

ZCU104 Evaluation Board

User Guide

UG1267 (v1.1) October 9, 2018



Revision History

The following table shows the revision history for this document.

| Date | Version | Revision |
|------------|---------|---|
| 10/09/2018 | 1.1 | <p>Chapter 2: Added Electrostatic Discharge Caution.</p> <p>Chapter 3: Updated introductory paragraphs in PS-Side: DDR4 Component Memory and PL-Side: DDR4 SODIMM Socket. In Table 3-12, updated GTR_REF_CLK_USB3 frequency to 26 MHz. In Table 3-24, replaced LVCMOS12 and LVCMOS18 with LVCMOS33.</p> <p>Appendix B: Updated appendix title and Overview. Removed ZCU104 Board Constraints File section.</p> <p>Appendix C: Updated Overview.</p> <p>Appendix D: Added <i>Zynq UltraScale+ MPSoC Data Sheet: DC and AC Switching Characteristics (DS925)</i> to References.</p> |
| 04/04/2018 | 1.0 | Initial Xilinx release. |

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Introduction

Overview

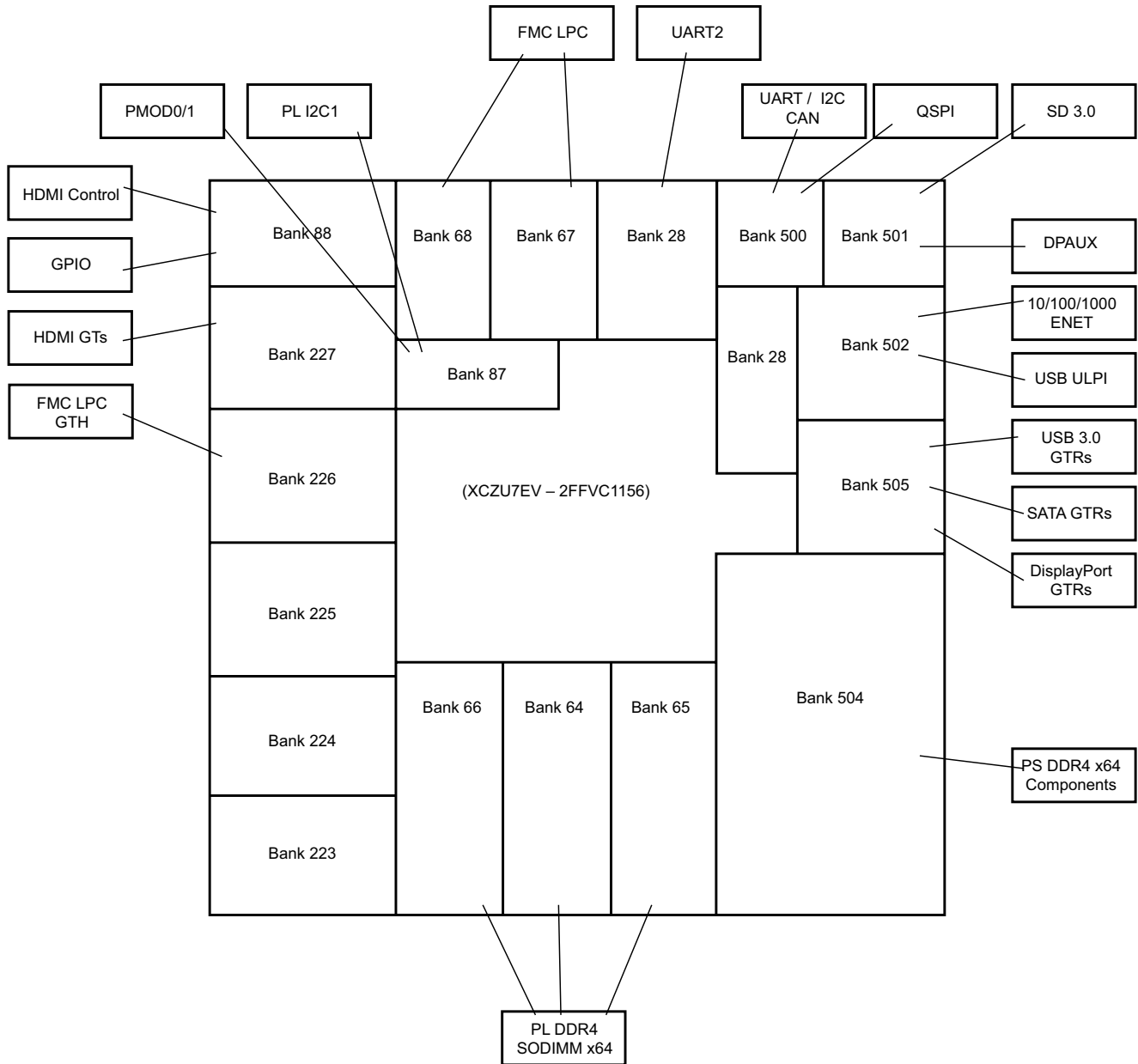
The embedded vision low cost (EVLC) development kit enables automotive, AR/VR, drones, machine vision, and industrial vision developers to build, prototype, and test their designs on a Zynq[®] UltraScale+[™] MPSoC XCZU7EV-2FFVC1156 device. The ZU7EV device integrates a quad core Arm[®] Cortex[™]-A53 processing system (PS) and a dual-core Arm Cortex-R5 real-time processor, which provides application developers an unprecedented level of heterogeneous multiprocessing. The ZCU104 evaluation board provides a flexible prototyping platform with high-speed DDR4 memory interfaces, an FMC expansion port, multi-gigabit per second serial transceivers, a variety of peripheral interfaces, and FPGA fabric for customized designs. The ZCU104 reVISION package provides out-of-box SDSoc[™] software development flow with OpenCV libraries, machine learning framework, and live sensor support.

Additional Resources

See [Appendix D, Additional Resources and Legal Notices](#) for references to documents, files, and resources relevant to the ZCU104 evaluation board.

Block Diagram

The ZCU104 board block diagram is shown in [Figure 1-1](#).



X20114-021218

Figure 1-1: ZCU104 Evaluation Board Block Diagram

Board Features

The ZCU104 evaluation board features are listed here. Detailed information for each feature is provided in [Component Descriptions in Chapter 3](#).

- XCZU7EV-2, FFVC1156 package
- PL V_{CCINT} for range in data sheet
- Rectangular form factor for benchtop use
- Configuration from Quad SPI
- Configuration from SD card
- Configuration over JTAG with platform cable USB header
- Configuration over USB-to-JTAG bridge
- IDT 8T49N287A clock chip
 - HDMI_DRU_CLOCK
 - PS_REF_CLK
 - GTR_REF_CLK_USB3
 - GTR_REF_CLK_DP
 - CLK_300
 - GTR_REF_CLK_SATA
 - CLK_125
- PS DDR4 64-bit component (4x16-bit)
- PL DDR4 64-bit SODIMM socket
- PS GTR assignment
 - DisplayPort (two GTRs)
 - USB3 (one GTR)
 - SATA (one GTR)
- PL GTH transceiver assignment (4 of 20 used)
 - High-definition multimedia interface (HDMI®) (three GTH transceivers)
 - FMC LPC DP (one GTH transceiver)
- PL FMC LPC connectivity - full LA bus
- PS MIO: single Quad SPI
- PS MIO: two channels of quad-UART bridge

- PS MIO: CAN
- PS MIO: I2C shared across PS and PL
- PS MIO: SD
- PS MIO: DisplayPort
- PS MIO: Ethernet
- PS MIO: USB3
- PS-side user LED (one)
- PL-side user LEDs (four)
- PL-side user DIP switch (4-position)
- PL-side user pushbuttons (four)
- PL-side CPU reset pushbutton
- PL-side PMOD headers
- PL-side bank 0 PROG_B pushbutton
- Security - PSBATT button battery backup
- Operational switches (power on/off, PROG_B, boot mode DIP switch)
- Operational status LEDs (power status, INIT, DONE, PG, DDR power good)
- Power management

The ZCU104 provides a rapid prototyping platform for the embedded vision low cost (EVLC) market using the XCZU7EV-2FFVC1156 device. The ZU7EV contains PS hard block peripherals exposed through the multi-use I/O (MIO) interface and several FPGA programmable logic (PL), high-density (HD), and high-performance (HP) banks. [Table 1-1](#) lists the resources available within the ZU7EV. See the *Zynq UltraScale+ MPSoC Data Sheet: Overview* (DS891) [\[Ref 1\]](#) for a feature set overview, description, and ordering information.

Table 1-1: Zynq UltraScale+ MPSoC ZU7EV Features and Resources

| Feature | Resource Count |
|---------------------------------|-------------------------------|
| Quad core Arm Cortex-A53 MPCore | 1 |
| Dual core Arm Cortex-R5 MPCore | 1 |
| Mali-400 MP2 GPU | 1 |
| H.264/H.265 VCU | 1 |
| HD banks | Two banks, total of 48 pins |
| HP banks | Six banks, total of 312 pins |
| MIO banks | Three banks, total of 78 pins |
| PS-GTR transceivers (6 Gb/s) | Four PS-GTR transceivers |
| GTH transceivers (16.3 Gb/s) | 20 GTH transceivers |
| System logic cells | 504K |
| CLB flip-flops | 461K |
| Maximum distributed RAM | 6.2 Mb |
| Total block RAM | 11 Mb |
| UltraRAM | 27 Mb |
| DSP slices | 1,728 |

Board Specifications

Dimensions

Height: 5.90 inch (14.98 cm)

Length: 7.05 inch (17.91 cm)

Thickness: 0.062 inch \pm 0.005 inch (0.157 cm \pm 0.0127 cm)

Note: A 3D model of this board is not available.

See [ZCU104 board documentation](#) for XDC listing, schematics, layout files, board outline drawings, etc.

Environmental

Temperature

Operating: 0°C to +45°C

Storage: -25°C to +60°C

Humidity

10% to 90% non-condensing

Operating Voltage

+12 V_{DC}

Board Setup and Configuration

Board Component Location

Figure 2-1 shows the ZCU104 board component locations. Each numbered component shown in the figure is keyed to Table 2-1. Table 2-1 identifies the components, references the respective schematic (0381794) page numbers, and links to a detailed functional description of the components and board features in Chapter 3.



IMPORTANT: Figure 2-1 is for visual reference only and might not reflect the current revision of the board.



IMPORTANT: There could be multiple revisions of this board. The specific details concerning the differences between revisions are not captured in this document. This document is not intended to be a reference design guide and the information herein should not be used as such. Always refer to the schematic, layout, and XDC files of the specific ZCU104 version of interest for such details.



CAUTION! The ZCU104 board can be damaged by electrostatic discharge (ESD). Follow standard ESD prevention measures when handling the board.

Electrostatic Discharge Caution



CAUTION! ESD can damage electronic components when they are improperly handled, and can result in total or intermittent failures. Always follow ESD-prevention procedures when removing and replacing components.

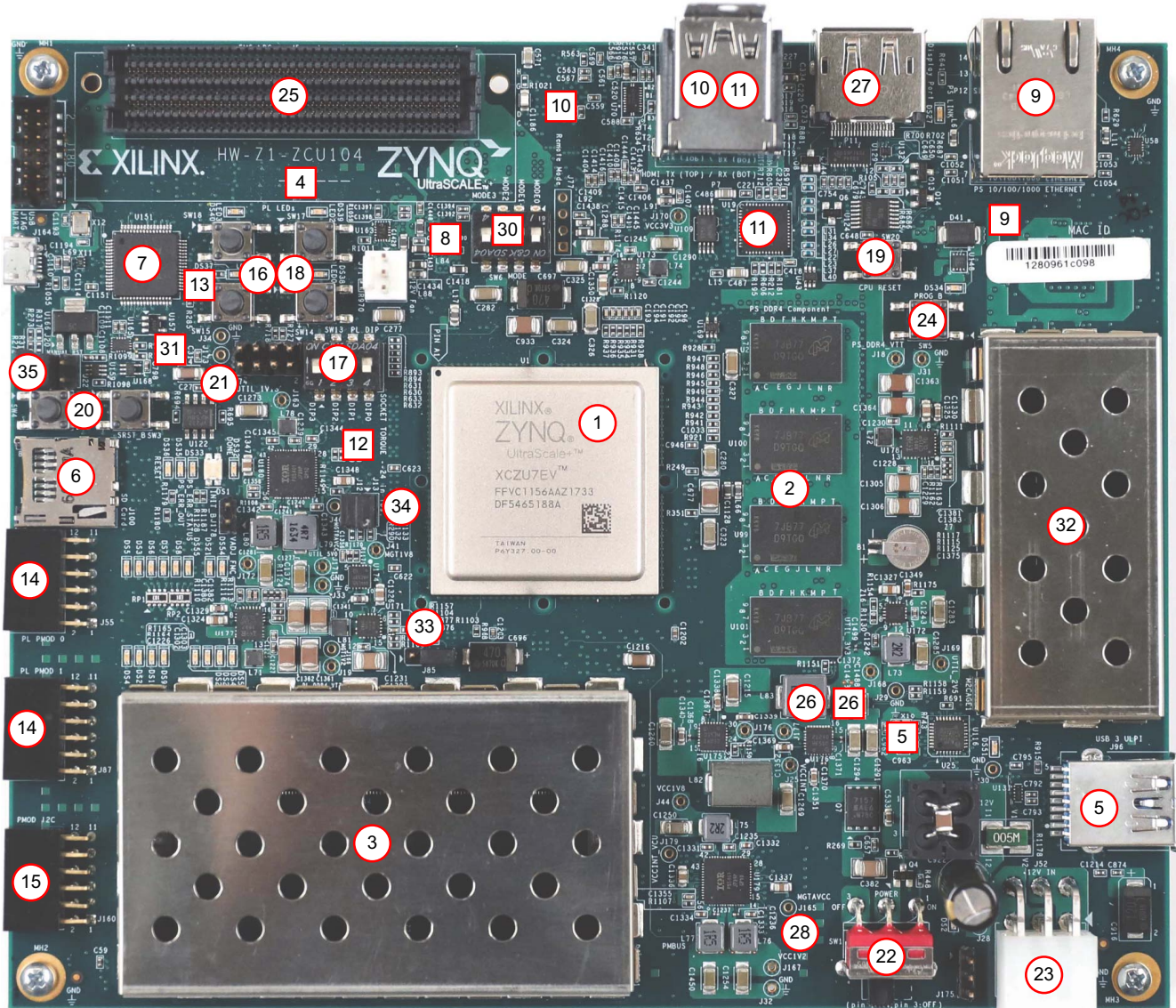
To prevent ESD damage:

- Use an ESD wrist or ankle strap and ensure that it makes skin contact. Connect the equipment end of the strap to an unpainted metal surface on the chassis.
- Avoid touching the adapter against your clothing. The wrist strap protects components from ESD on the body only.

- Handle the adapter by its bracket or edges only. Avoid touching the printed circuit board or the connectors.
- Put the adapter down only on an antistatic surface such as the bag supplied in your kit.
- If you are returning the adapter to Xilinx Product Support, place it back in its antistatic bag immediately.

⓪ Round callout references a component on the front side of the board

⓪ Square callout references a component on the back side of the board



X20272-022618

Figure 2-1: ZCU104 Evaluation Board Components

Table 2-1: ZCU104 Board Component Locations

| Callout Number | Ref. Des. | Feature ([B] = bottom of board) | Notes | Schematic Page |
|----------------|---------------------|--|---|----------------|
| 1 | U1 | Zynq UltraScale+ XCZU7EV MPSoC with Radian fan sink | XCZU7EV-2FFVC1156 FA35+K52B+T725 | 3–18 |
| 2 | U2, U99-U101 | PS-Side: DDR4 Component Memory, (2 GB total) | Micron MT40A256M16GE-083E (DDR4-2400) | 24–27 |
| 3 | J1 | PL-Side: DDR4 SODIMM Socket DDR4 SODIMM (not provided) | LOTES ADDR0067-P001A, supports MICRON MTA8ATF51264HZ-2G6B1 | 22 |
| 4 | U119 | Quad SPI Flash Memory (MIO 0–5) (512 Mb) [B] | Micron MT25QU512ABB8ESF-0SIT | 36 |
| 5 | U116, J96 | USB 3.0 Transceiver and USB 2.0 ULPI PHY USB Micro-AB connector | SMSC USB3320-EZK, KYCON KMMX-AB10-SMT1SB30TR | 40 |
| 6 | J100 | SD Card Interface connector | Hirose DMIAA-SF-PET(21) | 37 |
| 7 | U151, J164 | Programmable Logic JTAG Programming Options | FTDI FT4232HL_64LQFP, Hirose ZX62D-AB-5P8 | 21 |
| 8 | U182 | IDT8T49N287 FemtoClock NG Octal Universal Frequency Translator [B] | IDT 8T49N287A-501NLGI | 32 |
| 9 | U98, P12 | 10/100/1000 MHz Tri-Speed Ethernet PHY [B], RJ45 with magnetics | TI DP83867IRPAP, Bel Fuse L829-1J1T-43 | 41 |
| 10 | U94, P7 | HDMI Video Output [B] | TI SN65DP159RGZ, TE Connectivity 1888811-1 | 29 |
| 11 | U19, P7 | HDMI Video Output | TI TMDS181IRGZT, TE Connectivity 1888811-1 | 30 |
| 12 | U97 | I2C1 (MIO 16-17) [B] | TI TCA6416APWR | 44 |
| 13 | U34 | I2C1 (MIO 16-17) [B] | TI TCA9548APWR | 45 |
| 14 | J55, J87 | User PMOD GPIO Connectors | SULLINS PPPC062LJBN-RC | 43 |
| 15 | J160 | User I2C1 Receptacle | SULLINS PPPC062LJBN-RC | 43 |
| 16 | DS37-DS40 | User I/O (4 x green 0603 LED) | LUMEX SML-LX0603GW | 42 |
| 17 | SW13 | User I/O (4-pos. DIP switch) | CTS 218-4LPSTRF | 42 |
| 18 | SW14, 15, 17, 18 | User I/O (4 X SPST pushbutton) | E-switch TL3301EP100QG | 42 |
| 19 | SW20 | User I/O (CPU reset SPST pushbutton) | E-switch TL3301EP100QG | 42 |
| 20 | SW3, SW4 | Switches (2 x SPST pushbutton, POR) | E-switch TL3301EP100QG | 12 |
| 21 | U122, J98 | User I2C1 Receptacle | TI SN65HVD232, SULLINS PBC36DAAN | 39 |

Table 2-1: ZCU104 Board Component Locations (Cont'd)

| Callout Number | Ref. Des. | Feature ([B] = bottom of board) | Notes | Schematic Page |
|----------------|------------------|--|--|----------------|
| 22 | SW1 | Switches Power on/off slide switch) | C&K 1201M2S3AQE2 | 46 |
| 23 | J52 | Switches (2 x 3 mini-fit receptacle) | MOLEX 39-30-1060 | 46 |
| 24 | SW5 | Switches (PROG_B SPST pushbutton) | E-switch TL3301EP100QG | 12 |
| 25 | J5 | FMC LPC Connector J5 | Samtec ASP_134603_01 | 28 |
| 26 | – | Board Power System (top and bottom of board) | Maxim Regulators | 47–60 |
| 27 | P11 | DPAUX (MIO 27-30) | MOLEX 0472720001 | 34 |
| 28 | J175 | Monitoring Voltage and Current | Sullins PBC36SAAN (1x3 0.1 male pin header) | 44 |
| 29 | U181 | HDMI Clock Recovery [B] | IDT8T49N241-994NLGI | 31 |
| 30 | SW6 | Switches (MODE 4-pole DIP) | 4-pole C&K SDA04H1SBD | 12 |
| 31 | U23 | I2C1 (MIO 16-17) [B] (8 Kb EEPROM) | ST MICRO M24C08-WDW6TP | 33 |
| 32 | U170 | PS M.2 SATA Connector | Amphenol MDT420M02001 | 38 |
| 33 | J85 | Jumpers (POR Override Sel) | Sullins PBC36SAAN (1x3 0.1 male pin header) | 3 |
| 34 | J12, J13 | Jumpers (SYSMON I2C ADDR) | Sullins PBC36SAAN (1x3 0.1 male pin header) | 3 |
| 35 | J20, J21, J22 | Jumpers (POR circuit) | Sullins PBC36SAAN (1x3 0.1 male pin header) | 12 |

Default Jumper and Switch Settings

Figure 2-1 shows the ZCU104 board jumper header and DIP switch locations. Each numbered component shown in the figure is keyed to Table 2-2 (for default jumper settings) or Table 2-3 (for default switch settings). Both tables reference the respective schematic page numbers.

Jumpers

Table 2-2: Default Jumper Settings

| Number | Ref. Des. | Function | Default | Schematic Page |
|--------|-----------|--|---------|----------------|
| 33 | J85 | POR_OVERRIDE <ul style="list-style-type: none"> 1-2: Enable 2-3: Disable | 2-3 | 3 |
| 34 | J12 | YSYMON I2C address <ul style="list-style-type: none"> Open: SYSMON_VP_R floating 1-2: SYSMON_VP_P pulled down | 1-2 | 3 |
| 34 | J13 | YSYMON I2C address <ul style="list-style-type: none"> Open: SYSMON_VN_R floating 1-2: SYSMON_VP_N pulled down | 1-2 | 3 |
| 35 | J20 | Reset sequencer PS_POR_B <ul style="list-style-type: none"> Open: Sequencer does not control PS_POR_B 1-2: Sequencer can control PS_POR_B | 1-2 | 12 |
| 35 | J21 | Reset sequencer PS_SRST_B <ul style="list-style-type: none"> Open: Sequencer does not control PS_SRST_B 1-2: Sequencer can control PS_SRST_B | 1-2 | 12 |
| 35 | J22 | Reset sequencer inhibit <ul style="list-style-type: none"> Open: Sequencer normal operation 1-2: Sequencer inhibit (resets stay asserted) | Open | 12 |

Switches

Table 2-3: Default Switch Settings

| Number | Ref. Des. | Function | Default | Schematic Page |
|--------|-----------|--|---------|----------------|
| 30 | SW6 | 4-pole DIP switch PS_MODE select = [0010] (ON = pull down, OFF = pull up = 1) | | 12 |
| | | 4: PS_MODE3 PS_MODE[3:0] = 0010 | On | |
| | | 3: PS_MODE2 = QSPI32 boot default | On | |
| | | 2: PS_MODE1 | Off | |
| | | 1: PS_MODE0 | On | |
| 17 | SW13 | 4-pole DIP switch GPIO | All Off | 42 |
| 22 | SW1 | Main power slide switch | Off | 46 |

MPSoC Device Configuration

Zynq UltraScale+ XCZU7EV MPSoC devices use a multi-stage boot process as described in the “Boot and Configuration” chapter of the *Zynq UltraScale+ MPSoC Technical Reference Manual* (UG1085) [Ref 2]. Switch SW6 configuration option settings are listed in Table 2-4.

Table 2-4: Switch SW6 Configuration Option Settings

| Boot Mode | Mode Pins [3:0] | Mode SW6 [4:1] |
|-----------|---------------------------|----------------|
| JTAG | 0000 / 0x0 | ON,ON,ON,ON |
| QSPI32 | 0010 / 0x2 ⁽¹⁾ | ON,ON,OFF,ON |
| SD1 | 1110 / 0xE | OFF,OFF,OFF,ON |

Notes:

1. Default switch setting.

JTAG

Vivado®, SDK, or third-party tools can establish a JTAG connection to the Zynq UltraScale+ MPSoC device through the FT4232 Quad USB to multipurpose UART (U151) with micro-USB connector (J164).

Quad SPI

To boot from the dual Quad SPI nonvolatile configuration memory:

1. Store a valid Zynq UltraScale+ MPSoC boot image in the Quad SPI flash device (U119) connected to the MIO Quad SPI interface.
2. Set the boot mode pins SW6 [4:1] PS_MODE[3:0] as indicated in [Table 2-4](#) for Quad SPI32.
3. Either power-cycle or press the power-on reset (POR) pushbutton SW4. SW4 is callout 20 in [Figure 2-1](#).

SD

To boot from an SD card:

1. Store a valid Zynq UltraScale+ MPSoC boot image file on to an SD card (plugged into SD socket J100) connected to the MIO SD interface.
2. Set the boot mode pins SW6 [4:1] PS_MODE[3:0] as indicated in [Table 2-4](#) for SD1.
3. Either power-cycle or press the power-on reset (POR) pushbutton SW4. SW4 is callout 20 in [Figure 2-1](#).

See the *Zynq UltraScale+ MPSoC Technical Reference Manual* (UG1085) [\[Ref 2\]](#) for more information about Zynq UltraScale+ MPSoC configuration options.

Board Component Descriptions

Overview

This chapter provides a detailed functional description of the board's components and features. [Table 2-1, page 13](#) identifies the components, references the respective schematic (0381794) page numbers, and links to the corresponding detailed functional description in this chapter. Component locations are shown in [Table 2-1, page 13](#).

Component Descriptions

Zynq UltraScale+ XCZU7EV MPSoC

[[Figure 2-1](#), callout 1]

The ZCU104 board is populated with the Zynq UltraScale+ XCZU7EV-2FFVC1156 MPSoC, which combines a powerful processing system (PS) and programmable logic (PL) in the same device. The PS in a Zynq UltraScale+ MPSoC features the Arm[®] flagship Cortex[®]-A53 64-bit quad-core processor and Cortex-R5 dual-core real-time processor. Support of multiple speed grades requires voltage adjustments.

The V_{CCINT} supplies are user adjustable via the PMBus with the voltage ranges listed in [Table 3-1](#) to support multiple Zynq UltraScale+ MPSoC speed grades.

Table 3-1: Recommended Operating Conditions

| Symbol | Description | Min | Typ | Max | Units |
|---------------------------|--|-------|-------|-------|-------|
| Processing System | | | | | |
| $V_{CC_PSINTFP}$ | PS full-power domain supply voltage. | 0.808 | 0.850 | 0.892 | V |
| | For -1LI and -2LE ($V_{CCINT} = 0.72V$) devices: PS full-power domain supply voltage. | 0.808 | 0.850 | 0.892 | V |
| | For -3E devices: PS full-power domain supply voltage. | 0.873 | 0.900 | 0.927 | V |
| $V_{CC_PSINTLP}$ | PS low-power domain supply voltage. | 0.808 | 0.850 | 0.892 | V |
| | For -1LI and -2LE ($V_{CCINT} = 0.72V$) devices: PS low-power domain supply voltage. | 0.808 | 0.850 | 0.892 | V |
| | For -3E devices: PS low-power domain supply voltage. | 0.873 | 0.900 | 0.927 | V |
| Programmable Logic | | | | | |
| V_{CCINT} | PL internal supply voltage. | 0.825 | 0.850 | 0.876 | V |
| | For -1LI and -2LE ($V_{CCINT} = 0.72V$) devices: PL internal supply voltage. | 0.698 | 0.720 | 0.742 | V |
| | For -3E devices: PL internal supply voltage. | 0.873 | 0.900 | 0.927 | V |

The top-level block diagram is shown in Figure 3-1.

