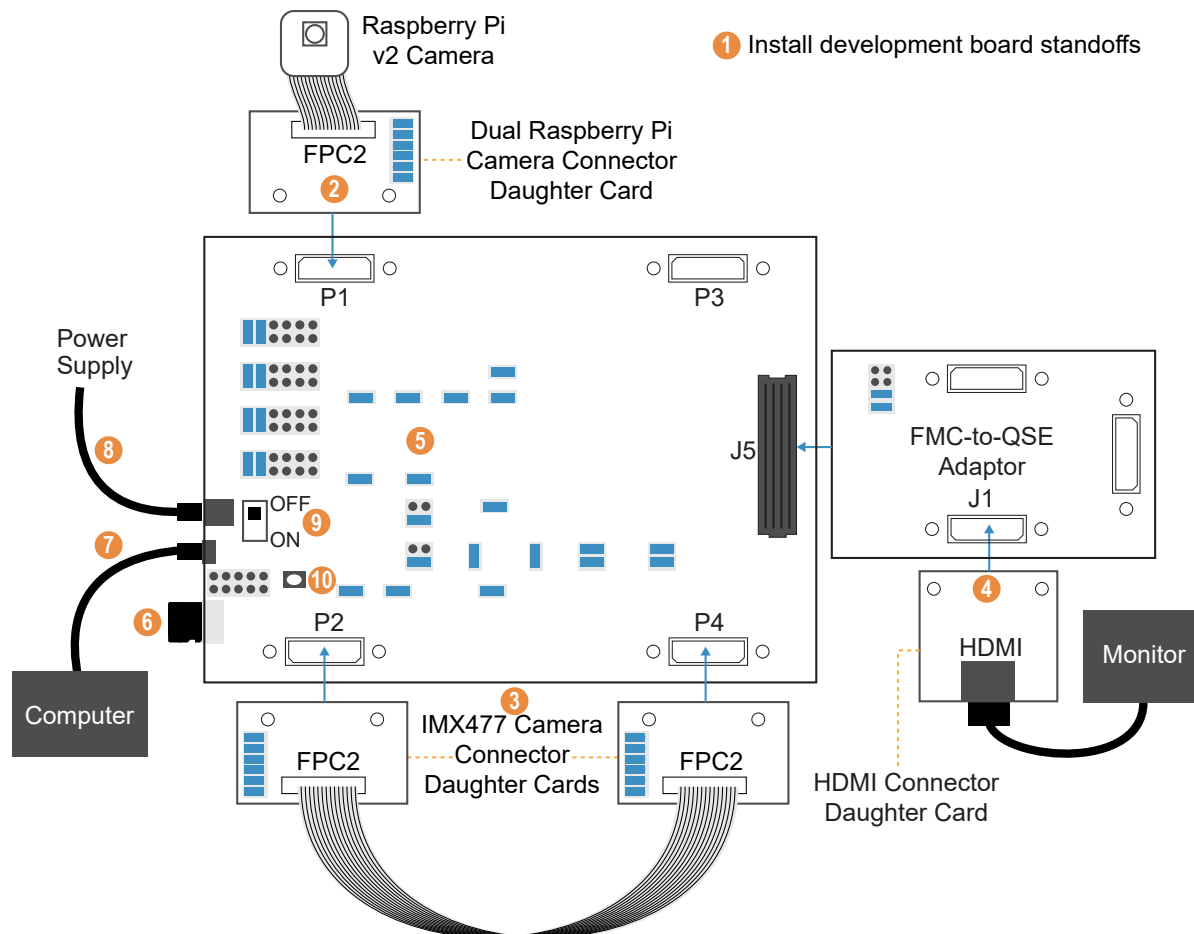
> ⚠ **Important:** Always switch off the power supply and board's power switch before attaching or detaching cables and daughter cards.

1. Install standoffs on the Titanium Ti180 M484 Development Board as described in **Installing Standoffs** on page 25.
2. **Attach the Dual Raspberry Pi Camera Connector Daughter Card** to the P1 connector of the Titanium Ti180 M484 Development Board.
3. **Attach two IMX477 Camera Connector Daughter Cards** to the P2 and P4 connectors of the Titanium Ti180 M484 Development Board. Use the 22-pin FPC cable to connect both daughter cards to create a loop-back.
4. **Attach the HDMI Connector Daughter Card** to the J5 connector of the Titanium Ti180 M484 Development Board.

5. Ensure that all boards have the following jumper settings:

Board	Header	Pins to Connect
Titanium Ti180 M484 Development Board	J9	N.C.
	J10, J11, J12, J13, PT1, and PT17	1 - 2 and 3 - 4
	PT2, PT3, PT4, PT5, PT6, PT7, PT8, PT9, PT10, PT11, PT12, PT13, PT14, PT15, and PT16	1 - 2
FMC-to-QSE Adapter Card	J5	5 -6 and 7 - 8
Dual Raspberry Pi Camera Connector Daughter Card	J1	1 - 2, 3 - 4, 5 - 6, 7 - 8, 9 - 10, and 11 - 12
IMX477 Camera Connector Daughter Cards	J1	1 - 2, 3 - 4, 5 - 6, 7 - 8, 9 - 10, and 11 - 12

6. Insert a Micro-SD card into the Micro-SD card slot. This is an optional step if you want to run the read SD card function.
7. Connect the USB header to a USB port of your computer.
8. Ensure the power supply and board power switch (PSW1) are turned off, then connect the 12 V power cable to the board connector and a power source.
9. Turn on the power supply and the board's power switch (PSW1).
10. After turning on the board, press pushbutton SW1 (CRESET_N).

The board LEDs light up to indicate the following board status.

Table 20: Board LED Outputs

LED	Description
LED11, LED12, and LED13 turned on	Power good
LED1 turned on	FPGA configuration done
LED7 turned on	DDR configuration done
LED6 turned on	DDR memory test done
LED2 blinking	MIPI channel RX0 is streaming input
LED3 blinking	MIPI channel RX1 is streaming input
LED4 blinking	MIPI channel RX2 is streaming input
LED5 blinking	MIPI channel RX3 is streaming input

ⓘ **Note:** If the monitor displays an abnormal video stream, press SW1 to reset the example design.

You can use the lens adjustment tool included in the kit to set the Raspberry Pi v2 camera module focus when the video is streaming.

Using the Multi-Input Video Stream Design

The design has five possible display outputs. You can change the display output by pressing the board's pushbutton or the computer keyboard keys.

Using Keyboard Keys to Change the Display Output

You need to set up a terminal on your computer before you can use this feature.

1. Open terminal software on the computer. You can use any Windows or Linux terminal application such as PuTTy, Tera Term, Minicom, and others.
2. Select the available USB serial COM port and set the following:
   - Baud rate: 115200
   - Data: 8-bit
   - Parity bit: No
   - Stop bit: 1
3. Press pushbutton SW1 to reconfigure the example design. The terminal displays the following output:

```
**********TI180 OOBTest*********
Cameras Initial!
Pi Camera 0 Initial Done !
Assert failure !
                Pi Camera 1 Initial Error !
Assert failure !
                Pi Camera 2 Initial Error !
Assert failure !
                Pi Camera 3 Initial Error !
```

4. Press keys 1, 2, 3, 4, or 5 on your keyboard to select the display output described in **Table 21: Display Outputs** on page 30.

Using a Pushbutton to Change the Display Output

Press pushbutton SW4 on the Titanium Ti180 M484 Development Board to change the input source. The display output changes sequentially each time you press the pushbutton.

