ML605 Hardware User Guide

UG534 (v1.2) January 15, 2010

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Revision History

The following table shows the revision history for this document.

Date	Version	Revision
8/17/09	1.0	Initial Xilinx release.
11/17/09	1.1	• Updated Figure 1-1, Figure 1-2, Figure 1-3, Figure 1-11, and Figure 1-14. • Added Figure 1-7, Figure 1-8, Figure 1-10, and Figure 1-13. • Updated Table 1-15 and Table 1-18. • Updated Appendix B, “VITA 57.1 FMC LPC (J63) and HPC (J64) Connector Pinout” and Appendix C, “ML605 Master UCF.” • Minor typographical edits.
01/15/10	1.2	• Updated Figure 1-2, Figure 1-3, Figure 1-17, Table 1-3, Table 1-8, Table 1-9, Table A-1, and Table A-2. Miscellaneous typographical edits.

Table of Contents

About This Guide

This manual accompanies the Virtex®-6 FPGA ML605 Evaluation Board and contains information about the ML605 hardware and software tools.

Guide Contents

This manual contains the following chapters:

- Chapter 1, "ML605 Evaluation Board," provides an overview of the embedded development board and details the components and features of the ML605 board.
- Appendix A, "Default Switch and Jumper Settings."
- Appendix B, "VITA 57.1 FMC LPC (J63) and HPC (J64) Connector Pinout."
- Appendix C, "ML605 Master UCF."
- Appendix D, "References."

Additional Documentation

The following documents are also available for download at http://www.xilinx.com/support/documentation/virtex-6.htm.

- Virtex-6 Family Overview

  The features and product selection of the Virtex-6 family are outlined in this overview.

- Virtex-6 FPGA Data Sheet: DC and Switching Characteristics

  This data sheet contains the DC and Switching Characteristic specifications for the Virtex-6 family.

- Virtex-6 FPGA Packaging and Pinout Specifications

  This specification includes the tables for device/package combinations and maximum I/Os, pin definitions, pinout tables, pinout diagrams, mechanical drawings, and thermal specifications.

- Virtex-6 FPGA Configuration Guide

  This all-encompassing configuration guide includes chapters on configuration interfaces (serial and SelectMAP), bitstream encryption, boundary-scan and JTAG configuration, reconfiguration techniques, and readback through the SelectMAP and JTAG interfaces.

- Virtex-6 FPGA Clocking Resources User Guide

  This guide describes the clocking resources available in all Virtex-6 devices, including the MMCM and PLLs.

- Virtex-6 FPGA Memory Resources User Guide

  The functionality of the block RAM and FIFO are described in this user guide.

- Virtex-6 FPGA SelectIO Resources User Guide

  This guide describes the SelectIO™ resources available in all Virtex-6 devices.

- Virtex-6 FPGA GTX Transceivers User Guide

  This guide describes the GTX transceivers available in all Virtex-6 FPGAs except the XC6VLX760.

- Virtex-6 FPGA Embedded Tri-Mode Ethernet MAC User Guide

  This guide describes the dedicated Tri-Mode Ethernet Media Access Controller available in all Virtex-6 FPGAs except the XC6VLX760.

- Virtex-6 FPGA DSP48E1 Slice User Guide

  This guide describes the architecture of the DSP48E1 slice in Virtex-6 FPGAs and provides configuration examples.

- Virtex-6 FPGA System Monitor User Guide

  The System Monitor functionality available in all Virtex-6 devices is outlined in this guide.

- Virtex-6 FPGA PCB Design Guide

  This guide provides information on PCB design for Virtex-6 devices, with a focus on strategies for making design decisions at the PCB and interface level.

Additional Support Resources

To search the database of silicon and software questions and answers or to create a technical support case in WebCase, see the Xilinx website at:

http://www.xilinx.com/support.

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Chapter 1

ML605 Evaluation Board

Overview

The ML605 board enables hardware and software developers to create or evaluate designs targeting the Virtex®-6 XC6VLX240T-1FFG1156 FPGA.

The ML605 provides board features common to many embedded processing systems. Some commonly used features include: a DDR3 SODIMM memory, an 8-lane PCI Express® interface, a tri-mode Ethernet PHY, general purpose I/O, and a UART. Additional user desired features can be added through mezzanine cards attached to the onboard high-speed VITA-57 FPGA Mezzanine Connector (FMC) high pin count (HPC) expansion connector, or the onboard VITA-57 FMC low pin count (LPC) connector.

"Features," page 8 provides a general listing of the board features with details provided in "Detailed Description," page 11.

Additional Information

Additional information and support material is located at:

- http://www.xilinx.com/ml605

This information includes:

- Current version of this user guide in PDF format
- Example design files for demonstration of Virtex-6 FPGA features and technology
- Demonstration hardware and software configuration files for the System ACE™ CF controller, Platform Flash configuration storage device, and linear flash chip
- Reference design files
- Schematics in PDF and DxDesigner formats
- Bill of materials (BOM)
- Printed-circuit board (PCB) layout in Allegro PCB format
- Gerber files for the PCB (Many free or shareware Gerber file viewers are available on the internet for viewing and printing these files.)
- Additional documentation, errata, frequently asked questions, and the latest news

For information about the Virtex-6 family of FPGA devices, including product highlights, data sheets, user guides, and application notes, see the Virtex-6 FPGA documentation page at http://www.xilinx.com/support/documentation/virtex-6.htm.

Features

The ML605 provides the following features:

- 1. Virtex-6 XC6VLX240T-1FFG1156 FPGA
- 2. 512 MB DDR3 Memory SODIMM
- 3. 128 Mb Platform Flash XL
- 4. 32 MB Linear BPI Flash
- 5. System ACE CF and CompactFlash Connector
- 6. USB JTAG
- 7. Clock Generation
  - Fixed 200 MHz oscillator (differential)
  - Socketed 2.5V oscillator (single-ended)
  - SMA connectors (differential)
  - SMA connectors for MGT clocking
- 8. Multi-Gigabit Transceivers (GTX MGTs)
  - FMC - HPC connector
  - FMC - LPC connector
  - SMA
  - PCIe
  - SFP Module connector
  - Ethernet PHY SGMII interface
- 9. PCI Express Endpoint Connectivity
  - Gen1 8-lane (x8)
  - Gen2 4-lane (x4)
- 10. SFP Module Connector
- 11. 10/100/1000 Tri-Speed Ethernet PHY
- 12. USB-to-UART Bridge
- 13. USB Controller
- 14. DVI Codec
- 15. IIC Bus
  - IIC EEPROM - 1 KB
  - DDR3 SODIMM socket
  - DVI CODEC
  - DVI connector
  - FMC HPC connector
  - FMC LPC connector
  - SFP module connector

- 16. Status LEDs
  - Ethernet status
  - FPGA INIT
  - FPGA DONE
  - System ACE CF Status
- 17. User I/O
  - USER LED Group 1 - GPIO (8)
  - USER LED Group 2 - directional (5)
  - User pushbuttons - directional (5)
  - CPU reset pushbutton
  - User DIP switch - GPIO (8-pole)
  - User SMA GPIO connectors (2)
  - LCD character display (16 characters x 2 lines)
- 18. Switches
  - Power on/off slide switch
  - System ACE CF reset pushbutton
  - System ACE CF bitstream image select DIP switch
  - Configuration MODE DIP switch
- 19. VITA 57.1 FMC HPC Connector
- 20. VITA 57.1 FMC LPC Connector
- 21. Power Management
  - PMBus voltage and current monitoring via TI power controller
  - 22. System Monitor
- Configuration Options
  - 3. 128 Mb Platform Flash XL
  - 4. 32 MB Linear BPI Flash
  - 5. System ACE CF and CompactFlash Connector
  - 6. USB JTAG

Block Diagram

Figure 1-1 shows a high-level block diagram of the ML605 and its peripherals.

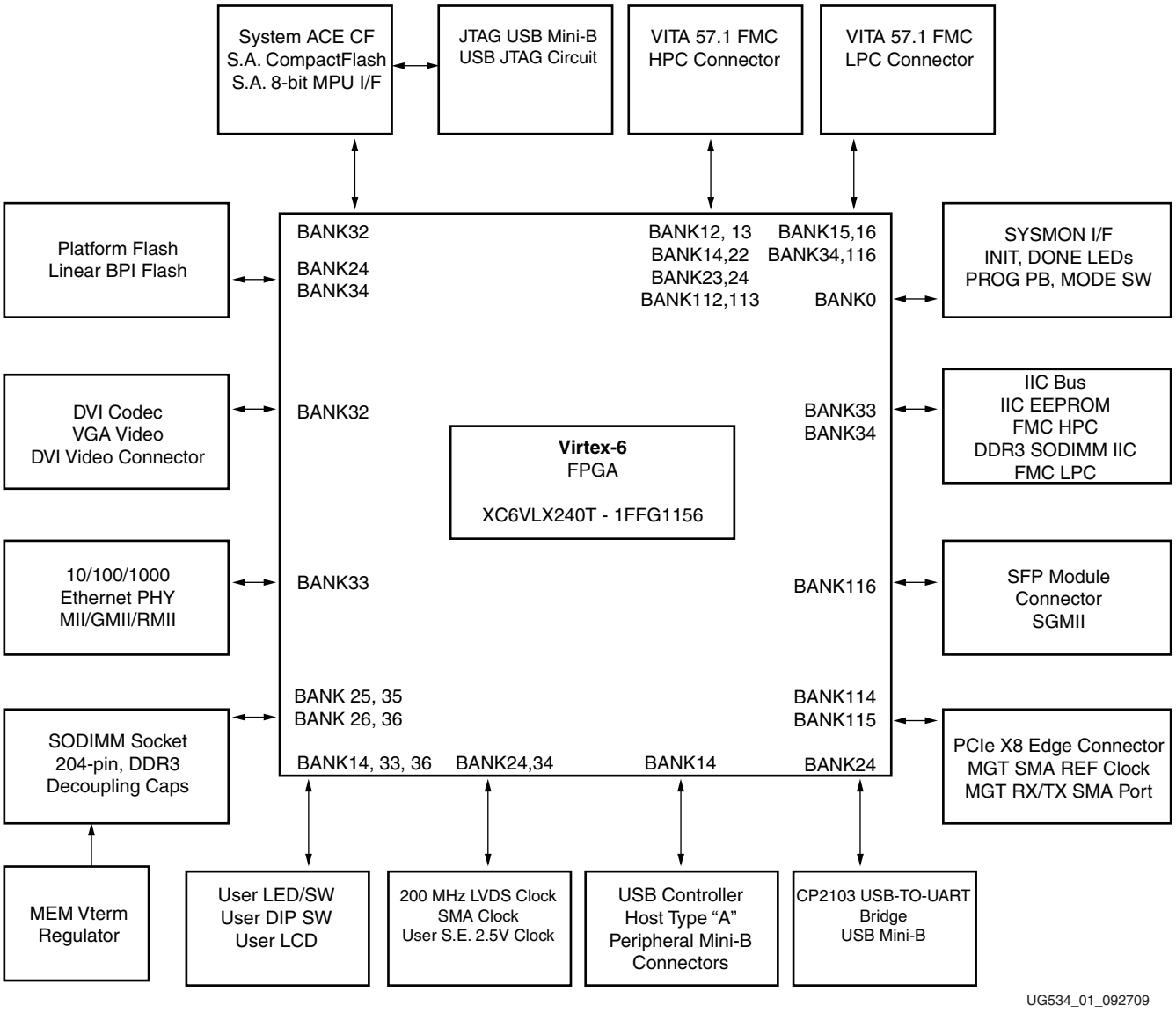


Figure 1-1: **ML605 High-Level Block Diagram**

Related Xilinx Documents

Prior to using the ML605 Evaluation Board, users should be familiar with Xilinx resources. See Appendix D, "References" for a direct link to Xilinx documentation. See the following locations for additional documentation on Xilinx tools and solutions:

- ISE: www.xilinx.com/ise
- EDK: www.xilinx.com/edk
- Intellectual Property: www.xilinx.com/ipcenter
- Answer Browser: www.xilinx.com/support

Detailed Description

Figure 1-2 shows a board photo with numbered features corresponding to Table 1-1 and the section headings in this document.