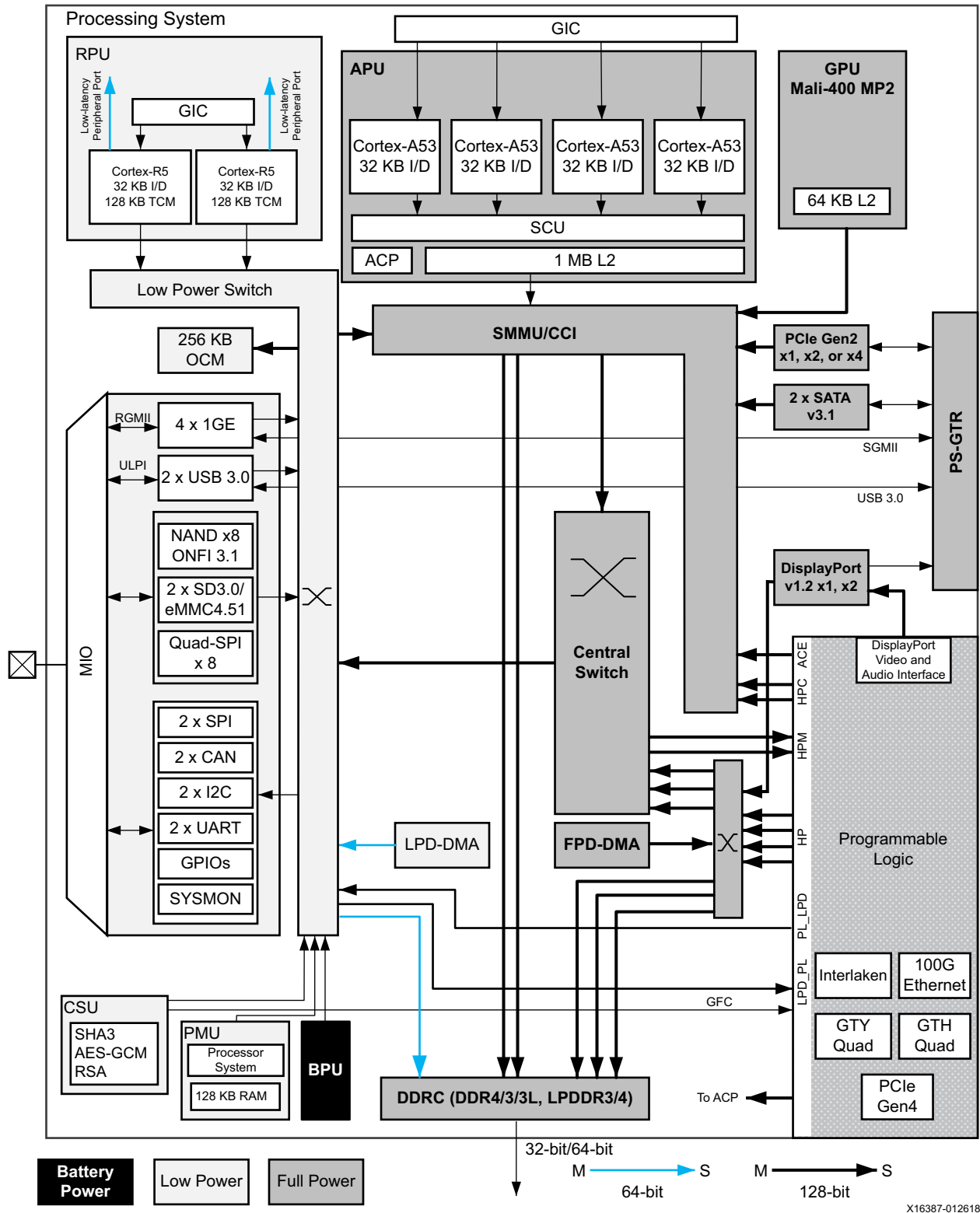


Figure 3-1: Top-Level Block Diagram

The Zynq UltraScale+ MPSoC PS block has three major processing units:

- Cortex-A53 application processing unit (APU)-Arm v8 architecture-based 64-bit quad-core multiprocessing CPU.
- Cortex-R5 real-time processing unit (RPU)-Arm v7 architecture-based 32-bit dual real-time processing unit with dedicated tightly coupled memory (TCM).
- Mali-400 graphics processing unit (GPU)-graphics processing unit with pixel and geometry processor and 64 KB L2 cache.

The Zynq UltraScale+ MPSoC PS has four high-speed serial I/O (HSSIO) interfaces supporting these protocols:

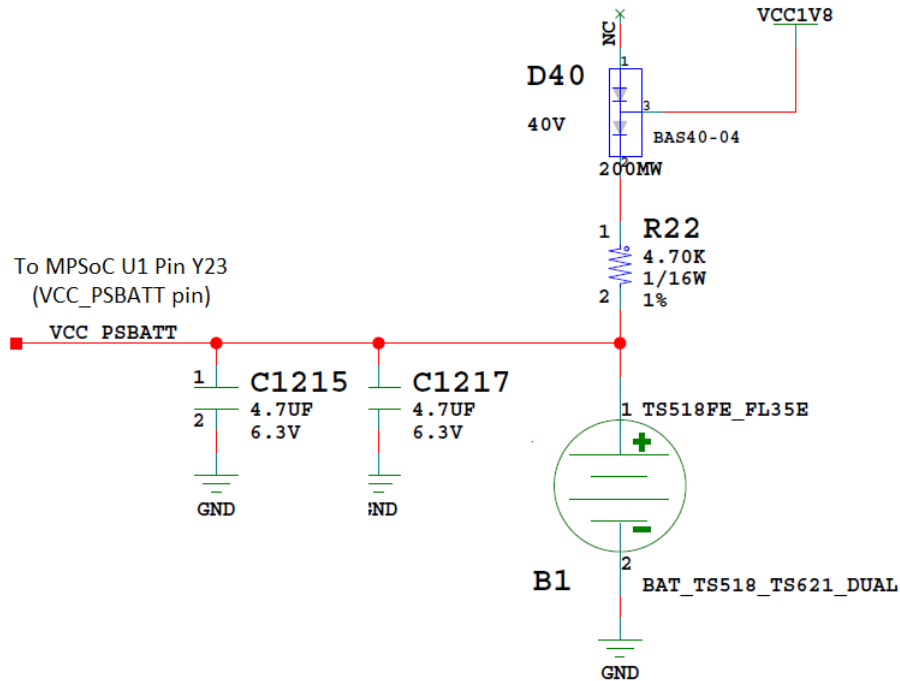
- Integrated block for PCI Express® interface-PCIe™ base specification version 2.1 compliant.
- SATA 3.1 specification compliant interface.
- DisplayPort interface-implements a DisplayPort source-only interface with video resolution up to 4K x 2K-30 (300 MHz pixel rate).
- USB 3.0 interface-compliant to USB 3.0 specification implementing a 5 Gb/s line rate.
- Serial GMII interface-supports a 1 Gb/s SGMII interface.

The PS and PL can be coupled with multiple interfaces and other signals to effectively integrate user-created hardware accelerators and other functions in the PL logic that are accessible to the processors. They can also access memory resources in the PS. The PS I/O peripherals, including the static/flash memory interfaces share a multiplexed I/O (MIO) of up to 78 MIO pins. Zynq UltraScale+ MPSoCs can also use the I/O in the PL domain for many of the PS I/O peripherals. This is done through an extended multiplexed I/O interface (EMIO).and boots at power-up or reset.

For additional information on Zynq UltraScale+ MPSoC devices, see the *Zynq UltraScale+ MPSoC Data Sheet: Overview* (DS891) [Ref 1]. See the *Zynq UltraScale+ MPSoC Technical Reference Manual* (UG1085) [Ref 2] for more information about Zynq UltraScale+ MPSoC configuration options.

Encryption Key Battery Backup Circuit

The XCZU7EV MPSoC U1 implements bit stream encryption key technology. The ZCU104 board provides the encryption key backup battery circuit shown in Figure 3-2.



X20247-013018

Figure 3-2: Encryption Key Backup Circuit

The Seiko TS518FE rechargeable 1.5V lithium button-type battery B1 is soldered to the board with the positive output connected to the XCZU7EV MPSoC U1 V_{CC_PSBATT} pin Y23. The battery supply current I_{BATT} specification is 150 nA maximum when board power is off. B1 is charged from the UTIL_1V8 1.8V rail through a series diode with a typical forward voltage drop of 0.38V and 4.7 Ω K current limit resistor. The nominal charging voltage is 1.42V.

I/O Voltage Rails

The XCZU7EV MPSoC PL I/O bank voltages on the ZCU104 board are listed in [Figure 3-2](#).

Table 3-2: I/O Voltage Rails

| XCZU7EV | Power Net Name | Voltage | Connected To |
|-------------|-------------------------------------|---------|---|
| PL Bank 28 | V _{CC1V8} | 1.8V | UART2 only (mostly NC pins) |
| PL Bank 64 | V _{CC1V2} | 1.2V | DDR4 SODIMM DQ[0:31] (PL) |
| PL Bank 65 | V _{CC1V2} | 1.2V | DDR4 SODIMM DQ[32:63] (PL) |
| PL Bank 66 | V _{CC1V2} | 1.2V | DDR4 SODIMM ADDR/CTRL (PL) |
| PL Bank 67 | V _{ADJ_FMC} ⁽¹⁾ | 1.8V | FMC_LPC LA BUS |
| PL Bank 68 | V _{ADJ_FMC} ⁽¹⁾ | 1.8V | FMC_LPC LA BUS |
| PL Bank 87 | V _{CC3V3} | 3.3V | PMOD0, PMOD1, HDMI CTRL, PL_I2C1 |
| PL Bank 88 | V _{CC3V3} | 3.3V | HDMI, GPIO LED/DIP SW/PB SW |
| PS Bank 500 | V _{CC1V8} | 1.8V | CAN, UART0/1, I2C0/1, QSPI LWR |
| PS Bank 501 | V _{CC1V8} | 1.8V | SDIO, DP |
| PS Bank 502 | V _{CC1V8} | 1.8V | ENET, USB_DATA[0:7], USB_CTRL |
| PS Bank 503 | V _{CC1V8} | 1.8V | PS CONFIG I/F |
| PS Bank 504 | V _{CC1V2} | 1.2V | DDR4 (4x16-BIT) 64-BIT COMPONENT I/F (PS) |

Notes:

1. The ZCU104 board is shipped with V_{ADJ_FMC} set to 1.8V.

PS-Side: DDR4 Component Memory

[Figure 2-1, callout 2]

The PS-side memory is wired to the XCZU7EV DDRC bank 504 hard memory controller. PS-side memory is a 2 GB, 64-bit wide DDR4 memory system comprised of four 256 Mb x 16 SDRAMs, U2, and 99-101.

- Manufacturer: Micron
- Part number: MT40A256M16GE-083E
- Description:
 - 4 Gb (256 Mb x 16)
 - 1.2V 96-ball FBGA
 - DDR4-2400

The ZCU104 XCZU7EV FFVC MPSoC PS DDR interface performance is documented in the *Zynq UltraScale+ MPSoC Data Sheet: DC and AC Switching Characteristics* (DS925) [Ref 3]. The DDR4 0.6V VTT termination voltage is supplied from sink-source regulator U178. The connections between the DDR4 memory and the U1 XCZU7EV bank 504 are listed in Table 3-3.

Table 3-3: DDR4 Component Memory Connection to XCZU7EV PS Bank 504

| XCZU7EV (U1) Pin | Net Name | DDR4 Component Memory | | |
|---------------------|----------|-----------------------|----------|-------------|
| | | Pin # | Pin Name | Ref. Des. |
| AN34 | DDR4_A0 | P3 | A0 | U2,U99-U101 |
| AM34 | DDR4_A1 | P7 | A1 | U2,U99-U101 |
| AM33 | DDR4_A2 | R3 | A2 | U2,U99-U101 |
| AL34 | DDR4_A3 | N7 | A3 | U2,U99-U101 |
| AL33 | DDR4_A4 | N3 | A4 | U2,U99-U101 |
| AK33 | DDR4_A5 | P8 | A5 | U2,U99-U101 |
| AK30 | DDR4_A6 | P2 | A6 | U2,U99-U101 |
| AJ30 | DDR4_A7 | R8 | A7 | U2,U99-U101 |
| AJ31 | DDR4_A8 | R2 | A8 | U2,U99-U101 |
| AH31 | DDR4_A9 | R7 | A9 | U2,U99-U101 |
| AG31 | DDR4_A10 | M3 | A10/AP | U2,U99-U101 |
| AF31 | DDR4_A11 | T2 | A11 | U2,U99-U101 |
| AG30 | DDR4_A12 | M7 | A12/BC_B | U2,U99-U101 |
| AF30 | DDR4_A13 | T8 | A13 | U2,U99-U101 |
| AE27 | DDR4_BA0 | N2 | BA0 | U2,U99-U101 |

Table 3-3: DDR4 Component Memory Connection to XCZU7EV PS Bank 504 (Cont'd)

| XCZU7EV (U1) Pin | Net Name | DDR4 Component Memory | | |
|---------------------|-----------|-----------------------|----------|-------------|
| | | Pin # | Pin Name | Ref. Des. |
| AE28 | DDR4_BA1 | N8 | BA1 | U2,U99-U101 |
| AD27 | DDR4_BG0 | M2 | BG0 | U2,U99-U101 |
| AP27 | DDR4_DQ0 | G2 | DQL0 | U101 |
| AP25 | DDR4_DQ1 | F7 | DQL1 | U101 |
| AP26 | DDR4_DQ2 | H3 | DQL2 | U101 |
| AM26 | DDR4_DQ3 | H7 | DQL3 | U101 |
| AP24 | DDR4_DQ4 | H2 | DQL4 | U101 |
| AL25 | DDR4_DQ5 | H8 | DQL5 | U101 |
| AM25 | DDR4_DQ6 | J3 | DQL6 | U101 |
| AM24 | DDR4_DQ7 | J7 | DQL7 | U101 |
| AM28 | DDR4_DQ8 | A3 | DQU0 | U101 |
| AN28 | DDR4_DQ9 | B8 | DQU1 | U101 |
| AP29 | DDR4_DQ10 | C3 | DQU2 | U101 |
| AP28 | DDR4_DQ11 | C7 | DQU3 | U101 |
| AM31 | DDR4_DQ12 | C2 | DQU4 | U101 |
| AP31 | DDR4_DQ13 | C8 | DQU5 | U101 |
| AN31 | DDR4_DQ14 | D3 | DQU6 | U101 |
| AM30 | DDR4_DQ15 | D7 | DQU7 | U101 |
| AF25 | DDR4_DQ16 | G2 | DQL0 | U99 |
| AG25 | DDR4_DQ17 | F7 | DQL1 | U99 |
| AG26 | DDR4_DQ18 | H3 | DQL2 | U99 |
| AJ25 | DDR4_DQ19 | H7 | DQL3 | U99 |
| AG24 | DDR4_DQ20 | H2 | DQL4 | U99 |
| AK25 | DDR4_DQ21 | H8 | DQL5 | U99 |
| AJ24 | DDR4_DQ22 | J3 | DQL6 | U99 |
| AK24 | DDR4_DQ23 | J7 | DQL7 | U99 |
| AH28 | DDR4_DQ24 | A3 | DQU0 | U99 |
| AH27 | DDR4_DQ25 | B8 | DQU1 | U99 |
| AJ27 | DDR4_DQ26 | C3 | DQU2 | U99 |
| AK27 | DDR4_DQ27 | C7 | DQU3 | U99 |
| AL26 | DDR4_DQ28 | C2 | DQU4 | U99 |
| AL27 | DDR4_DQ29 | C8 | DQU5 | U99 |
| AH29 | DDR4_DQ30 | D3 | DQU6 | U99 |
| AL28 | DDR4_DQ31 | D7 | DQU7 | U99 |

Table 3-3: DDR4 Component Memory Connection to XCZU7EV PS Bank 504 (Cont'd)

| XCZU7EV (U1) Pin | Net Name | DDR4 Component Memory | | |
|---------------------|-----------|-----------------------|--------------|-----------|
| | | Pin # | Pin Name | Ref. Des. |
| AB29 | DDR4_DQ32 | G2 | DQL0 | U100 |
| AB30 | DDR4_DQ33 | F7 | DQL1 | U100 |
| AC29 | DDR4_DQ34 | H3 | DQL2 | U100 |
| AD32 | DDR4_DQ35 | H7 | DQL3 | U100 |
| AC31 | DDR4_DQ36 | H2 | DQL4 | U100 |
| AE30 | DDR4_DQ37 | H8 | DQL5 | U100 |
| AC28 | DDR4_DQ38 | J3 | DQL6 | U100 |
| AE29 | DDR4_DQ39 | J7 | DQL7 | U100 |
| AC27 | DDR4_DQ40 | A3 | DQU0 | U100 |
| AA27 | DDR4_DQ41 | B8 | DQU1 | U100 |
| AA28 | DDR4_DQ42 | C3 | DQU2 | U100 |
| AB28 | DDR4_DQ43 | C7 | DQU3 | U100 |
| W27 | DDR4_DQ44 | C2 | DQU4 | U100 |
| W29 | DDR4_DQ45 | C8 | DQU5 | U100 |
| W28 | DDR4_DQ46 | D3 | DQU6 | U100 |
| V27 | DDR4_DQ47 | D7 | DQU7 | U100 |
| AA32 | DDR4_DQ48 | G2 | DQL0 | U2 |
| AA33 | DDR4_DQ49 | F7 | DQL1 | U2 |
| AA34 | DDR4_DQ50 | H3 | DQL2 | U2 |
| AE34 | DDR4_DQ51 | H7 | DQL3 | U2 |
| AD34 | DDR4_DQ52 | H2 | DQL4 | U2 |
| AB31 | DDR4_DQ53 | H8 | DQL5 | U2 |
| AC34 | DDR4_DQ54 | J3 | DQL6 | U2 |
| AC33 | DDR4_DQ55 | J7 | DQL7 | U2 |
| AA30 | DDR4_DQ56 | A3 | DQU0 | U2 |
| Y30 | DDR4_DQ57 | B8 | DQU1 | U2 |
| AA31 | DDR4_DQ58 | C3 | DQU2 | U2 |
| W30 | DDR4_DQ59 | C7 | DQU3 | U2 |
| Y33 | DDR4_DQ60 | C2 | DQU4 | U2 |
| W33 | DDR4_DQ61 | C8 | DQU5 | U2 |
| W34 | DDR4_DQ62 | D3 | DQU6 | U2 |
| Y34 | DDR4_DQ63 | D7 | DQU7 | U2 |
| AN24 | DDR4_DM0 | E7 | DML_B/DBIL_B | U101 |
| AM29 | DDR4_DM1 | E2 | DMU_B/DBIU_B | U101 |

Table 3-3: DDR4 Component Memory Connection to XCZU7EV PS Bank 504 (Cont'd)

| XCZU7EV (U1) Pin | Net Name | DDR4 Component Memory | | |
|---------------------|----------------|-----------------------|--------------|-------------|
| | | Pin # | Pin Name | Ref. Des. |
| AH24 | DDR4_DM2 | E7 | DML_B/DBIL_B | U99 |
| AJ29 | DDR4_DM3 | E2 | DMU_B/DBIU_B | U99 |
| AD29 | DDR4_DM4 | E7 | DML_B/DBIL_B | U100 |
| Y29 | DDR4_DM5 | E2 | DMU_B/DBIU_B | U100 |
| AC32 | DDR4_DM6 | E7 | DML_B/DBIL_B | U2 |
| Y32 | DDR4_DM7 | E2 | DMU_B/DBIU_B | U2 |
| AN26 | DDR4_DQS0_T | G3 | DQSL_T | U101 |
| AN27 | DDR4_DQS0_C | F3 | DQSL_C | U101 |
| AN29 | DDR4_DQS1_T | B7 | DQSU_T | U101 |
| AP30 | DDR4_DQS1_C | A7 | DQSU_C | U101 |
| AH26 | DDR4_DQS2_T | G3 | DQSL_T | U99 |
| AJ26 | DDR4_DQS2_C | F3 | DQSL_C | U99 |
| AK28 | DDR4_DQS3_T | B7 | DQSU_T | U99 |
| AK29 | DDR4_DQS3_C | A7 | DQSU_C | U99 |
| AD30 | DDR4_DQS4_T | G3 | DQSL_T | U100 |
| AD31 | DDR4_DQS4_C | F3 | DQSL_C | U100 |
| Y27 | DDR4_DQS5_T | B7 | DQSU_T | U100 |
| Y28 | DDR4_DQS5_C | A7 | DQSU_C | U100 |
| AB33 | DDR4_DQS6_T | G3 | DQSL_T | U2 |
| AB34 | DDR4_DQS6_C | F3 | DQSL_C | U2 |
| W31 | DDR4_DQS7_T | B7 | DQSU_T | U2 |
| W32 | DDR4_DQS7_C | A7 | DQSU_C | U2 |
| AL31 | DDR4_CK_T | K7 | CK_T | U2,U99-U101 |
| AN32 | DDR4_CK_C | K8 | CK_C | U2,U99-U101 |
| AN33 | DDR4_CKE | K2 | CKE | U2,U99-U101 |
| AP32 | DDR4_ODT | K3 | ODT | U2,U99-U101 |
| AF28 | DDR4_A16_RAS_B | L8 | RAS_B/A16 | U2,U99-U101 |
| AG28 | DDR4_A15_CAS_B | M8 | CAS_B_A15 | U2,U99-U101 |
| AG29 | DDR4_A14_WE_B | L2 | WE_B/A14 | U2,U99-U101 |
| AE25 | DDR4_ACT_B | L3 | ACT_B | U2,U99-U101 |
| AB26 | DDR4_ALERT_B | P9 | ALERT_B | U2,U99-U101 |
| AA26 | DDR4_PAR | T3 | PAR | U2,U99-U101 |
| AD26 | DDR4_RESET_B | P1 | RESET_B | U2,U99-U101 |

Table 3-3: DDR4 Component Memory Connection to XCZU7EV PS Bank 504 (Cont'd)

| XCZU7EV (U1) Pin | Net Name | DDR4 Component Memory | | |
|---------------------|-----------|-----------------------|----------|-------------|
| | | Pin # | Pin Name | Ref. Des. |
| AP33 | DDR4_CS_B | L7 | CS_B | U2,U99-U101 |
| R156 P/D | DDR4_TEN | N9 | TEN | U2,U99-U101 |

The ZCU104 board DDR4 64-bit component PS memory interface adheres to the constraints guidelines documented in the “PCB Guidelines for DDR4” section of *UltraScale Architecture PCB Design User Guide* (UG583) [Ref 4]. The ZCU104 DDR4 PS component interface is a 40Ω impedance implementations. Other memory interface details are also available in the *UltraScale Architecture FPGAs Memory Interface Solutions Product Guide* (PG150) [Ref 5]. For more details, see the Micron MT40A256M16HA-083E data sheet at the Micron website [Ref 11].

PL-Side: DDR4 SODIMM Socket

[Figure 2-1, callout 3]

The XCZU7EV PL-side banks 64, 65, and 66 are wired to DDR4 SODIMM socket J1. The ZCU104 kit is shipped without a DDR4 SODIMM installed.

The recommended SODIMM is:

- Manufacturer: Micron
- Part Number: MTA8ATF51264HZ-2G6B1
- Description:
 - 4 GByte (x64), 260-pin
 - 512 Meg x 8
 - Single rank
 - DDR4-2666

The ZCU104 XCZU7EV FFVC MPSoC PL DDR interface performance is documented in the *Zynq UltraScale+ MPSoC Data Sheet: DC and AC Switching Characteristics (DS925)* [Ref 3]. The DDR4 0.6V VTT termination voltage is supplied from sink-source regulator U177. The DDR4 SODIMM socket J1 connections are listed in Table 3-4.

Table 3-4: DDR4 SODIMM Socket J1 Connections to FPGA PL Banks 64, 65, and 66

| XCZU7EV (U1) Pin | Net Name | I/O Standard | DDR4 SODIMM Memory J1 | |
|---------------------|-----------------|--------------|-----------------------|----------|
| | | | Pin Number | Pin Name |
| AH8 | DDR4_SODIMM_A0 | SSTL12_DCI | 144 | A0 |
| AG8 | DDR4_SODIMM_A1 | SSTL12_DCI | 133 | A1 |
| AF8 | DDR4_SODIMM_A2 | SSTL12_DCI | 132 | A2 |
| AG10 | DDR4_SODIMM_A3 | SSTL12_DCI | 131 | A3 |
| AG11 | DDR4_SODIMM_A4 | SSTL12_DCI | 128 | A4 |
| AH9 | DDR4_SODIMM_A5 | SSTL12_DCI | 126 | A5 |
| AG9 | DDR4_SODIMM_A6 | SSTL12_DCI | 127 | A6 |
| AH13 | DDR4_SODIMM_A7 | SSTL12_DCI | 122 | A7 |
| AK10 | DDR4_SODIMM_A8 | SSTL12_DCI | 125 | A8 |
| AJ10 | DDR4_SODIMM_A9 | SSTL12_DCI | 121 | A9 |
| AL8 | DDR4_SODIMM_A10 | SSTL12_DCI | 146 | A10/AP |
| AK8 | DDR4_SODIMM_A11 | SSTL12_DCI | 120 | A11 |
| AL12 | DDR4_SODIMM_A12 | SSTL12_DCI | 119 | A12 |
| AK12 | DDR4_SODIMM_A13 | SSTL12_DCI | 158 | A13 |

Table 3-4: DDR4 SODIMM Socket J1 Connections to FPGA PL Banks 64, 65, and 66 (Cont'd)

| XCZU7EV (U1) Pin | Net Name | I/O Standard | DDR4 SODIMM Memory J1 | |
|---------------------|------------------|--------------|-----------------------|----------|
| | | | Pin Number | Pin Name |
| AL10 | DDR4_SODIMM_BA0 | SSTL12_DCI | 150 | BA0 |
| AL11 | DDR4_SODIMM_BA1 | SSTL12_DCI | 145 | BA1 |
| AE14 | DDR4_SODIMM_BG0 | SSTL12_DCI | 115 | BG0 |
| AE13 | DDR4_SODIMM_BG1 | SSTL12_DCI | 113 | BG1 |
| AG14 | DDR4_SODIMM_DQ0 | POD12_DCI | 8 | DQ0 |
| AG15 | DDR4_SODIMM_DQ1 | POD12_DCI | 7 | DQ1 |
| AF15 | DDR4_SODIMM_DQ2 | POD12_DCI | 20 | DQ2 |
| AF16 | DDR4_SODIMM_DQ3 | POD12_DCI | 21 | DQ3 |
| AF17 | DDR4_SODIMM_DQ4 | POD12_DCI | 4 | DQ4 |
| AE17 | DDR4_SODIMM_DQ5 | POD12_DCI | 3 | DQ5 |
| AG18 | DDR4_SODIMM_DQ6 | POD12_DCI | 16 | DQ6 |
| AF18 | DDR4_SODIMM_DQ7 | POD12_DCI | 17 | DQ7 |
| AD16 | DDR4_SODIMM_DQ8 | POD12_DCI | 28 | DQ8 |
| AD17 | DDR4_SODIMM_DQ9 | POD12_DCI | 29 | DQ9 |
| AB14 | DDR4_SODIMM_DQ10 | POD12_DCI | 41 | DQ10 |
| AA14 | DDR4_SODIMM_DQ11 | POD12_DCI | 42 | DQ11 |
| AB15 | DDR4_SODIMM_DQ12 | POD12_DCI | 24 | DQ12 |
| AB16 | DDR4_SODIMM_DQ13 | POD12_DCI | 25 | DQ13 |
| AC16 | DDR4_SODIMM_DQ14 | POD12_DCI | 38 | DQ14 |
| AC17 | DDR4_SODIMM_DQ15 | POD12_DCI | 37 | DQ15 |
| AJ15 | DDR4_SODIMM_DQ16 | POD12_DCI | 50 | DQ16 |
| AJ16 | DDR4_SODIMM_DQ17 | POD12_DCI | 49 | DQ17 |
| AK17 | DDR4_SODIMM_DQ18 | POD12_DCI | 62 | DQ18 |
| AJ17 | DDR4_SODIMM_DQ19 | POD12_DCI | 63 | DQ19 |
| AL18 | DDR4_SODIMM_DQ20 | POD12_DCI | 46 | DQ20 |
| AK18 | DDR4_SODIMM_DQ21 | POD12_DCI | 45 | DQ21 |
| AL15 | DDR4_SODIMM_DQ22 | POD12_DCI | 58 | DQ22 |
| AL16 | DDR4_SODIMM_DQ23 | POD12_DCI | 59 | DQ23 |
| AN16 | DDR4_SODIMM_DQ24 | POD12_DCI | 70 | DQ24 |
| AN17 | DDR4_SODIMM_DQ25 | POD12_DCI | 71 | DQ25 |
| AP15 | DDR4_SODIMM_DQ26 | POD12_DCI | 83 | DQ26 |
| AP16 | DDR4_SODIMM_DQ27 | POD12_DCI | 84 | DQ27 |
| AN18 | DDR4_SODIMM_DQ28 | POD12_DCI | 66 | DQ28 |
| AM18 | DDR4_SODIMM_DQ29 | POD12_DCI | 67 | DQ29 |