Table 21: Display Outputs

Output Display Sequence	Input Source		Description
	Development Board	Daughter Card	
1	P1	FPC2 of Dual Raspberry Pi Camera Connector	MIPI RX0 (default) The monitor displays the video stream from the Raspberry Pi v2 camera module.
2	P1	FPC1 of Dual Raspberry Pi Camera Connector	MIPI RX1 There are no camera modules connected to this QSE connector. The monitor displays a colour bar (indicating no input). You will see a video stream if you connect a Raspberry Pi v2 camera module to this header.
3	P2	FPC1 of IMX477 Camera Connector	MIPI RX2 There are no camera modules connected to this header. The monitor displays a colour bar (indicating no input). You will see a video stream if you connect a camera module to this QSE connector.
4	P2	FPC2 of IMX477 Camera Connector	MIPI RX3 The monitor displays the loop-back video generated by the example design. You will see a video stream if you connect a camera module to this QSE connector.
5	All four inputs		The monitor displays all four input sources to a single video output. Top-left: Display input from MIPI RX0 Top-right: Display input from MIPI RX1 Bottom-left: Display input from MIPI RX2 Bottom-right: Display input from MIPI RX3

Reading SD the Card Information

1. Open terminal software on the computer. You can use any Windows or Linux terminal application such as PuTTy, Tera Term, Minicom, and others.
2. Select the available USB serial COM port and set the following:
   - Baud rate: 115200
   - Data: 8-bit
   - Parity bit: No
   - Stop bit: 1
3. Press the U key on your keyboard to start the SD card test.
4. If the test passed, the console displays the SD card information.

```
--- EFX-SD Card Demo---

Initialize...Loop: 0
Reponse: 0x40FF8000
Reponse: 0x40FF8000
Reponse: 0x40FF8000
Done

************START SD Card TEST************
**SD CLOCK SPEED = 50000
**CARD SPEED = 25000 kHz
**CARD SIZE = 15080 Mbyte Total BLOCK = 30883840
**SD BUS WIDTH = 4
**BLOCK SIZE = 512 BUFFER OF BLOCK = 256
**TEST SIZE - 128 kbyte
*****************************************
```

If the test failed or there is no SD card inserted in the slot, the console displays:

```
--- EFX-SD Card Demo---

Initialize...Loop: 0
Reponse: 0x0
Reponse: 0x0
Reponse: 0x0
Reponse: 0x0
Reponse: 0x0
Loop: 1
Reponse: 0x0
Reponse: 0x0
Reponse: 0x0
Reponse: 0x0
Reponse: 0x0
Err: ACMD41 OCR BUSY!
SD Initial Error
```

Creating Your Own Design

The Titanium Ti180 M484 Development Board allows you to create and explore designs for the Ti180 FPGA. Efinix® provides example code and designs to help you get started:

- Our Support Center (www.efinixinc.com/support) includes examples targeting the board.
- The Efinity® software includes also example designs that you can use as a starting point for your own project and includes a step-by-step tutorial.

Restoring the Demonstration Design

After you have used the board for other designs, you may want to go back to the original pre-loaded example design. The preloaded example design project file is available in the **Titanium Ti180 M484 Development Board Demonstration Design** page.

Note: The example design available in the support center requires Efinity software v2022.1 with v2022.1.226.1.9 patch or later.

The example design consists of the FPGA bitstream and the RISC-V SoC application binary. You need to program these files if you want to restore the example design. There are two ways of programming the files into the SPI flash:

- Program the FPGA bitstream and the application binary together with a combined bitstream
- Program the FPGA bitstream and the application binary separately with two bitstreams

Generally, you use the combined bitstream to quickly restore the entire example design. Use the separate bitstream if you want to restore either the FPGA bitstream or the application binary portion only.

Figure 6: Example Design SPI Flash Content
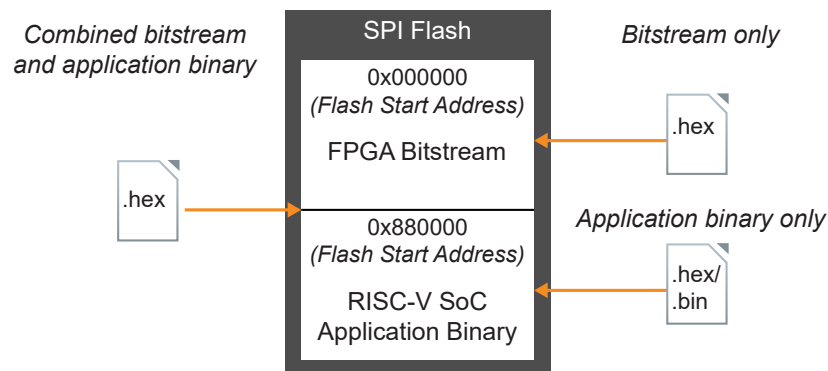
Example Design Files

The example design includes the following design files.

Table 22: Design Example File and Directories

File or Directory	Description
ti180_oob.xml	Example design project file.
Bitstream\RestoreBitstream \Combine_TI180M484_oob.hex	Combined file consists of the FPGA bitstream and RISC-V SoC application binary. Program this file into the SPI flash using SPI active configuration mode.
Bitstream\RestoreBitstream \FPGA_TI180M484_oob.hex	FPGA bitstream only. Program this file into the SPI flash using SPI active configuration mode.
Bitstream\RestoreBitstream\FW_TI180M484_oob.hex	RISC-V SoC application binary only. Program this file into the SPI flash using SPI active configuration mode.
Bitstream\RestoreBitstream \FPGA_TI180M484_oob.bit	FPGA bitstream only. Use this file to configure the Ti180 FPGA using JTAG mode configuration.
Bitstream\FlashLoader\jtag_spi_flash_loader_dual.bit	Pre-compiled JTAG Bridge image file.
Bitstream\SocFW\ti180M484_oob.elf	Pre-compiled example design application binary file to run using OpenOCD Debugger.
Bitstream\SocFW\ti180M484_oob.bin	Pre-compiled example design application binary file to program into SPI flash using OpenOCD Debugger.
Bitstream\BootLoader\bootloader.hex	Pre-compiled SPI flash bootloader binary file. The example design does not use the default Sapphire RISC-V SoC SPI flash bootloader. Use this bootloader to overwrite the default SPI flash bootloader if you regenerate the Sapphire RISC-V SoC in IP Manager.
Bitstream\BootLoader\bootloader.elf	Pre-compiled bootloader binary file to run using OpenOCD Debugger.
embedded_sw\soc_ti180m484_oob	RISC-V SoC workspace.
embedded_sw\soc_ti180m484_oob\software \standalone\ti180M484_oob	RISC-V SoC example design project files.
embedded_sw\soc_ti180m484_oob\software \standalone\bootloader	RISC-V SoC bootloader project files.

Learn more: Before working with the RISC-V SoC included with this example design, you should already be familiar with using the Sapphire SoC and RISC-V SDK. Refer to the **Sapphire RISC-V SoC Hardware and Software User Guide** for more information about the Sapphire SoC.

Programming the Development Board

Note: This section describes the steps to program the example design FPGA bitstream and RISC-V SoC application binary using the SPI Active mode in Efinity Programmer with **.hex** and **.bit** files. For instructions to program or boot the RISC-V SoC application binary using the OpenOCD Debugger with **.bin** or **.elf** files, refer to the Sapphire RISC-V SoC Hardware and Software User Guide.

Before programming the board, connect the Titanium Ti180 M484 Development Board to your computer using a USB cable and power-on the board.

Combined Bitstream

To program the combined bitstream into the SPI flash:

1. In the Efinity Programmer, select the **SPI Active using JTAG Bridge** Programming Mode.
2. Under **Image**, click the **Select Image File** button and select **Combine_TI180M484_oob.hex**.
3. Under **Auto configure JTAG Bridge Image**, click the **Select Image File** button and select **jtag_spi_flash_loaded_dual.bit** file.
4. Ensure that the **Starting Flash Address** is set to 0x000000.
5. Click the **Start Program** button.