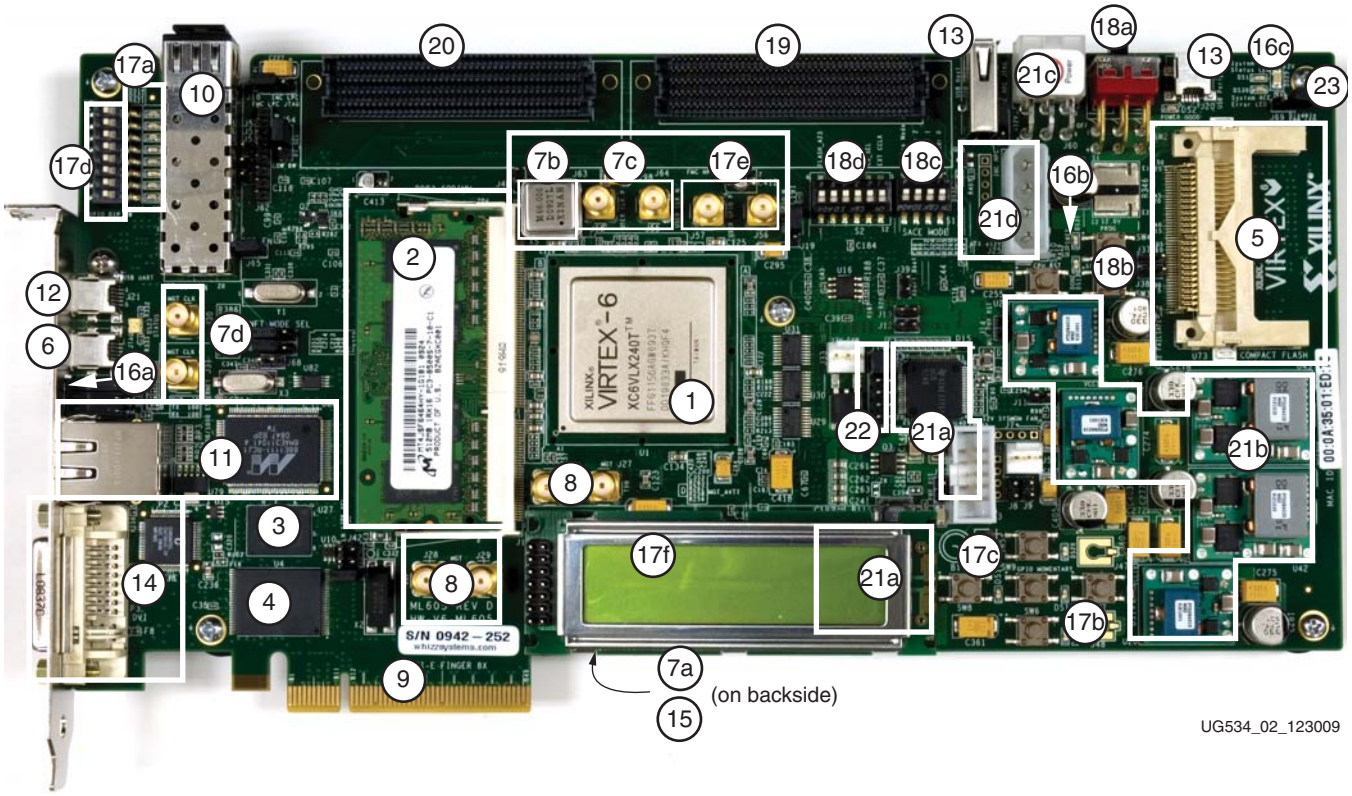


Figure 1-2: **ML605 Board Photo**

The numbered features in Figure 1-2 correlate to the features and notes listed in Table 1-1.

Table 1-1: **ML605 Features**

Number	Feature	Notes	Schematic Page
1	Virtex-6 FPGA	XC6VLX240T-1FFG1156	2 - 12
2	DDR3 SODIMM	Micron 512 MB MT4JSF6464HY-1G1	15
3	128 Mb Platform Flash XL	Xilinx XCF128X-FTG64C	25
4	Linear BPI Flash	Numonyx JS28F256P30T95	26
5	System ACE CF controller, CF connector	Xilinx XCCACE-TQ144I (bottom of board)	13
6	JTAG cable connector (USB Mini-B)	USB JTAG download circuit	46

Table 1-1: **ML605 Features *(Cont'd)***

Number	Feature	Notes	Schematic Page
7	Clock generation	200 MHz OSC, oscillator socket, SMA connectors	30
	a. 200 MHz oscillator (on backside)	Epson 200 MHz 2.5V LVDS OSC	30
	b. Oscillator socket, single-ended	MMD Components 66 MHz 2.5V	30
	c. SMA connectors	SMA pair	30
	d. MGT REFCLK SMA connectors	SMA pair	30
8	GTX RX/TX port	SMA x4	30
9	PCIe Gen1 (8-lane), Gen2 (4-lane)	Card edge connector, 8-lane	21
10	SFP connector and cage	AMP 136073-1	23
11	Ethernet (10/100/1000) with SGMII	Marvell M88E1111 EPHY	24
12	USB Mini-B, USB-to-UART bridge	Silicon Labs CP2103GM bridge	33
13	USB-A Host, USB Mini-B peripheral connectors	Cypress CY7C67300-100AXI controller	27
14	Video - DVI connector	Chrontel CH7301C-TF Video codec	28, 29
15	IIC NV EEPROM, 8 Kb (on backside)	ST Microelectronics M24C08-WDW6TP	32
16	Status LEDs		13, 24, 31
	a. Ethernet status	Right-angle link rate and direction LEDs	24
	b. FPGA INIT, DONE	Init (red), Done (green)	31
	c. System ACE CF status	Status (green), Error (red)	13
17	User I/O		31
	a. User LEDs, green (8)	User I/O (active-High)	30, 31, 33
	b. User pushbuttons, N.O. momentary (5)	User I/O (active-High)	31
	c. User LEDs, green (5)	User I/O (active-High)	31
	d. User DIP switch (8-pole)	User I/O (active-High)	31
	e. User GPIO SMA connectors	SMA pair	30
	f. LCD 16 character x 2 line display	Displaytech S162D BA BC	33

Table 1-1: **ML605 Features *(Cont'd)***

Number	Feature	Notes	Schematic Page
18	Switches		13, 25, 39
	a. Power On/Off	Slide switch	39
	b. FPGA_PROG_B pushbutton	active-Low	13
	c. System ACE CF Image Select	4-pole DIP switch (active-High)	25
	d. Mode Switch	6-pole DIP switch (active-High)	25
19	FMC - HPC connector	Samtec ASP-134486-01	16 -19
20	FMC - LPC connector	Samtec ASP-134603-01	20
21	Power management		35 - 44
	a. PMBus controllers	2 x TI UCD9240PFC	35, 40
	b. Voltage regulators	2 x PTD08A020W, 3 x PTD08A010W	36-38, 43, 44
	c. 12V power input connector	6-pin Molex mini-fit connector	39
	d. 12V power input connector	4-pin ATX disk type connector	39
22	System Monitor Interface connector	2x6 DIP male pin header	34
23	System ACE Error DS30 LED disable jumper J69	Jumper on = enable LED Jumper off = disable LED	13

1. Virtex-6 XC6VLX240T-1FFG1156 FPGA

A Virtex-6 XC6VLX240T-1FFG1156 FPGA is installed on the embedded development board.

Keep-Out areas and drill holes are defined around the FPGA to support an Ironwood Electronics SG-BGA-6046 FPGA socket.

References

See the *Virtex-6 FPGA Data Sheet*. [Ref 4]

Configuration

The ML605 supports configuration in the following modes:

- Slave SelectMAP (using Platform Flash XL with the onboard 47 MHz oscillator)
- Master BPI-Up (using Linear BPI Flash device)
- JTAG (using the included USB-A to Mini-B cable)
- JTAG (using System ACE CF and CompactFlash card)

The ML605 supports Master BPI-Up, JTAG, and Slave SelectMAP. These are selected by setting M[2:0] options `010`, `101` and `110` shown in Table 1-2.

Table 1-2: **Virtex-6 FPGA Configuration Modes**

Configuration Mode	M[2:0]	Bus Width(1)	CCLK Direction
Master Serial(2)	000	1	Output
Master SPI(2)	001	1	Output
Master BPI-Up(2)	010	8, 16	Output
Master BPI-Down(2)	011	8, 16	Output
Master SelectMAP(2)	100	8, 16	Output
JTAG	101	1	Input (TCK)
Slave SelectMAP	110	8, 16, 32	Input
Slave Serial(3)	111	1	Input

Notes:

1. The parallel configuration modes bus is auto-detected by the configuration logic.
2. In Master configuration mode, the CCLK pin is the clock source for the Virtex-6 FPGA internal configuration logic. The Virtex-6 FPGA CCLK output pin must be free from reflections to avoid double-clocking the internal configuration logic. See the *Virtex-6 FPGA Configuration User Guide* for more details. [Ref 5]
3. This is the default setting due to internal pull-up termination on mode pins.

For an overview on configuring the FPGA, see "Configuration Options," page 73.

Note: The mode switches are part of DIP switch S2. The default mode setting (see Table A-1, page 75) is M[2:0]=010, which selects Master BPI-Up at board power-on. Switch S1 position 4 must be OFF to disable the System ACE controller from attempting to boot if a CF card is present.

References

See the *Virtex-6 FPGA Configuration User Guide* for detailed configuration information. [Ref 5]

I/O Voltage Rails

There are 16 I/O banks available on the Virtex-6 device. The voltage applied to the FPGA I/O banks used by the ML605 board is summarized in Table 1-3.

Table 1-3: **Voltage Rails**

U1 FPGA Bank	I/O Rail	Voltage
Bank 0	VCC2V5_FPGA	2.5V
Bank 12(1)	FMC_VIO_B_M2C	2.5V
Bank 13	VCC2V5_FPGA	2.5V
Bank 14	VCC2V5_FPGA	2.5V
Bank 15	VCC2V5_FPGA	2.5V
Bank 16	VCC2V5_FPGA	2.5V
Bank 22	VCC2V5_FPGA	2.5V
Bank 23	VCC2V5_FPGA	2.5V

Table 1-3: **Voltage Rails *(Cont'd)***

U1 FPGA Bank	I/O Rail	Voltage
Bank 24	VCC2V5_FPGA	2.5V
Bank 25	VCC1V5_FPGA	1.5V
Bank 26	VCC1V5_FPGA	1.5V
Bank 32	VCC2V5_FPGA	2.5V
Bank 33	VCC2V5_FPGA	2.5V
Bank 34	VCC2V5_FPGA	2.5V
Bank 35	VCC1V5_FPGA	1.5V
Bank 36	VCC1V5_FPGA	1.5V

Notes:

1. The VITA 57.1 specification stipulates that the Bank 12 voltage named FMC_VIO_B_M2C is supplied by the FMC card plugged onto the relevant FMC connector (ML605 J64). FMC_VIO_B_M2C cannot exceed the base board (ML605) Vadj of the FMC connector. The ML605 FMC Vadj maximum is 2.5V.

References

See the Xilinx Virtex-6 FPGA documentation for more information at http://www.xilinx.com/support/documentation/virtex-6.htm.