Table 3-4: DDR4 SODIMM Socket J1 Connections to FPGA PL Banks 64, 65, and 66 (Cont'd)

| XCZU7EV (U1) Pin | Net Name | I/O Standard | DDR4 SODIMM Memory J1 | |
|---------------------|------------------|--------------|-----------------------|----------|
| | | | Pin Number | Pin Name |
| AP13 | DDR4_SODIMM_DQ30 | POD12_DCI | 79 | DQ30 |
| AN13 | DDR4_SODIMM_DQ31 | POD12_DCI | 80 | DQ31 |
| AA20 | DDR4_SODIMM_DQ32 | POD12_DCI | 174 | DQ32 |
| AA19 | DDR4_SODIMM_DQ33 | POD12_DCI | 173 | DQ33 |
| AD19 | DDR4_SODIMM_DQ34 | POD12_DCI | 187 | DQ34 |
| AC18 | DDR4_SODIMM_DQ35 | POD12_DCI | 186 | DQ35 |
| AE20 | DDR4_SODIMM_DQ36 | POD12_DCI | 170 | DQ36 |
| AD20 | DDR4_SODIMM_DQ37 | POD12_DCI | 169 | DQ37 |
| AC19 | DDR4_SODIMM_DQ38 | POD12_DCI | 183 | DQ38 |
| AB19 | DDR4_SODIMM_DQ39 | POD12_DCI | 182 | DQ39 |
| AE24 | DDR4_SODIMM_DQ40 | POD12_DCI | 195 | DQ40 |
| AE23 | DDR4_SODIMM_DQ41 | POD12_DCI | 194 | DQ41 |
| AF22 | DDR4_SODIMM_DQ42 | POD12_DCI | 207 | DQ42 |
| AF21 | DDR4_SODIMM_DQ43 | POD12_DCI | 208 | DQ43 |
| AG20 | DDR4_SODIMM_DQ44 | POD12_DCI | 191 | DQ44 |
| AG19 | DDR4_SODIMM_DQ45 | POD12_DCI | 190 | DQ45 |
| AH21 | DDR4_SODIMM_DQ46 | POD12_DCI | 203 | DQ46 |
| AG21 | DDR4_SODIMM_DQ47 | POD12_DCI | 204 | DQ47 |
| AJ22 | DDR4_SODIMM_DQ48 | POD12_DCI | 216 | DQ48 |
| AJ21 | DDR4_SODIMM_DQ49 | POD12_DCI | 215 | DQ49 |
| AK20 | DDR4_SODIMM_DQ50 | POD12_DCI | 228 | DQ50 |
| AJ20 | DDR4_SODIMM_DQ51 | POD12_DCI | 229 | DQ51 |
| AK19 | DDR4_SODIMM_DQ52 | POD12_DCI | 211 | DQ52 |
| AJ19 | DDR4_SODIMM_DQ53 | POD12_DCI | 212 | DQ53 |
| AL23 | DDR4_SODIMM_DQ54 | POD12_DCI | 224 | DQ54 |
| AL22 | DDR4_SODIMM_DQ55 | POD12_DCI | 225 | DQ55 |
| AN23 | DDR4_SODIMM_DQ56 | POD12_DCI | 237 | DQ56 |
| AM23 | DDR4_SODIMM_DQ57 | POD12_DCI | 236 | DQ57 |
| AP23 | DDR4_SODIMM_DQ58 | POD12_DCI | 249 | DQ58 |
| AN22 | DDR4_SODIMM_DQ59 | POD12_DCI | 250 | DQ59 |
| AP22 | DDR4_SODIMM_DQ60 | POD12_DCI | 232 | DQ60 |
| AP21 | DDR4_SODIMM_DQ61 | POD12_DCI | 233 | DQ61 |
| AN19 | DDR4_SODIMM_DQ62 | POD12_DCI | 245 | DQ62 |
| AM19 | DDR4_SODIMM_DQ63 | POD12_DCI | 246 | DQ63 |

Table 3-4: DDR4 SODIMM Socket J1 Connections to FPGA PL Banks 64, 65, and 66 (Cont'd)

| XCZU7EV (U1) Pin | Net Name | I/O Standard | DDR4 SODIMM Memory J1 | |
|---------------------|--------------------|-----------------|-----------------------|--------------|
| | | | Pin Number | Pin Name |
| AH18 | DDR4_SODIMM_DM0_B | POD12_DCI | 12 | DM0_N/DBI0_N |
| AD15 | DDR4_SODIMM_DM1_B | POD12_DCI | 33 | DM1_N/DBI1_N |
| AM16 | DDR4_SODIMM_DM2_B | POD12_DCI | 54 | DM2_N/DBI2_N |
| AP18 | DDR4_SODIMM_DM3_B | POD12_DCI | 75 | DM3_N/DBI3_N |
| AE18 | DDR4_SODIMM_DM4_B | POD12_DCI | 178 | DM4_N/DBI4_N |
| AH22 | DDR4_SODIMM_DM5_B | POD12_DCI | 199 | DM5_N/DBI5_N |
| AL20 | DDR4_SODIMM_DM6_B | POD12_DCI | 220 | DM6_N/DBI6_N |
| AP19 | DDR4_SODIMM_DM7_B | POD12_DCI | 241 | DM7_N/DBI7_N |
| AH14 | DDR4_SODIMM_DQS0_T | DIFF_POD12_DCI | 13 | DQS0_T |
| AJ14 | DDR4_SODIMM_DQS0_C | DIFF_POD12_DCI | 11 | DQS0_C |
| AA16 | DDR4_SODIMM_DQS1_T | DIFF_POD12_DCI | 34 | DQS1_T |
| AA15 | DDR4_SODIMM_DQS1_C | DIFF_POD12_DCI | 32 | DQS1_C |
| AK15 | DDR4_SODIMM_DQS2_T | DIFF_POD12_DCI | 55 | DQS2_T |
| AK14 | DDR4_SODIMM_DQS2_C | DIFF_POD12_DCI | 53 | DQS2_C |
| AM14 | DDR4_SODIMM_DQS3_T | DIFF_POD12_DCI | 76 | DQS3_T |
| AN14 | DDR4_SODIMM_DQS3_C | DIFF_POD12_DCI | 74 | DQS3_C |
| AA18 | DDR4_SODIMM_DQS4_T | DIFF_POD12_DCI | 179 | DQS4_T |
| AB18 | DDR4_SODIMM_DQS4_C | DIFF_POD12_DCI | 177 | DQS4_C |
| AF23 | DDR4_SODIMM_DQS5_T | DIFF_POD12_DCI | 200 | DQS5_T |
| AG23 | DDR4_SODIMM_DQS5_C | DIFF_POD12_DCI | 198 | DQS5_C |
| AK22 | DDR4_SODIMM_DQS6_T | DIFF_POD12_DCI | 221 | DQS6_T |
| AK23 | DDR4_SODIMM_DQS6_C | DIFF_POD12_DCI | 219 | DQS6_C |
| AM21 | DDR4_SODIMM_DQS7_T | DIFF_POD12_DCI | 242 | DQS7_T |
| AN21 | DDR4_SODIMM_DQS7_C | DIFF_POD12_DCI | 240 | DQS7_C |
| AH11 | DDR4_SODIMM_CK0_T | DIFF_SSTL12_DCI | 139 | CK0_C |
| AJ11 | DDR4_SODIMM_CK0_C | DIFF_SSTL12_DCI | 137 | CK0_T |
| AJ9 | DDR4_SODIMM_CK1_T | DIFF_SSTL12_DCI | 140 | CK1_C/NF |
| AK9 | DDR4_SODIMM_CK1_C | DIFF_SSTL12_DCI | 138 | CK1_T/NF |
| AB13 | DDR4_SODIMM_CKE0 | SSTL12_DCI | 109 | CKE0 |
| AL13 | DDR4_SODIMM_CKE1 | SSTL12_DCI | 110 | CKE1 |
| AF10 | DDR4_SODIMM_ODT0 | SSTL12_DCI | 155 | ODT0 |
| AK13 | DDR4_SODIMM_ODT1 | SSTL12_DCI | 161 | ODT1 |
| AF11 | DDR4_SODIMM_RAS_B | SSTL12_DCI | 152 | RAS_N/A16 |
| AE12 | DDR4_SODIMM_CAS_B | SSTL12_DCI | 156 | CAS_N/A15 |

Table 3-4: DDR4 SODIMM Socket J1 Connections to FPGA PL Banks 64, 65, and 66 (Cont'd)

| XCZU7EV (U1) Pin | Net Name | I/O Standard | DDR4 SODIMM Memory J1 | |
|------------------|---------------------|--------------|-----------------------|----------|
| | | | Pin Number | Pin Name |
| AC12 | DDR4_SODIMM_WE_B | SSTL12_DCI | 151 | WE_N/A14 |
| AD14 | DDR4_SODIMM_ACT_B | SSTL12_DCI | 114 | ACT_N |
| AF13 | DDR4_SODIMM_ALERT_B | SSTL12_DCI | 116 | ALERT_N |
| AC13 | DDR4_SODIMM_PARITY | SSTL12_DCI | 143 | PARITY |
| AD12 | DDR4_SODIMM_CS0_B | SSTL12_DCI | 149 | CS0_N |
| AM13 | DDR4_SODIMM_CS1_B | SSTL12_DCI | 157 | CS1_N |
| AF12 | DDR4_SODIMM_RESET_B | LVC MOS12 | 108 | RESET_N |

The ZCU104 board PL DDR4 SODIMM interface adheres to the constraints guidelines documented in the “PCB Guidelines for DDR4” section of *UltraScale Architecture PCB Design User Guide* (UG583) [Ref 4]. The PL DDR4 SODIMM interface is a 40Ω impedance implementation. Other memory interface details are also available in the *UltraScale Architecture FPGAs Memory Interface Solutions Product Guide* (PG150) [Ref 5].

PSMIO

Table 3-5 provides PS MIO peripheral mapping implemented on the ZCU104 board. See the *Zynq UltraScale+ MPSoC Technical Reference Manual* (UG1085) [Ref 2] for more information on PS MIO peripheral mapping.

Table 3-5: MIO Connections

| MIO [25:0] Bank 500 | ZU7EV U1 Pin No. | Schematic Net Name | Type | MI [51:26] Bank 501 | ZU7EV U1 Pin No. | Schematic Net Name | Type | MIO [77:52] Bank 502 | ZU7EV U1 Pin No. | Schematic Net Name | Type |
|---------------------|------------------|---------------------|-------|---------------------|------------------|--------------------|------|----------------------|------------------|--------------------|-------|
| MIO25 | D29 | MIO25_CAN_RX | CAN | MIO51 | F34 | MIO51_SDIO_CLK_R | SD1 | MIO77 | L34 | MIO77_ENET_MDIO | MDIO3 |
| MIO24 | E28 | MIO24_CAN_TX | CAN | MIO50 | F33 | MIO50_SDIO_CMD_R | SD1 | MIO76 | L33 | MIO76_ENET_MDC | MDIO3 |
| MIO23 | B29 | Not Connected | NC | MIO49 | F32 | MIO49_SDIO_DAT3_R | SD1 | MIO75 | L30 | MIO75_ENET_RX_CTRL | GEM3 |
| MIO22 | F28 | Not Connected | NC | MIO48 | F31 | MIO48_SDIO_DAT2_R | SD1 | MIO74 | L29 | MIO74_ENET_RX_D3 | GEM3 |
| MIO21 | C28 | UART1_TXD_MIO21_RXD | UART1 | MIO47 | F30 | MIO47_SDIO_DAT1_R | SD1 | MIO73 | K34 | MIO73_ENET_RX_D2 | GEM3 |
| MIO20 | E29 | UART1_RXD_MIO20_TXD | UART1 | MIO46 | E34 | MIO46_SDIO_DAT0_R | SD1 | MIO72 | K33 | MIO72_ENET_RX_D1 | GEM3 |
| MIO19 | B28 | UART0_RXD_MIO19_TXD | UART0 | MIO45 | E33 | MIO45_SDIO_DETECT | SD1 | MIO71 | K32 | MIO71_ENET_RX_D0 | GEM3 |
| MIO18 | F27 | UART0_TXD_MIO18_RXD | UART0 | MIO44 | E32 | Not Connected | NC | MIO70 | K31 | MIO70_ENET_RX_CLK | GEM3 |
| MIO17 | C29 | MIO17_I2C1_SDA | I2C1 | MIO43 | E30 | Not Connected | NC | MIO69 | K30 | MIO69_ENET_TX_CTRL | GEM3 |
| MIO16 | A28 | MIO16_I2C1_SCL | I2C1 | MIO42 | D34 | Not Connected | NC | MIO68 | K29 | MIO68_ENET_TX_D3 | GEM3 |
| MIO15 | E27 | Not Connected | NC | MIO41 | D32 | Not Connected | NC | MIO67 | K28 | MIO67_ENET_TX_D2 | GEM3 |
| MIO14 | A27 | Not Connected | NC | MIO40 | D31 | Not Connected | NC | MIO66 | J34 | MIO66_ENET_TX_D1 | GEM3 |
| MIO13 | D27 | Not Connected | NC | MIO39 | D30 | Not Connected | NC | MIO65 | J32 | MIO65_ENET_TX_D0 | GEM3 |
| MIO12 | C27 | Not Connected | NC | MIO38 | C34 | Not Connected | NC | MIO64 | J31 | MIO64_ENET_TX_CLK | GEM3 |
| MIO11 | B26 | Not Connected | NC | MIO37 | C33 | Not Connected | NC | MIO63 | J30 | MIO63_USB_DATA7_R | USB0 |
| MIO10 | F26 | Not Connected | NC | MIO36 | C32 | Not Connected | NC | MIO62 | J29 | MIO62_USB_DATA6_R | USB0 |

Table 3-5: MIO Connections (Cont'd)

| MIO [25:0] Bank 500 | ZU7EV U1 Pin No. | Schematic Net Name | Type | MI [51:26] Bank 501 | ZU7EV U1 Pin No. | Schematic Net Name | Type | MIO [77:52] Bank 502 | ZU7EV U1 Pin No. | Schematic Net Name | Type |
|---------------------|------------------|--------------------|------|---------------------|------------------|--------------------|-------|----------------------|------------------|--------------------|------|
| MIO9 | C26 | Not Connected | NC | MIO35 | C31 | Not Connected | NC | MIO61 | H34 | MIO61_USB_DATA5_R | USB0 |
| MIO8 | D26 | Not Connected | NC | MIO34 | B34 | Not Connected | NC | MIO60 | H33 | MIO60_USB_DATA4_R | USB0 |
| MIO7 | B25 | Not Connected | NC | MIO33 | B33 | Not Connected | NC | MIO59 | H32 | MIO59_USB_DATA3_R | USB0 |
| MIO6 | A26 | Not Connected | NC | MIO32 | B31 | Not Connected | NC | MIO58 | H31 | MIO58_USB_STP_R | USB0 |
| MIO5 | D25 | MIO5_QSPI_LWR_CS_B | QSPI | MIO31 | B30 | Not Connected | NC | MIO57 | H29 | MIO57_USB_DATA1_R | USB0 |
| MIO4 | A25 | MIO4_QSPI_LWR_DQ0 | QSPI | MIO30 | A33 | MIO30_DP_AUX_IN | DPAUX | MIO56 | G34 | MIO56_USB_DATA0_R | USB0 |
| MIO3 | E25 | MIO3_QSPI_LWR_DQ3 | QSPI | MIO29 | A32 | MIO29_DP_OE | DPAUX | MIO55 | G33 | MIO55_USB_NXT | USB0 |
| MIO2 | B24 | MIO2_QSPI_LWR_DQ2 | QSPI | MIO28 | A31 | MIO28_DP_HPD | DPAUX | MIO54 | G31 | MIO54_USB_DATA2_R | USB0 |
| MIO1 | C24 | MIO1_QSPI_LWR_DQ1 | QSPI | MIO27 | A30 | MIO27_DP_AUX_OUT | DPAUX | MIO53 | G30 | MIO53_USB_DIR | USB0 |
| MIO0 | A24 | MIO0_QSPI_LWR_CLK | QSPI | MIO26 | A29 | Not Connected | NC | MIO52 | G29 | MIO52_USB_CLK | USB0 |

Quad SPI Flash Memory (MIO 0–5)

[Figure 2-1, callout 4]

The Micron MT25QU512ABB8ESF serial NOR flash Quad SPI flash memory can hold the boot image for the MPSoC system. This interface is used to support QSPI32 boot mode as defined in the *Zynq UltraScale+ MPSoC Technical Reference Manual (UG1085)* [Ref 2].

The Quad SPI flash memory (U119) is located on the bottom of the board, and provides 512 Mb of non-volatile storage that can be used for configuration and data storage.

- Part number: MT25QU512ABB8ESF-0SIT (Micron)
- Supply voltage: 1.8V
- Datapath width: 4 bits
- Data rate: Various depending on single, dual, or quad mode

The connections between the SPI flash memory and the XCZU7EV MPSoC are listed in Table 3-6.

Table 3-6: Quad SPI Flash Memory Component Connections to MPSoC U1

| XCZU7EV (U1) Pin | Net Name | Quad SPI U119 (LWR), U120 (UPR) | |
|------------------|--------------------|---------------------------------|----------------|
| | | Pin # | Pin Name |
| A25 | MIO4_QSPI_LWR_DQ0 | 15 | DQ0 |
| C24 | MIO1_QSPI_LWR_DQ1 | 8 | DQ1 |
| B24 | MIO2_QSPI_LWR_DQ2 | 9 | DQ2_WP_B |
| E25 | MIO3_QSPI_LWR_DQ3 | 1 | DQ3_RST_HOLD_B |
| A24 | MIO0_QSPI_LWR_CLK | 16 | C |
| D25 | MIO5_QSPI_LWR_CS_B | 7 | S_B |

The configuration and Quad SPI flash memory section of the *Zynq UltraScale+ MPSoC Technical Reference Manual* (UG1085) [Ref 2] provides details on using the memory. For more Quad SPI details, see the Micron MT25QU512ABB8ESF-0SIT data sheet at the Micron website [Ref 11].

USB0 (MIO 52-63)

The USB interface on the PS-side serves multiple roles as a host or device controller. The USB 3.0 interface is supported by the MPSoC GTR interface while the USB 2.0 capabilities of the SMSC USB3320C controller are shared on a common USB 3.0 USB type AB connector (J96).

USB 3.0 Transceiver and USB 2.0 ULPI PHY

[Figure 2-1, callout 5]

The ZCU104 board uses a Standard Microsystems Corporation USB3320 USB 2.0 ULPI transceiver at U116 to support a USB connection to the host computer (see Figure 3-3). A USB cable is supplied in the ZCU104 evaluation kit (standard-A connector to host computer, micro-B connector to ZCU104 board connector J96). The USB3320 is a high-speed USB 2.0 PHY supporting the UTMI+ low pin interface (ULPI) interface standard. The ULPI standard defines the interface between the USB controller IP and the PHY device, which drives the physical USB bus. Use of the ULPI standard reduces the interface pin count between the USB controller IP and the PHY device.

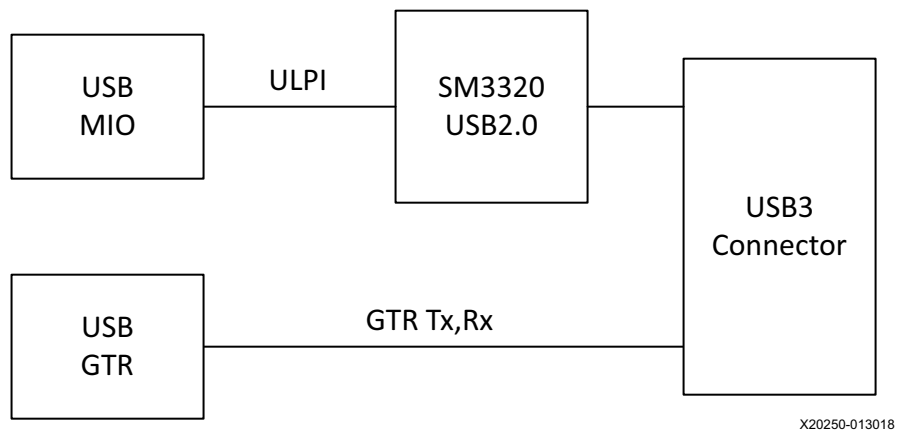


Figure 3-3: USB Interface

The USB3320 is clocked by a 24 MHz crystal. See the Standard Microsystems Corporation (SMSC) USB3320 data sheet for clocking mode details [Ref 12]. The interface to the USB3320 PHY is implemented through the IP in the XCZU7EV MPSoC PS. The ZCU104 USB3320 PHY supports host only mode. The connections between the USB 2.0 PHY at U116 and the XCZU7EV MPSoC are listed in Table 3-7.

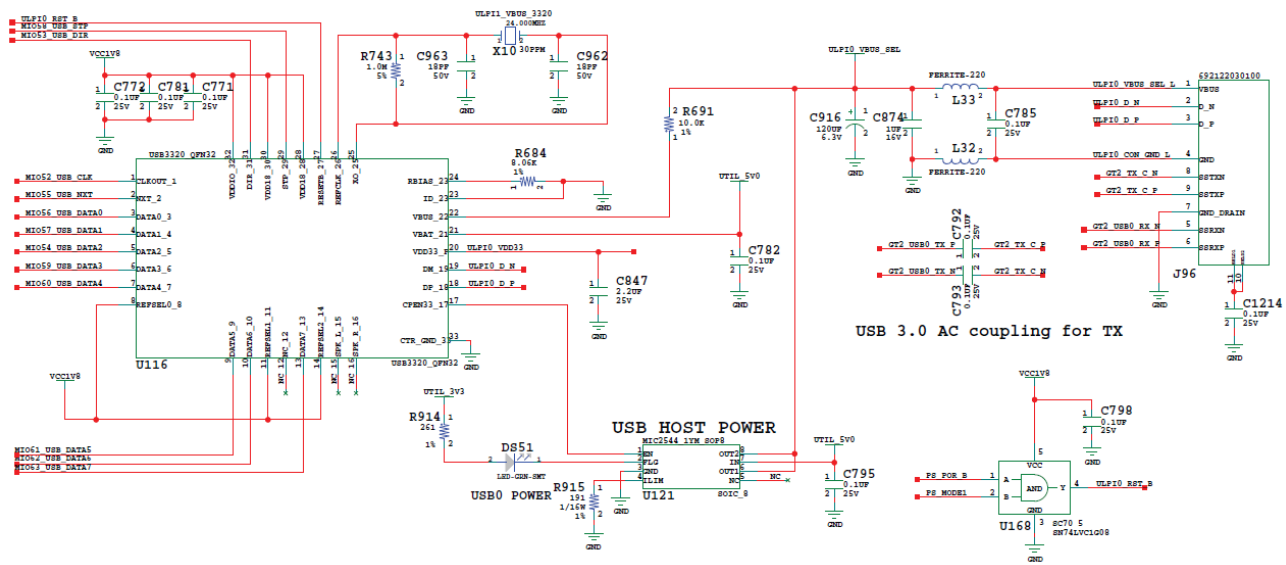
Table 3-7: USB 2.0 ULPI Transceiver Connections to XCZU7EV MPSoC

| XCZU7EV (U1) Pin | Net Name | USB3320 U116 | |
|------------------|--------------------------------|--------------|----------|
| | | Pin # | Pin Name |
| U168.4 | ULPI0_RST_B ⁽¹⁾ | 27 | RESET_B |
| H31 | MIO58_USB_STP ⁽²⁾ | 29 | STP |
| G30 | MIO53_USB_DIR | 31 | DIR |
| G29 | MIO52_USB_CLK | 1 | CLKOUT |
| G33 | MIO55_USB_NXT | 2 | NXT |
| G34 | MIO56_USB_DATA0 ⁽²⁾ | 3 | DATA0 |
| H29 | MIO57_USB_DATA1 ⁽²⁾ | 4 | DATA1 |
| G31 | MIO54_USB_DATA2 ⁽²⁾ | 5 | DATA2 |
| H32 | MIO59_USB_DATA3 ⁽²⁾ | 6 | DATA3 |
| H33 | MIO60_USB_DATA4 ⁽²⁾ | 7 | DATA4 |
| H34 | MIO61_USB_DATA5 ⁽²⁾ | 9 | DATA5 |
| J29 | MIO62_USB_DATA6 ⁽²⁾ | 10 | DATA6 |
| J30 | MIO63_USB_DATA7 ⁽²⁾ | 13 | DATA7 |

Notes:

1. PS_POR_B (U1.M24) or PS_MODE1 (DIP SW6.2) drive U116 RST_B via OR gate U168.
2. These nets are 30Ω series resistor coupled.

The USB3320 ULPI U116 transceiver circuit (see [Figure 3-4](#)) has a Micrel MIC2544 high-side programmable current limit switch (U121). This switch has an open-drain output fault flag on pin 2, which turns on LED DS51 if over current or thermal shutdown conditions are detected. DS51 is located in the U116 circuit area near pushbutton SW4 ([Figure 2-1](#), callout 20).



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Figure 3-4: ULPI U116 Transceiver Circuit

SD1 (MIO 45-51)

A PS-side interface to an SD card connector is provided for booting and file system storage. This interface is used for the SD boot mode and supports SD3.0 access post boot.

SD Card Interface

[Figure 2-1, callout 6]

The ZCU104 board includes a secure digital input/output (SDIO) interface to provide access to general purpose non-volatile SDIO memory cards and peripherals. See the SanDisk Corporation [Ref 13] or SD Association [Ref 14] websites for more information on the SD I/O card specification. The ZCU104 SD card interface supports the SD1_LS configuration boot mode documented in the *Zynq UltraScale+ MPSoC Technical Reference Manual* (UG1085) [Ref 2].

The SDIO signals are connected to XCZU7EV MPSoC PS bank 501, which has its V_{CCMIO} set to 1.8V. Each of the six MIOxx_SDIO_* nets has a series 30Ω resistor at the source. A MAX13035E voltage level-translator (U145) is present between the XCZU7EV MPSoC and the SD card connector (J100).

Figure 3-5 shows the connections of the SD card interface on the ZCU104 board.

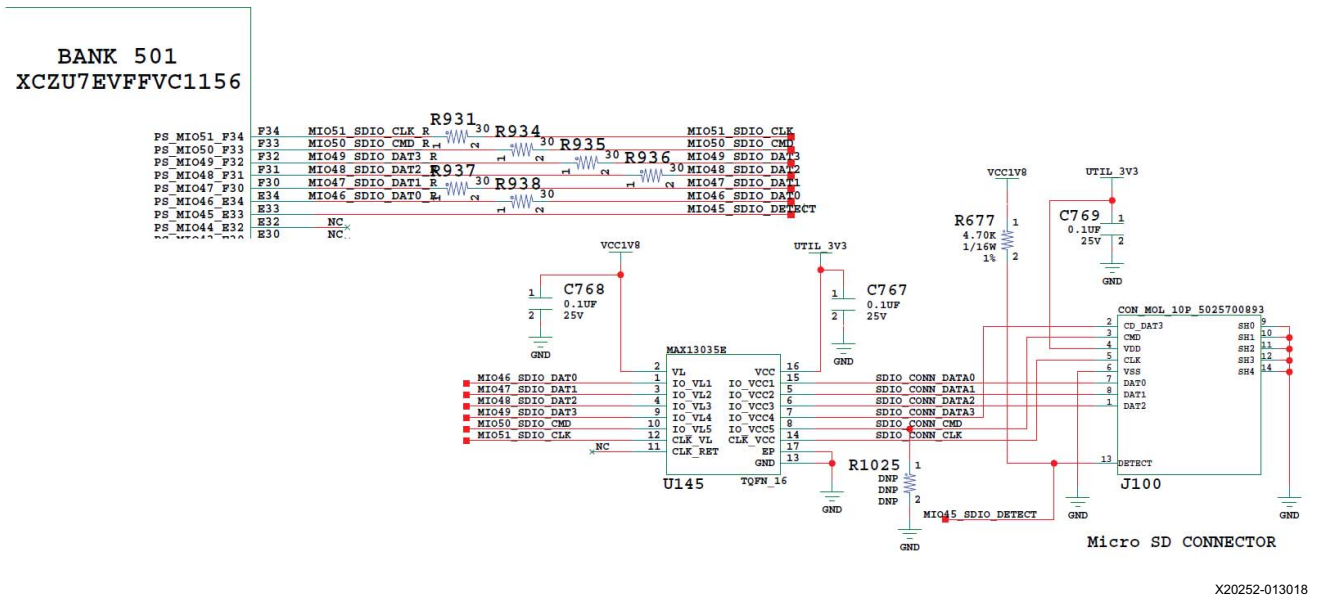


Figure 3-5: SD Card Interface

Table 3-8 lists the SD card interface connections to the XCZU7EV MPSoC.