Separate FPGA Bitstream and Application Binary

To program the FPGA bitstream into the SPI flash:

1. In the Efinity Programmer, select the **SPI Active using JTAG Bridge** Programming Mode.
2. Under **Image**, click the **Select Image File** button and select **FPGA_TI180M484_oob.hex**.
3. Under **Auto configure JTAG Bridge Image**, click the **Select Image File** button and select **jtag_spi_flash_loaded_dual.bit** file.
4. Ensure that the **Starting Flash Address** is set to 0x000000.
5. Click the **Start Program** button.

To program the application binary into the SPI flash:

1. In the Efinity Programmer, select the **SPI Active using JTAG Bridge** Programming Mode.
2. Under **Image**, click the **Select Image File** button and select **FW_TI180M484_oob.hex**.
3. Under **Auto configure JTAG Bridge Image**, click the **Select Image File** button and select **jtag_spi_flash_loaded_dual.bit** file.
4. Ensure that the **Starting Flash Address** is set to 0x880000.
5. Click the **Start Program** button.

FMC-to-QSE Adapter Card

The FMC-to-QSE Adapter Card adds three additional multi-purpose QSE connectors to the Titanium Ti180 M484 Development Board. The adapter card connects to the Titanium Ti180 M484 Development Board using the FMC LPC connector. You can use the QSE connectors to attach:

- **HDMI Connector Daughter Card**
- **Ethernet Connector Daughter Card**
- **MIPI and LVDS Expansion Daughter Card**

📖 **Learn more:** Refer to the **FMC-to-QSE Adapter Card Schematics and BOM** for the part details and schematics.

Figure 7: FMC-to-QSE Adapter Card

Top   Bottom
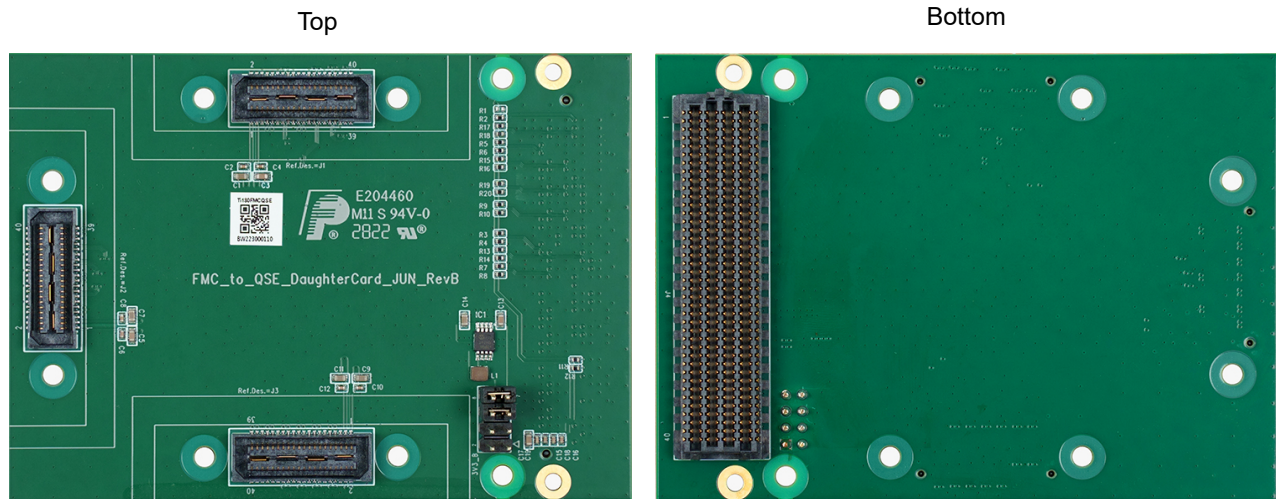
⚠️ **Warning:** The board can be damaged without proper anti-static handling.

Features

- Three QSE multi-purpose connector extension for Titanium Ti180 M484 Development Board
- Power supplied from the development board; no external power required

Headers

Table 23: FMC-to-QSE Adapter Card Headers

Reference Designator	Description
J1	40-pin multi-purpose high-speed QSE connector for GPIO
J2	40-pin multi-purpose high-speed QSE connector for GPIO
J3	40-pin multi-purpose high-speed QSE connector for GPIO

Header J1, J2, and J3 (Multi-Purpose)

J1, J2, and J3 are multi-purpose high-speed QSE interface connectors for Ti180's GPIO. The following table lists the J1, J2, and J3 header signals when you connect FMC-to-QSE Adapter Card to the Titanium Ti180 M484 Development Board.

Table 24: J1, J2, and J3 Pin Assignments

| Pin Number	Signal Name		
	J1	J2	J3
1	3V3	3V3	3V3
2	GPIOR_P_23_CLK12_P	GPIOR_P_27_CLK8_P	GPIOB_P_29_CDI22
3	5V	5V	5V
4	GPIOR_N_23_CLK12_N	GPIOR_N_27_CLK8_N	GPIOB_N_29_CDI23
5	GND	GND	GND
6	GND	GND	GND
7	GPIOR_P_19	GPIOR_P_41	GPIOB_P_23_PLLIN0
8	GPIOR_P_21_CLK14_P	GPIOR_P_25_CLK10_P	GPIOB_P_30_CDI25
9	GPIOR_N_19	GPIOR_N_41	GPIOB_N_23_CDI12
10	GPIOR_N_21_CLK14_N	GPIOR_N_25_CLK10_N	GPIOB_N_30_CDI24
11	GND	GND	GND
12	GND	GND	GND
13	GPIOR_P_18	GPIOR_P_42	GPIOB_P_24_EXTFB
14	GPIOT_P_20_CLK23_P	GPIOR_P_28	GPIOB_P_31_CDI27
15	GPIOR_N_18	GPIOR_N_42	GPIOB_N_24_CDI13
16	GPIOT_N_20_CLK23_N	GPIOR_N_28	GPIOB_N_31_CDI26
17	GND	GND	GND
18	GND	GND	GND
19	GPIOR_P_20_CLK15_P	GPIOR_P_43	GPIOB_P_25_CDI15
20	GPIOR_P_22_CLK13_P	GPIOR_P_26_CLK9_P	GPIOB_P_32_CDI28
21	GPIOR_N_20_CLK15_N	GPIOR_N_43	GPIOB_N_25_CDI14
22	GPIOR_N_22_CLK13_N	GPIOR_N_26_CLK9_N	GPIOB_N_32_CDI29
23	GND	GND	GND

Pin Number	Signal Name		
	J1	J2	J3
24	GND	GND	GND
25	GPIOR_P_17	GPIOR_P_44_EXTFB	GPIOB_P_26_CDI16
26	GPIOR_P_24_CLK11_P	GPIOR_P_31_PLLIN1	GPIOB_P_33_CDI31
27	GPIOR_N_17	GPIOR_N_44	GPIOB_N_26_CDI17
28	GPIOR_N_24_CLK11_N	GPIOR_N_31	GPIOB_N_33_CDI30
29	GND	GND	GND
30	GND	GND	GND
31	GPIOR_P_16_PLLIN1	GPIOR_P_45_PLLIN0	GPIOB_P_27_CDI19
32	GPIOT_P_12_EXTFB	GPIOT_P_17_CLK20_P	GPIOT_P_15_CLK18_P
33	GPIOR_N_16	GPIOR_N_45	GPIOB_N_27_CDI18
34	GPIOT_N_12	GPIOT_N_17_CLK20_N	GPIOT_N_15_CLK18_N
35	GND	GND	GND
36	GND	GND	GND
37	GPIOT_P_13_CLK16_P	GPIOL_32_PLLIN1	GPIOT_P_14_CLK17_P
38	GPIOB_P_15_CLK2_P	GPIOB_P_16_EXTSPICLK_CLK3_P	GPIOT_P_16_CLK19_P
39	GPIOT_N_13_CLK16_N	GPIOL_36_PLLIN1	GPIOT_N_14_CLK17_N
40	GPIOB_N_15_CLK2_N	GPIOB_N_16_CLK3_N	GPIOT_N_16_CLK19_N

Attaching the FMC-to-QSE Adapter Card

The FMC-to-QSE Adapter Card attaches to the FMC connector (J5) of the Titanium Ti180 M484 Development Board.