2. 512 MB DDR3 Memory SODIMM

A 512MB DDR3 SODIMM is provided as a flexible and efficient form-factor volatile memory for user applications. The ML605 SODIMM socket is wired to support a maximum SODIMM size of 2 GB.

The ML605 DDR3 64-bit wide interface has been tested to 800 MT/s.

The DDR3 interface is implemented in FPGA banks 25, 26, 35, and 36. DCI VRP/N resistor connections are only implemented banks 26 and 36. DCI functionality in banks 25 and 35 is achieved in the UCF by cascading DCI between adjacent banks as follows:

```
CONFIG DCI_CASCADE = "36 35";
CONFIG DCI_CASCADE = "26 25";
```

Table 1-4 shows the connections and pin numbers for the DDR3 SODIMM.

Table 1-4: **DDR3 SODIMM Connections**

U1 FPGA Pin	Schematic Net Name	J1 SODIMM	
		Pin Number	Pin Name
L14	DDR3_A0	98	A0
A16	DDR3_A1	97	A1
B16	DDR3_A2	96	A2
E16	DDR3_A3	95	A3
D16	DDR3_A4	92	A4
J17	DDR3_A5	91	A5

Table 1-4: **DDR3 SODIMM Connections *(Cont'd)***

U1 FPGA Pin	Schematic Net Name	J1 SODIMM	
		Pin Number	Pin Name
A15	DDR3_A6	90	A6
B15	DDR3_A7	86	A7
G15	DDR3_A8	89	A8
F15	DDR3_A9	85	A9
M16	DDR3_A10	107	A10/AP
M15	DDR3_A11	84	A11
H15	DDR3_A12	83	A12_BC_N
J15	DDR3_A13	119	A13
D15	DDR3_A14	80	A14
C15	DDR3_A15	78	A15
K19	DDR3_BA0	109	BA0
J19	DDR3_BA1	108	BA1
L15	DDR3_BA2	79	BA2
J11	DDR3_D0	5	DQ0
E13	DDR3_D1	7	DQ1
F13	DDR3_D2	15	DQ2
K11	DDR3_D3	17	DQ3
L11	DDR3_D4	4	DQ4
K13	DDR3_D5	6	DQ5
K12	DDR3_D6	16	DQ6
D11	DDR3_D7	18	DQ7
M13	DDR3_D8	21	DQ8
J14	DDR3_D9	23	DQ9
B13	DDR3_D10	33	DQ10
B12	DDR3_D11	35	DQ11
G10	DDR3_D12	22	DQ12
M11	DDR3_D13	24	DQ13
C12	DDR3_D14	34	DQ14
A11	DDR3_D15	36	DQ15
G11	DDR3_D16	39	DQ16
F11	DDR3_D17	41	DQ17
D14	DDR3_D18	51	DQ18
C14	DDR3_D19	53	DQ19

Table 1-4: **DDR3 SODIMM Connections *(Cont'd)***

U1 FPGA Pin	Schematic Net Name	J1 SODIMM	
		Pin Number	Pin Name
G12	DDR3_D20	40	DQ20
G13	DDR3_D21	42	DQ21
F14	DDR3_D22	50	DQ22
H14	DDR3_D23	52	DQ23
C19	DDR3_D24	57	DQ24
G20	DDR3_D25	59	DQ25
E19	DDR3_D26	67	DQ26
F20	DDR3_D27	69	DQ27
A20	DDR3_D28	56	DQ28
A21	DDR3_D29	58	DQ29
E22	DDR3_D30	68	DQ30
E23	DDR3_D31	70	DQ31
G21	DDR3_D32	129	DQ32
B21	DDR3_D33	131	DQ33
A23	DDR3_D34	141	DQ34
A24	DDR3_D35	143	DQ35
C20	DDR3_D36	130	DQ36
D20	DDR3_D37	132	DQ37
J20	DDR3_D38	140	DQ38
G22	DDR3_D39	142	DQ39
D26	DDR3_D40	147	DQ40
F26	DDR3_D41	149	DQ41
B26	DDR3_D42	157	DQ42
E26	DDR3_D43	159	DQ43
C24	DDR3_D44	146	DQ44
D25	DDR3_D45	148	DQ45
D27	DDR3_D46	158	DQ46
C25	DDR3_D47	160	DQ47
C27	DDR3_D48	163	DQ48
B28	DDR3_D49	165	DQ49
D29	DDR3_D50	175	DQ50
B27	DDR3_D51	177	DQ51
G27	DDR3_D52	164	DQ52
A28	DDR3_D53	166	DQ53

Table 1-4: **DDR3 SODIMM Connections *(Cont'd)***

U1 FPGA Pin	Schematic Net Name	J1 SODIMM	
		Pin Number	Pin Name
E24	DDR3_D54	174	DQ54
G25	DDR3_D55	176	DQ55
F28	DDR3_D56	181	DQ56
B31	DDR3_D57	183	DQ57
H29	DDR3_D58	191	DQ58
H28	DDR3_D59	193	DQ59
B30	DDR3_D60	180	DQ60
A30	DDR3_D61	182	DQ61
E29	DDR3_D62	192	DQ62
F29	DDR3_D63	194	DQ63
E11	DDR3_DM0	11	DM0
B11	DDR3_DM1	28	DM1
E14	DDR3_DM2	46	DM2
D19	DDR3_DM3	63	DM3
B22	DDR3_DM4	136	DM4
A26	DDR3_DM5	153	DM5
A29	DDR3_DM6	170	DM6
A31	DDR3_DM7	187	DM7
E12	DDR3_DQS0_N	10	DQS0_N
D12	DDR3_DQS0_P	12	DQS0_P
J12	DDR3_DQS1_N	27	DQS1_N
H12	DDR3_DQS1_P	29	DQS1_P
A14	DDR3_DQS2_N	45	DQS2_N
A13	DDR3_DQS2_P	47	DQS2_P
H20	DDR3_DQS3_N	62	DQS3_N
H19	DDR3_DQS3_P	64	DQS3_P
C23	DDR3_DQS4_N	135	DQS4_N
B23	DDR3_DQS4_P	137	DQS4_P
A25	DDR3_DQS5_N	152	DQS5_N
B25	DDR3_DQS5_P	154	DQS5_P
G28	DDR3_DQS6_N	169	DQS6_N
H27	DDR3_DQS6_P	171	DQS6_P
D30	DDR3_DQS7_N	186	DQS7_N

Table 1-4: **DDR3 SODIMM Connections *(Cont'd)***

U1 FPGA Pin	Schematic Net Name	J1 SODIMM	
		Pin Number	Pin Name
C30	DDR3_DQS7_P	188	DQS7_P
F18	DDR3_ODT0	116	ODT0
E17	DDR3_ODT1	120	ODT1
E18	DDR3_RESET_B	30	RESET_B
K18	DDR3_S0_B	114	S0_B
K17	DDR3_S1_B	121	S1_B
D17	DDR3_TEMP_EVENT	198	EVENT_B
B17	DDR3_WE_B	113	WE_B
C17	DDR3_CAS_B	115	CAS_B
L19	DDR3_RAS_B	110	RAS_B
M18	DDR3_CKE0	73	CKE0
M17	DDR3_CKE1	74	CKE1
H18	DDR3_CLK0_N	103	CK0_N
G18	DDR3_CLK0_P	101	CK0_P
L16	DDR3_CLK1_N	104	CK1_N
K16	DDR3_CLK1_P	102	CK1_P

The Memory Interface Generator (MIG) tool guidelines specify a set of U1 FPGA "No Connect" pins. These should be added to the UCF as CONFIG PROHIBIT pins as follows:

```
CONFIG PROHIBIT = H22;
CONFIG PROHIBIT = F21;
CONFIG PROHIBIT = B20;
CONFIG PROHIBIT = F19;

CONFIG PROHIBIT = C13;
CONFIG PROHIBIT = M12;
CONFIG PROHIBIT = L13;
CONFIG PROHIBIT = K14;

CONFIG PROHIBIT = F25;
CONFIG PROHIBIT = C29;
CONFIG PROHIBIT = C28;
CONFIG PROHIBIT = D24;
```

References

See the Micron Technology, Inc. for more information [Ref 22].

In addition, see the *Virtex-6 FPGA Memory Interface Solutions User Guide* [Ref 6] and the *Virtex-6 FPGA Memory Resources User Guide* [Ref 9].

3. 128 Mb Platform Flash XL

A 128 Mb Xilinx XCF128X-FTG64C Platform Flash XL device is used with an onboard 47 MHz oscillator (X4) to configure the FPGA in less than 100 ms from power valid as required by the *PCI Express Card Electromechanical Specification*. This allows the PCIe interface to be recognized and enumerated when plugged into a host PC.

To achieve the fastest configuration speed, the FPGA mode pins are set to Slave SelectMAP and the onboard 47 MHz clock source external to the FPGA is used for configuration. Configuration DIP switch S2, switch 1, controls the 47 MHz oscillator enable as outlined in "18. Switches," page 53.

See S2 switch setting details in Table 1-26, page 56. Also, see the "FPGA Design Considerations for the Configuration Flash," page 23 for FPGA design recommendations.

4. 32 MB Linear BPI Flash

A Numonyx JS28F256P30 Linear BPI Flash memory (P30) on the ML605 provides 32 MB of non-volatile storage that can be used for configuration as well as software storage. The Linear BPI Flash shares the dual use configuration pins in parallel with the XCF128 Platform Flash XL.

The P30_CS net is used to select the P30 or the XCF128. Power-on configuration is selected by the P30_CS net which is tied to a dip switch S2 (selects pullup/pulldown) and is also wired to an FPGA non-config pin. The dip switch allows power selection for the configuration device P30 or XCF128XL. The dip switch selection can be overridden by the FPGA after configuration by controlling the logic level of the P30_CS signal.

See S2 switch setting details in Table 1-26, page 56. For an overview on configuring the FPGA, see "Configuration Options," page 73.

Figure 1-3 shows a block diagram for the Platform Flash and BPI Flash.

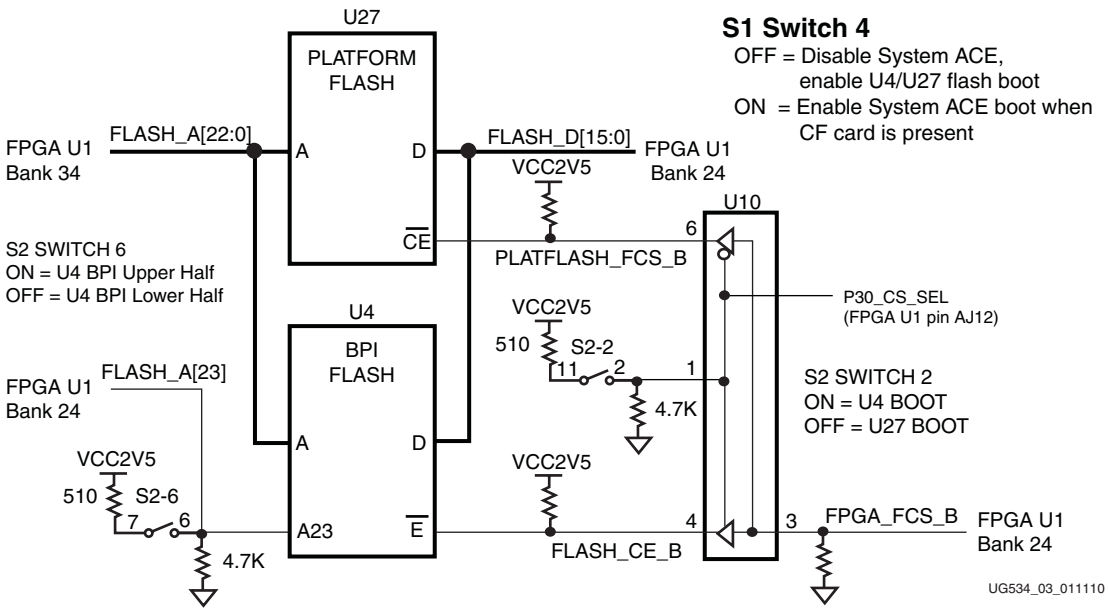


Figure 1-3: **Platform Flash and BPI Flash Block Diagram**

ML605 Flash Boot Options

The ML605 has two parallel wired flash memory devices as shown in Figure 1-3. At ML605 power-up, before FPGA configuration, DIP switch S2 switch 2 selects which flash device, U4 (BPI) or U27 (Platform Flash), provides the boot bitstream. Typically S2 switch 2 will be open/OFF to select the U27 Platform Flash. Given that the mode switches (S2 switch 3/M0, switch 4/M1 and switch 5/M2) are set to Slave SelectMAP mode, then U27, driven at 47 MHz, can load a PCIe core bitstream before a host PC motherboard can scan its PCIe slots.When S2 switch 2 is closed/ON at power up, the FPGA will be configured from the BPI flash device U4. Note that U4 address bit A23 is switched by S2 switch 6, which allows the lower or upper half of U4 to be chosen as a data source.