Table 3-8: XCZU7EV MIO Connections to SD Socket via U145

| XCZU7EV (U1) Pin | Net Name | J100 SD Card Socket | |
|---------------------|-------------------|---------------------|----------|
| | | Pin # | Pin Name |
| E34 | MIO46_SDIO_DAT0 | 7 | DAT0 |
| F30 | MIO47_SDIO_DAT1 | 8 | DAT1 |
| F31 | MIO48_SDIO_DAT2 | 1 | DAT2 |
| F32 | MIO49_SDIO_DAT3 | 2 | CD_DAT3 |
| F33 | MIO50_SDIO_CMD | 3 | CMD |
| F34 | MIO51_SDIO_CLK | 5 | CLK |
| E33 | MIO45_SDIO_DETECT | 13 | DETECT |

Programmable Logic JTAG Programming Options

[Figure 2-1, callouts 7 and 25]

The ZCU104 board JTAG chain is shown in Figure 3-6.

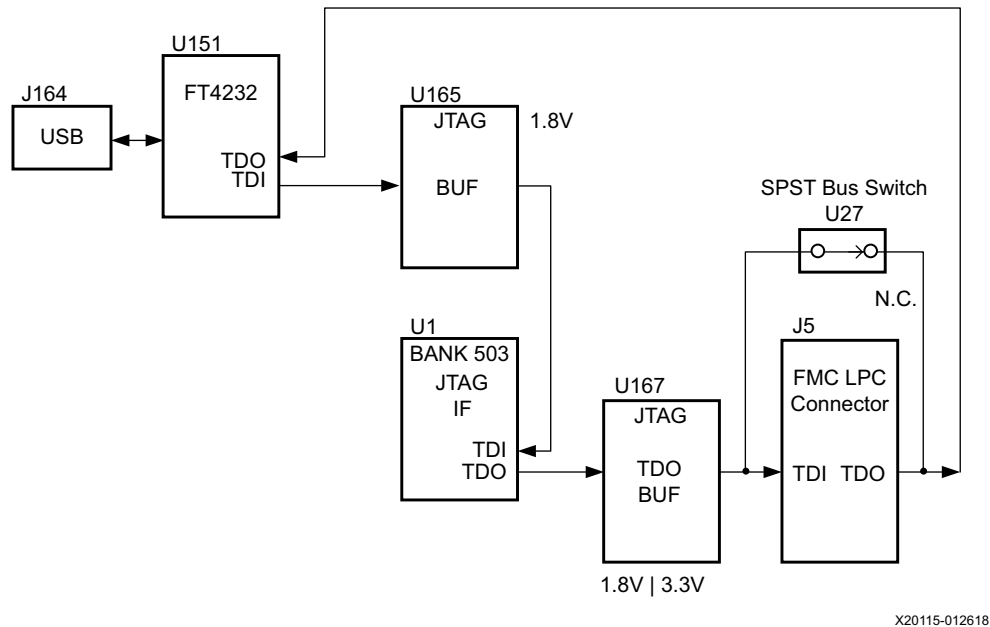


Figure 3-6: JTAG Chain Block Diagram

FMC Connector JTAG Bypass

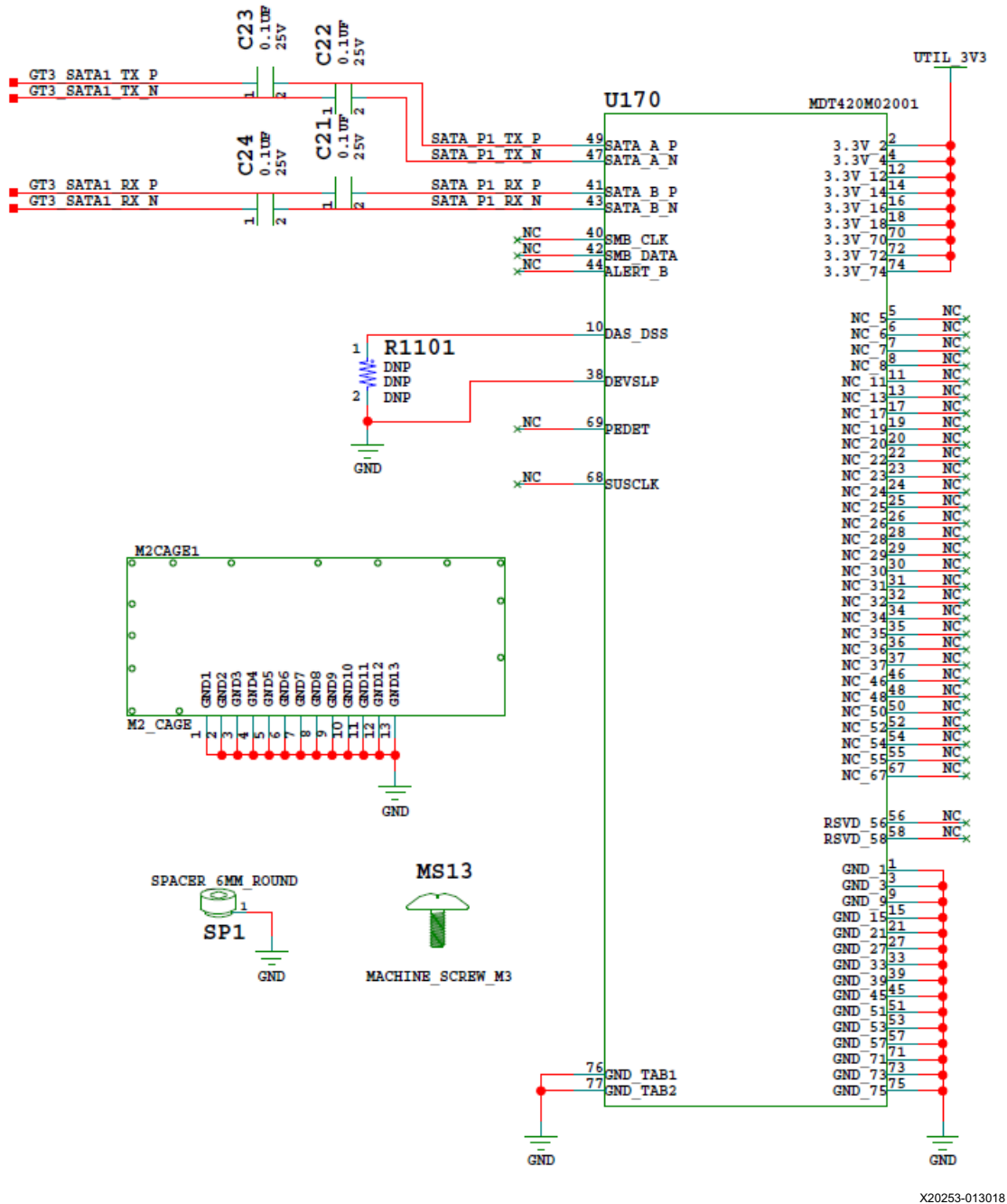
When an FPGA mezzanine card (FMC) is attached to J5, it is automatically added to the JTAG chain through electronically controlled single-pole single-throw (SPST) switch U27. The SPST switch is normally closed and transitions to an open state when an FMC is attached. Switch U27 adds an attached FMC to the JTAG chain as determined by the FMC_LPC_PRSENT_M2C_B signal. The attached FMC card must implement a TDI-to-TDO connection using a device or bypass jumper to ensure that the JTAG chain connects to the U1 XCZU7EV MPSoC.

PS M.2 SATA Connector

[Figure 2-1, callout 32]

The M.2 SATA interface is provided for SATA SSD access using the PS-side bank 505 GTR transceiver. Figure 3-7 shows M.2 connector U170.

The socket 2 SATA adapter pinout with key M is shown in Table 3-9. SATA-A data connection is used for TX and SATA-B for RX. The M.2 connector U170 is a type 2242 (active component section 22 mm wide with overall length 42 mm form factor) used on socket 2.



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Figure 3-7: M.2 Connector U170

The M.2 U170 connector pinout is listed in [Table 3-9](#).

Table 3-9: M.2 Connector U170 Pinout

| Pin | Signal |
|-----|----------------------------|
| 74 | 3.3V |
| 72 | 3.3V |
| 70 | 3.3V |
| 68 | SUSCLK(32 kHz) (I)(0/3.3V) |
| | ADD_IN CARD KEY M |
| | ADD_IN CARD KEY M |
| | ADD_IN CARD KEY M |
| | ADD_IN CARD KEY M |
| 58 | Reserved for MGFG_CLOCK |
| 56 | Reserved for MGFG_DATA |
| 54 | NC |
| 52 | NC |
| 50 | NC |
| 48 | NC |
| 46 | NC |
| 44 | ALERT# (O) (0/1.8V) |
| 42 | SMB_DATA (I/O) (0/1.8V) |
| 40 | SMB_CLK (I/O) (0/1.8V) |
| 38 | DEVSLP (I) |
| 36 | NC |
| 34 | NC |
| 32 | NC |
| 30 | NC |
| 28 | NC |
| 26 | NC |
| 24 | NC |
| 22 | NC |
| 20 | NC |
| 18 | 3.3V |
| 16 | 3.3V |
| 14 | 3.3V |
| 12 | 3.3V |
| 10 | DAS/DSS (I/O) |

Table 3-9: M.2 Connector U170 Pinout (Cont'd)

| Pin | Signal |
|-----|-------------------|
| 8 | NC |
| 6 | NC |
| 4 | 3.3V |
| 2 | 3.3V |
| 75 | GND |
| 73 | GND |
| 71 | GND |
| 69 | PEDET (GND-SATA) |
| 67 | NC |
| | ADD_IN CARD KEY M |
| | ADD_IN CARD KEY M |
| | ADD_IN CARD KEY M |
| | ADD_IN CARD KEY M |
| 57 | GND |
| 55 | NC |
| 53 | NC |
| 51 | GND |
| 49 | SATA-A+ |
| 47 | SATA-A- |
| 45 | GND |
| 43 | SATA-B+ |
| 41 | SATA-B- |
| 39 | GND |
| 37 | NC |
| 35 | NC |
| 33 | GND |
| 31 | NC |
| 29 | NC |
| 27 | GND |
| 25 | NC |
| 23 | NC |
| 21 | GND |
| 19 | NC |
| 17 | NC |
| 15 | GND |

Table 3-9: M.2 Connector U170 Pinout (Cont'd)

| Pin | Signal |
|-----|--------|
| 13 | NC |
| 11 | NC |
| 9 | GND |
| 7 | NC |
| 5 | NC |
| 3 | GND |
| 1 | GND |

The M.2 adapter tie-offs as implemented on the ZCU104 board are listed in [Table 3-10](#).

Table 3-10: M.2 U170 Connector Tie-offs

| M.2 Signal Name | ZCU104 Tie-Off | U170 Pin |
|-----------------|----------------|----------|
| SUSCLK | No Connect | 68 |
| ALERT# | No Connect | 44 |
| SMB_DATA | No Connect | 42 |
| SMB_CLK | No Connect | 40 |
| DEVSLP | GND | 38 |
| DAS/DSS | DNP Res to GND | 10 |
| PEDET | No Connect | 69 |
| SATA-A | GTR TX | 49, 47 |
| SATA-B | GTR RX | 43, 41 |

The M.2 U170 connector to MPSoC connections are listed in [Table 3-11](#).

Table 3-11: M.2 U170 Connections to XCZU7EV MPSoC

| XCZU7EV (U1) Pin | Net Name | I/O Standard | M.2 Connector U170 | |
|------------------|----------------|--------------|--------------------|----------|
| | | | Pin Number | Pin Name |
| N29 | GT3_SATA1_TX_P | (1) | 49 | SATA-A+ |
| N30 | GT3_SATA1_TX_N | (1) | 47 | SATA-A- |
| N33 | GT3_SATA1_RX_P | (1) | 41 | SATA-B+ |
| N34 | GT3_SATA1_RX_N | (1) | 43 | SATA-B- |

Notes:

1. Series capacitor coupled, MGT I/F, I/O standards do not apply.

For more information, see [PCI_Express_M.2_Specification_Rev1.1_TS_12092016_NCB \[Ref 17\]](#).

Clock Generation

The ZCU104 board provides an IDT8T49N287 FemtoClock® NG octal universal frequency translator (U182) clock generator. [Table 3-12](#) lists the frequency for each clock.

Table 3-12: Clock Sources

| Clock (Net) Name | Frequency | IDT8T49N287 U182 Clock Output |
|------------------|------------|-------------------------------|
| HDMI_DRU_CLOCK | 156.25 MHz | Q0 |
| PS_REF_CLK | 33.33 MHz | Q1 |
| GTR_REF_CLK_USB3 | 26 MHz | Q2 |
| GTR_REF_CLK_DP | 27 MHz | Q3 |
| CLK_300_P | 300 MHz | Q4 |
| GTR_REF_CLK_SATA | 125 MHz | Q5 |
| CLK_125 | 125 MHz | Q6 |

[Table 3-13](#) lists the connectivity for each clock.

Table 3-13: Clock Connections, Source to XCZU7EV MPSoC

| Clock Source Pin | Net Name | I/O Standard | XCZU7EV (U1) Pin |
|------------------|--------------------|--------------------------|------------------|
| U182.48 | HDMI_DRU_CLOCK_P | (2) | U10 |
| U182.47 | HDMI_DRU_CLOCK_N | (2) | U9 |
| U182.44 | PS_REF_CLK | LVC MOS18 ⁽¹⁾ | R24 |
| U182.27 | GTR_REF_CLK_USB3_P | (2) | M27 |
| U182.28 | GTR_REF_CLK_USB3_N | (2) | M28 |
| U182.23 | GTR_REF_CLK_DP_P | (2) | M31 |
| U182.24 | GTR_REF_CLK_DP_N | (2) | M32 |
| U182.40 | CLK_300_C_P | (2) | AH12 |
| U182.39 | CLK_300_C_N | (2) | AJ12 |
| U182.37 | GTR_REF_CLK_SATA_P | (2) | P27 |
| U182.36 | GTR_REF_CLK_SATA_N | (2) | P28 |
| U182.34 | CLK_125_P | LVDS | H11 |
| U182.33 | CLK_125_N | LVDS | G11 |

Notes:

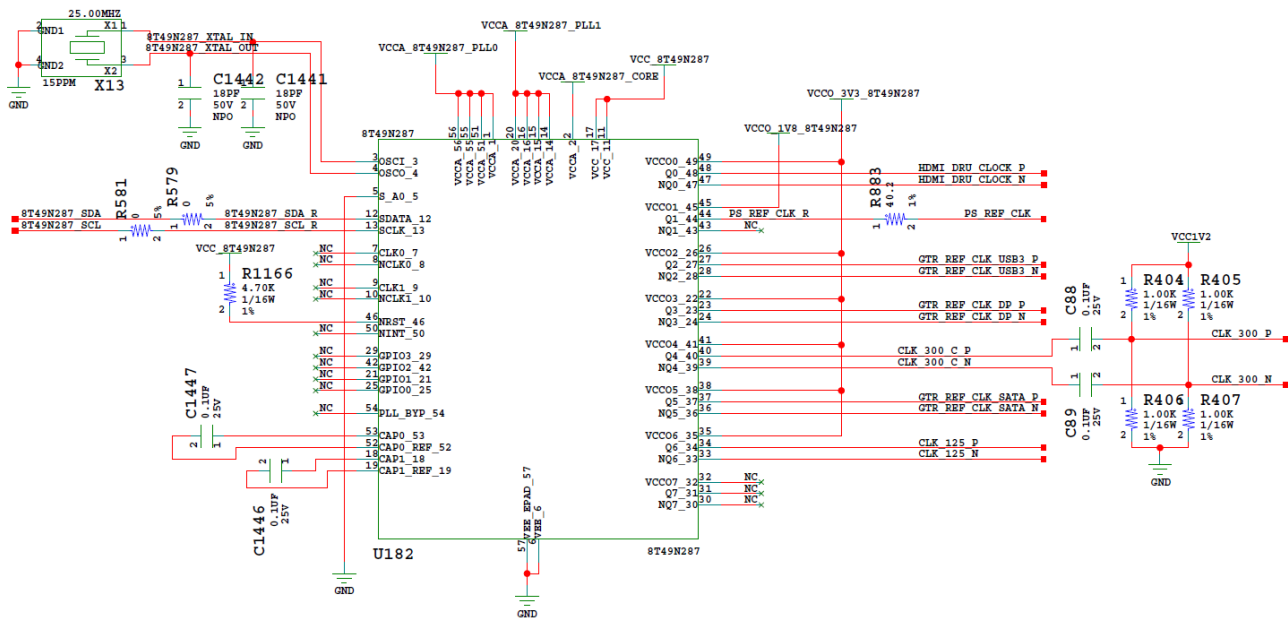
1. U1 XCZU7EV Bank 503 supports LVC MOS level inputs.
2. U1 MGT (I/O standards do not apply).

IDT8T49N287 FemtoClock NG Octal Universal Frequency Translator

[Figure 2-1, callout 8]

- Clock generator: IDT8T49N287A-501NLGI
- Jitter: <0.3 ps RMS typical

The IDT8T49N287A-501NLGI U182 (located on the bottom of the board) is a one-time programmable clock source with frequency adjustment available over the I2C bus. The clock circuit is shown in Figure 3-8.



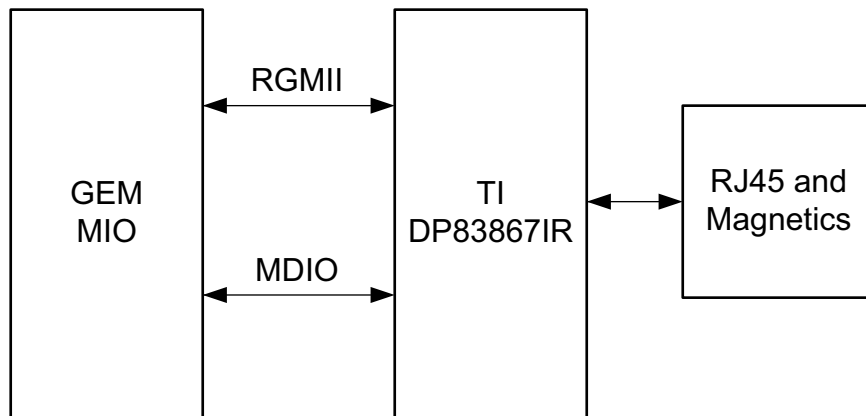
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Figure 3-8: IDT8T49N287 Clock Generator

For more details, see the IDT8T49N287A data sheet [Ref 21].

GEM3 Ethernet (MIO 64-77)

The PS-side Gigabit Ethernet MAC (GEM) implements a 10/100/1000 Mb/s Ethernet interface (see [Figure 3-9](#)), which connects to a TI DP83867IRPAP Ethernet RGMII PHY U98 routed to an RJ45 Ethernet connector. The RGMII Ethernet PHY is boot strapped to PHY address 5'b01100 (0x0C) and Auto Negotiation is set to *Enable*. The communication with the device is described in the DP83867 RGMII PHY data sheet [\[Ref 16\]](#).



X16527-100818

Figure 3-9: Ethernet Block Diagram

10/100/1000 MHz Tri-Speed Ethernet PHY

[[Figure 2-1](#), callout 9]

The ZCU104 board uses the TIDP83867IRPAP Ethernet RGMII PHY [\[Ref 16\]](#) (U98) for Ethernet communications at 10 Mb/s, 100 Mb/s, or 1000 Mb/s. The board supports RGMII mode only. The PHY connection to a user-provided Ethernet cable is through a Bel Fuse L829-1J1T-43 RJ-45 connector (P12) with built-in magnetics and LED indicators. The connections from XCZU7EV MPSoC U1 to the DP83867IRPAP PHY device U98 (bottom of the board) are listed in [Table 3-14](#).

Table 3-14: DP83867 PHY Connections to XCZU7EV MPSoC

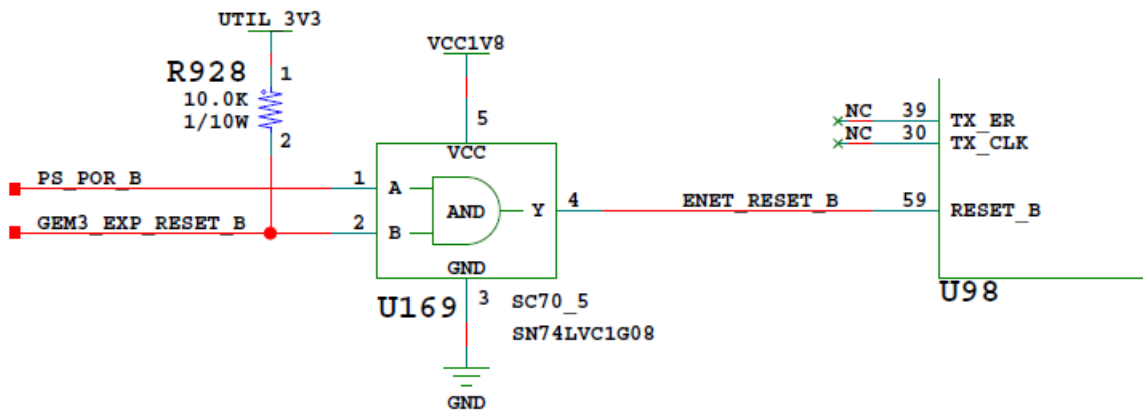
| XCZU7EV (U1) Pin | Net Name | DP83867 PHY U98 | |
|------------------|--------------------|-----------------|---------------|
| | | Pin # | Pin Name |
| J31 | MIO64_ENET_TX_CLK | 40 | GTX_CLK |
| J32 | MIO65_ENET_TX_D0 | 38 | TX_DO |
| J34 | MIO66_ENET_TX_D1 | 37 | TX_D1 |
| K28 | MIO67_ENET_TX_D2 | 36 | TX_D2 |
| K29 | MIO68_ENET_TX_D3 | 35 | TX_D3 |
| K30 | MIO69_ENET_TX_CTRL | 52 | TX_EN_TX_CTRL |

Table 3-14: DP83867 PHY Connections to XCZU7EV MPSoC (Cont'd)

| XCZU7EV (U1) Pin | Net Name | DP83867 PHY U98 | |
|------------------|--------------------|-----------------|---------------|
| | | Pin # | Pin Name |
| K31 | MIO70_ENET_RX_CLK | 43 | RX_CLK |
| K32 | MIO71_ENET_RX_D0 | 44 | RX_D0 |
| K33 | MIO72_ENET_RX_D1 | 45 | RX_D1 |
| K34 | MIO73_ENET_RX_D2 | 46 | RX_D2 |
| L29 | MIO74_ENET_RX_D3 | 47 | RX_D3 |
| L30 | MIO75_ENET_RX_CTRL | 53 | RX_DV_RX_CTRL |
| L33 | MIO76_ENET_MDC | 20 | MDC |
| L34 | MIO77_ENET_MDIO | 21 | MDIO |

Ethernet PHY Reset

The DP83867IRPAP PHY reset gate U169 is shown in Figure 3-10. The DP83867IRPAP can be reset by the MAX16025 U22 MPSoC PS-side POR reset device (PS_POR_B) or the I2C0 connected U97 TCA6416A I/O expander pin 10 port P06 (GEM3_EXP_RESET_B).



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Figure 3-10: Ethernet PHY Reset Circuit

Ethernet PHY LED Interface

[Figure 2-1, callout 9]

The DP83867IRPAP PHY U98 LED interface (LED_0, LED_2) uses the two LEDs embedded in the P12 RJ45 connector bezel. The LED functional description is listed in Table 3-15.

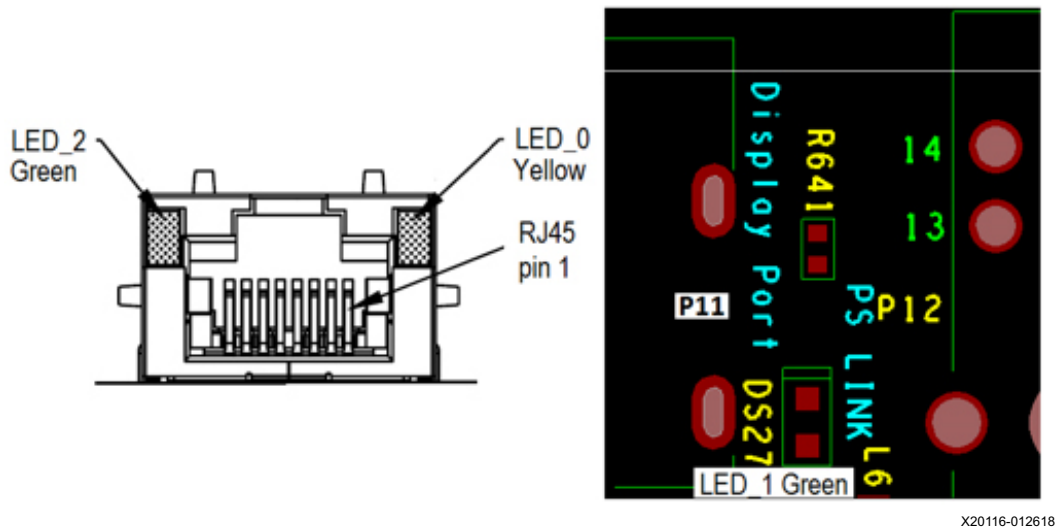
Table 3-15: Ethernet PHY LED Functional Description

| Pin | | Type | Description |
|-------|--------|------------|---|
| Name | Number | | |
| LED_2 | 61 | S, I/O, PD | By default, this pin indicates receive or transmit activity. Additional functionality is configurable using LEDCR1[11:8] register bits. Note: This pin is a strap configuration pin for RGZ devices only. |
| LED_1 | 62 | S, I/O, PD | By default, this pin indicates that 100BASE-T link is established. Additional functionality is configurable using LEDCR1[7:4] register bits. |
| LED_0 | 63 | S, I/O, PD | By default, this pin indicates that link is established. Additional functionality is configurable using LEDCR1[3:0] register bits. |

The LED functions can be re-purposed with a LEDCR1 register write available via the PHY's management data interface, MDIO/MDC. LED_2 is assigned to the activity indicator (ACT) and LED_0 indicates link established. For more Ethernet PHY details, see the TI DS83867 data sheet [Ref 16].

The DP83867IRPAP PHY LED indicators are shown in [Figure 3-11](#).

- LED_0 is the RJ-45 P12 bezel right-side yellow LED, link established indicator.
- LED_2 is the RJ-45 P12 bezel left-side green LED, TX/RX activity indicator.
- LED_1 is the green DS27 LED, mounted on the ZCU104 board top between the display port connector P11 and the Ethernet RJ-45 connector P12, indicates the 1000BASE-T link is established.