Figure 8: Attaching FMC-to-QSE Adapter Card
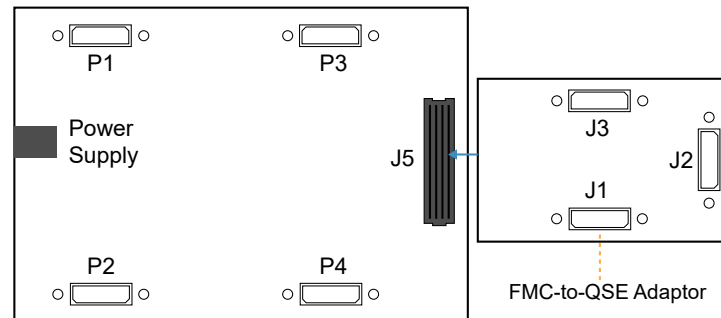
To connect a daughter card:

1. **Install standoffs** and screws on the FMC-to-QSE Adapter Card and the daughter with a QTE connector.
2. Connect the daughter card to the FMC-to-QSE Adapter Card.
3. Install the nuts on the FMC-to-QSE Adapter Card.
4. Ensure the power supply and board power switch are turned off, then connect FMC-to-QSE Adapter Card to the Titanium Ti180 M484 Development Board.
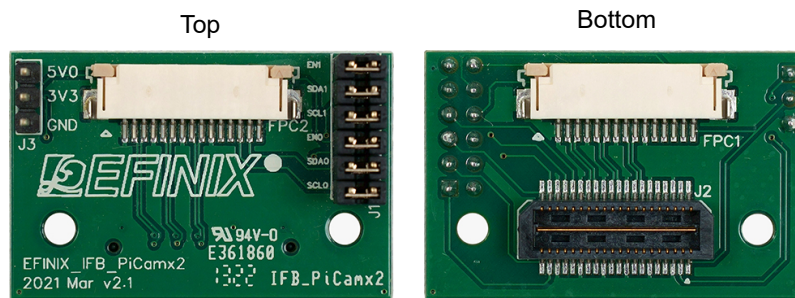5. Install the nuts on the Titanium Ti180 M484 Development Board.

Dual Raspberry Pi Camera Connector Daughter Card

The Dual Raspberry Pi Camera Connector Daughter Card (part number: EFINIX_IFB_PICAMX2) bridges between the development board and two Raspberry Pi v2 camera modules. You can connect two Raspberry Pi cameras using the 15-pin flat cable to headers FPC1 (bottom) and FPC2 (top). Additionally, the board has a 12-pin header for optional camera control pins.

Learn more: Refer to the Dual Raspberry Pi Camera Connector Daughter Card Schematics and BOM for the part details and schematics.

Figure 9: Dual Raspberry Pi Camera Connector Daughter Card

Warning: The board can be damaged without proper anti-static handling.

Features

- Bridges 40-pin MIPI CSI-2 interface on the development board to two 15-pin interfaces
- Pin to pin compatible with Raspberry Pi v2 camera modules
- Supports up to 2.5 Gbps on MIPI interface
- User selectable pins for optional camera functions
- Power supplied from the development board; no external power required

Note: For technical support using Raspberry Pi v2 camera modules, please refer to their web site at www.raspberrypi.org.

Headers

Table 25: Dual Raspberry Pi Camera Connector Daughter Card Headers

Reference Designator	Description
FPC1	15-pin flexible printed cable (FPC) receptacle for Raspberry Pi camera v2 camera modules
FPC2	15-pin flexible printed cable (FPC) receptacle for Raspberry Pi camera v2 camera modules
J1	12-pin header for optional camera signals
J2	40-pin QTE connector bringing MIPI signals, and power from the development board.
J3	3-pin header for supply test points

Headers FPC1 and FPC2 (Raspberry Pi v2 Camera Module Connector)

FPC1 and FPC2 are 15-pin flexible flat cable headers for connecting to Raspberry Pi v2 camera modules.

Table 26: FPC1 and FPC2 Pin Assignments

Pin Number	Pin Name		Description
	FPC1	FPC2	
1	GND	GND	Ground
2	DN0_1	DN0_0	Differential MIPI lane 0
3	DP0_1	DP0_0	
4	GND	GND	Ground
5	DN1_1	DN1_0	Differential MIPI lane 1
6	DP1_1	DP1_0	
7	GND	GND	Ground
8	CN0_1	CN0_0	MIPI clock lane
9	CP0_1	CP0_0	
10	GND	GND	Ground
11	CAM_EN_1	CAM_EN_0	Camera enable/reset
12	N.C.	N.C.	No connect
13	CAM_SCL_1	CAM_SCL_0	I^2C control
14	CAM_SDA_1	CAM_SDA_0	I^2C control
15	3V3	3V3	3.3 V power supply

Header J1 (Optional Camera Signals)

J1 is a 12-pin header that has optional pins (SCL and SDA) used for MIPI Camera Command Set (CSS) transactions. These signals are routed to the FPGA on the board. You can control these pins with an external device by removing the jumpers and connecting wires from the header to an external device. The header controls the settings for both cameras, but each camera has the dedicated pins shown in the following table.

Table 27: J1 Pin Assignments

Pin Number	Pin Name	Description	Pin Number	Pin Name	Description
1	SCL_0	I^2C signal for FPC2	2	CAM_SCL_0	I^2C signal for FPC2
3	SDA_0	I^2C signal for FPC2	4	CAM_SDA_0	I^2C signal for FPC2
5	EN_0	Camera GPIO for FPC2	6	CAM_EN_0	Camera GPIO for FPC2
7	SCL_1	I^2C signal for FPC1	8	CAM_SCL_1	I^2C signal for FPC1
9	SDA_1	I^2C signal for FPC1	10	CAM_SDA_1	I^2C signal for FPC1
11	EN_1	Camera GPIO for FPC1	12	CAM_EN_1	Camera GPIO for FPC1

Header J2 (QTE Connector)

J2 is a 40-pin QTE connector to connect the daughter card to the QSE connector on the development board.