Table 1-5 shows the connections and pin numbers for the boot flash devices.

Table 1-5: **Platform Flash and BPI Flash Connections**

U1 FPGA Pin	Schematic Net Name	U4 BPI Flash		U27 Platform Flash	
		Pin Number	Pin Name	Pin Number	Pin Name
AL8	FLASH_A0	29	A1	A1	A00
AK8	FLASH_A1	25	A2	B1	A01
AC9	FLASH_A2	24	A3	C1	A02
AD10	FLASH_A3	23	A4	D1	A03
C8	FLASH_A4	22	A5	D2	A04
B8	FLASH_A5	21	A6	A2	A05
E9	FLASH_A6	20	A7	C2	A06
E8	FLASH_A7	19	A8	A3	A07
A8	FLASH_A8	8	A9	B3	A08
A9	FLASH_A9	7	A10	C3	A09
D9	FLASH_A10	6	A11	D3	A10
C9	FLASH_A11	5	A12	C4	A11
D10	FLASH_A12	4	A13	A5	A12
C10	FLASH_A13	3	A14	B5	A13
F10	FLASH_A14	2	A15	C5	A14
F9	FLASH_A15	1	A16	D7	A15
AH8	FLASH_A16	55	A17	D8	A16
AG8	FLASH_A17	18	A18	A7	A17
AP9	FLASH_A18	17	A19	B7	A18
AN9	FLASH_A19	16	A20	C7	A19
AF10	FLASH_A20	11	A21	C8	A20
AF9	FLASH_A21	10	A22	A8	A21
AL9	FLASH_A22	9	A23	G1	A22
AA23	FLASH_A23	26	A24	NC	A23

Table 1-5: **Platform Flash and BPI Flash Connections *(Cont'd)***

U1 FPGA Pin	Schematic Net Name	U4 BPI Flash		U27 Platform Flash	
		Pin Number	Pin Name	Pin Number	Pin Name
AF24	FLASH_D0	34	DQ0	F2	DQ00
AF25	FLASH_D1	36	DQ1	E2	DQ01
W24	FLASH_D2	39	DQ2	G3	DQ02
V24	FLASH_D3	41	DQ3	E4	DQ03
H24	FLASH_D4	47	DQ4	E5	DQ04
H25	FLASH_D5	49	DQ5	G5	DQ05
P24	FLASH_D6	51	DQ6	G6	DQ06
R24	FLASH_D7	53	DQ7	H7	DQ07
G23	FLASH_D8	35	DQ8	E1	DQ08
H23	FLASH_D9	37	DQ9	E3	DQ09
N24	FLASH_D10	40	DQ10	F3	DQ10
N23	FLASH_D11	42	DQ11	F4	DQ11
F23	FLASH_D12	48	DQ12	F5	DQ12
F24	FLASH_D13	50	DQ13	H5	DQ13
L24	FLASH_D14	52	DQ14	G7	DQ14
M23	FLASH_D15	54	DQ15	E7	DQ15
J26	FLASH_WAIT	56	WAIT	NA(1)	NA(1)
AF23	FPGA_FWE_B	14	/WE	G8	/W
AA24	FPGA_FOE_B	32	/OE	F8	/G
K8	FPGA_CCLK	NA(1)	NA(1)	F1	K
AC23	PLATFLASH_L_B	NA(1)	NA(1)	H1	/L
Y24	FPGA_FCS_B(2)	NA(1)	NA(1)	NA(1)	NA(1)
NA(1)	PLATFLASH_FCS_B(3)	NA(1)	NA(1)	B4	/E
NA(1)	FLASH_CE_B(4)	30	/OE	NA(1)	NA(1)

Notes:

1. Not Applicable
2. FPGA control flash memory select signal connected to pin U10.3
3. Platform Flash select signal connected to pin U10.6
4. BPI Flash select signal connected to pin U10.4

FPGA Design Considerations for the Configuration Flash

After FPGA configuration, the FPGA design can disable the configuration flash or access the configuration flash to read/write code or data.

When the FPGA design does not use the configuration flash, the FPGA design must drive the FPGA FCS_B pin High in order to disable the configuration flash and put the flash into a quiescent, low-power state. Otherwise, the Platform Flash XL, in particular, can continue to drive its array data onto the data bus causing unnecessary switching noise and power consumption.

For FPGA designs that access the flash for reading/writing stored code or data, connect the FPGA design or EDK embedded memory controller (EMC) peripheral to the flash through the pins defined in Table 1-5, page 21.

The Platform Flash XL defaults to a synchronous read mode. Typically, the Platform Flash XL requires an initialization procedure to put the Platform Flash XL into the common, asynchronous read mode before accessing stored code or data. To put the Platform Flash XL into asynchronous read mode, apply the Set Configuration Register command sequence. See the *Platform Flash XL High-Density Configuration and Storage Device Data Sheet* for details on the Set Configuration Register command. [Ref 17]

References

See the Numonyx *StrataFlash Embedded Memory Data Sheet*. [Ref 24]

Visit the Xilinx Platform Flash product page and click the Resources tab for more information.

Also, see the *Platform Flash XL High-Density Configuration and Storage Device Data Sheet* [Ref 17] and the *Virtex-6 Configuration User Guide* [Ref 10].

5. System ACE CF and CompactFlash Connector

The Xilinx System ACE CompactFlash (CF) configuration controller allows a Type I or Type II CompactFlash card to program the FPGA through the JTAG port. Both hardware and software data can be downloaded through the JTAG port. The System ACE CF controller supports up to eight configuration images on a single CompactFlash card. The configuration address switches allow the user to choose which of the eight configuration images to use.

The CompactFlash (CF) card shipped with the board is correctly formatted to enable the System ACE CF controller to access the data stored in the card. The System ACE CF controller requires a FAT16 file system, with only one reserved sector permitted, and a sector-per-cluster size of more than one (UnitSize greater than 512). The FAT16 file system supports partitions of up to 2 GB. If multiple partitions are used, the System ACE CF directory structure must reside in the first partition on the CompactFlash, with the `xilinx.sys` file located in the root directory. The `xilinx.sys` file is used by the System ACE CF controller to define the project directory structure, which consists of one main folder containing eight sub-folders used to store the eight ACE files containing the configuration images. Only one ACE file should exist within each sub-folder. All folder names must be compliant to the DOS 8.3 short file name format. This means that the folder names can be up to eight characters long, and cannot contain the following reserved characters: < > " / \ |. This DOS 8.3 file name restriction does not apply to the actual ACE file names. Other folders and files may also coexist with the System ACE CF project within the FAT16 partition. However, the root directory must not contain more than a total of 16 folder and/or file entries, including deleted entries. When ejecting or unplugging the CompactFlash device, it is important to safely stop any read or write access to the CompactFlash device to avoid data corruption.

System ACE CF error and status LEDs indicate the operational state of the System ACE CF controller:

- A blinking red error LED indicates that no CompactFlash card is present.
- A solid red error LED indicates an error condition during configuration.
- A blinking green status LED indicates a configuration operation is ongoing.
- A solid green status LED indicates a successful download.

Note: Jumper J69 can be removed to disable the Red Error LED circuit. It is recommended that this jumper is installed during operations utilizing the CompactFlash card.

Every time a CompactFlash card is inserted into the System ACE CF socket, a configuration operation is initiated. Pressing the System ACE CF reset button re-programs the FPGA.

Note: System ACE CF configuration is enabled by way of DIP switch S1. See "18. Switches," page 53 for more details.

The System ACE CF MPU port is connected to the FPGA. This connection allows the FPGA to use the System ACE CF controller to reconfigure the system or access the CompactFlash card as a generic FAT file system.

Table 1-6 lists the System ACE CF connections.

Table 1-6: **System ACE CF Connections**

U1 FPGA Pin	Schematic Net Name	U19 XCCACETQ144I	
		Pin Number	Pin Name
AM15	SYSACE_D0	66	MPD00
AJ17	SYSACE_D1	65	MPD01
AJ16	SYSACE_D2	63	MPD02
AP16	SYSACE_D3	62	MPD03
AG16	SYSACE_D4	61	MPD04
AH15	SYSACE_D5	60	MPD05
AF16	SYSACE_D6	59	MPD06
AN15	SYSACE_D7	58	MPD07
AC15	SYSACE_MPA00	70	MPA00
AP15	SYSACE_MPA01	69	MPA01
AG17	SYSACE_MPA02	68	MPA02
AH17	SYSACE_MPA03	67	MPA03
AG15	SYSACE_MPA04	45	MPA04
AF15	SYSACE_MPA05	44	MPA05
AK14	SYSACE_MPA06	43	MPA06
AJ15	SYSACE_MPBRDY	39	MPBRDY
AJ14	SYSACE_MPCE	42	MPCE
L9	SYSACE_MPIRQ	41	MPIRQ
AL15	SYSACE_MPOE	77	MPOE
AL14	SYSACE_MPWE	76	MPWE
AC8	SYSACE_CFGTDI	81	CFGTDI
AE8	FPGA_TCK	80	CFGTCK
AD8	FPGA_TDI	82	CFGTDO
AF8	FPGA_TMS	85	CFGTMS
AE16	CLK_33MHZ_SYSACE(1)	93	CLK

Notes:

1. The System ACE CF clock is sourced from U28 32.000 MHz osc.

References

See the System ACE CF product page and the *System ACE CompactFlash Solution Data Sheet*. [Ref 18]

6. USB JTAG

JTAG configuration is provided through onboard USB-to-JTAG configuration logic where a computer host accesses the ML605 JTAG chain through a Type-A (computer host side) to Type-Mini-B (ML605 side) USB cable.

The JTAG chain of the board is illustrated in Figure 1-4. JTAG configuration is allowable at any time under any mode pin setting. JTAG initiated configuration takes priority over the mode pin settings.