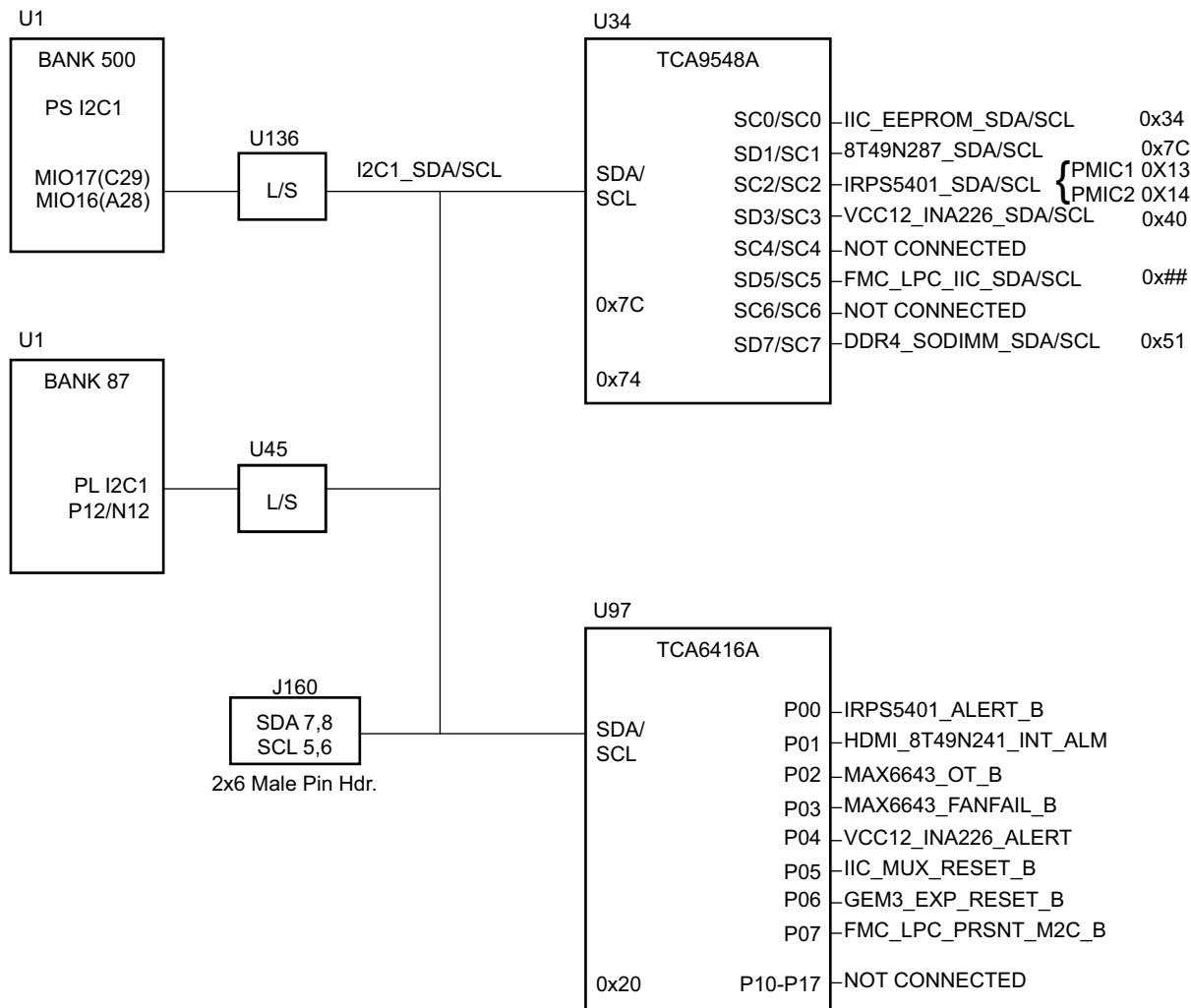
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Figure 3-11: Ethernet PHY Status LEDs

I2C1 (MIO 16-17)

[Figure 2-1, callouts 12 and 13]

The I2C1 interface provides access to I2C peripherals through I2C switch TCA9548A U34. A TCA6416A port expander U97 is also attached to the I2C1 bus. The I2C1 PS-side bank 500 connection is shared with PL-side bank 87. Figure 3-12 shows a high-level view of the I2C1 bus connectivity represented in Table 3-16 and Table 3-17. TCA9548A U34 is set to 0x74 and the TCA6416A is set to 0x20.



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Figure 3-12: I2C1 Bus Topology

Table 3-16 and Table 3-17 show U34 and U97 (located on the bottom of the board) connections, respectively.

Table 3-16: I2C1 TCA9548A U34 Multiplexer Connections

| U34 I2C1 Mux (Addr 0x74) Port | I2C1 Bus Device | Target Device Address |
|-------------------------------|------------------------|------------------------|
| 0 | EEPROM U23 | 0x34 |
| 1 | IDT8T49N287 Clock U182 | 0x7C |
| 2 | IRP5401 PMICs | PMIC1 0x13; PMIC2 0x14 |
| 3 | VCC12 INA226 U183 | 0x40 |
| 4 | No connection | NA |
| 5 | FMC LPC J5 | 0x## |
| 6 | No connection | NA |
| 7 | DDR4 SODIMM J1 | 0x51 |

Table 3-17: TCA6416A U97 I2C Expander

| U97 I2C1 Expander (Addr 0x20) Port | Schematic Net Name | Target Device Pin |
|------------------------------------|-----------------------|-------------------|
| P00 | IRP5401_ALERT_B | U179.17 |
| P01 | HDMI_8T49N241_INT_ALM | U181.29 |
| P02 | MAX6643_OT_B | U128.9 |
| P03 | MAX6643_FANFAIL_B | U128.4 |
| P04 | VCC12_INA226_ALERT | U183.3 |
| P05 | IIC_MUX_RESET_B | U34.3 |
| P06 | GEM3_EXP_RESET_B | U169.2 |
| P07 | FMC_LPC_PRSNT_M2C_B | J5.H2 |

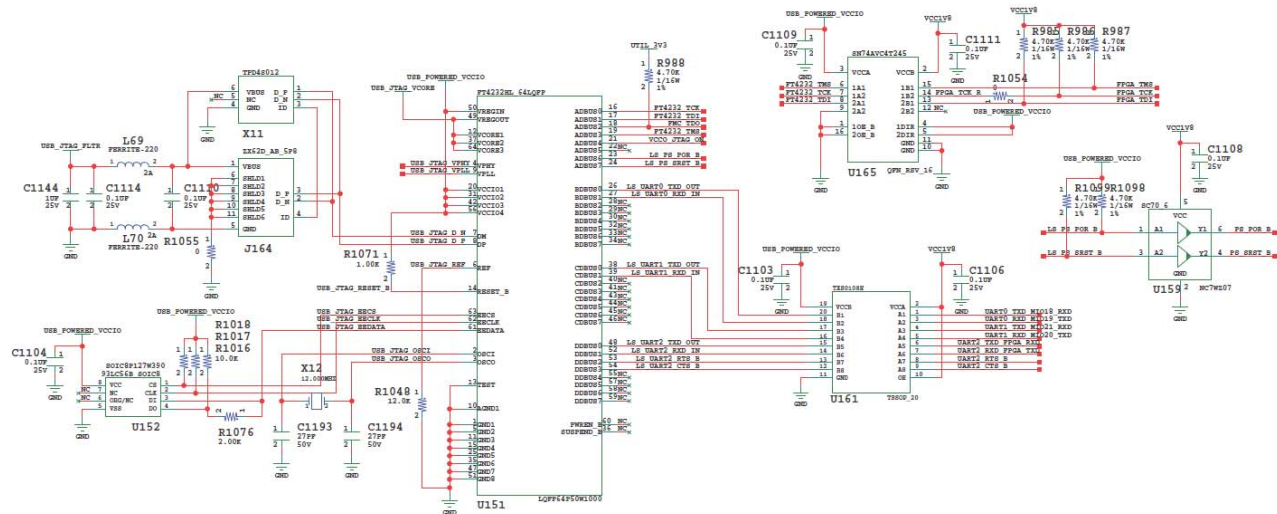
FT4232HL USB UART Interface (MIO 18-21)

[Figure 2-1, callout 7]

The FT4232HL U151 quad USB-UART on the ZCU104 board provides three level-shifted UART connections through the single micro-AB USB connector J164.

- Channel A is configured to support the JTAG chain.
- Channel B implements UART0 MIO18/19 connections.
- Channel C implements UART1 MIO20/21 connections.
- Channel D implements UART2 PL-side bank 28 4-wire interface.

The USB UART interface circuit is shown in Figure 3-13. The FTDI FT4232HL data sheet is available on the Silicon Labs website [Ref 15].



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Figure 3-13: Quad USB UART Interface

The nets of the three UART channel are level-shifted by U161. The UART connections from XCZU7EV MPSoC U1 PL-side bank 28 to the FT4232HL device through U161 are listed in [Table 3-18](#).

Table 3-18: XCZU7EV U1 PL-side to FT4232HL U151 Connections via L/S U161

| XCZU7EV (U1) Pin | Net Name | FT4232HL U151 | |
|------------------|--------------------|---------------|-------|
| | | Pin Name | Pin # |
| A20 | UART2_TXD_FPGA_RXD | DDBUS1 | 52 |
| C19 | UART2_RXD_FPGA_TXD | DDBUS0 | 48 |
| C18 | UART2_RTS_B | DDBUS2 | 53 |
| A19 | UART2_CTS_B | DDBUS3 | 54 |

UART0 (MIO 18-19)

This is the primary Zynq UltraScale+ MPSoC PS-side UART interface and is connected to the U151 FT4232HL USB-to-Quad-UART with port assignments as listed in [Table 3-19](#). PS-side UART0 is accessed through the U151 FT4232HL USB-to-Quad-UART bridge BDBUS port. The UART connections from XCZU7EV MPSoC U1 PS-side MIO 18 and 19 to the FT4232HL device through level-shifter U161 are listed in [Table 3-19](#).

Table 3-19: XCZU7EV U1 PS-side MIO 18, 19 to FT4232HL U151 Connections via L/S U161

| XCZU7EG U1 | | Schematic Net Name | FT4232HL U151 | |
|------------|------|---------------------|---------------|-------|
| Pin Name | Pin# | | Pin Name | Pin # |
| PS_MIO18 | F27 | UART0_TXD_MIO18_RXD | BDBUS1 | 27 |
| PS_MIO19 | B28 | UART0_RXD_MIO19_TXD | BDBUS0 | 26 |

UART1 (MIO 20-21)

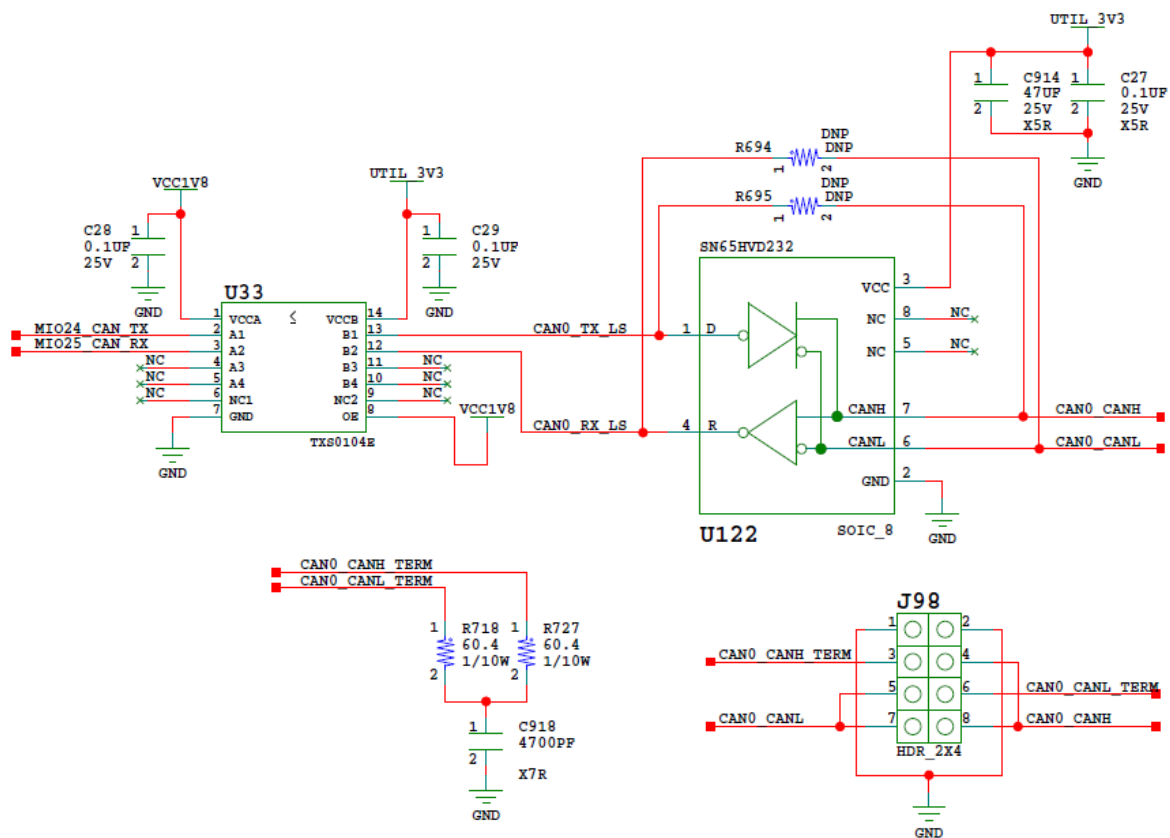
PS-side UART1 is accessed through the U151 FT4232HL USB-to-Quad-UART bridge CDBUS port. The UART connections from XCZU7EV MPSoC U1 PS-side MIO 20 and 21 to the FT4232HL device through level-shifter U161 are listed in [Table 3-20](#).

Table 3-20: XCZU7EV U1 PS-side MIO 20, 21 to FT4232HL U151 Connections via L/S U161

| XCZU7EG U1 | | Schematic Net Name | FT4232HL U151 | |
|------------|------|---------------------|---------------|-------|
| Pin Name | Pin# | | Pin Name | Pin # |
| PS_MIO21 | C28 | UART1_TXD_MIO21_RXD | CDBUS1 | 39 |
| PS_MIO20 | E29 | UART1_RXD_MIO20_TXD | CDBUS0 | 38 |

CAN1 (MIO 24-25)

The PS-side CAN bus TX (MIO24, U1 pin E28) and RX (MIO25, U1 pin D29) signals are routed through TXS0104E level-translator U33 and TI SN65HVD232 CAN-bus transceiver U122 to the 0.1 inch centered 8-pin male header J98 as shown in [Figure 3-14](#).



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Figure 3-14: PS-Side CAN Bus Circuit

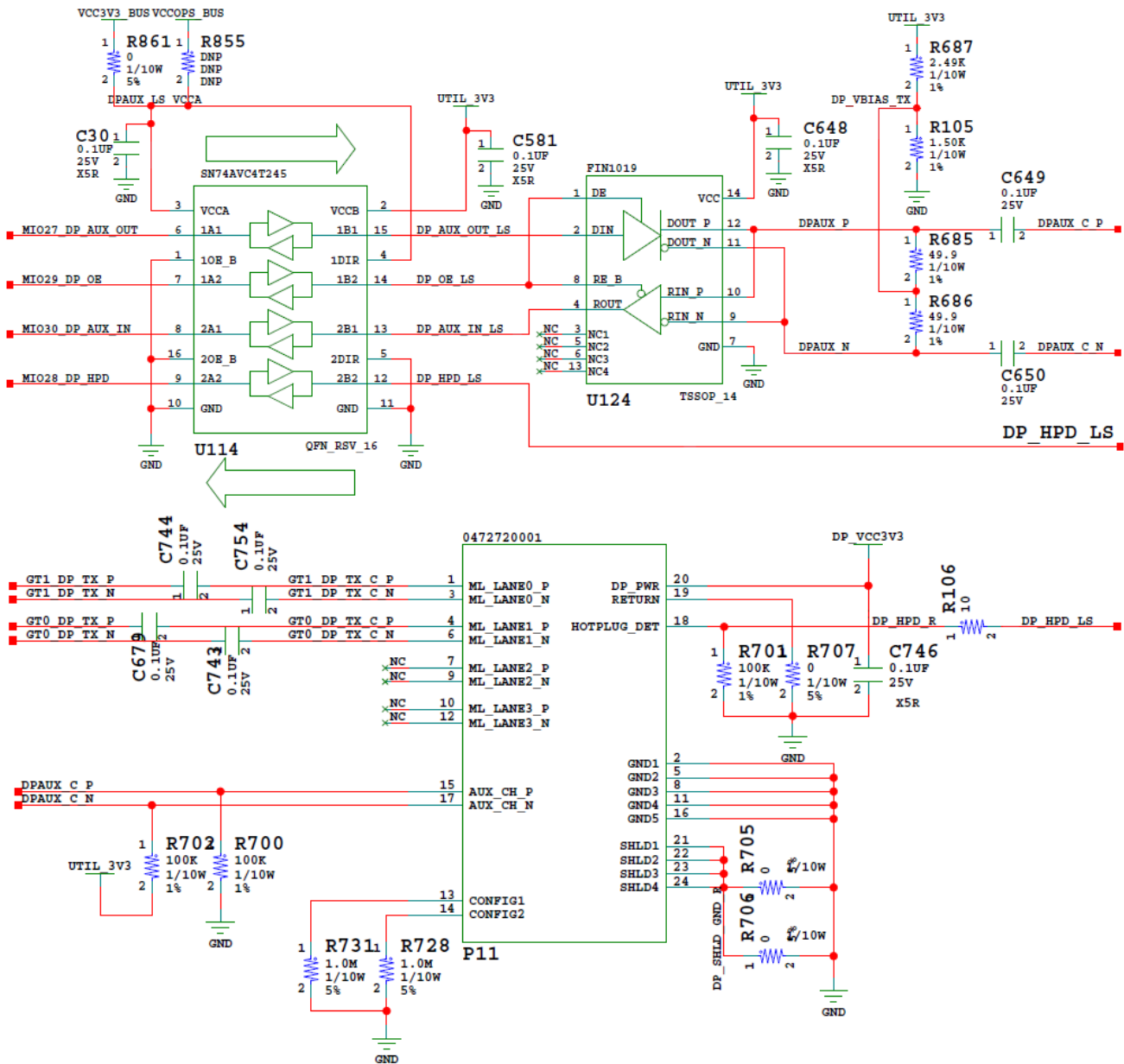
DPAUX (MIO 27-30)

[Figure 2-1, callout 27]

The Zynq UltraScale+ MPSoC provides a VESA DisplayPort 1.2 source-only controller that supports up to two lanes of main link data at rates of 1.62 Gb/s, 2.70 Gb/s, or 5.40 Gb/s. The DisplayPort standard defines an auxiliary channel that uses LVDS signaling at a 1 Mb/s data rate, which is translated from single-ended MIO signals to the differential DisplayPort AUX channel, DPAUX (see Table 3-21). The DisplayPort circuit is shown in Figure 3-15.

Table 3-21: DPAUX/MIO Connections

| XCZU7EV (U1) Pin | Net Name | Level Shifter U114 | |
|------------------|------------------|--------------------|-------|
| | | Pin Name | Pin # |
| A33 | MIO30_DP_AUX_IN | 2A1 | 8 |
| A32 | MIO29_DP_OE | 1A2 | 7 |
| A31 | MIO28_DP_HPD | 2A2 | 9 |
| A30 | MIO27_DP_AUX_OUT | 1A1 | 6 |



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Figure 3-15: DisplayPort Circuit

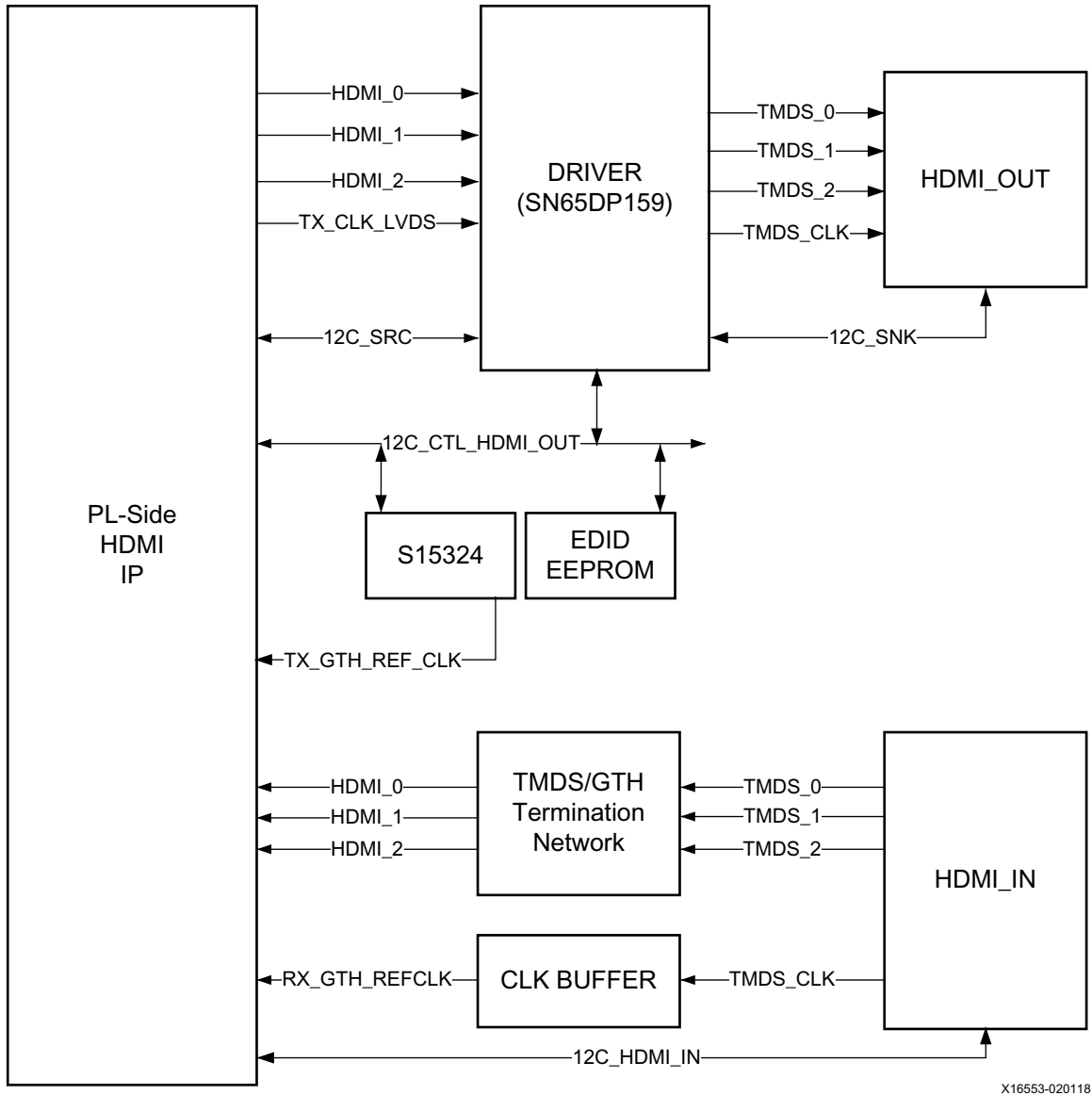
HDMI Video Output

[[Figure 2-1](#), callouts 10 and 11]

The ZCU104 board provides an HDMI® video output using a TI SN65DP159RGZ re-timer at U94. The output is provided on a TE Connectivity 1888811-1 right-angle dual-stacked HDMI type-A receptacle at P7. The SN65DP159RGZ device is a dual mode DisplayPort to transition-minimized differential signal (TMDS) re-timer supporting digital video interface (DVI) 1.0, HDMI 1.4b, and 2.0 output signals.

The SN65DP159RGZ device supports the dual mode standard version 1.1 type 1 and type 2 through the digital down converter (DDC) link or AUX channel. The SN65DP159RGZ device supports data rates up to 6 Gb/s per data lane to support Ultra HD (4K x 2K/60 Hz) 8-bits per color high-resolution video and HDTV with 16-bit color depth at 1080p (1920 x 1080/60 Hz). The SN65DP159RGZ device can automatically configure itself as a re-driver at data rates <1 Gb/s, or as a re-timer at more than this data rate. This feature can be turned off with I2C programming.

The HDMI block diagram, TX interface circuit, and RX interface circuit are shown in [Figure 3-16](#), [Figure 3-17](#), and [Figure 3-18](#), respectively. The XCZU7EV MPSoC U1 to HDMI circuit connections are listed in [Table 3-22](#).



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Figure 3-16: HDMI Interface Block Diagram

Table 3-22: HDMI Connections to MPSoC U1

| XCZU7EV (U1) Pin | Schematic Net Name | I/O Standard | Connected Component | | |
|------------------|---------------------|--------------|---------------------|----------|--|
| | | | Pin | Name | Device |
| M4 | HDMI_TX0_P | (1) | 8 | IN_D0P | SN65DP159 (U94) Wired to top port (P7) |
| M3 | HDMI_TX0_N | (1) | 9 | IN_D0N | |
| L6 | HDMI_TX1_P | (1) | 5 | IN_D1P | |
| L5 | HDMI_TX1_N | (1) | 6 | IN_D1N | |
| K4 | HDMI_TX2_P | (1) | 2 | IN_D2P | |
| K3 | HDMI_TX2_N | (1) | 3 | IN_D2N | |
| H9 | HDMI_TX_LVDS_OUT_P | LVDS | 11 | IN_CLKP | |
| G9 | HDMI_TX_LVDS_OUT_N | LVDS | 12 | IN_CLKN | |
| B1 | HDMI_TX_SRC_SCL | LVCMOS33 | 46 | SCL_SRC | |
| C1 | HDMI_TX_SRC_SDA | LVCMOS33 | 47 | SDA_SRC | |
| A2 | HDMI_TX_EN | LVCMOS33 | 42 | OE | TPD12S016RK (U70) |
| A3 | HDMI_TX_CEC | LVCMOS33 | 24 | CEC_A | |
| E3 | HDMI_TX_HPD | LVCMOS33 | 3 | HPD_A | |
| N11 | HDMI_SI5324_LOL | LVCMOS33 | 18 | LOL | SI5319C (U108) |
| M12 | HDMI_SI5324_RST | LVCMOS33 | 1 | RST_B | |
| G14 | HDMI_REC_CLOCK_C_P | LVDS | 16 | CKIN1_P | |
| F13 | HDMI_REC_CLOCK_C_N | LVDS | 17 | CKIN1_N | |
| T8 | HDMI_SI5324_OUT_C_P | (1) | 28 | CKOUT1_P | |
| T7 | HDMI_SI5324_OUT_C_N | (1) | 29 | CKOUT1_N | |
| N2 | HDMI_RX0_C_P | (1) | 29 | OUT_D0P | TMDS181IRGZT (U19) Wired to HDMI bottom port(P7) |
| M3 | HDMI_RX0_C_N | (1) | 28 | OUT_D0N | |
| L2 | HDMI_RX1_C_P | (1) | 32 | OUT_D1P | |
| L1 | HDMI_RX1_C_N | (1) | 31 | OUT_D1N | |
| J2 | HDMI_RX2_C_P | (1) | 35 | OUT_D2P | |
| J1 | HDMI_RX2_C_N | (1) | 34 | OUT_D2N | |
| R10 | HDMI_RX_CLK_C_P | (1) | 26 | OUT_CLKP | |
| R9 | HDMI_RX_CLK_C_N | (1) | 25 | OUT_CLKN | |
| F6 | HDMI_RX_HPD | LVCMOS33 | 33 | HPD_SNK | |
| E5 | HDMI_RX_PWR_DET | LVCMOS33 | 3 | D | |
| D1 | HDMI_CTL_SCL | LVCMOS33 | 15 | SCL_CTL | (2) |
| E1 | HDMI_CTL_SDA | LVCMOS33 | 16 | SDA_CTL | |

Table 3-22: HDMI Connections to MPSoC U1 (Cont'd)

| XCZU7EV (U1) Pin | Schematic Net Name | I/O Standard | Connected Component | | |
|------------------|--------------------|--------------|---------------------|-------|--------------------|
| | | | Pin | Name | Device |
| D2 | HDMI_RX_SNK_SCL | LVC MOS33 | 1 | SCL_A | TPD12S016RK (U102) |
| E2 | HDMI_RX_SNK_SDA | LVC MOS33 | 1 | SDA_A | |

Notes:

- U1 MGT (I/O standards do not apply).
- TMDS181IRG (U19), SN65DP159 (U94), M24C64-W (U109), and SI5324C (U108).