Table 28: J2 Pin Assignments

Pin Number	Pin Name	Description	Pin Number	Pin Name	Description
1	3V3	3.3 V supply	2	N.C.	No connect
3	5V0	5.0 V supply	4	N.C.	No connect
5	GND	Ground	6	GND	Ground
7	DP0_0	Differential MIPI lane 0 for FPC2	8	N.C.	No connect
9	DN0_0	Differential MIPI lane 0 for FPC2	10	N.C.	No connect
11	GND	Ground	12	GND	Ground
13	DP1_0	Differential MIPI lane 1 for FPC2	14	CP0_1	MIPI clock lane for FPC1
15	DN1_0	Differential MIPI lane 1 for FPC2	16	CN0_1	MIPI clock lane for FPC1
17	GND	Ground	18	GND	Ground
19	CP0_0	MIPI clock lane for FPC2	20	DP1_1	Differential MIPI lane 1 for FPC1
21	CN0_0	MIPI clock lane for FPC2	22	DN1_1	Differential MIPI lane 1 for FPC1
23	GND	Ground	24	GND	Ground
25	N.C.	No connect	26	DP0_1	Differential MIPI lane 0 for FPC1
27	N.C.	No connect	28	DN0_1	Differential MIPI lane 0 for FPC1
29	GND	Ground	30	GND	Ground
31	N.C.	No connect	32	SCL_1	I^2C control pin for FPC1
33	N.C.	No connect	34	SDA_1	I^2C control pin for FPC1
35	GND	Ground	36	GND	Ground
37	SCL_0	I^2C control pin for FPC2	38	EN_1	Camera enable/reset for FPC1
39	SDA_0	I^2C control pin for FPC2	40	EN_0	Camera enable/reset for FPC2

Header J3 (Supply Test Points)

J3 is a 3-pin header connected to the available Dual Raspberry Pi Camera Connector Daughter Card power supplies. Connect to the following pins to evaluate the corresponding power supply.
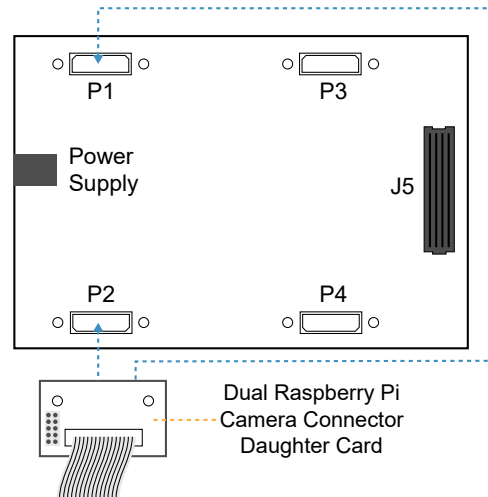
Table 29: J3 Pin Assignments

Pin Number	Voltage
1	5 V
2	3.3 V
3	GND

Attaching the Dual Raspberry Pi Camera Connector Daughter Card

The Dual Raspberry Pi Camera Connector Daughter Card attaches to the multi-purpose QSE connector on the Titanium Ti180 M484 Development Board.

Figure 10: Attaching Dual Raspberry Pi Camera Connector Daughter Card

> **ⓘ** **Note:** P3 and P4 connectors include only MIPI TX signals. No camera input signals are available on these connectors. However, you still can connect the daughter card to these connectors as output of a loop-back design.

To connect a daughter card:

1. **Install standoffs** and screws on the Dual Raspberry Pi Camera Connector Daughter Card.
2. Connect the 15-pin FPC cable to the Dual Raspberry Pi Camera Connector Daughter Card.
3. Ensure the power supply and board power switch are turned off, then connect the Dual Raspberry Pi Camera Connector Daughter Card to the Titanium Ti180 M484 Development Board.
4. Install the nuts on the Titanium Ti180 M484 Development Board.
5. Connect the camera module to the daughter card using a 15-pin FPC cable.

IMX477 Camera Connector Daughter Card

The IMX477 Camera Connector Daughter Card has two headers, FPC1 (bottom) and FPC2 (top), to which you can connect the included 22-pin flat cable. You then connect any IMX477 camera modules that use a 22-pin flat cable to the daughter card. Additionally, the board has a 12-pin header for optional camera control pins.
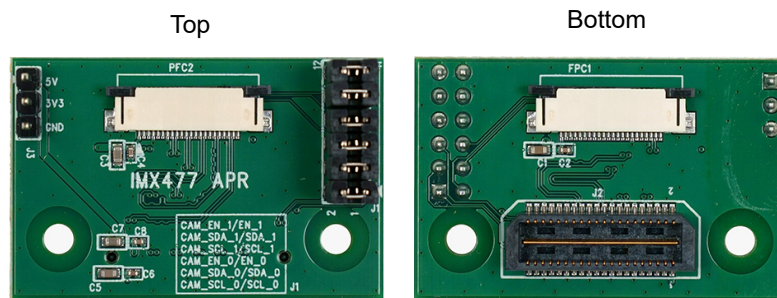
ⓘ **Note:** IMX477 camera modules are not included in the Titanium Ti180 M484 Development Kit.

📖 **Learn more:** Refer to the IMX477 Camera Connector Daughter Card Schematics and BOM for the part details and schematics.

Figure 11: IMX477 Camera Connector Daughter Card

⚠ **Warning:** The board can be damaged without proper anti-static handling.

Features

- Bridges 40-pin MIPI CSI-2 interface on the development board to two 22-pin interfaces
- Pin to pin compatible with IMX477 camera modules
- Supports up to 2.5 Gbps on MIPI interface
- User selectable pins for optional camera functions
- Power supplied from the development board; no external power required

Headers

Table 30: IMX477 Camera Connector Daughter Card Headers

Reference Designator	Description
FPC1	22-pin flexible printed cable (FPC) receptacle for IMX477 camera modules
FPC2	22-pin flexible printed cable (FPC) receptacle for IMX477 camera modules
J1	12-pin header for optional camera signals
J2	40-pin QTE connector bringing MIPI signals, and power from the development board.
J3	3-pin header for supply test points

Headers FPC1 and FPC2 (IMX477 Connector)

FPC1 and FPC2 are 22-pin flexible flat cable headers for connecting to IMX477 camera modules.

Table 31: FPC1 and FPC2 Pin Assignments

Pin Number	Pin Name		Description
	FPC1	FPC2	
1	3V3	3V3	3.3 V power supply
2	CAM_SDA_0	CAM_SDA_1	I^{2}C control
3	CAM_SCL_0	CAM_SCL_1	
4	GND	GND	Ground
5	N.C.	N.C.	No connect
6	CAM_EN_0	CAM_EN_1	Camera enable/reset
7	GND	GND	Ground
8	MIPI0_RXDP4	MIPI1_RXDP4	Differential MIPI lane 3
9	MIPI0_RXDN4	MIPI1_RXDN4	
10	GND	GND	Ground
11	MIPI0_RXDP3	MIPI1_RXDP3	Differential MIPI lane 2
12	MIPI0_RXDN3	MIPI1_RXDN3	
13	GND	GND	Ground
14	MIPI0_RXDP2	MIPI1_RXDP2	MIPI clock lane
15	MIPI0_RXDN2	MIPI1_RXDN2	
16	GND	GND	Ground
17	MIPI0_RXDP1	MIPI1_RXDP1	Differential MIPI lane 1
18	MIPI0_RXDN1	MIPI1_RXDN1	
19	GND	GND	Ground
20	MIPI0_RXDP0	MIPI1_RXDP0	Differential MIPI lane 0
21	MIPI0_RXDN0	MIPI1_RXDN0	
22	GND	GND	Ground

Header J1 (Optional Camera Signals)

J1is a 12-pin header that has optional pins (SCL and SDA) used for MIPI Camera Command Set (CSS) transactions. These signals are routed to the FPGA on the board. You can control these pins with an external device by removing the jumpers and connecting wires from the header to an external device. The header controls the settings for both cameras, but each camera has the dedicated pins shown in the following table.

Table 32: J1 Pin Assignments

Pin Number	Pin Name	Description	Pin Number	Pin Name	Description
1	SCL_0	I^2C signal for FPC1	2	CAM_SCL_0	I^2C signal for FPC1
3	SDA_0	I^2C signal for FPC1	4	CAM_SDA_0	I^2C signal for FPC1
5	EN_0	Camera GPIO for FPC1	6	CAM_EN_0	Camera GPIO for FPC1
7	SCL_1	I^2C signal for FPC2	8	CAM_SCL_1	I^2C signal for FPC2
9	SDA_1	I^2C signal for FPC2	10	CAM_SDA_1	I^2C signal for FPC2
11	EN_1	Camera GPIO for FPC2	12	CAM_EN_1	Camera GPIO for FPC2

Header J2 (QTE Connector)

J2 is a 40-pin QTE connector to connect the daughter card to the QSE connector on the development board.