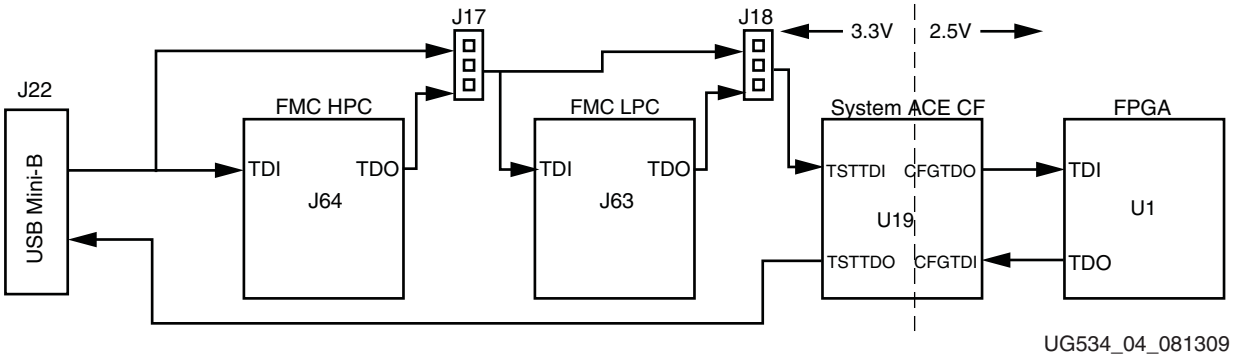


Figure 1-4: **JTAG Chain Diagram**

FMC bypass jumpers J17 and J18 must be connected between pins 1-2 (bypass) to enable JTAG access to the FPGA on the basic ML605 board (without FMC expansion modules installed), as shown in Figure 1-5 and Figure 1-6. When either or both VITA 57.1 FMC expansion connectors are populated with an expansion module that has a JTAG chain, the respective jumper(s) must be set to connect pins 2-3 in order to include the FMC expansion module's JTAG chain in the main ML605 JTAG chain.

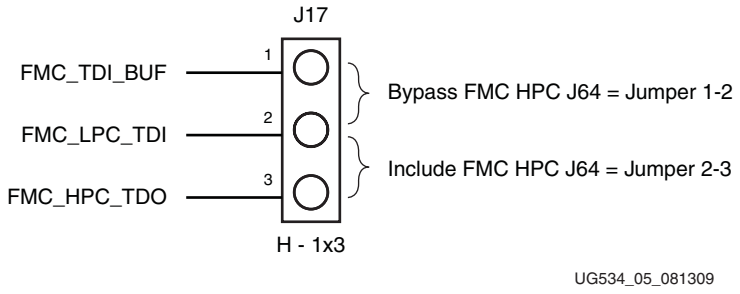


Figure 1-5: **VITA 57.1 FMC HPC (J64) JTAG Bypass Jumper J17**

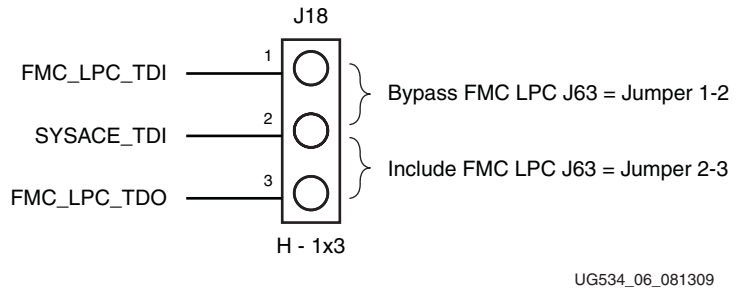


Figure 1-6: **VITA 57.1 FMC LPC (J63) JTAG Bypass Jumper J18**

The JTAG chain can be used to program the FPGA and access the FPGA for hardware and software debug.

The JTAG connector (USB Mini-B J22) allows a host computer to download bitstreams to the FPGA using the Xilinx iMPACT software tool. In addition, the JTAG connector allows debug tools such as the ChipScope™ Pro Analyzer tool or a software debugger to access the FPGA. The iMPACT software tool can also program the BPI flash via the USB J22 connection. iMPACT can download a temporary design to the FPGA through the JTAG. This provides a connection within the FPGA from the FPGA's JTAG port to the FPGA's BPI interface. Through the connection made by the temporary design in the FPGA, iMPACT can indirectly program the BPI flash or the Platform Flash XL from the JTAG USB J22 connector.

For an overview on configuring the FPGA, see "Configuration Options," page 73.

7. Clock Generation

There are three FPGA fabric clock sources available on the ML605.

Oscillator (Differential)

The ML605 has one 2.5V LVDS differential 200 MHz oscillator (U11) soldered onto the board and wired to an FPGA global clock input.

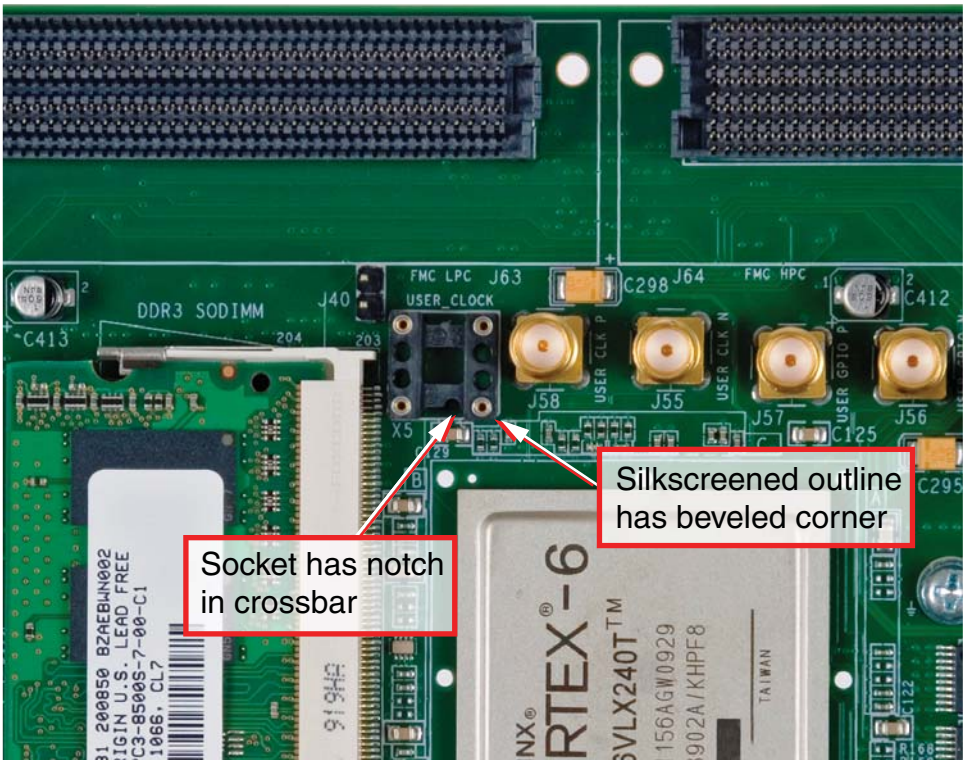
- Crystal oscillator: Epson EG-2121CA-200.0000M-LHPA
- PPM frequency jitter: 50 ppm

For more details, see the Epson EG-2121CA data sheet. [Ref 25].

Oscillator Socket (Single-Ended, 2.5V)

One populated single-ended clock socket (X5) is provided for user applications. The option of 3.3V or 2.5V power may be selected via a 0 ohm resistor selection. The X5 socket is populated with a 66 MHz 2.5V single-ended MMD Components MBH2100H-66.000 MHz oscillator.

For more details, see the MMD Components *MBH Series Data Sheet*. [Ref 26]



UG534_07_092109

Figure 1-7: **ML605 Oscillator Socket Pin 1 Location Identifiers**

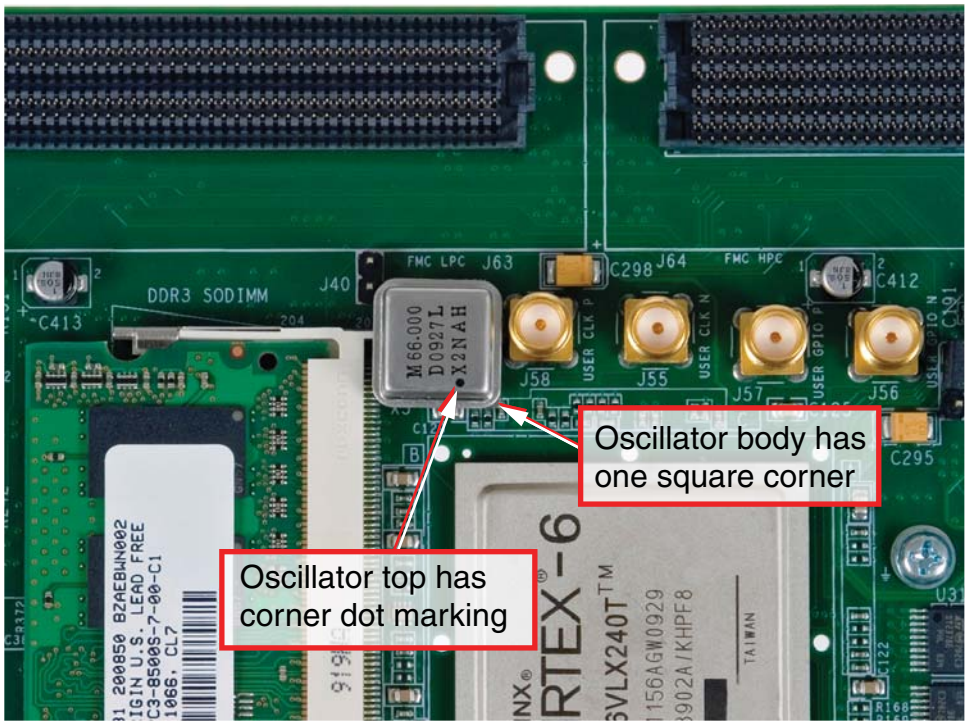


Figure 1-8: **ML605 Oscillator Pin 1 Location Identifiers**

SMA Connectors (Differential)

A high-precision clock signal can be provided to the FPGA using differential clock signals through the onboard 50-ohm SMA connectors J58(P)/J55(N).

GTX SMA Clock

The ML605 includes a pair of SMA connectors for a GTX (MGT) Clock as described in Figure 1-9 and Table 1-7.

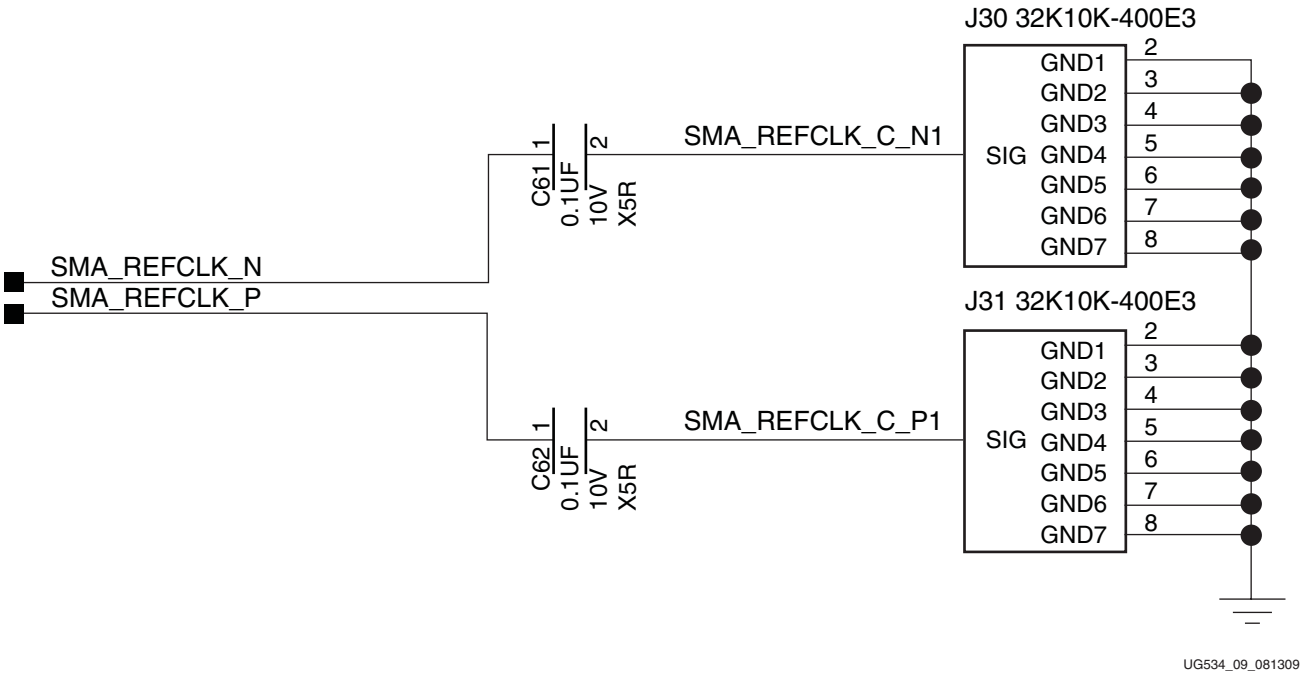


Figure 1-9: **GTX SMA Clock**

Table 1-7: **GTX SMA Clock Connections**

U1 FPGA Pin	Schematic Net Name	SMA Pin
F5	SMA_REFCLK_N	J30.1
F6	SMA_REFCLK_P	J31.1

8. Multi-Gigabit Transceivers (GTX MGTs)

The ML605 provides access to 20 MGTs.