HDMI Clock Recovery

[Figure 2-1, callout 29]

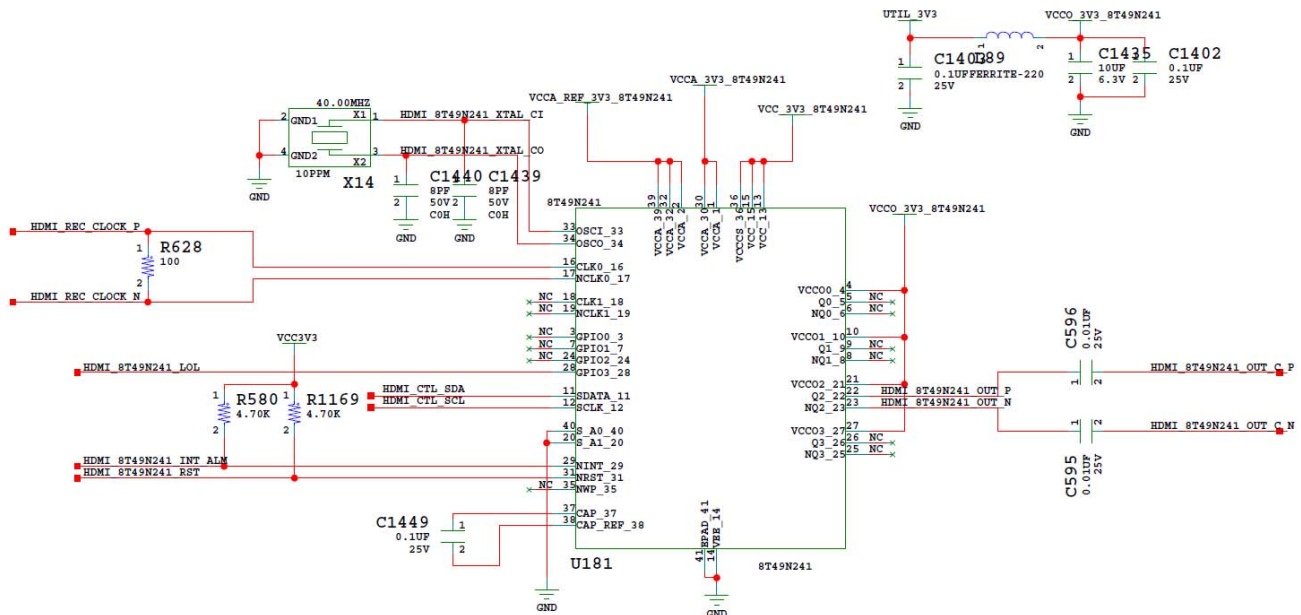
The ZCU104 board includes an IDT 8T49N241 jitter attenuator U181. The 8T49N241 has one fractional feedback phase-locked loop (PLL) that can be used as a jitter attenuator and frequency translator.

The FPGA can output the RX recovered clock to a differential I/O pair on I/O bank 67 (HDMI_REC_CLOCK_P, pin G14 and HDMI_REC_CLOCK_N, pin F13) for jitter attenuation. The jitter attenuated clock (HDMI_SI5324_OUT_C_P (U181 pin 22), HDMI_SI5324_OUT_C_N (U081 pin 39) is then routed as a series capacitor coupled reference clock to GTH Quad 227 inputs MGTREFCLK0P (U1 pin T8) and MGTREFCLK0N (U1 pin T7).

The 8T49N241 is used to generate the reference clock for the HDMI transmitter subsystem. When the HDMI transmitter is used in standalone mode, the 8T49N241 operates in free-running mode and uses an external oscillator as the reference. When the HDMI transmitter is used in pass-through mode, the 8T49N241 generates a jitter attenuated reference clock to drive the HDMI transmitter subsystem with a phase-aligned version of the HDMI Rx subsystem HDMI Rx TMDS clock, so that they are phase aligned. The 8T49N241 is controlled by an I2C interface connected to the FPGA. Enabling the jitter attenuation feature requires additional user programming through the FPGA connected HDMI_CTL I2C bus. The jitter attenuated clock circuit is shown in Figure 3-19.



IMPORTANT: The IDT 8T49N241 pin 31 reset net HDMI_8T49N241_RST must be driven High to enable the device. U181 pin 31 net HDMI_8T49N241_RST is connected to FPGA U1 bank 87 pin M12.



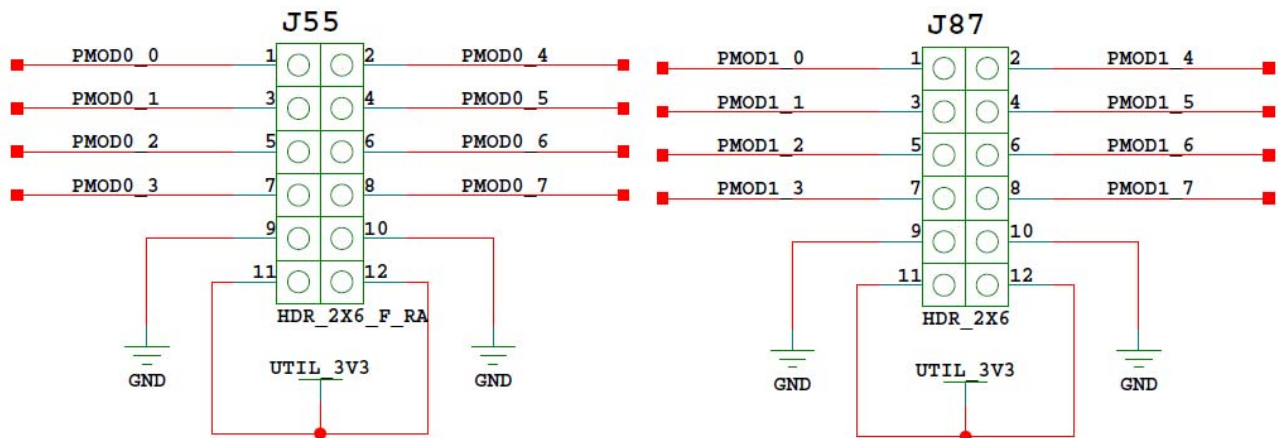
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Figure 3-19: HDMI Interface Clock Recovery

User PMOD GPIO Connectors

[Figure 2-1, callout 14]

The ZCU104 evaluation board supports two PMOD GPIO headers J55 (right-angle female) and J87 (vertical male). The 3.3V PMOD nets are wired to the XCZU7EV device U1 bank 87. Figure 3-20 shows the GPIO PMOD headers J55 and J87. Table 3-23 lists the connections between the XCZU7EV MPSoC and the PMOD connectors.



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Figure 3-20: PMOD Connectors

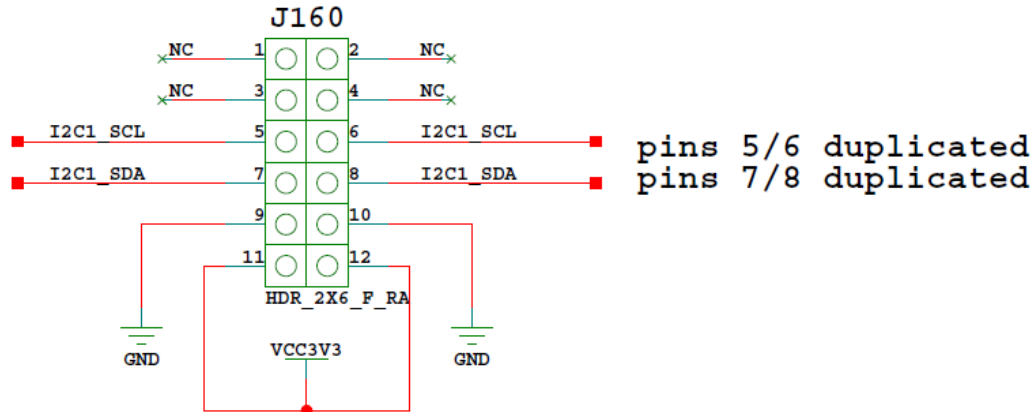
Table 3-23: XCZU7EV U1 to PMOD Connections

| XCZU7EV (U1) Pin | Net Name | I/O Standard | PMOD Pin |
|------------------|----------|--------------|----------|
| G8 | PMOD0_0 | LVC MOS33 | J55.1 |
| H8 | PMOD0_1 | LVC MOS33 | J55.3 |
| G7 | PMOD0_2 | LVC MOS33 | J55.5 |
| H7 | PMOD0_3 | LVC MOS33 | J55.7 |
| G6 | PMOD0_4 | LVC MOS33 | J55.2 |
| H6 | PMOD0_5 | LVC MOS33 | J55.4 |
| J6 | PMOD0_6 | LVC MOS33 | J55.6 |
| J7 | PMOD0_7 | LVC MOS33 | J55.8 |
| J9 | PMOD1_0 | LVC MOS33 | J87.1 |
| K9 | PMOD1_1 | LVC MOS33 | J87.3 |
| K8 | PMOD1_2 | LVC MOS33 | J87.5 |
| L8 | PMOD1_3 | LVC MOS33 | J87.7 |
| L10 | PMOD1_4 | LVC MOS33 | J87.2 |
| M10 | PMOD1_5 | LVC MOS33 | J87.4 |
| M8 | PMOD1_6 | LVC MOS33 | J87.6 |
| M9 | PMOD1_7 | LVC MOS33 | J77.8 |

User I2C1 Receptacle

[Figure 2-1, callout 21]

The ZCU104 evaluation board supports a PMOD 2X6 receptacle (right-angle female) J160. Figure 3-21 shows the I2C1 PMOD receptacle J160. The I2C1 nets are a branch of the I2C1 main bus (see Figure 3-11, page 49). See the Digilent website [Ref 20] for more information about the PMOD.



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Figure 3-21: J160 PMOD I2C1 Right-Angle Receptacle

User I/O

[Figure 2-1, callouts 16-19]

The ZCU104 board provides these user and general purpose I/O capabilities:

- Four user LEDs (callout 16)
 - GPIO_LED[7-0]: DS38, DS37, DS39, DS40
- Four user pushbuttons and CPU reset switch (callouts 18 and 19)
 - GPIO_PB_SW[0:3]: SW18, SW17, SW16, SW14, SW15
 - CPU_RESET: SW20
- 4-position user DIP switch (callout 17)
 - GPIO_DIP_SW[7:0]: SW13

Figure 3-22 through Figure 3-24 show the GPIO circuits. Table 3-24 lists the GPIO connections to XCZU7EV U1 3.3V bank 88.

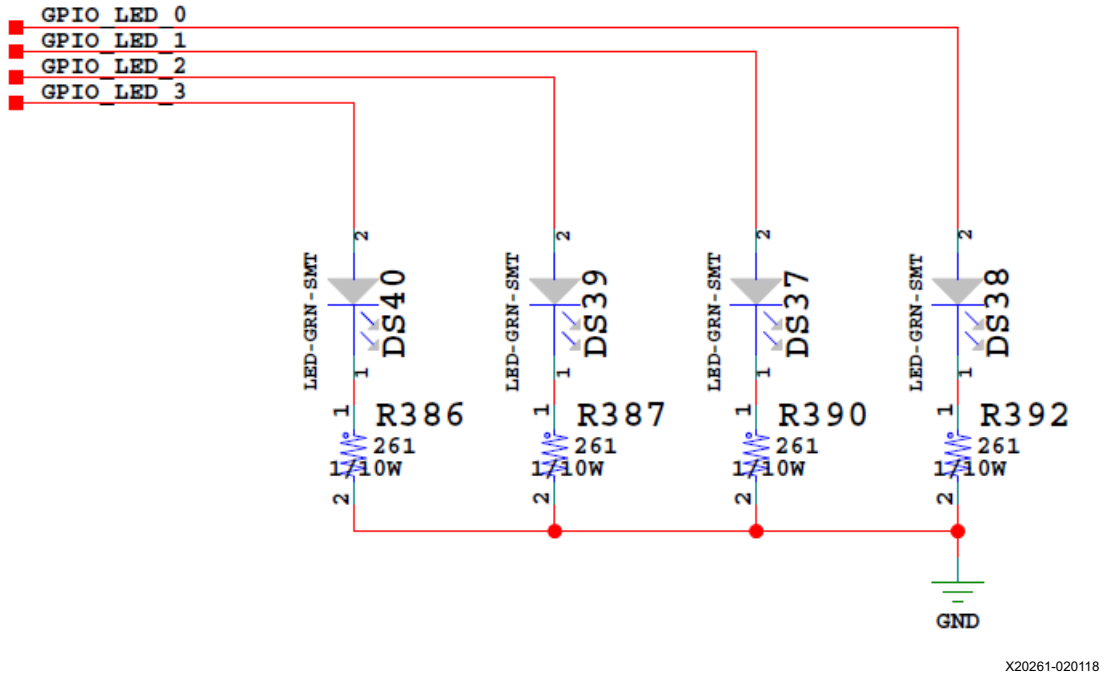
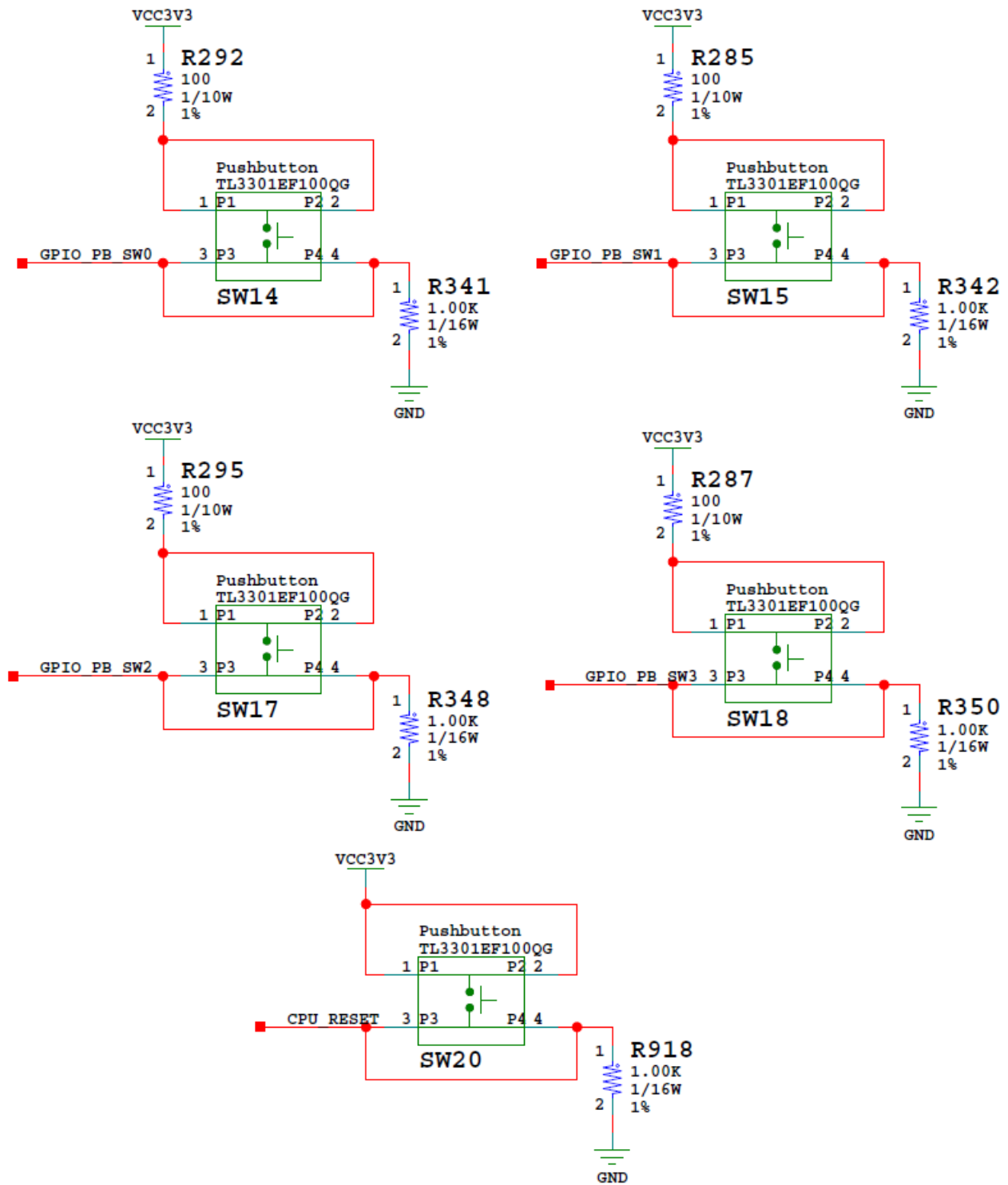
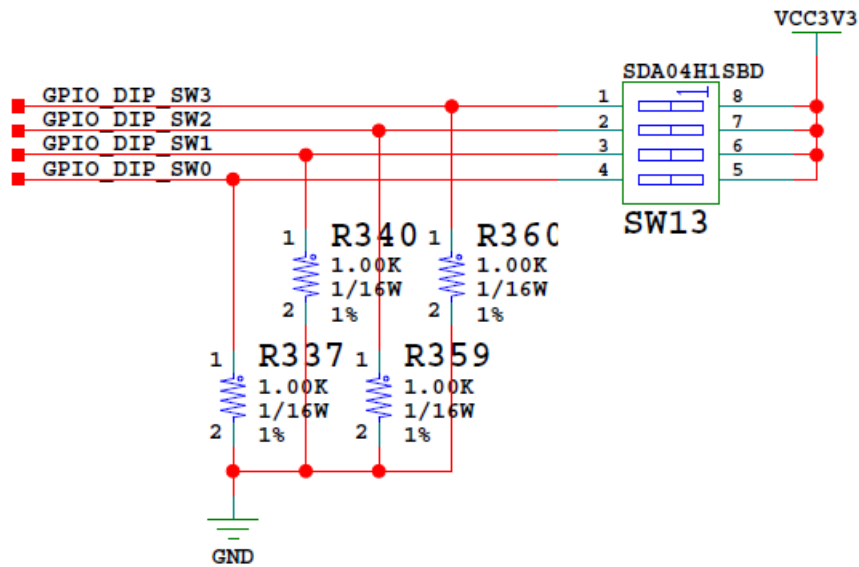


Figure 3-22: GPIO LEDs



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Figure 3-23: GPIO Pushbutton Switches



X20263-020118

Figure 3-24: GPIO 8-Pole DIP Switch

Table 3-24: XCZU7EV U1 to GPIO Connections

| XCZU7EV (U1) Pin | Net Name | I/O Standard | Device |
|--|--------------|--------------|--------|
| GPIO LEDs (Active High) ⁽¹⁾ | | | |
| D5 | GPIO_LED_0 | LVCMOS33 | DS38.2 |
| D6 | GPIO_LED_1 | LVCMOS33 | DS37.2 |
| A5 | GPIO_LED_2 | LVCMOS33 | DS39.2 |
| B5 | GPIO_LED_3 | LVCMOS33 | DS40.2 |
| Directional Pushbuttons (Active High) | | | |
| B4 | GPIO_PB_SW0 | LVCMOS33 | SW14.3 |
| C4 | GPIO_PB_SW1 | LVCMOS33 | SW15.3 |
| B3 | GPIO_PB_SW2 | LVCMOS33 | SW17.3 |
| C3 | GPIO_PB_SW3 | LVCMOS33 | SW18.3 |
| CPU Reset Pushbutton (Active High) | | | |
| M11 | CPU_RESET | LVCMOS33 | SW20.3 |
| GPIO DIP SW (Active High) | | | |
| E4 | GPIO_DIP_SW0 | LVCMOS33 | SW13.8 |
| D4 | GPIO_DIP_SW1 | LVCMOS33 | SW13.7 |
| F5 | GPIO_DIP_SW2 | LVCMOS33 | SW13.6 |
| F4 | GPIO_DIP_SW3 | LVCMOS33 | SW13.5 |

Notes:

- LEDs are driven through the U163 SN74AVC4T245 buffer.

Power and Status LEDs

[Figure 2-1, area of callout 34]

Table 3-25 defines the power and status LEDs. For user controlled LEDs, see [User I/O](#), page 64.

Table 3-25: Power and Status LEDs

| Ref. Des. | Net Name | LED Color | Description |
|-----------|------------------------------|-----------|---|
| DS1 | PS_INIT_B | Green/Red | Green: FPGA initialization was successful Red: FPGA initialization is in progress |
| DS2 | VCC12_SW | Green | 12 VDC power on |
| DS3 | VCC1V8_PGOOD | Green | VCC1V8 1.8 VDC power on |
| DS4 | MGTAVCC_PGOOD | Green | MGTAVCC 0.9 VDC power on |
| DS5 | VCCINT_PGOOD | Green | VCCINT 0.85 VDC power on |
| DS6 | VCC1V2_PGOOD | Green | VCC1V2 1.2 VDC power on |
| DS7 | VCC3V3_PGOOD | Green | VCC3V3 3.3 VDC power on |
| DS8 | VADJ_FMC_PGOOD | Green | VADJ_FMC 1.8 VDC (nominal) power on |
| DS9 | MGT1V8_PGOOD | Green | MGTVCCAUX, PS_MGTRAVCC 1.81 VDC power on |
| DS10 | MGT1V2_PGOOD | Green | MGTAVTT. VCC_PSPLL 1.2 VDC power on |
| DS21 | PL_DDR4_VTERM_0V60_PGOOD | Green | PL_DDR4_VTERM 0.6 VDC power on |
| DS24 | UTIL_2V5 | Green | UTIL_2V5 2.5 VDC power on |
| DS25 | UTIL_3V3_PGOOD | Green | UTIL_3V3 3.3 VDC power on |
| DS26 | MGTRAVCC_PGOOD | Green | MGTRAVCC 0.85 VDC power on |
| DS27 | ENET_LED_1 | Green | EHPY U98 1000BASE-T link speed |
| DS32 | PS_DONE | Green | MPSoC U1 bit file download is complete |
| DS33 | PS_ERR_STATUS ⁽¹⁾ | Green | PS error status indicates a secure lockdown state. Alternatively, it can be used by the PMU firmware to indicate system status. |
| DS35 | PS_ERR_OUT ⁽¹⁾ | Red | PS error out is asserted for accidental loss of power, an error in the PMU that holds the CSU in reset, or an exception in the PMU. |
| DS36 | POR_RST_B | Red | POR U22 asserts RST_B low when any of the monitored voltages (IN_) falls below its respective threshold, any EN_ goes low, or MR is asserted. |
| DS49 | UTIL_1V13_PG | Green | UTIL_1V13 1.13 VDC power on |
| DS51 | USB3 MIC2544 U121 FLG | Green | PS USB 3.0 ULPI VBUS power error |
| DS53 | UTIL_5V0_PGOOD | Green | UTIL_5V0 5 VDC power on |

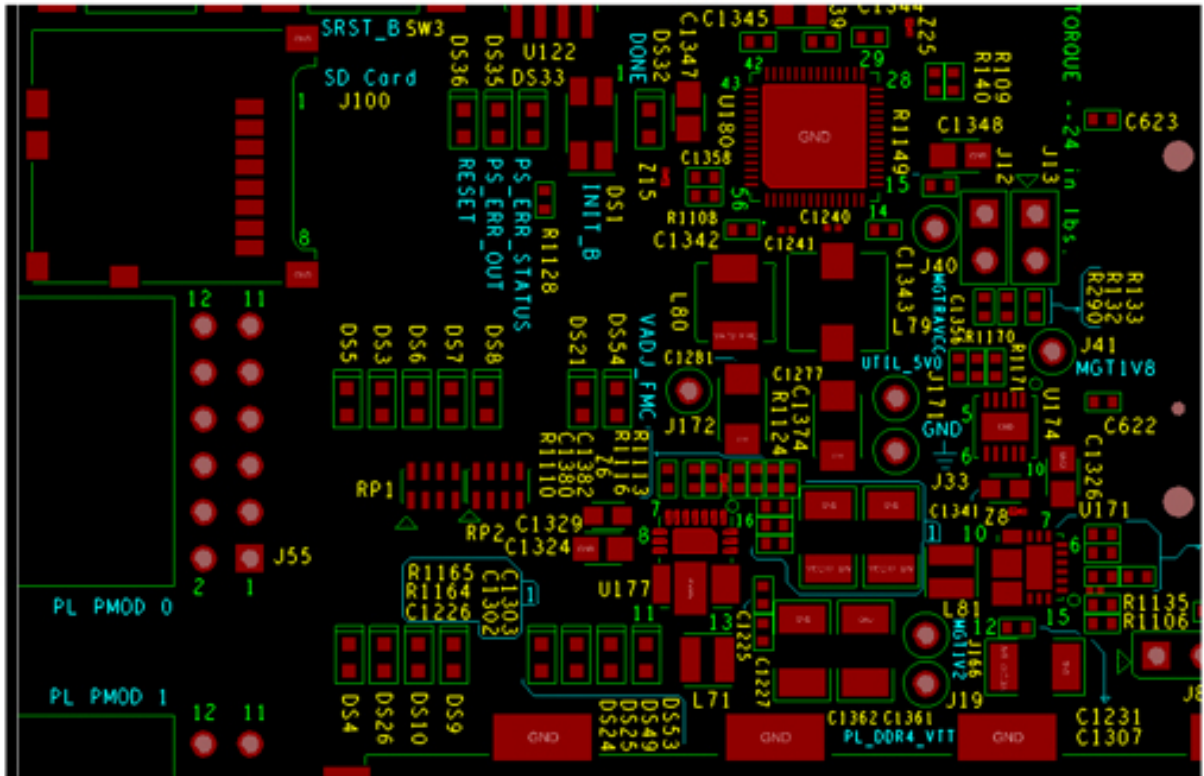
Table 3-25: Power and Status LEDs (Cont'd)

| Ref. Des. | Net Name | LED Color | Description |
|-----------|--------------------------|-----------|--------------------------------|
| DS54 | PS_DDR4_VTERM_0V60_PGOOD | Green | PS_DDR4_VTERM 0.6 VDC power on |

Notes:

1. See the *Zynq UltraScale+ MPSoC Technical Reference Manual* (UG1085) [Ref 2] for more information about Zynq UltraScale+ MPSoC configuration pins.

Figure 3-25 shows the power and status LEDs area of the board.



X20118-012618

Figure 3-25: Power and Status LEDs

GTH Transceivers

[Figure 2-1, callout 1]

The Zynq UltraScale+ XCZU7EV MPSoC has 20 GTH gigabit transceivers (16.3 Gb/s capable) on the PL-side. The GTH transceivers in the XCZU7EV device are grouped into four channels referred to as Quads. The reference clock for a Quad can be sourced from the Quad above or the Quad below the GTH Quad of interest. There are five GTH Quads on the ZCU104 board with connectivity as listed here:

Quad 223:

- MGTREFCLK0 - Not connected
- MGTREFCLK1 - Not connected
- Four GTH transceivers not connected

Quad 224:

- MGTREFCLK0 - Not connected
- MGTREFCLK1 - Not connected
- Four GTH transceivers not connected

Quad 225:

- MGTREFCLK0 - Not connected
- MGTREFCLK1 - Not connected
- Four GTH transceivers not connected

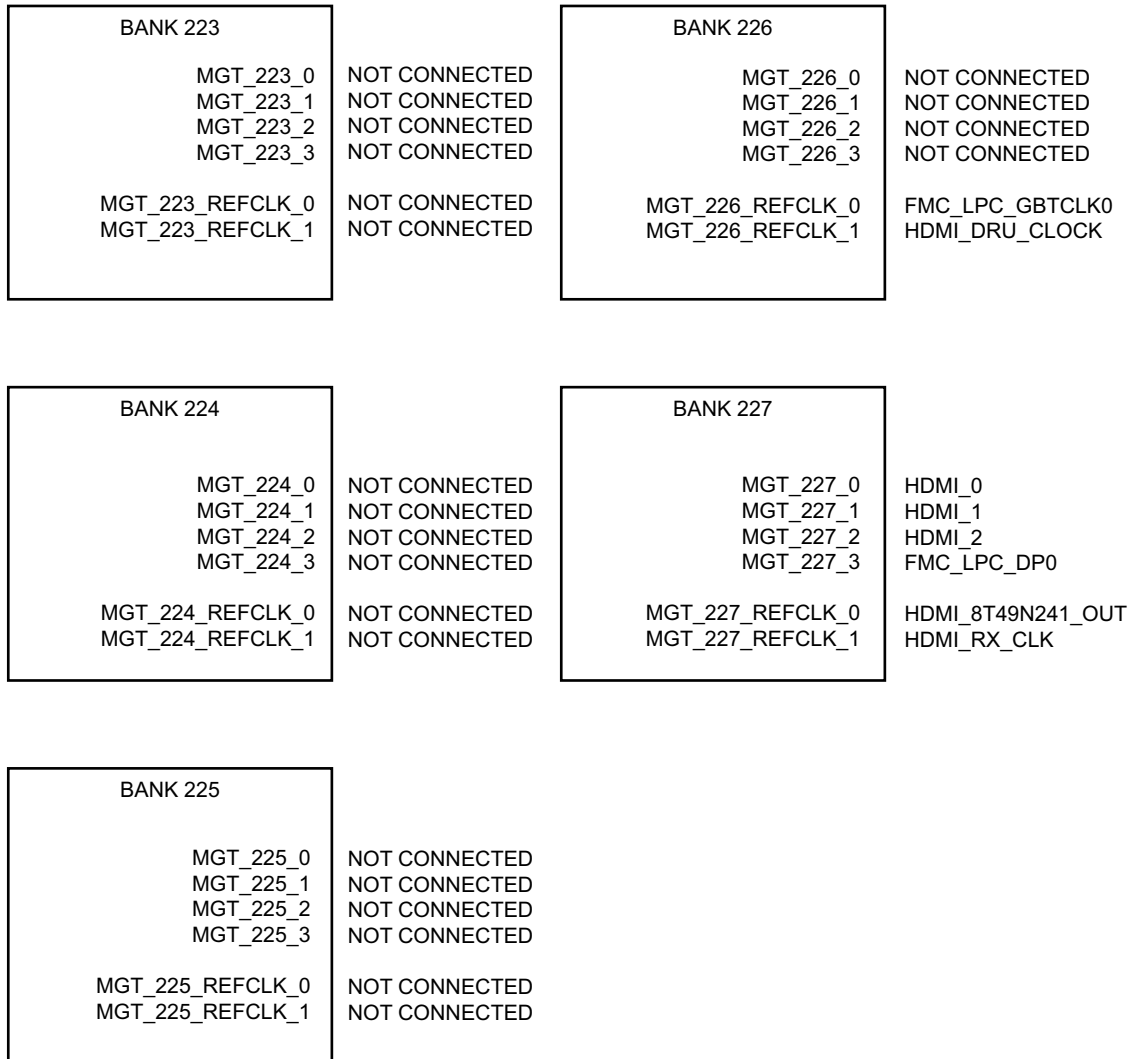
Quad 226:

- MGTREFCLK0 - FMC_LPC_GBTCLK0_M2C_C_P/N
- MGTREFCLK1 - HDMI_DRU_CLOCK_C_P/N
- Contains one GTH transceiver allocated to FMC_LPC_DP0_C2M/M2C_P/N
- Four GTH transceivers not connected

Quad 227:

- MGTREFCLK0 - HDMI_8T49N241_OUT_C_P/N
- MGTREFCLK1 - HDMI_RX_CLK_C_P/N
- Contains three GTH transceivers allocated to HDMI_TX/RX[0:2]_P/N
- Contains one GTH transceiver allocated to FMC_LPC_DP0_C2M/M2C_P/N

GTH transceiver interface assignments on the ZCU104 are shown in Figure 3-26.