Table 33: J2 Pin Assignments

Pin Number	Pin Name	Description	Pin Number	Pin Name	Description
1	3V3	3.3 V supply	2	MIPI1_RXDP0	Differential MIPI lane 0 for FPC2
3	5V0	5.0 V supply	4	MIPI1_RXDN0	
5	GND	Ground	6	GND	Ground
7	MIPI0_RXDP0	Differential MIPI lane 0 for FPC1	8	MIPI1_RXDP1	Differential MIPI lane 1 for FPC2
9	MIPI0_RXDN0		10	MIPI1_RXDN1	
11	GND	Ground	12	GND	Ground
13	MIPI0_RXDP1	Differential MIPI lane 1 for FPC1	14	MIPI1_RXDP2	MIPI clock lane
15	MIPI0_RXDN1		16	MIPI1_RXDN2	
17	GND	Ground	18	GND	Ground
19	MIPI0_RXDP2	MIPI clock lane	20	MIPI1_RXDP3	Differential MIPI lane 2 for FPC2
21	MIPI0_RXDN2		22	MIPI1_RXDN3	
23	GND	Ground	24	GND	Ground
25	MIPI0_RXDP3	Differential MIPI lane 2 for FPC1	26	MIPI1_RXDP4	Differential MIPI lane 3 for FPC2
27	MIPI0_RXDN3		28	MIPI1_RXDN4	
29	GND	Ground	30	GND	Ground
31	MIPI0_RXDP4	Differential MIPI lane 3 for FPC1	32	SCL_1	I^{2}C control pin for FPC2
33	MIPI0_RXDN4		34	SDA_1	I^{2}C control pin for FPC2
35	GND	Ground	36	GND	Ground
37	SCL_0	I^{2}C control pin for FPC1	38	EN_0	Camera enable/reset for FPC1
39	SDA_0	I^{2}C control pin for FPC1	40	EN_1	Camera enable/reset for FPC2

Header J3 (Supply Test Points)

J3 is a 3-pin header connected to the available IMX477 Camera Connector Daughter Card power supplies. Connect to the following pins to evaluate the corresponding power supply.
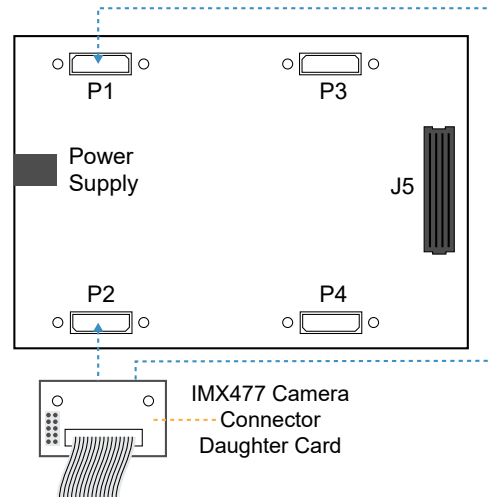
Table 34: J3 Pin Assignments

Pin Number	Voltage
1	5 V
2	3.3 V
3	GND

Attaching the IMX477 Camera Connector Daughter Card

The IMX477 Camera Connector Daughter Card attaches to the multi-purpose QSE connector on the Titanium Ti180 M484 Development Board.

Figure 12: Attaching IMX477 Camera Connector Daughter Card

> **ⓘ** **Note:** P3 and P4 connectors include only MIPI TX signals. No camera input signals are available on these connectors. However, you still can connect the daughter card to these connectors as output of a loop-back design.

To connect a daughter card:

1. **Install standoffs** and screws on the IMX477 Camera Connector Daughter Card.
2. Connect the 22-pin FPC cable to the IMX477 Camera Connector Daughter Card.
3. Ensure the power supply and board power switch are turned off, then connect the IMX477 Camera Connector Daughter Card to the Titanium Ti180 M484 Development Board.
4. Install the nuts on the Titanium Ti180 M484 Development Board.
5. Connect the IMX477[2] camera module to the daughter card using a 22-pin FPC cable; or, if you want to do a loop-back, connect the 22-pin FPC cable to another IMX477 Camera Connector Daughter Card (See **Set Up the Hardware** on page 27 for an example of a loop-back setup.)

[2] IMX477 camera modules are not included in the kit.

HDMI Connector Daughter Card

The HDMI Connector Daughter Card adds an HDMI interface output to the Titanium Ti180 M484 Development Board. The HDMI Connector Daughter Card outputs video through the on-board HDMI transmitter, U1, from Analog Devices (part number: ADV7511). The ADV7511 is set to address 0x72, and you can access it through the I^{2}C interface.

📖 **Learn more:** Refer to the HDMI Connector Daughter Card Schematics and BOM for the part details and schematics.

Figure 13: HDMI Connector Daughter Card
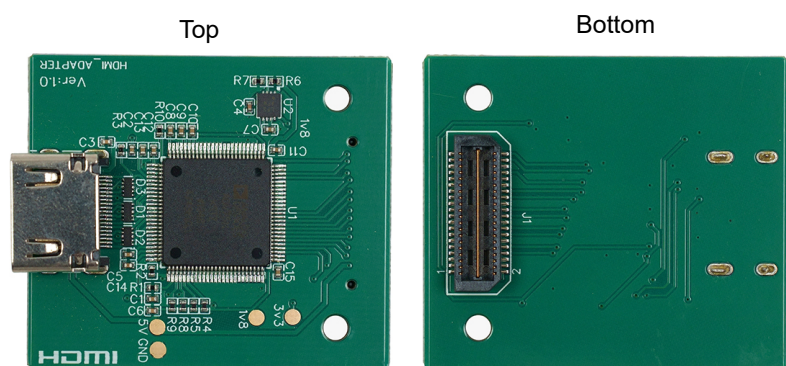
⚠️ **Warning:** The board can be damaged without proper anti-static handling.

Features

- Analog Devices ADV7511 transmitter
- 225 MHz HDMI v1.4 with audio return channel (ARC)
- Supports resolutions of up to 1080p and 12-bit deep colors operation
- Power supplied from the development board; no external power required

Headers

Table 35: HDMI Connector Daughter Card Headers

Reference Designator	Description
AUDIO1	HDMI output connector
J1	40-pin QTE connector bringing GPIO signals, and power from the development board.

AUDIO1 (HDMI Output Connector)

Table 36: AUDIO1 Pin Assignments

Pin Number	Signal Name	U1 Pin Name	Description
1	TMDS_DAT2p	TX2+	Differential TMDS output channel 2
2	GND	–	Ground
3	TMDS_DAT2n	TX2-	Differential TMDS output channel 2
4	TMDS_DAT1p	TX1+	Differential TMDS output channel 1
5	GND	–	Ground
6	TMDS_DAT1n	TX1-	Differential TMDS output channel 1
7	TMDS_DAT0p	TX0+	Differential TMDS output channel 0
8	GND	–	Ground
9	TMDS_DAT0n	TX0-	Differential TMDS output channel 0
10	TMDS_CLKp	TXC+	Differential TMDS clock output
11	GND	–	Ground
12	TMDS_CLKn	TXC-	Differential TMDS clock output
13	N.C.	–	No connect
14	HEACp	HEAC+	Differential ARC
15	DDCSCL	DDCSCL	Serial port data clock input
16	DDCSDA	DDCSDA	Serial port data I/O to sink
17	GND	–	Ground
18	5V0	–	5.0 V supply
19	HotPlug	HPD	Hot Plug detect signal

J1 (QTE Connector)

J1 is a 40-pin QTE connector to connect the daughter card to the QSE connector on the development board.