- Eight (8) of the MGTs are wired to the PCIe x8 Endpoint (P1) edge connector fingers
- Eight (8) of the MGTs are wired to the FMC HPC connector (J64)
- One (1) MGT is wired to SMA connectors (J26, J27)
- One (1) MGTs is wired to the FMC LPC connector (J63)
- One (1) MGT is wired to the SFP Module connector (P4)
- One (1) MGT is used for an SGMII connection to the Ethernet PHY (U80)

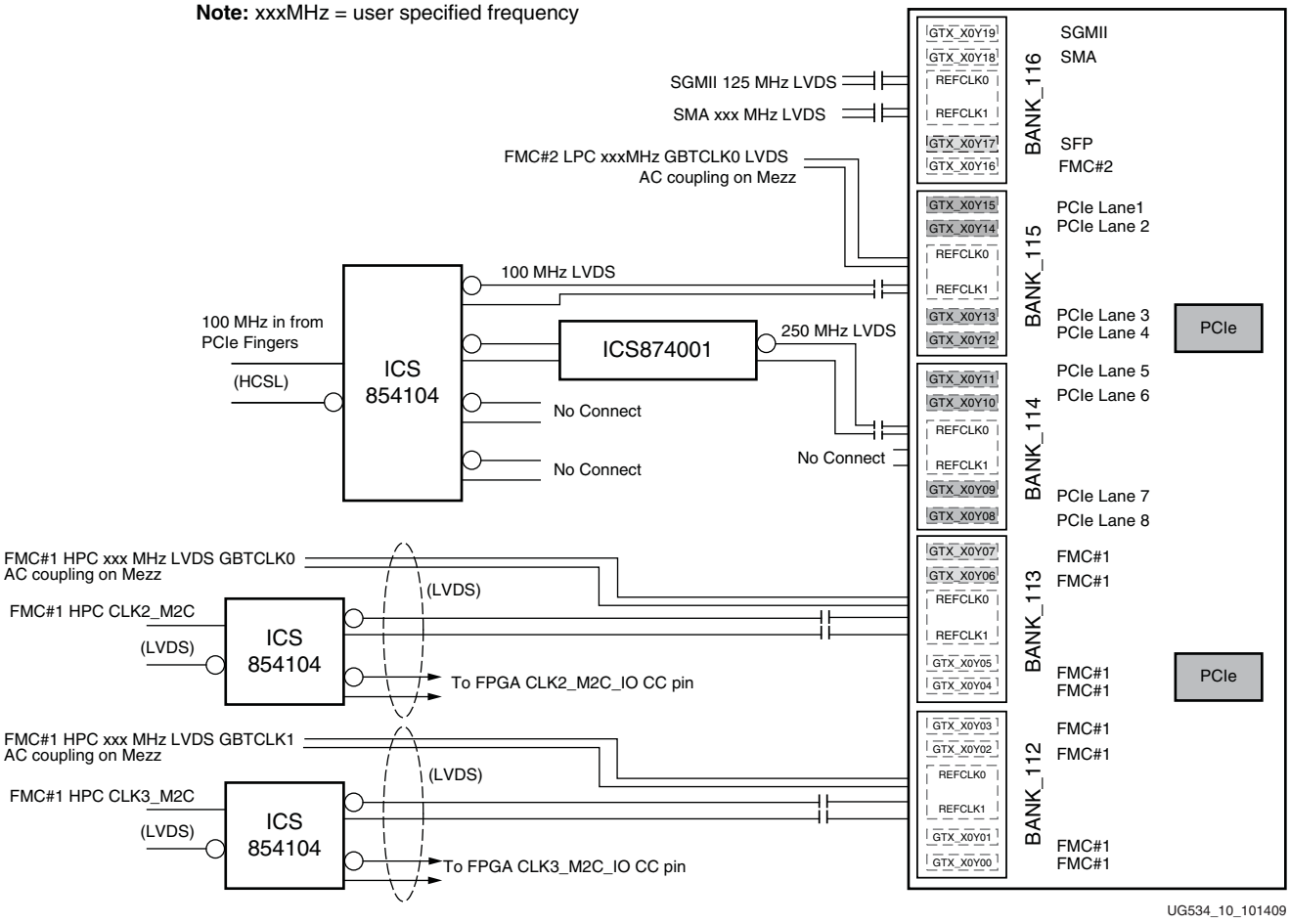


Figure 1-10: **MGT Clocking**

References

See the *Virtex-6 FPGA GTX Transceivers User Guide*. [Ref 12]

9. PCI Express Endpoint Connectivity

The 8-lane PCIe edge connector performs data transfers at the rate of 2.5 GT/s for a Gen1 application and 5.0 GT/s for a Gen2 application. The Virtex FPGA GTX MGTs are used for the multi-gigabit per second serial interfaces.

The ML605 board trace impedance on all PCIe lanes supports both Gen1 and Gen2 applications. The ML605 supports up to Gen1 x8 and Gen2 x4 as shipped with a -1 speed grade for the LX240T device.

Figure 1-11, page 32 is a diagram of the PCIe MGT bank 114 and 115 clocking.

Note: PCIe edge connector signal nomenclature is from perspective of the system/motherboard.

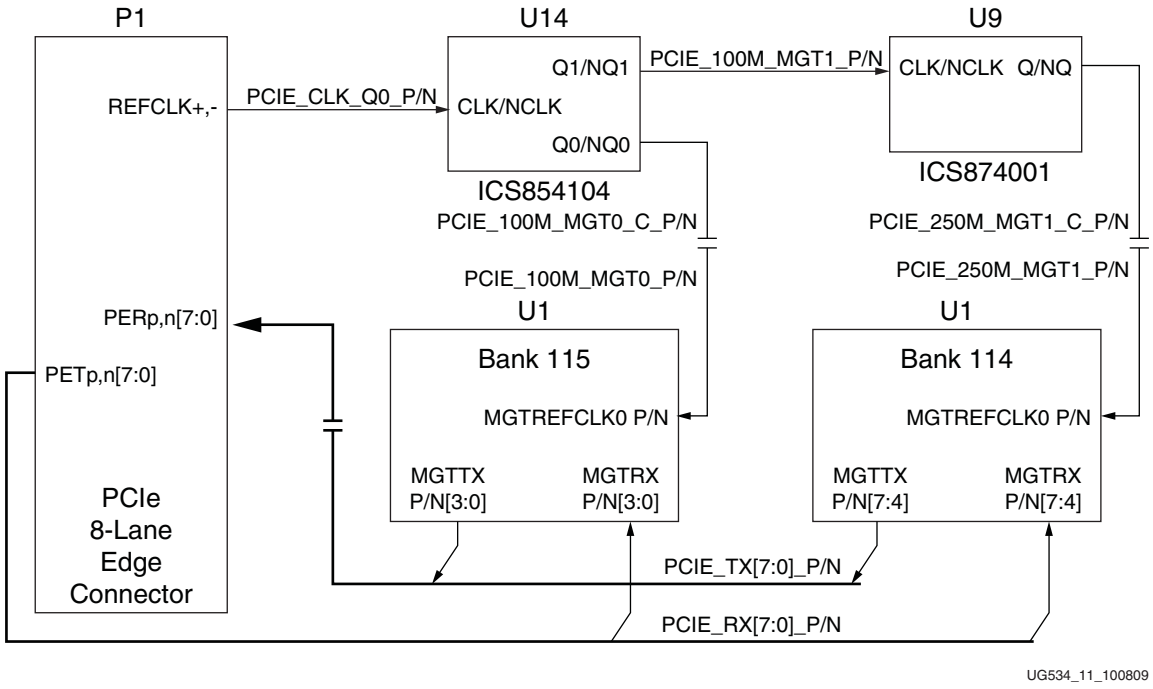


Figure 1-11: **PCIe MGT Banks 114 and 115 Clocking**

PCIe lane width/size is selected via jumper J42 as shown in Figure 1-12. The default lane size selection is 1-lane (J42 pins 1 and 2 jumpered).

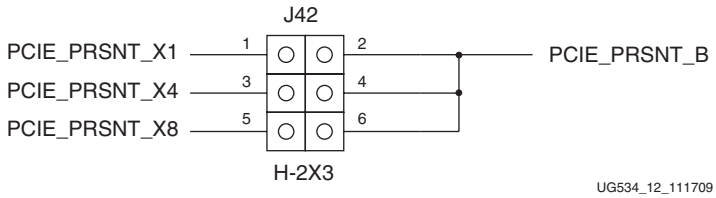


Figure 1-12: **PCIe Lane Size Select Jumper J42**

Table 1-8 shows the PCIe connector (P1) that provides up to 8-lane access through the GTX transceivers to the Virtex-6 FPGA integrated Endpoint block for PCIe designs.

Table 1-8: **PCIe Edge Connector Connections**

U1 FPGA Pin	Schematic Net Name	P1 PCIe Edge Connector		Description	Package Placement
		Pin Number	Pin Name		
F1	PCIE_TXO_P	A16	PERp0	Integrated Endpoint block transmit pair	GTXE1_X0Y15
F2	PCIE_TXO_N	A17	PERn0		
H1	PCIE_TX1_P	A21	PERp1	Integrated Endpoint block transmit pair	GTXE1_X0Y14
H2	PCIE_TX1_N	A22	PERn1		
K1	PCIE_TX2_P	A25	PERp2	Integrated Endpoint block transmit pair	GTXE1_X0Y13
K2	PCIE_TX2_N	A26	PERn2		
M1	PCIE_TX3_P	A29	PERp3	Integrated Endpoint block transmit pair	GTXE1_X0Y11
M2	PCIE_TX3_N	A30	PERn3		
P1	PCIE_TX4_P	A35	PERp4	Integrated Endpoint block transmit pair	GTXE1_X0Y10
P2	PCIE_TX4_N	A36	PERn4		
T1	PCIE_TX5_P	A39	PERp5	Integrated Endpoint block transmit pair	GTXE1_X0Y9
T2	PCIE_TX5_N	A40	PERn5		
V1	PCIE_TX6_P	A43	PERp6	Integrated Endpoint block transmit pair	GTXE1_X0Y8
V2	PCIE_TX6_N	A44	PERn6		
Y1	PCIE_TX7_P	A47	PERp7	Integrated Endpoint block transmit pair	GTXE1_X0Y7
Y2	PCIE_TX7_N	A48	PERn7		
J3	PCIE_RXO_P	B14	PETp0	Integrated Endpoint block receive pair	GTXE1_X0Y15
J4	PCIE_RXO_N	B15	PETn0		
K5	PCIE_RX1_P	B19	PETp1	Integrated Endpoint block receive pair	GTXE1_X0Y14
K6	PCIE_RX1_N	B20	PETn1		
L3	PCIE_RX2_P	B23	PETp2	Integrated Endpoint block receive pair	GTXE1_X0Y13
L4	PCIE_RX2_N	B24	PETn2		
N3	PCIE_RX3_P	B27	PETp3	Integrated Endpoint block receive pair	GTXE1_X0Y11
N4	PCIE_RX3_N	B28	PETn3		
R3	PCIE_RX4_P	B33	PETp4	Integrated Endpoint block receive pair	GTXE1_X0Y10
R4	PCIE_RX4_N	B34	PETn4		
U3	PCIE_RX5_P	B37	PETp5	Integrated Endpoint block receive pair	GTXE1_X0Y9
U4	PCIE_RX5_N	B38	PETn5		
W3	PCIE_RX6_P	B41	PETp6	Integrated Endpoint block receive pair	GTXE1_X0Y8
W4	PCIE_RX6_N	B42	PETn6		