X20119-021218

Figure 3-26: GTH Transceiver Bank Assignments

FMC LPC

The FMC low pin count (LPC) connector J5 has its full LA[00:33] bus connected across the XCZU7EV MPSoC PL banks 67 and 68.

The three FMC LPC clocks are connected as follows:

- FMC_LPC_GBTCLK0_M2C_C_P/N is connected to GTH bank 226 MGTREFCLK0
- FMC_LPC_CLK0_M2C_P/N is connected to PL bank 67 (LA[00:16]) GC pins E15/E14
- FMC_LPC_CLK1_M2C_P/N is connected to PL bank 68 (LA[17:33]) GC pins G10/F10

HDMI

Three PL-side GTH transceivers are dedicated for HDMI source and sink. Modes supported are 4K, 2K at 60 f/s, and 2160p60. External circuitry for interfacing TMDS signals with the GTH transceivers is required. [Table 3-26](#) and [Table 3-27](#) list MGTH banks 226 and 227 connections, respectively.

Table 3-26: GTH Bank 226 Interface Connections

| XCZU7EV (U1) Pin | XCZU7EV Pin Name | Schematic Net Name ⁽²⁾ | Connected To | | |
|------------------|------------------|--|--------------|---------------|------------|
| | | | Pin No. | Pin Name | Device |
| U6 | MGHTXP0 | Not connected | NA | NA | NA |
| U5 | MGHTXN0 | Not connected | NA | NA | |
| V4 | MGTHRX0 | Not connected | NA | NA | |
| V3 | MGTHRXN0 | Not connected | NA | NA | |
| T4 | MGHTXP1 | Not connected | NA | NA | |
| T3 | MGHTXN1 | Not connected | NA | NA | |
| U2 | MGTHRX1 | Not connected | NA | NA | |
| U1 | MGTHRXN1 | Not connected | NA | NA | |
| R6 | MGHTXP2 | Not connected | NA | NA | |
| R5 | MGHTXN2 | Not connected | NA | NA | |
| R2 | MGTHRX2 | Not connected | NA | NA | |
| R1 | MGTHRXN2 | Not connected | NA | NA | |
| N6 | MGHTXP3 | Not Connected | NA | NA | |
| N5 | MGHTXN3 | Not Connected | NA | NA | |
| P4 | MGTHRX3 | Not Connected | NA | NA | |
| P3 | MGTHRXN3 | Not Connected | NA | NA | FMC LPC J5 |
| V8 | MGTREFCLK0P | FMC_LPC_GBTCLK0_M2C_C_P ⁽¹⁾ | D4 | GBTCLK0_M2C_P | |
| V7 | MGTREFCLK0N | FMC_LPC_GBTCLK0_M2C_C_N ⁽¹⁾ | D5 | GBTCLK0_M2C_N | |

Table 3-26: GTH Bank 226 Interface Connections (Cont'd)

| XCZU7EV (U1) Pin | XCZU7EV Pin Name | Schematic Net Name ⁽²⁾ | Connected To | | |
|------------------|------------------|-----------------------------------|--------------|----------|---------------|
| | | | Pin No. | Pin Name | Device |
| U10 | MGTREFCLK1P | HDMI_DRU_CLOCK_C_N ⁽¹⁾ | 48 | Q0 | 8T49N287 U182 |
| U9 | MGTREFCLK1N | HDMI_DRU_CLOCK_C_P ⁽¹⁾ | 47 | NQ0 | |

Notes:

1. Series capacitor coupled.
2. MGT connections I/O standard not applicable.

Table 3-27: GTH Bank 227 Interface Connections

| XCZU7EV (U1) Pin | XCZU7EV Pin Name | Schematic Net Name ⁽²⁾ | Connected To | | |
|------------------|------------------|--------------------------------------|--------------|-----------|----------------|
| | | | Pin No. | Pin Name | Device |
| M4 | MGTHTXP0 | HDMI_TX0_P ⁽¹⁾ | 8 | IN_D0P | SN64DP159R U94 |
| M3 | MGTHTXN0 | HDMI_TX0_N ⁽¹⁾ | 9 | IN_D0N | |
| L6 | MGTHTXP1 | HDMI_TX1_P ⁽¹⁾ | 5 | IN_D1P | |
| L5 | MGTHTXN1 | HDMI_TX1_N ⁽¹⁾ | 6 | IN_D1N | |
| K4 | MGTHTXP2 | HDMI_TX2_P ⁽¹⁾ | 2 | IN_D2P | |
| K3 | MGTHTXN2 | HDMI_TX2_N ⁽¹⁾ | 3 | IN_D2N | |
| N2 | MGTHRXP0 | HDMI_RX0_C_P | 29 | OUT_D0P | TMDS181IR U19 |
| N1 | MGTHRXN0 | HDMI_RX0_C_N | 28 | OUT_D0N | |
| L2 | MGTHRXP1 | HDMI_RX1_C_P | 32 | OUT_D1P | |
| L1 | MGTHRXN1 | HDMI_RX1_C_N | 31 | OUT_D1N | |
| J2 | MGTHRXP2 | HDMI_RX2_C_P | 35 | OUT_D2P | |
| J1 | MGTHRXN2 | HDMI_RX2_C_N | 34 | OUT_D2N | |
| H4 | MGTHTXP3 | FMC_LPC_DP0_C2M_N | A34 | DP4_C2M_P | FMC LPC J5 |
| H3 | MGTHTXN3 | FMC_LPC_DP0_C2M_P | A35 | DP4_C2M_N | |
| G2 | MGTHRXP3 | FMC_LPC_DP0_M2C_P | A14 | DP4_M2C_P | |
| G1 | MGTHRXN3 | FMC_LPC_DP0_M2C_N | A15 | DP4_M2C_N | |
| T8 | MGTREFCLK0P | HDMI_8T49N241_OUT_C_N ⁽¹⁾ | 22 | Q2 | 8T49N241 U181 |
| T7 | MGTREFCLK0N | HDMI_8T49N241_OUT_C_P ⁽¹⁾ | 23 | NQ2 | |
| R10 | MGTREFCLK1P | HDMI_RX_CLK_C_P ⁽¹⁾ | 26 | OUT_CLKP | TMDS181IR U19 |
| R9 | MGTREFCLK1N | HDMI_RX_CLK_C_N ⁽¹⁾ | 25 | OUT_CLKN | |

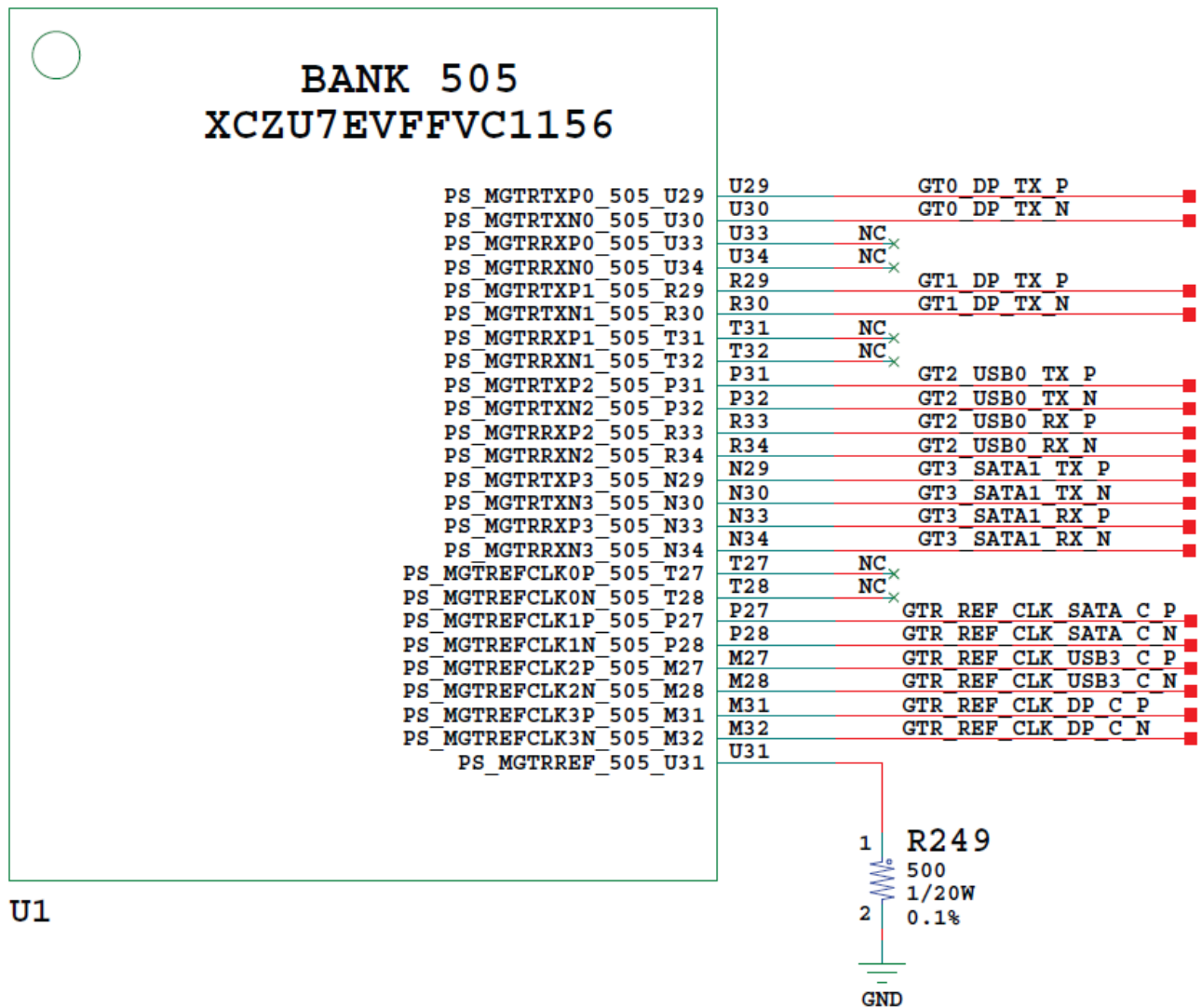
Notes:

1. Series capacitor coupled.
2. MGT connections I/O standard not applicable.

PS-Side: GTR Transceivers

[Figure 2-1, callout 1]

The PS-side GTR transceiver bank 505 supports two DisplayPort transmit channels, USB (3.0) and SATA, as shown in Figure 3-27.



X20265-020118

Figure 3-27: PS-GTR Lane Assignments

Bank 505 DP (DisplayPort) lanes 0 and 1 TX support the 2-channel source only PS-side DisplayPort circuitry described in [DPAUX \(MIO 27-30\)](#), page 55.

Bank 505 USB0 lane 2 supports the USB3.0 interface described in [USB 3.0 Transceiver and USB 2.0 ULPI PHY](#), page 35.

Bank 505 SATA1 lane 3 supports the M.2 SATA connector U170 as shown in [Figure 3-7](#).

Bank 505 reference clocks are connected to the U182 8T49N287 clock generator as described in [Clock Generation](#), page 44.

Bank 505 connections are shown in [Table 3-28](#).

Table 3-28: PS-GTR Bank 505 Interface Connections

| XCZU7EV (U1) Pin | XCZU7EV Pin Name | Schematic Net Name ⁽²⁾ | Connected To | | |
|------------------|------------------|-----------------------------------|--------------|------------|---------------------------|
| | | | Pin No. | Pin Name | Device |
| U29 | PS_MGTRTXP0 | GT0_DP_TX_P ⁽¹⁾ | 4 | ML_LANE1_P | DisplayPort connector P11 |
| U30 | PS_MGTRTXN0 | GT0_DP_TX_N ⁽¹⁾ | 6 | ML_LANE1_N | |
| R29 | PS_MGTRTXP1 | GT1_DP_TX_P ⁽¹⁾ | 1 | ML_LANE0_P | |
| R30 | PS_MGTRTXN1 | GT1_DP_TX_N ⁽¹⁾ | 3 | ML_LANE0_N | |
| U33 | PS_MGTRRXPO | NC | NA | NA | NA |
| U34 | PS_MGTRRXNO | NC | NA | NA | |
| T31 | PS_MGTRRXPO | NC | NA | NA | |
| T32 | PS_MGTRRXNO | NC | NA | NA | |
| P31 | PS_MGTRTXP2 | GT2_USB0_TX_P ⁽¹⁾ | 9 | SSTXP | USB J96 |
| P32 | PS_MGTRTXN2 | GT2_USB0_TX_N ⁽¹⁾ | 8 | SSTXN | |
| R33 | PS_MGTRRXPO | GT2_USB0_RX_P | 6 | SSRXP | |
| R34 | PS_MGTRRXNO | GT2_USB0_RX_N | 5 | SSRXN | |
| N29 | PS_MGTRTXP3 | GT3_SATA1_TX_P ⁽¹⁾ | 2 | SATA_A_P | M.2 U170 |
| N30 | PS_MGTRTXN3 | GT3_SATA1_TX_N ⁽¹⁾ | 3 | SATA_A_N | |
| N33 | PS_MGTRRXPO | GT3_SATA1_RX_P ⁽¹⁾ | 6 | SATA_B_P | |
| N34 | PS_MGTRRXNO | GT3_SATA1_RX_N ⁽¹⁾ | 5 | SATA_B_N | |
| T27 | PS_MGTREFCLK0P | NC | NA | NA | NA |
| T28 | PS_MGTREFCLK0N | NC | NA | NA | |

Table 3-28: PS-GTR Bank 505 Interface Connections (Cont'd)

| XCZU7EV (U1) Pin | XCZU7EV Pin Name | Schematic Net Name ⁽²⁾ | Connected To | | |
|------------------|------------------|-------------------------------------|--------------|----------|---------------|
| | | | Pin No. | Pin Name | Device |
| P27 | PS_MGTREFCLK1P | GTR_REF_CLK_SATA_C_P ⁽¹⁾ | 37 | Q5 | 8T49N287 U182 |
| P28 | PS_MGTREFCLK1N | GTR_REF_CLK_SATA_C_N ⁽¹⁾ | 36 | NQ5 | |
| M27 | PS_MGTREFCLK2P | GTR_REF_CLK_USB3_C_P ⁽¹⁾ | 27 | Q2 | |
| M28 | PS_MGTREFCLK2N | GTR_REF_CLK_USB3_C_N ⁽¹⁾ | 28 | NQ2 | |
| M31 | PS_MGTREFCLK3P | GTR_REF_CLK_DP_C_P ⁽¹⁾ | 23 | Q3 | |
| M32 | PS_MGTREFCLK3N | GTR_REF_CLK_DP_C_N ⁽¹⁾ | 23 | NQ3 | |

Notes:

1. Series capacitor coupled.
2. MGT connections I/O standard not applicable.

FPGA Mezzanine Card Interface

[Figure 2-1, callout 25]

The ZCU104 evaluation board supports the VITA 57.1 FPGA mezzanine card (FMC) specification [Ref 19] by implementing the LPC connector (J5). LPC connectors use a 10 x 40 form factor, partially populated with 160 pins. The connector is keyed so that a mezzanine card, when installed in the FMC LPC connector on the ZCU104 evaluation board, faces away from the board

FMC LPC Connector J5

[Figure 2-1, callout 25]

The FMC connector at J5 implements the full FMC LPC connectivity:

- 68 single-ended, or 34 differential user-defined pairs (34 LA pairs: LA[00:33])
- One GTH transceiver DP differential pair
- Two GBTCLK differential clocks
- 61 ground and 10 power connections

The ZCU104 board FMC VADJ voltage for LPC connector J5 is determined by the IRPS5401MTRPBF U180 voltage regulator described in [Board Power System, page 83](#). Valid values for the VADJ_FMC rail are 1.2V, 1.5V, and 1.8V. The LPC J5 connections to XCZU7EV U1 are shown in [Table 3-29](#) and [Table 3-30](#).

Table 3-29: J5 LPC FMC Section C and D Connections to XCZU7EV U1

| J5 Pin | Schematic Net Name | I/O Standard | U1 FPGA Pin | J5 Pin | Schematic Net Name | I/O Standard | U1 FPGA Pin |
|--------|--------------------|--------------|-------------|--------|--------------------------------------|--------------|-------------|
| C2 | FMC_LPC_DP0_C2M_P | (2) | H4 | D1 | VADJ_FMC_PGOOD | | |
| C3 | FMC_LPC_DP0_C2M_N | (2) | H3 | D4 | FMC_LPC_GBTCLK0_M2C_P ⁽¹⁾ | LVDS | V8 |
| C6 | FMC_LPC_DP0_M2C_P | (2) | G2 | D5 | FMC_LPC_GBTCLK0_M2C_N ⁽¹⁾ | LVDS | V7 |
| C7 | FMC_LPC_DP0_M2C_N | (2) | G1 | D8 | FMC_LPC_LA01_CC_P | LVDS | H18 |
| C10 | FMC_LPC_LA06_P | LVDS | H19 | D9 | FMC_LPC_LA01_CC_N | LVDS | H17 |
| C11 | FMC_LPC_LA06_N | LVDS | G19 | D11 | FMC_LPC_LA05_P | LVDS | K17 |
| C14 | FMC_LPC_LA10_P | LVDS | L15 | D12 | FMC_LPC_LA05_N | LVDS | J17 |
| C15 | FMC_LPC_LA10_N | LVDS | K15 | D14 | FMC_LPC_LA09_P | LVDS | H16 |
| C18 | FMC_LPC_LA14_P | LVDS | C13 | D15 | FMC_LPC_LA09_N | LVDS | G16 |
| C19 | FMC_LPC_LA14_N | LVDS | C12 | D17 | FMC_LPC_LA13_P | LVDS | G15 |
| C22 | FMC_LPC_LA18_CC_P | LVDS | D11 | D18 | FMC_LPC_LA13_N | LVDS | F15 |
| C23 | FMC_LPC_LA18_CC_N | LVDS | D10 | D20 | FMC_LPC_LA17_CC_P | LVDS | F11 |
| C26 | FMC_LPC_LA27_P | LVDS | A8 | D21 | FMC_LPC_LA17_CC_N | LVDS | E10 |
| C27 | FMC_LPC_LA27_N | LVDS | A7 | D23 | FMC_LPC_LA23_P | LVDS | B11 |
| C30 | FMC_LPC_IIC_SCL | | | D24 | FMC_LPC_LA23_N | LVDS | A11 |
| C31 | FMC_LPC_IIC_SDA | | | D26 | FMC_LPC_LA26_P | LVDS | B9 |
| C34 | GND | | | D27 | FMC_LPC_LA26_N | LVDS | B8 |
| C35 | VCC12_SW | | | D29 | F4232_TCK | | |
| C37 | VCC12_SW | | | D30 | FPGA_TDO_FMC_TDI_LS | | |
| C39 | UTIL_3V3 | | | D31 | FMC_TDO | | |
| | | | | D32 | UTIL_3V3 | | |
| | | | | D33 | FT4232_TMS | | |
| | | | | D34 | NC | | |
| | | | | D35 | GA1=0=GND | | |
| | | | | D36 | UTIL_3V3 | | |
| | | | | D38 | UTIL_3V3 | | |
| | | | | D40 | UTIL_3V3 | | |

Notes:

1. Series capacitor coupled.
2. MGT connections I/O standard not applicable.

Table 3-30: J5 HPC0 FMC Section G and H Connections to XCZU7EV U1

| J5 Pin | Schematic Net Name | I/O Standard | U1 FPGA Pin | J5 Pin | Schematic Net Name | I/O Standard | U1 FPGA Pin |
|--------|--------------------|--------------|-------------|--------|---------------------|--------------|-------------|
| G2 | FMC_LPC_CLK1_M2C_P | LVDS | G10 | H1 | NC | | |
| G3 | FMC_LPC_CLK1_M2C_N | LVDS | F10 | H2 | FMC_LPC_PRSNT_M2C_B | | |
| G6 | FMC_LPC_LA00_CC_P | LVC MOS18 | F17 | H4 | FMC_LPC_CLK0_M2C_P | LVDS | E15 |
| G7 | FMC_LPC_LA00_CC_N | LVC MOS18 | F16 | H5 | FMC_LPC_CLK0_M2C_N | LVDS | E14 |
| G9 | FMC_LPC_LA03_P | LVDS | K19 | H7 | FMC_LPC_LA02_P | LVDS | L20 |
| G10 | FMC_LPC_LA03_N | LVDS | K18 | H8 | FMC_LPC_LA02_N | LVDS | K20 |
| G12 | FMC_LPC_LA08_P | LVDS | E18 | H10 | FMC_LPC_LA04_P | LVDS | L17 |
| G13 | FMC_LPC_LA08_N | LVDS | E17 | H11 | FMC_LPC_LA04_N | LVDS | L16 |
| G15 | FMC_LPC_LA12_P | LVDS | G18 | H13 | FMC_LPC_LA07_P | LVDS | J16 |
| G16 | FMC_LPC_LA12_N | LVDS | F18 | H14 | FMC_LPC_LA07_N | LVDS | J15 |
| G18 | FMC_LPC_LA16_P | LVDS | D17 | H16 | FMC_LPC_LA11_P | LVDS | A13 |
| G19 | FMC_LPC_LA16_N | LVDS | C17 | H17 | FMC_LPC_LA11_N | LVDS | A12 |
| G21 | FMC_LPC_LA20_P | LVDS | F12 | H19 | FMC_LPC_LA15_P | LVDS | D16 |
| G22 | FMC_LPC_LA20_N | LVDS | E12 | H20 | FMC_LPC_LA15_N | LVDS | C16 |
| G24 | FMC_LPC_LA22_P | LVDS | H13 | H22 | FMC_LPC_LA19_P | LVDS | D12 |
| G25 | FMC_LPC_LA22_N | LVDS | H12 | H23 | FMC_LPC_LA19_N | LVDS | C11 |
| G27 | FMC_LPC_LA25_P | LVDS | C7 | H25 | FMC_LPC_LA21_P | LVDS | B10 |
| G28 | FMC_LPC_LA25_N | LVDS | C6 | H26 | FMC_LPC_LA21_N | LVDS | A10 |
| G30 | FMC_LPC_LA29_P | LVDS | K10 | H28 | FMC_LPC_LA24_P | LVDS | B6 |
| G31 | FMC_LPC_LA29_N | LVDS | J10 | H29 | FMC_LPC_LA24_N | LVDS | A6 |
| G33 | FMC_LPC_LA31_P | LVDS | F7 | H31 | FMC_LPC_LA28_P | LVDS | M13 |
| G34 | FMC_LPC_LA31_N | LVDS | E7 | H32 | FMC_LPC_LA28_N | LVDS | L13 |
| G36 | FMC_LPC_LA33_P | LVDS | C9 | H34 | FMC_LPC_LA30_P | LVDS | E9 |
| G37 | FMC_LPC_LA33_N | LVDS | C8 | H35 | FMC_LPC_LA30_N | LVDS | D9 |
| G39 | VADJ | | | H37 | FMC_LPC_LA32_P | LVDS | F8 |
| | | | | H38 | FMC_LPC_LA32_N | LVDS | E8 |
| | | | | H40 | VADJ | | |

Cooling Fan Connector

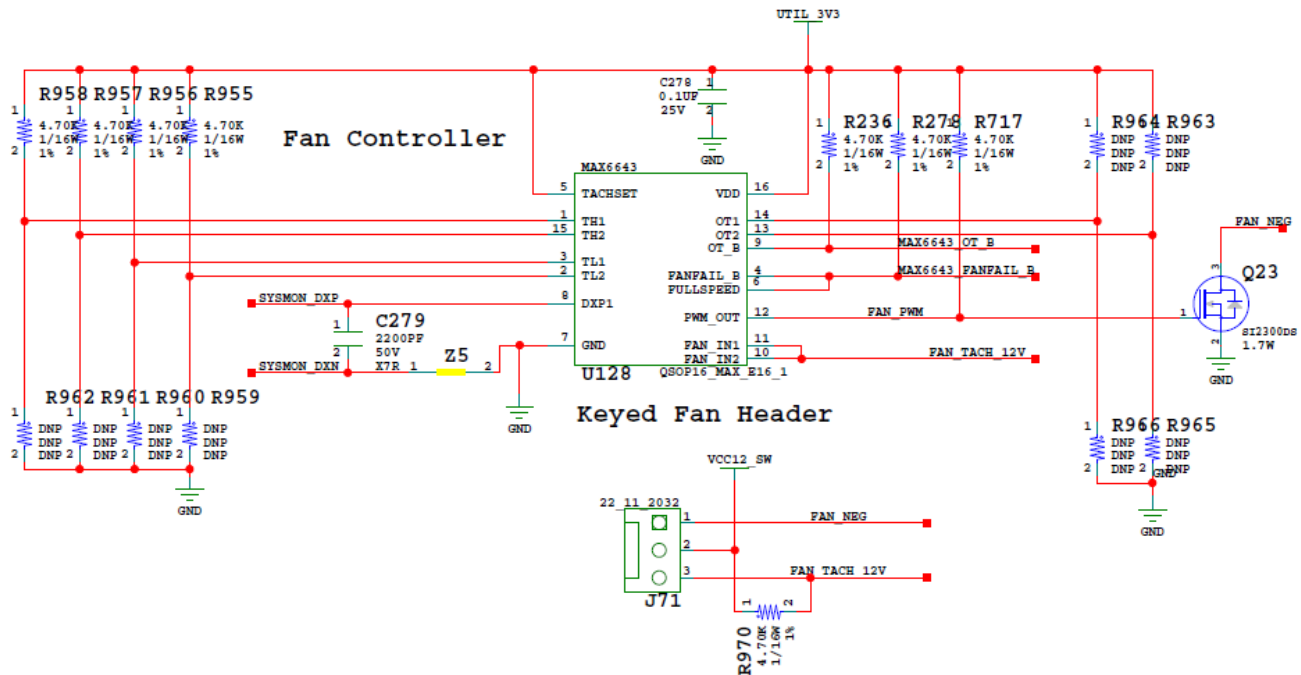
[Figure 2-1, near callout 17]

The ZCU104 cooling fan connector is shown in Figure 3-28.

The ZCU104 uses the Maxim MAX6643 fan controller, which autonomously controls the fan speed by controlling the pulse width modulation (PWM) signal to the fan based on the die temperature sensed via the FPGA's DXP and DXN pins. The fan rotates slowly (acoustically quiet) when the FPGA is cool and rotates faster as the FPGA heats up (acoustically noisy).