Table 37: J1 Pin Assignments

Pin Number	Pin Name	Description	Pin Number	Pin Name	Description
1	3V3	3.3 V supply	2	HDMI_D9	Video data
3	+5V	5.0 V supply	4	CLK	Video clock
5	GND	Ground	6	GND	Ground
7	HDMI_D8	Video data	8	HDMI_D10	Video data
9	HDMI_D7	Video data	10	HDMI_D11	Video data
11	GND	Ground	12	GND	Ground
13	HDMI_D6	Video data	14	HDMI_D12	Video data
15	HDMI_D5	Video data	16	HDMI_D13	Video data
17	GND	Ground	18	GND	Ground
19	HDMI_D4	Video data	20	HDMI_D14	Video data
21	HDMI_D3	Video data	22	HDMI_D15	Video data
23	GND	Ground	24	GND	Ground
25	HDMI_D2	Video data	26	SDA	I^2C control
27	HDMI_D1	Video data	28	SCL	I^2C control
29	GND	Ground	30	GND	Ground
31	HDMI_D0	Video data	32	N.C.	No connect
33	DE	Digital video Data Enable signal	34	INT	Interrupt signal
35	GND	Ground	36	GND	Ground
37	HSYNC	Horizontal sync	38	SPDIF_CLK	SPDIF reference clock
39	VSYNC	Vertical sync	40	SPDIF	SPDIF audio

Attaching the HDMI Connector Daughter Card

The HDMI Connector Daughter Card attaches to the multi-purpose QSE connector on the FMC-to-QSE Adapter Card. The HDMI Connector Daughter Card cannot be attached directly to the Titanium Ti180 M484 Development Board.

Figure 14: Attaching HDMI Connector Daughter Card
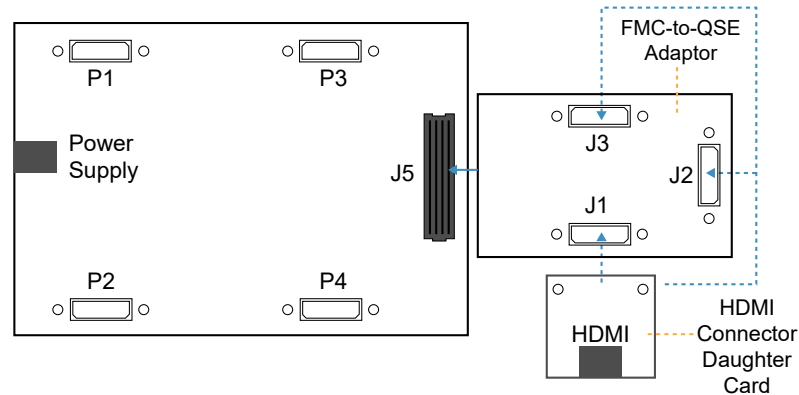
To connect a daughter card:

1. **Install standoffs** and screws on the FMC-to-QSE Adapter Card and HDMI Connector Daughter Card.
2. Connect the HDMI Connector Daughter Card to the FMC-to-QSE Adapter Card.
3. Install the nuts on the FMC-to-QSE Adapter Card.
4. Ensure the power supply and board power switch are turned off, then connect FMC-to-QSE Adapter Card to the Titanium Ti180 M484 Development Board.
5. Install the nuts on the Titanium Ti180 M484 Development Board.
6. Connect the HDMI Connector Daughter Card to a monitor using an HDMI cable.
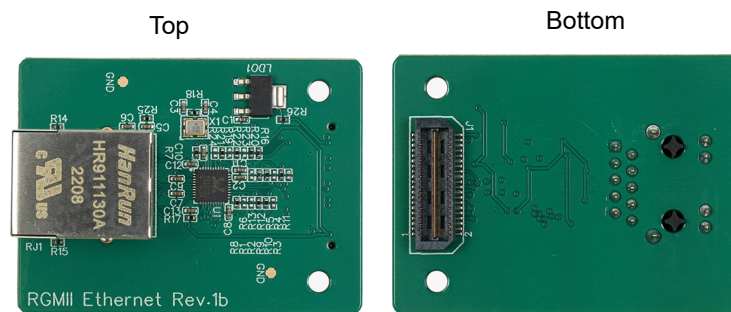
Ethernet Connector Daughter Card

The Ethernet Connector Daughter Card adds Ethernet connectivity to the development board. The Ethernet Connector Daughter Card has a Gigabit Ethernet transceiver from Realtek (part number: RTL8211FD-CG) which is compliant with 10Base-T, 100Base-TX, and 1000Base-T IEEE 802.3 standards.

📖 **Learn more:** Refer to the Ethernet Connector Daughter Card Schematics and BOM for the part details and schematics.

Figure 15: Ethernet Connector Daughter Card

Top   Bottom

⚠️ **Warning:** The board can be damaged without proper anti-static handling.

Features

- Realtek RTL8211FD-CG transceiver
- Single-port RJ-45 connector with integrated magnetics and LEDs
- Power supplied from the development board; no external power required

Headers

Table 38: Ethernet Connector Daughter Card Headers

Reference Designator	Description
RJ1	RJ-45 Ethernet connector
J1	40-pin QTE connector bringing GPIO signals and power from the development board.

RJ1 (Ethernet)

RJ1 is an RJ-45 receptacle.

Table 39: RJ1 Pin Assignments

Pin Number	Signal Name	U1 Pin Name	Description
P1	GND	–	Ground
P2	MDI0+	MDIP0	Transmitter data pair 0
P3	MDI0-	MDIN0	
P4	MDI1+	MDIP1	Transmitter data pair 1
P5	MDI2+	MDIP2	
P6	MDI2-	MDIN2	Transmitter data pair 2
P7	MDI1-	MDIN1	
P8	MDI3+	MDIP3	Transmitter data pair 3
P9	MDI3-	MDIN3	
P10	GND	–	Ground
11	LED Green	CFG_EXT	External power source mode configuration
12	GND	–	Ground
13	GND	–	Ground
14	LED Yellow	CFG_LDO0	LDO output voltage selection

J1 (QTE Connector)

J1 is a 40-pin QTE connector to connect the daughter card to the QSE connector on the development board.

Table 40: J1 Pin Assignments

Pin Number	Pin Name	Description	Pin Number	Pin Name	Description
1	3V3	3.3 V supply	2	RCLK	RGMII receive clock
3	N.C.	No connect	4	N.C.	No connect
5	GND	Ground	6	GND	Ground
7	N.C.	No connect	8	TXD3	RGMII transmit data
9	N.C.	No connect	10	TXD2	RGMII transmit data
11	GND	Ground	12	GND	Ground
13	RXD3	RGMII receive data	14	TXD1	RGMII transmit data
15	RXD2	RGMII receive data	16	TXD0	RGMII transmit data
17	GND	Ground	18	GND	Ground
19	RXD1	RGMII receive data	20	TX_CTL	Transmit control signal
21	RXD0	RGMII receive data	22	N.C.	No connect
23	GND	Ground	24	GND	Ground
25	N.C.	No connect	26	TCLK	RGMII transmit data
27	RX_CTL	Receive control signal	28	N.C.	No connect
29	GND	Ground	30	GND	Ground
31	RCLK	RGMII receive clock	32	PMEB	No connect
33	N.C.	No connect	34	N.C.	No connect
35	GND	Ground	36	GND	Ground
37	MDIO	Serial data line	38	INTB	Interrupt signal
39	MDC	Serial clock line	40	RSTN	PHY reset

Attaching the Ethernet Connector Daughter Card

The Ethernet Connector Daughter Card attaches to the multi-purpose QSE connector on the FMC-to-QSE Adapter Card. The HDMI Connector Daughter Card cannot be attached directly to the Titanium Ti180 M484 Development Board.