Table 1-8: **PCIe Edge Connector Connections *(Cont'd)***

U1 FPGA Pin	Schematic Net Name	P1 PCIe Edge Connector		Description	Package Placement
		Pin Number	Pin Name		
AA3	PCIE_RX7_P	B45	PETp7	Integrated Endpoint block receive pair	GTXE1_X0Y7
AA4	PCIE_RX7_N	B46	PETn7		
P6	PCIE_100M_MGT0_P	U14.16	Q0	Sourced from U14 ICS854104	GTXE1_X0Y6
P5	PCIE_100M_MGT0_N	U14.15	NQ0	clock driver	
V6	PCIE_250M_MGT1_P	U9.18	Q	Sourced from U9 ICS874001	GTXE1_X0Y4
V5	PCIE_250M_MGT1_N	U9.17	NQ	clock multiplier/driver	
U14.6	PCIE_CLK_QO_P	A13	REFCLK+	Integrated Endpoint block differential clock pair from PCIe edge connector	
U14.7	PCIE_CLK_QO_N	A14	REFCLK-		
J42.2,4,6	PCIE_PRSNT_B	A1	PRSNT#1	J42 Lane Size Select jumper	
AD22	PCIE_WAKE_B	B11	WAKE#	Integrated Endpoint block wake signal, not connected on ML605 board	
AE13	PCIE_PERST_B	A11	PERST	Integrated Endpoint block reset signal	

Notes:

1. PCIE_TXn_P/N pairs are capacitively coupled to FPGA
2. PCIE_100M_MGT0_P/N pairs are capacitively coupled to FPGA
3. PCIE_250M_MGT1_P/N pairs are capacitively coupled to FPGA
4. PCIE_PERST_B is level-shifted by U32
5. For ML605, access is through MGT Banks 114 and 115

The PCIe interface obtains its power from the DC power supply provided with the ML605 or through the 12V ATX power supply connector. The PCIe edge connector is not used for any power connections.

The board can be powered by one of two 12V sources; J60, a 6-pin (2x3) molex-type connector and J25, a 4-pin (inline) ATX disk drive type connector.

The 6-pin molex-type connector provides 60W (12V @ 5A) from the AC power adapter provided with the board while the 4-pin ATX disk drive connector is provided for users who want to power their board while it is installed inside a PC chassis.

For applications requiring additional power, such as the use of expansion cards drawing significant power, a larger AC adapter might be required. If a different AC adapter is used, its load regulation should be better than ±10%.

ML605 power switch SW2 turns the board on and off by controlling the 12V supply to the board.

> ***Caution!*** Never apply power to the power brick connector (J60) and the 4-pin ATX disk drive connector (J25) at the same time as this will result in damage to the board. See Figure 1-23, page 53. Never connect an auxiliary PCIe 6-pin molex power connector to J60 6-pin molex on the ML605 board as this could result in damage to the PCIe motherboard and/or ML605 board. The 6-pin molex connector is marked with a **no PCIe power** label to warn users of the potential hazard.

References

See the following websites for more Virtex-6 FPGA Integrated Endpoint Block for PCI Express information:

- http://www.xilinx.com/products/ipcenter/V6_PCI_Express_Block.htm
- http://www.xilinx.com/support/documentation/ipbusinterfacei-o_pci-express_v6pciexpressendpointblock.htm

In addition, see the PCI Express specifications for more information. [Ref 27]

10. SFP Module Connector

The board contains a small form-factor pluggable (SFP) connector and cage assembly that accepts SFP modules. The SFP interface is connected to MGT Bank 116 on the FPGA. The SFP module serial ID interface is connected to the "SFP" IIC bus (see "15. IIC Bus," page 42 for more information). The control and status signals for the SFP module are connected to jumpers and test points as described in Table 1-9. The SFP module connections are shown in Table 1-10, page 36.

Table 1-9: **SFP Module Control and Status**

SFP Control/Status Signal	Board Connection
SFP_TX_FAULT	Test Point J52
	High = Fault
	Low = Normal Operation
SFP_TX_DISABLE	Jumper J65
	Off = SFP Disabled
	On = SFP Enabled
SFP_MOD_DETECT	Test Point J53
	High = Module Not Present
	Low = Module Present
SFP_RT_SEL	Jumper J54
	Jumper Pins 1-2 = Full Bandwidth
	Jumper Pins 2-3 = Reduced Bandwidth
SFP_LOS	Test Point J51
	High = Loss of Receiver Signal
	Low = Normal Operation

Table 1-10: **SFP Module Connections**

U1 FPGA Pin	Schematic Net Name	P4 SFP Module Connector	
		Pin Number	Pin Name
E3	SFP_RX_P	13	RDP_13
E4	SFP_RX_N	12	RDN_12
C3	SFP_TX_P	18	TDP_18
C4	SFP_TX_N	19	TDN_19
V23	SFP_LOS	8	LOS
AP12	SFP_TX_DISABLE(1)	3	TX_DISABLE

Notes:

1. The SFP TX Disable pin 3 is driven by transistor Q22, the base of which is driven by the FPGA signal SFP_TX_DISABLE_FPGA.

11. 10/100/1000 Tri-Speed Ethernet PHY

The ML605 utilizes the onboard Marvell Alaska PHY device (88E1111) for Ethernet communications at 10, 100, or 1000 Mb/s. The board supports MII, GMII, RGMII, and SGMII interfaces from the FPGA to the PHY (Table 1-11). The PHY connection to a user-provided Ethernet cable is through a Halo HFJ11-1G01E RJ-45 connector with built-in magnetics.

Table 1-11: **PHY Default Interface Mode**

Mode	Jumper Settings		
	J66	J67	J68
GMII/MII to copper (default)	Jumper over pins 1-2	Jumper over pins 1-2	No jumper
SGMII to copper, no clock	Jumper over pins 2-3	Jumper over pins 2-3	No jumper
RGMII	Jumper over pins 1-2	No jumper	Jumper on

On power-up, or on reset, the PHY is configured to operate in GMII mode with PHY address `0b00111` using the settings shown in Table 1-12. These settings can be overwritten via software commands passed over the MDIO interface.

Table 1-12: **Board Connections for PHY Configuration Pins**

Pin	Connection on Board	Bit[2] Definition and Value	Bit[1] Definition and Value	Bit[0] Definition and Value
CFG0	V_{CC} 2.5V	PHYADR[2] = 1	PHYADR[1] = 1	PHYADR[0] = 1
CFG1	Ground	ENA_PAUSE = 0	PHYADR[4] = 0	PHYADR[3] = 0
CFG2	V_{CC} 2.5V	ANEG[3] = 1	ANEG[2] = 1	ANEG[1] = 1
CFG3	V_{CC} 2.5V	ANEG[0] = 1	ENA_XC = 1	DIS_125 = 1
CFG4	V_{CC} 2.5V	HWCFG_MD[2] = 1	HWCFG_MD[1] = 1	HWCFG_MD[0] = 1

Table 1-12: **Board Connections for PHY Configuration Pins *(Cont'd)***

Pin	Connection on Board	Bit[2] Definition and Value	Bit[1] Definition and Value	Bit[0] Definition and Value
CFG5	V_{CC} 2.5V	DIS_FC = 1	DIS_SLEEP = 1	HWCFG_MD[3] = 1
CFG6	PHY_LED_RX	SEL_BDT = 0	INT_POL = 1	75/50 OHM = 0

SGMII GTX Transceiver Clock Generation

An Integrated Circuit Systems ICS844021I chip generates a high-quality, low-jitter, 125-MHz LVDS clock from an inexpensive 25-MHz crystal oscillator. This clock is sent to the GTX driving the SGMII interface. Series AC coupling capacitors are also present to allow the clock input of the FPGA to set the common mode voltage.

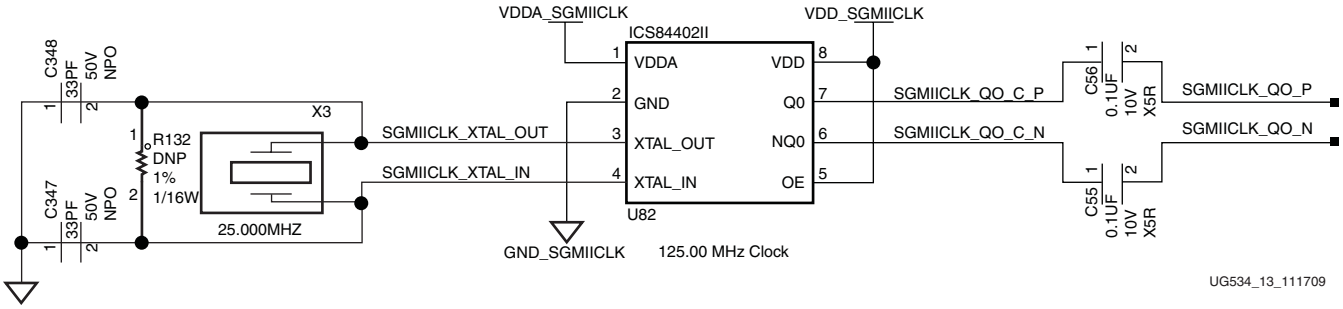


Figure 1-13: **Ethernet SGMII Clock - 125 MHz**

Table 1-13 shows the connections and pin numbers for the PHY.

Table 1-13: **Ethernet PHYConnections**

U1 FPGA Pin	Schematic Net Name	U80 M88E1111	
		Pin Number	Pin Name
AN14	PHY_MDIO	33	MDIO
AP14	PHY_MDC	35	MDC
AH14	PHY_INT	32	INT_B
AH13	PHY_RESET	36	RESET_B
AL13	PHY_CRS	115	CRS
AK13	PHY_COL	114	COL
AP11	PHY_RXCLK	7	RXCLK
AG12	PHY_RXER	8	RXER
AM13	PHY_RXCTL_RXDV	4	RXDV
AN13	PHY_RXD0	3	RXD0
AF14	PHY_RXD1	128	RXD1
AE14	PHY_RXD2	126	RXD2
AN12	PHY_RXD3	125	RXD3

Table 1-13: **Ethernet PHYConnections *(Cont'd)***

U1 FPGA Pin	Schematic Net Name	U80 M88E1111	
		Pin Number	Pin Name
AM12	PHY_RXD4	124	RXD4
AD11	PHY_RXD5	123	RXD5
AC12	PHY_RXD6	121	RXD6
AC13	PHY_RXD7	120	RXD7
AH12	PHY_TXC_GTXCLK	14	GTXCLK
AD12	PHY_TXCLK	10	TXCLK
AH10	PHY_TXER	13	TXER
AJ10	PHY_TXCTL_TXEN	16	TXEN
AM11	PHY_TXD0	18	TXD0
AL11	PHY_TXD1	19	TXD1
AG10	PHY_TXD2	20	TXD2
AG11	PHY_TXD3	24	TXD3
AL10	PHY_TXD4	25	TXD4
AM10	PHY_TXD5	26	TXD5
AE11	PHY_TXD6	28	TXD6
AF11	PHY_TXD7	29	TXD7
A3	SGMII_TX_P	113	SIN_P
A4	SGMII_TX_N	112	SIN_N
B5	SGMII_RX_P	107	SOUT_P
B6	SGMII_RX_N	105	SOUT_N

References

See the Marvell *Alaska Gigabit Ethernet Transceivers* product page for more information. [Ref 28]

Also, see the *LogiCORE™ IP Tri-Mode Ethernet MAC User Guide*. [Ref 19]

12. USB-to-UART Bridge

The ML605 contains a Silicon Labs CP2103GM USB-to-UART bridge device (U34) which allows connection to a host computer with a USB cable. The USB cable is supplied in this evaluation kit (Type A end to host computer, Type Mini-B end to ML605 connector J21). Table 1-14 details the ML605 J21 pinout.