The fan speed (PWM) versus the FPGA die temperature algorithm along with the over temperature set point and fan failure alarm mechanisms are defined by the strapping resistors on the MAX6643 device. The over temperature and fan failures alarms can be monitored by any available processor in the FPGA by polling the MAX6643_OT_B and MAX6643_FANFAIL_B signals wired to I2C expander U97 ports p02 and p03, U97 and pins 6 and 7, respectively. See the MAX6643 [Ref 18] data sheet for more information on the device circuit implementation on this board.

Note: At initial power on, it is normal for the fan controller to energize at full speed for a few seconds.



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Figure 3-28: 12V Fan Header

Switches

[Figure 2-1, callouts 20, 22, 24, and 30]

The ZCU104 board includes power, program, configuration, and reset switches:

- SW1 power on/off slide switch (callout 22)
- SW5 (PS_PROG_B), active-Low pushbutton (callout 24)
- SW3 (SRST_B), active-Low pushbutton (callout 20)
- SW4 (POR_B), active-Low pushbutton (callout 20)
- SW6 U1 MPSoC PS bank 503 4-pole mode DIP switch (callout 30)

Power On/Off Slide Switch

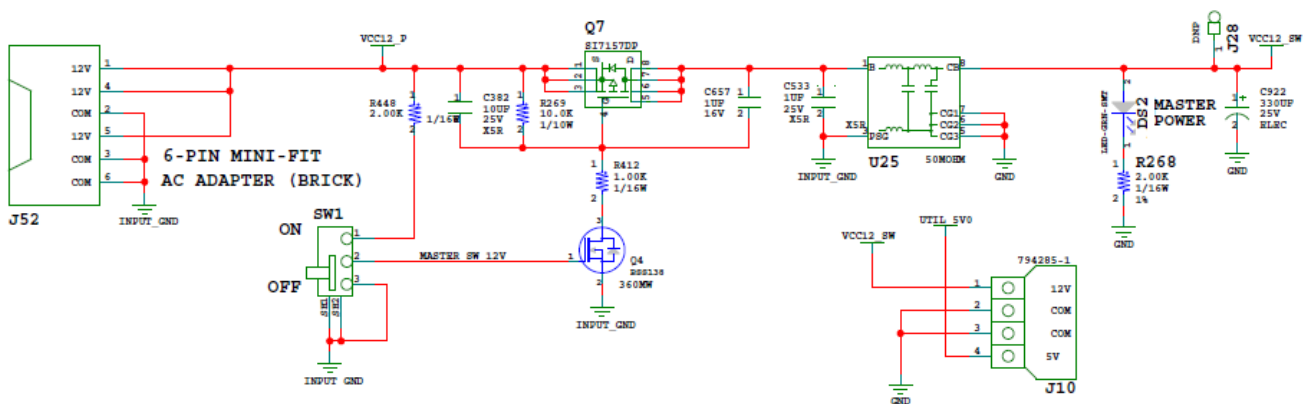
[Figure 2-1, callout 22]

The ZCU104 board power switch is SW1. Sliding the switch actuator from the off to the on position applies 12V power from J52, a 6-pin mini-fit connector. Green LED DS2 illuminates when the ZCU104 board power is on. See [Board Power System, page 83](#) for details on the on-board power system.



CAUTION! Do NOT plug a PC ATX power supply 6-pin connector into the ZCU104 board power connector J52. The ATX 6-pin connector has a different pin-out than J52. Connecting an ATX 6-pin connector into J52 damages the ZCU104 board and voids the board warranty.

Figure 3-29 shows the power connector J52, power switch SW1, and LED indicator DS2.



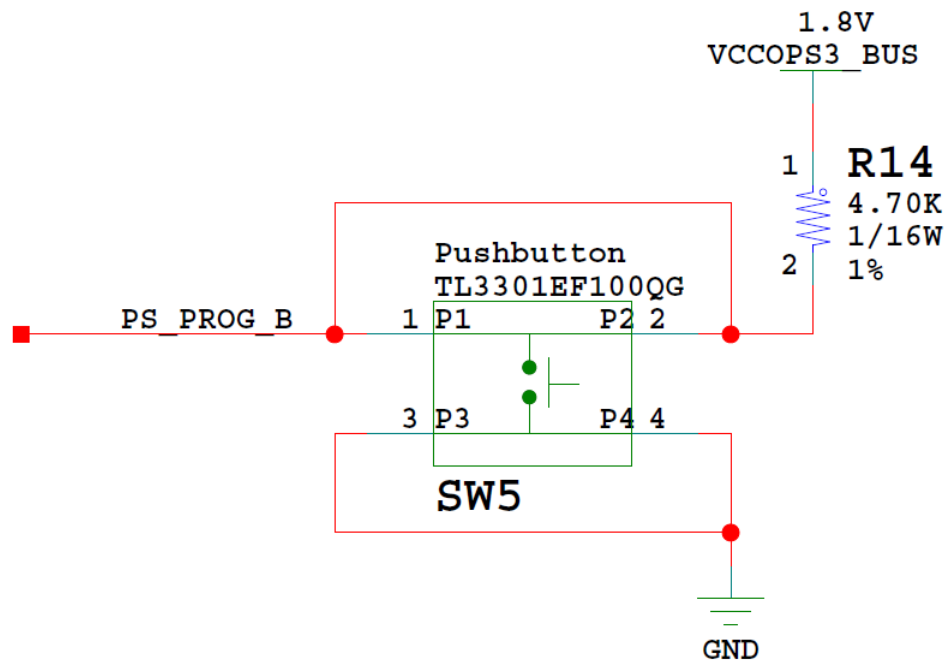
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Figure 3-29: Power Input

Program_B Pushbutton

[Figure 2-1, callout 24]

PS_PROG_B pushbutton switch SW5 grounds the XCZU7EV MPSoC PS_PROG_B pin T24 when pressed (see Figure 3-30). This action clears the programmable logic configuration, which can then be acted on by the PS software. See the *Zynq UltraScale+ MPSoC Technical Reference Manual* (UG1085) [Ref 2] for information about Zynq UltraScale+ MPSoC configuration.



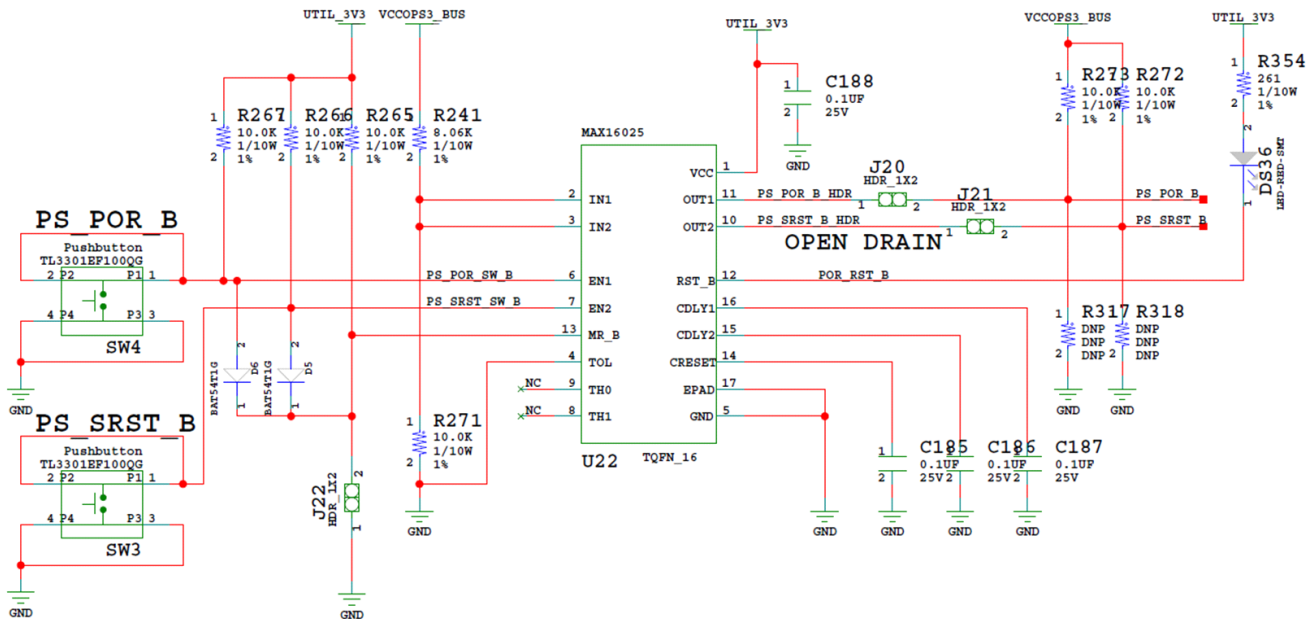
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Figure 3-30: PS_PROG_B Pushbutton Switch SW5

System Reset Pushbuttons

[Figure 2-1, callout 20]

Figure 3-31 shows the reset circuitry for the PS.



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Figure 3-31: PS_SRST_B and POR_B Pushbutton Switches SW3 and SW4

PS_POR_B Reset

Depressing and then releasing pushbutton SW4 causes net PS_POR_B to strobe Low. This reset is used to hold the PS in reset until all PS power supplies are at the required voltage levels. It must be held Low through PS power-up. PS_POR_B should be generated by the power supply power-good signal. When the voltage at U22 IN1 is below its threshold or EN1 (P.B. switch SW4 is pressed) goes Low, OUT1 (PS_POR_B) goes Low.

PS_SRST_B Reset

Depressing and then releasing pushbutton SW3 causes net PS_SRST_B to strobe Low. This reset is used to force a system reset. It can be tied or pulled High, and can be High during the PS supply power ramps. When the voltage at IN2 is below its threshold or EN2 (P.B. switch SW3 is pressed) goes Low, OUT2 (PS_SRST_B) goes Low.

Active-Low reset output RST_B asserts when any of the monitored voltages (IN_) falls below the respective threshold, any EN_ goes Low, or MR is asserted. RST_B remains asserted for the reset time-out period after all of the monitored voltages exceed their respective threshold, all EN_ are High, all OUT_ are High, and MR is deasserted. See the *Zynq*

UltraScale+ MPSoC Technical Reference Manual (UG1085) [Ref 2] for information on the resets.

Board Power System

[Figure 2-1, callout 26]

The ZCU104 hosts a Infineon PMBus based power system. Each individual Infineon IRPS5401MTRPBF voltage regulator has a PMBus interface.

Figure 3-32 shows the ZCU104 power system block diagram.

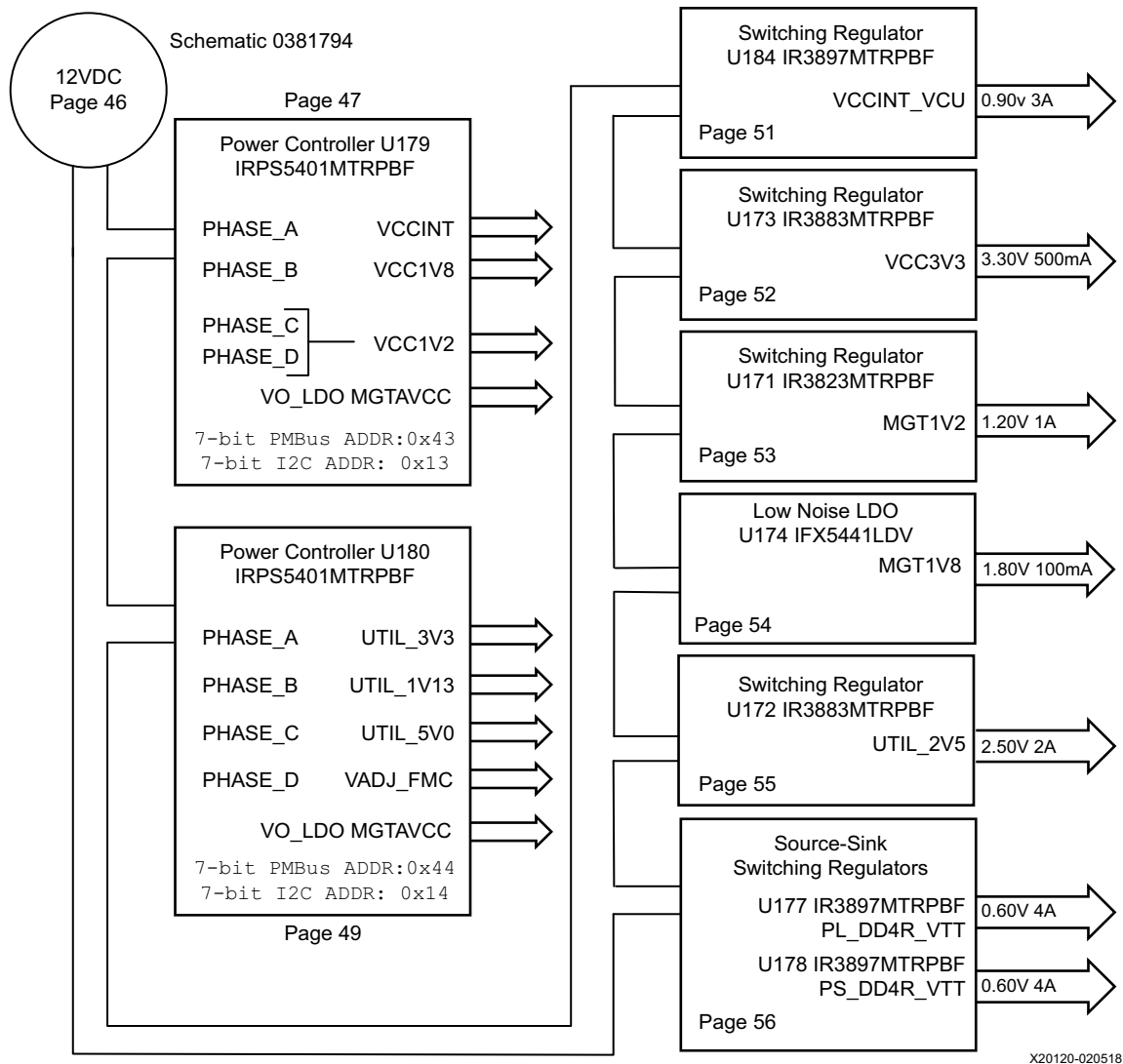


Figure 3-32: Power System Block Diagram

The ZCU104 evaluation board uses both PMBus compliant POL controllers and no-PMBus regulators from Infineon Technologies [Ref 22] to supply the core and auxiliary voltages listed in Table 3-31. The schematic page references are to 0381794.

Table 3-31: Power System Devices

| Device Type | Ref. Des. | PMBus Addr. | I2C Addr. | Description | Output | Power Rail Net Name | Power Rail Voltage | Max. Current | Schem. Page |
|----------------|-----------|-------------|-----------|-------------------------------------|---------|---------------------|--------------------|--------------|-------------|
| IRPS5401MTRPBF | U179 | 0x43 | 0x13 | Infineon IRPS5401 multi-output PMIC | PHASE_A | VCCINT | 0.85V | | 47 |
| | | | | | PHASE_B | VCC1V8 | 1.80V | | |
| | | | | | PHASE_C | VCC1V2 | 1.20V | | |
| | | | | | PHASE_D | | | | |
| LDO | MGTAVCC | 0.85V | | | | | | | |
| IRPS5401MTRPBF | U180 | 0x44 | 0x14 | Infineon IRPS5401 multi-output PMIC | PHASE_A | UTIL_3V3 | 3.30V | | 49 |
| | | | | | PHASE_B | VCC1V13 | 1.13V | | |
| | | | | | PHASE_C | UTIL_5V0 | 5.00V | | |
| | | | | | PHASE_D | VADJ_FMC | 1.80V | | |
| | | | | | LDO | MGTRAVCC | 0.85V | | |
| IR3883MTRPBF | U173 | NA | NA | POL Switching regulator | SW | VCC3V3 | 3.30V | 3A | 51 |
| IR3823MTRPBF | U171 | NA | NA | Switching regulator | SW | MGT1V2 | 1.20V | 3A | 52 |
| IFX54441LDV | U174 | NA | NA | Low noise LDO | OUT | MGT1V8 | 1.81V | 500 mA | 53 |
| IR3883MTRPBF | U172 | NA | NA | POL switching regulator | SW | UTIL_2V5 | 2.50V | 3A | 54 |
| IR3897MTRPBF | U177 | NA | NA | Source-sink switching regulator | SW | PL_DDR4_VTT | 0.60V | 4A | 55 |
| IR3897MTRPBF | U178 | NA | NA | Source-sink switching regulator | SW | PS_DDR4_VTT | 0.60V | 4A | 55 |

The FMC LPC (J5) VADJ pins are wired to the programmable rail VADJ_FMC. The VADJ_FMC rail is programmed to 1.80V by default. The valid values of the VADJ_FMC rail are 1.2V, 1.5V, and 1.8V. The VADJ_FMC rail also powers the XCZU7EV HP banks 67 and 68 (see Table 3-2, page 23).

Documentation describing PMBus programming for the Infineon Technologies PMIC flexible power management unit power controllers is available at the Infineon Technologies website [Ref 22]. The PCB layout and power system design meets the recommended criteria described in the *UltraScale Architecture PCB Design User Guide* (UG583) [Ref 4].

Monitoring Voltage and Current

[Figure 2-1, callout 28]

Voltage and current monitoring and control are available on the power rails provided by the Infineon IRPS5401 power controllers through the Infineon IR PowerCenter graphical user interface. The onboard Infineon IRPS5401 power controllers listed in [Table 3-31](#) are accessed through the I2C 1x3 male pin connector J175, which is included with the Infineon USB cable (Infineon part number USB005). The cable can be ordered from the Infineon website [[Ref 22](#)]. The associated Infineon IR PowerCenter GUI can be downloaded from the Infineon website. This is the most convenient way to monitor the voltage and current values for the Infineon PMBus programmed power rails listed in [Table 3-31](#).

VITA 57.1 FMC Connector Pinouts

Overview

Figure A-1 shows the pinout of the FPGA mezzanine card (FMC) low pin count (LPC) connector defined by the VITA 57.1 FMC specification. For a description of how the ZCU104 evaluation board implements the FMC specification, see [FPGA Mezzanine Card Interface, page 76](#) and [FMC LPC Connector J5, page 76](#).

| | K | J | H | G | F | E | D | C | B | A |
|----|----|----|-------------|------------|----|----|---------------|-----------|----|----|
| 1 | NC | NC | VREF_A_M2C | GND | NC | NC | PG_C2M | GND | NC | NC |
| 2 | NC | NC | PRSNT_M2C_L | CLK1_M2C_P | NC | NC | GND | DP0_C2M_P | NC | NC |
| 3 | NC | NC | GND | CLK1_M2C_N | NC | NC | GND | DP0_C2M_N | NC | NC |
| 4 | NC | NC | CLK0_M2C_P | GND | NC | NC | GBTCLK0_M2C_P | GND | NC | NC |
| 5 | NC | NC | CLK0_M2C_N | GND | NC | NC | GBTCLK0_M2C_N | GND | NC | NC |
| 6 | NC | NC | GND | LA00_P_CC | NC | NC | GND | DP0_M2C_P | NC | NC |
| 7 | NC | NC | LA02_P | LA00_N_CC | NC | NC | GND | DP0_M2C_N | NC | NC |
| 8 | NC | NC | LA02_N | GND | NC | NC | LA01_P_CC | GND | NC | NC |
| 9 | NC | NC | GND | LA03_P | NC | NC | LA01_N_CC | GND | NC | NC |
| 10 | NC | NC | LA04_P | LA03_N | NC | NC | GND | LA06_P | NC | NC |
| 11 | NC | NC | LA04_N | GND | NC | NC | LA05_P | LA06_N | NC | NC |
| 12 | NC | NC | GND | LA08_P | NC | NC | LA05_N | GND | NC | NC |
| 13 | NC | NC | LA07_P | LA08_N | NC | NC | GND | GND | NC | NC |
| 14 | NC | NC | LA07_N | GND | NC | NC | LA09_P | LA10_P | NC | NC |
| 15 | NC | NC | GND | LA12_P | NC | NC | LA09_N | LA10_N | NC | NC |
| 16 | NC | NC | LA11_P | LA12_N | NC | NC | GND | GND | NC | NC |
| 17 | NC | NC | LA11_N | GND | NC | NC | LA13_P | GND | NC | NC |
| 18 | NC | NC | GND | LA16_P | NC | NC | LA13_N | LA14_P | NC | NC |
| 19 | NC | NC | LA15_P | LA16_N | NC | NC | GND | LA14_N | NC | NC |
| 20 | NC | NC | LA15_N | GND | NC | NC | LA17_P_CC | GND | NC | NC |
| 21 | NC | NC | GND | LA20_P | NC | NC | LA17_N_CC | GND | NC | NC |
| 22 | NC | NC | LA19_P | LA20_N | NC | NC | GND | LA18_P_CC | NC | NC |
| 23 | NC | NC | LA19_N | GND | NC | NC | LA23_P | LA18_N_CC | NC | NC |
| 24 | NC | NC | GND | LA22_P | NC | NC | LA23_N | GND | NC | NC |
| 25 | NC | NC | LA21_P | LA22_N | NC | NC | GND | GND | NC | NC |
| 26 | NC | NC | LA21_N | GND | NC | NC | LA26_P | LA27_P | NC | NC |
| 27 | NC | NC | GND | LA25_P | NC | NC | LA26_N | LA27_N | NC | NC |
| 28 | NC | NC | LA24_P | LA25_N | NC | NC | GND | GND | NC | NC |
| 29 | NC | NC | LA24_N | GND | NC | NC | TCK | GND | NC | NC |
| 30 | NC | NC | GND | LA29_P | NC | NC | TDI | SCL | NC | NC |
| 31 | NC | NC | LA28_P | LA29_N | NC | NC | TDO | SDA | NC | NC |
| 32 | NC | NC | LA28_N | GND | NC | NC | 3P3VAUX | GND | NC | NC |
| 33 | NC | NC | GND | LA31_P | NC | NC | TMS | GND | NC | NC |
| 34 | NC | NC | LA30_P | LA31_N | NC | NC | TRST_L | GA0 | NC | NC |
| 35 | NC | NC | LA30_N | GND | NC | NC | GA1 | 12P0V | NC | NC |
| 36 | NC | NC | GND | LA33_P | NC | NC | 3P3V | GND | NC | NC |
| 37 | NC | NC | LA32_P | LA33_N | NC | NC | GND | 12P0V | NC | NC |
| 38 | NC | NC | LA32_N | GND | NC | NC | 3P3V | GND | NC | NC |
| 39 | NC | NC | GND | VADJ | NC | NC | GND | 3P3V | NC | NC |
| 40 | NC | NC | VADJ | GND | NC | NC | 3P3V | GND | NC | NC |

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Figure A-1: FMC LPC Connector Pinouts

Xilinx Constraints File

Overview

The Xilinx design constraints (XDC) file template for the ZCU104 board provides for designs targeting the ZCU104 evaluation board. Net names in the constraints correlate with net names on the latest ZCU104 evaluation board schematic. Identify the appropriate pins and replace the net names with net names in the user RTL. See the *Vivado Design Suite User Guide: Using Constraints* (UG903) [Ref 10] for more information.

The FMC connector J5 (LPC) is connected to MPSoC banks powered by the variable voltage V_{AJ_FMC} . Because different FMC cards implement different circuitry, the FMC bank I/O standards must be uniquely defined by each customer.



IMPORTANT: *The XDC file can be accessed on the [Zynq UltraScale+ MPSoC ZCU104 Evaluation Kit website](#).*

Regulatory and Compliance Information

Overview

This product is designed and tested to conform to the European Union directives and standards described in this section.

[Zynq UltraScale+ MPSoC ZCU104 Evaluation Kit — Known Issues and Release Notes Master Answer Record 69344](#)

For Technical Support, open a [Support Service Request](#).

CE Directives

2006/95/EC, *Low Voltage Directive (LVD)*

2004/108/EC, *Electromagnetic Compatibility (EMC) Directive*

CE Standards

EN standards are maintained by the European Committee for Electrotechnical Standardization (CENELEC). IEC standards are maintained by the International Electrotechnical Commission (IEC).

Electromagnetic Compatibility

EN 55022:2010, *Information Technology Equipment Radio Disturbance Characteristics – Limits and Methods of Measurement*

EN 55024:2010, *Information Technology Equipment Immunity Characteristics – Limits and Methods of Measurement*

This is a Class A product. In a domestic environment, this product can cause radio interference, in which case the user might be required to take adequate measures.

Safety

IEC 60950-1:2005, *Information technology equipment – Safety, Part 1: General requirements*

EN 60950-1:2006, *Information technology equipment – Safety, Part 1: General requirements*

Markings



This product complies with Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). The affixed product label indicates that the user must not discard this electrical or electronic product in domestic household waste.



This product complies with Directive 2002/95/EC on the restriction of hazardous substances (RoHS) in electrical and electronic equipment.



This product complies with CE Directives 2006/95/EC, *Low Voltage Directive (LVD)* and 2004/108/EC, *Electromagnetic Compatibility (EMC) Directive*.

Additional Resources and Legal Notices

Xilinx Resources

For support resources such as Answers, Documentation, Downloads, and Forums, see [Xilinx Support](#).

Solution Centers

See the [Xilinx Solution Centers](#) for support on devices, software tools, and intellectual property at all stages of the design cycle. Topics include design assistance, advisories, and troubleshooting tips.

Documentation Navigator and Design Hubs

Xilinx[®] Documentation Navigator provides access to Xilinx documents, videos, and support resources, which you can filter and search to find information. To open the Xilinx Documentation Navigator (DocNav):

- From the Vivado[®] IDE, select **Help > Documentation and Tutorials**.
- On Windows, select **Start > All Programs > Xilinx Design Tools > DocNav**.
- At the Linux command prompt, enter `docnav`.

Xilinx Design Hubs provide links to documentation organized by design tasks and other topics, which you can use to learn key concepts and address frequently asked questions. To access the Design Hubs:

- In the Xilinx Documentation Navigator, click the **Design Hubs View** tab.
- On the Xilinx website, see the [Design Hubs](#) page.

Note: For more information on Documentation Navigator, see the [Documentation Navigator](#) page on the Xilinx website.

References

The most up to date information related to the ZCU104 board and its documentation is available on the [Zynq UltraScale+ MPSoC ZCU104 Evaluation Kit](#) website.

These Xilinx documents provide supplemental material useful with this guide:

1. *Zynq UltraScale+ MPSoC Data Sheet: Overview* ([DS891](#))
2. *Zynq UltraScale+ MPSoC Technical Reference Manual* ([UG1085](#))
3. *Zynq UltraScale+ MPSoC Data Sheet: DC and AC Switching Characteristics* ([DS925](#))
4. *UltraScale Architecture PCB Design User Guide* ([UG583](#))
5. *UltraScale Architecture-Based FPGAs Memory IP LogiCORE IP Product Guide* ([PG150](#))
6. *UltraScale Architecture GTH Transceivers User Guide* ([UG576](#))
7. *UltraScale Architecture Gen3 Integrated Block for PCI Express LogiCORE IP Product Guide* ([PG156](#))
8. *Silicon Labs CP210x USB-to-UART Installation Guide* ([UG1033](#))
9. *Tera Term Terminal Emulator Installation Guide* ([UG1036](#))
10. *Vivado Design Suite User Guide: Using Constraints* ([UG903](#))

The following websites provide supplemental material useful with this guide:

11. Micron Technology: www.micron.com
(MT40A256M16GE-075E, MT25QU512ABB8ESF-0SIT data sheets)
12. Standard Microsystems Corporation (SMSC): www.microchip.com
(USB3320 data sheet)
13. SanDisk Corporation: www.sandisk.com
14. SD Association: www.sdcard.org
15. Silicon Labs: www.silabs.com/Pages/default.aspx
(SI5341B, Si570, Si5319C, Si53340, CP2108 data sheets)
16. Texas Instruments: www.ti.com/product/DP83867IR
(TI DP83867 data sheet)
17. PCI: https://pcsig.com/specifications/pciexpress/M.2_Specification/
18. Maxim Integrated Circuits: <https://www.maximintegrated.com>

19. VITA FMC Marketing Alliance: www.vita.com/fmc
20. Digilent: www.digilentinc.com
(Pmod peripheral modules)
21. Integrated Device Technology (IDT): www.idt.com
(8T49N241, 8T49N287 data sheets)
22. Infineon Technologies: <https://www.infineon.com/>
(IRPS5401 data sheet)
23. Future Technology Devices International Ltd.: www.ftdichip.com
(FT2232H data sheet)

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