Figure 16: Attaching Ethernet Connector Daughter Card
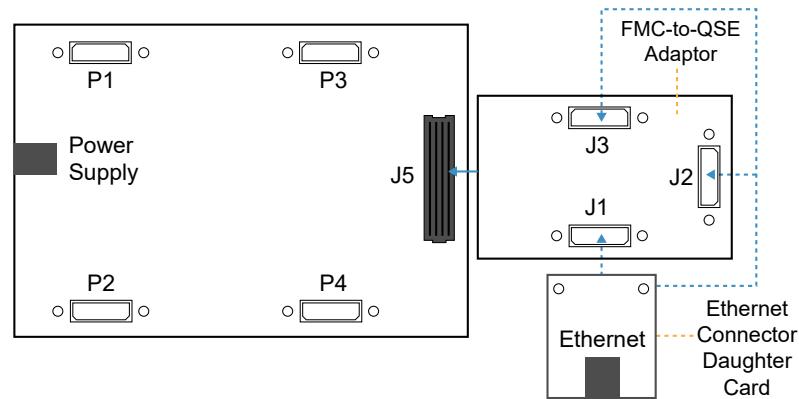
To connect a daughter card:

1. **Install standoffs** and screws on the FMC-to-QSE Adapter Card and Ethernet Connector Daughter Card.
2. Connect the Ethernet Connector Daughter Card to the FMC-to-QSE Adapter Card.
3. Install the nuts on the FMC-to-QSE Adapter Card.
4. Ensure the power supply and board power switch are turned off, then connect FMC-to-QSE Adapter Card to the Titanium Ti180 M484 Development Board.
5. Install the nuts on the Titanium Ti180 M484 Development Board.
6. Connect the Ethernet cable to the Ethernet Connector Daughter Card.

MIPI and LVDS Expansion Daughter Card

The MIPI and LVDS Expansion Daughter Card (part number: EFX_DC_GPIO_B) converts the signals from the development board's QSE connector.

📖 **Learn more:** Refer to the MIPI and LVDS Expansion Daughter Card Schematics and BOM for the part details and schematics.

Figure 17: MIPI and LVDS Expansion Daughter Card
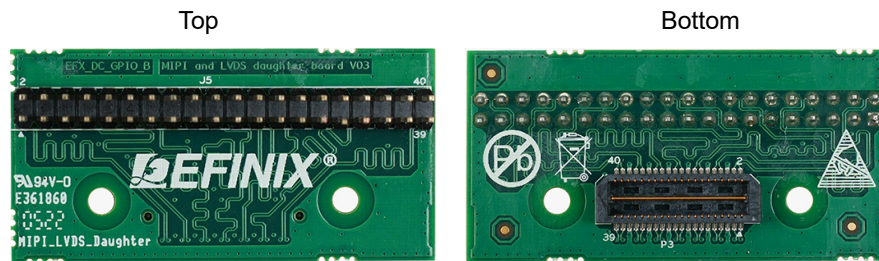
⚠️ **Warning:** The board can be damaged without proper anti-static handling.

Features

- Bridges 40-pin QSE connector on the development board to a 40-pin header
- Power supplied from the development board; no external power required
  — Each pin supports up to 3 A

Headers

Table 41: MIPI and LVDS Expansion Daughter Card Headers

Reference Designator	Description
P3	40-pin QTE connector bringing MIPI or LVDS signals, power, and GPIO pins from the development board.
J5	40-pin header.

Headers P3 (QTE Connector) and J5 (40-Pin Header)

P3 is a 40-pin QTE connector to connect the daughter card to the QSE connector on the development board. J5 is a 40-pin header.

Table 42: P3 and J5 Pin Assignments

Pin Number	Pin Name	Description	Pin Number	Pin Name	Description
1	GPIO_H01	User I/O	2	GPIO_H02	User I/O
3	GPIO_H03	User I/O	4	GPIO_H04	User I/O
5	GND	Ground	6	GND	Ground
7	GPIO_H07	User I/O	8	GPIO_H08	User I/O
9	GPIO_H09	User I/O	10	GPIO_H10	User I/O
11	GND	Ground	12	GND	Ground
13	GPIO_H13	User I/O	14	GPIO_H14	User I/O
15	GPIO_H15	User I/O	16	GPIO_H16	User I/O
17	GND	Ground	18	GND	Ground
19	GPIO_H19	User I/O	20	GPIO_H20	User I/O
21	GPIO_H21	User I/O	22	GPIO_H22	User I/O
23	GND	Ground	24	GND	Ground
25	GPIO_H25	User I/O	26	GPIO_H26	User I/O
27	GPIO_H27	User I/O	28	GPIO_H28	User I/O
29	GND	Ground	30	GND	Ground
31	GPIO_H31	User I/O	32	GPIO_H32	User I/O
33	GPIO_H33	User I/O	34	GPIO_H34	User I/O
35	GND	Ground	36	GND	Ground
37	GPIO_H37	User I/O	38	GPIO_H38	User I/O
39	GPIO_H39	User I/O	40	GPIO_H40	User I/O

Attaching the MIPI and LVDS Expansion Daughter Card

The HDMI Connector Daughter Card attaches to the multi-purpose QSE connector on to the Titanium Ti180 M484 Development Board or FMC-to-QSE Adapter Card.

Figure 18: Attaching MIPI and LVDS Expansion Daughter Card
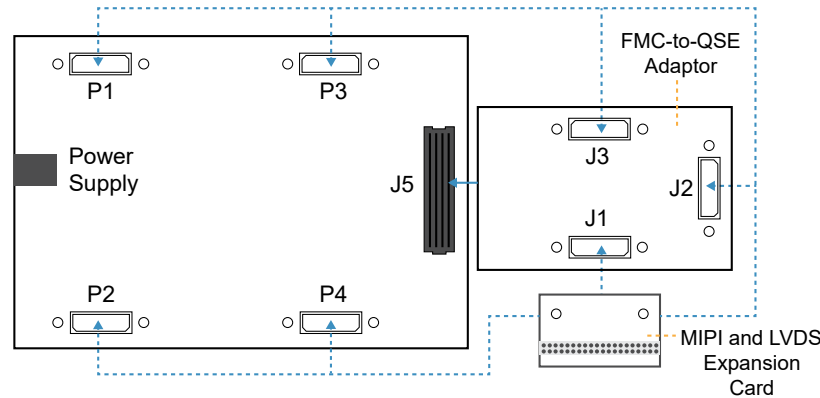
To connect the daughter card:

1. **Install standoffs** and screws to the MIPI and LVDS Expansion Daughter Card and the FMC-to-QSE Adapter Card (if desired).
2. Connect cables or a female header to the 40-pin header (J5) of the MIPI and LVDS Expansion Daughter Card as needed for your application.
3. Ensure the power supply and board power switch are turned off:
   - Attach the MIPI and LVDS Expansion Daughter Card to the Titanium Ti180 M484 Development Board, or
   - Attach the MIPI and LVDS Expansion Daughter Card to the FMC-to-QSE Adapter Card and install the nuts, then attach the FMC-to-QSE Adapter Card to the Titanium Ti180 M484 Development Board.
4. Install the nuts on the Titanium Ti180 M484 Development Board.

Revision History

Table 43: Revision History

Date	Version	Description
October 2022	1.0	Initial release.