Xilinx UART IP is expected to be implemented in the FPGA fabric (for instance, Xilinx XPS UART Lite. The FPGA supports the USB-to-UART bridge using four signal pins: Transmit (TX), Receive (RX), Request to Send (RTS), and Clear to Send (CTS).

Silicon Labs provides royalty-free Virtual COM Port (VCP) drivers which permit the CP2103GM USB-to-UART bridge to appear as a COM port to host computer communications application software (for example, HyperTerm or TeraTerm). The VCP device driver must be installed on the host PC prior to establishing communications with the ML605. Refer to the evaluation kit *Getting Started Guide* for driver installation instructions.

Table 1-14: **USB Type B Pin Assignments and Signal Definitions**

USB Connector Pin	Signal Name	Description
1	VBUS	+5V from host system (not used)
2	USB_DATA_N	Bidirectional differential serial data (N-side)
3	USB_DATA_P	Bidirectional differential serial data (P-side)
4	GROUND	Signal ground

Table 1-15: **USB-to-UART Connections**

U1 FPGA Pin	UART function in FPGA	Schematic Net Name	U34 CP2103GM Pin	UART Function in CP2103GM
T24	RTS, output	USB_1_CTS	22	CTS, input
T23	CTS, input	USB_1_RTS	23	RTS, output
J25	TX, data out	USB_1_RX	24	RXD, data in
J24	RX, data in	USB_1_TX	25	TXD, data out

References

Refer to the Silicon Labs website for technical information on the CP2103GM and the VCP drivers.

In addition, see some of the Xilinx UART IP specifications at:

- http://www.xilinx.com/support/documentation/ip_documentation/xps_uartlite.pdf
- http://www.xilinx.com/support/documentation/ip_documentation/xps_uart16550.pdf

13. USB Controller

The ML605 provides USB support via a Cypress CY7C67300 EZ-Host™ Programmable Embedded USB Host and Peripheral Controller (U81). The host port is a USB Type-A connector (J5). A USB keyboard (without an internal USB hub) will be able to connect to this USB Host port to demonstrate functionality. The peripheral port is a USB Type Mini-B (J20).

Table 1-16: **USB Controller Connections**

U1 FPGA Pin	Schematic Net Name	U81 USB Controller	
		Pin Number	Pin Name
Y32	USB_A0_LS	52	GPIO19_A0_CS0_52
W26	USB_A1_LS	50	50_GPIO20_A1_CS1
W27	USB_CS_B_LS	49	49_GPIO21_CS_N
R33	USB_D0_LS	94	GPIO0_D0_94
R34	USB_D1_LS	93	GPIO1_D1_93
T30	USB_D2_LS	92	GPIO2_D2_92
T31	USB_D3_LS	91	GPIO3_D3_91
T29	USB_D4_LS	90	GPIO4_D4_90
V28	USB_D5_LS	89	GPIO5_D5_89
V27	USB_D6_LS	87	GPIO6_D6_87
U25	USB_D7_LS	86	GPIO7_D7_86
Y28	USB_D8_LS	66	GPIO8_D8_MISO_66
W32	USB_D9_LS	65	GPIO9_D9_nSSI_65
W31	USB_D10_LS	61	GPIO10_D10_SCK_61
Y29	USB_D11_LS	60	GPIO11_D11_MOSI_60
W29	USB_D12_LS	59	GPIO12_D12_59
Y34	USB_D13_LS	58	GPIO13_D13_58
Y33	USB_D14_LS	57	GPIO14_D14_57
Y31	USB_D15_LS	56	GPIO15_D15_SSI_N_56
Y27	USB_INT_LS	46	46_GPIO24_INT_IORDY_IRQ0
W25	USB_RD_B_LS	47	47_GPIO23_RD_N_IOR
T25	USB_RESET_B_LS	85	RESET_N_85
V25	USB_WR_B_LS	48	48_GPIO22_WR_N_IOW

References

See the Cypress *CY7C67300 Data Sheet* for more information. [Ref 29]

In addition, see the *USB Specifications* for more information. [Ref 30]

The FPGA requires implementation of a peripheral controller in order to communicate with the Cypress USB device. See the *XPS External Peripheral Controller (EPC) v1.02a Data Sheet* for more information. [Ref 20]

14. DVI Codec

The ML605 features a DVI connector (P3) to support an external video monitor. The DVI circuitry utilizes a Chrontel CH7301C (U38) capable of 1600 X 1200 resolution with 24-bit color. The video interface chip drives both the digital and analog signals to the DVI connector. A DVI monitor can be connected to the board directly. A VGA monitor can also be connected to the board using the supplied DVI-to-VGA adaptor. The Chrontel CH7301C is controlled by way of the video IIC bus.

The DVI connector (Table 1-17) supports the IIC protocol to allow the board to read the monitor's configuration parameters. These parameters can be read by the FPGA using the DVI IIC bus (see "15. IIC Bus," page 42).

Table 1-17: **DVI Controller Connections**

U1 FPGA Pin	Schematic Net Name	U38 Chrontel CH7301C	
		Pin Number	Pin Name
AJ19	DVI_D0	63	D0
AH19	DVI_D1	62	D1
AM17	DVI_D2	61	D2
AM16	DVI_D3	60	D3
AD17	DVI_D4	59	D4
AE17	DVI_D5	58	D5
AK18	DVI_D6	55	D6
AK17	DVI_D7	54	D7
AE18	DVI_D8	53	D8
AF18	DVI_D9	52	D9
AL16	DVI_D10	51	D10
AK16	DVI_D11	50	D11
AD16	DVI_DE	2	DE
AN17	DVI_H	4	H
AP17	DVI_RESET_B_LS	13	RESET_B
AD15	DVI_V	5	V
AC17	DVI_XCLK_N	56	XCLK_N
AC18	DVI_XCLK_P	57	XCLK_P
No Connect	DVI_GPIO0	8	GPIO0
No Connect	DVI_GPIO1	7	GPIO1

15. IIC Bus

The ML605 implements four IIC bus interfaces at the FPGA.

The "MAIN" IIC bus hosts four items:

- FPGA U1 Bank 34 "MAIN" IIC interface
- 8Kb NV Memory U6
- FMC HPC connector J64
- DDR3 SODIMM Socket J1

The "DVI" IIC bus hosts two items:

- FPGA U1 Bank 34 "DVI" IIC interface
- DVI codec U38 and DVI connector J63

The "LPC" IIC bus hosts two items:

- FPGA U1 Bank 33 "LPC" IIC interface
- FMC LPC connector J63

The "SFP" IIC bus hosts two items:

- FPGA U1 Bank 13 "SFP" IIC interface
- SFP module connector P4

The ML605 IIC bus topology is shown in Figure 1-14.

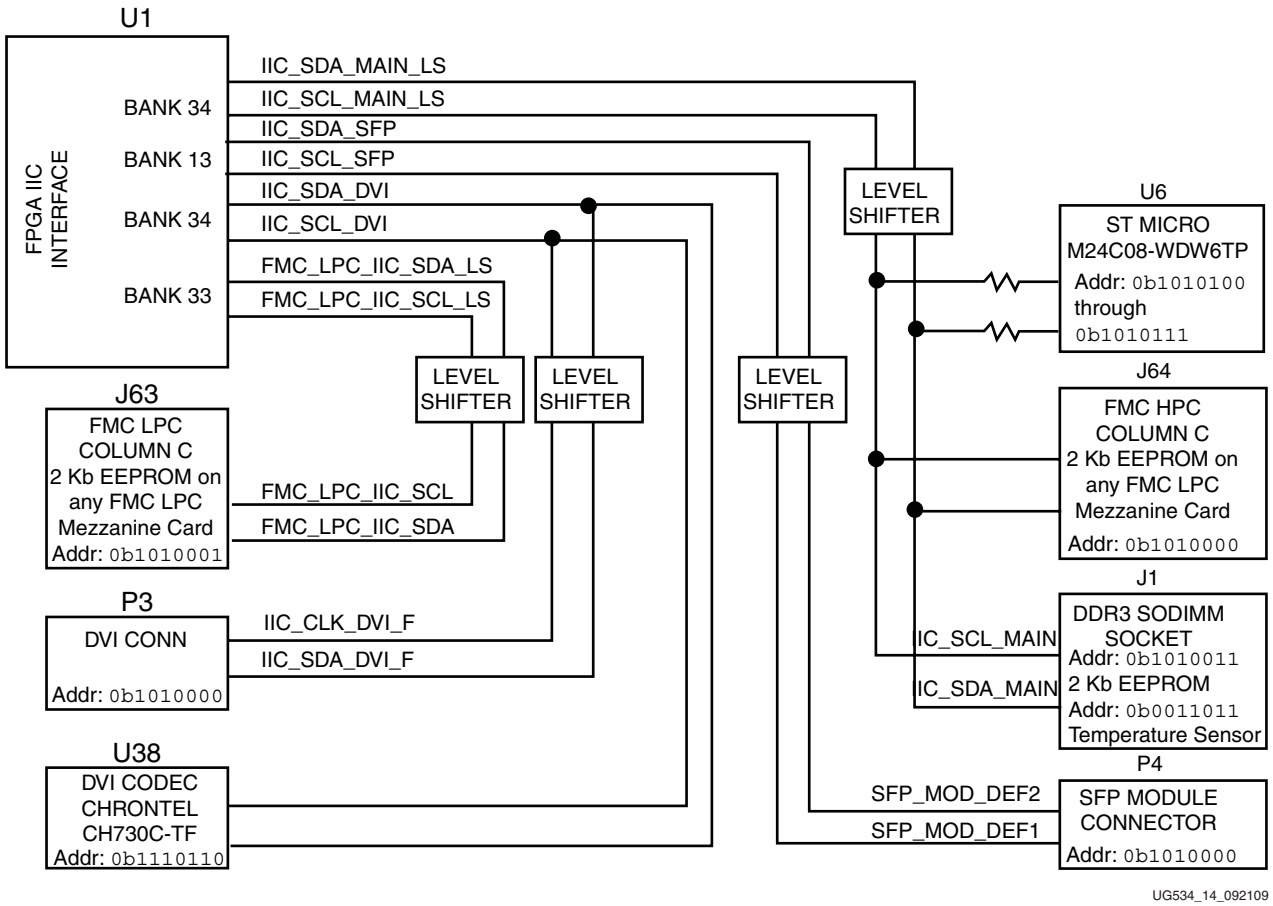


Figure 1-14: **IIC Bus Topology**

8 Kb NV Memory

The ML605 hosts an 8 Kb ST Microelectronics M24C08-WDW6TP IIC parameter storage memory device (U6). The IIC address of U7 is 0b1010100, and U6 is not write protected (WP pin 7 is tied to GND).

The IIC memory is shown in Figure 1-15.

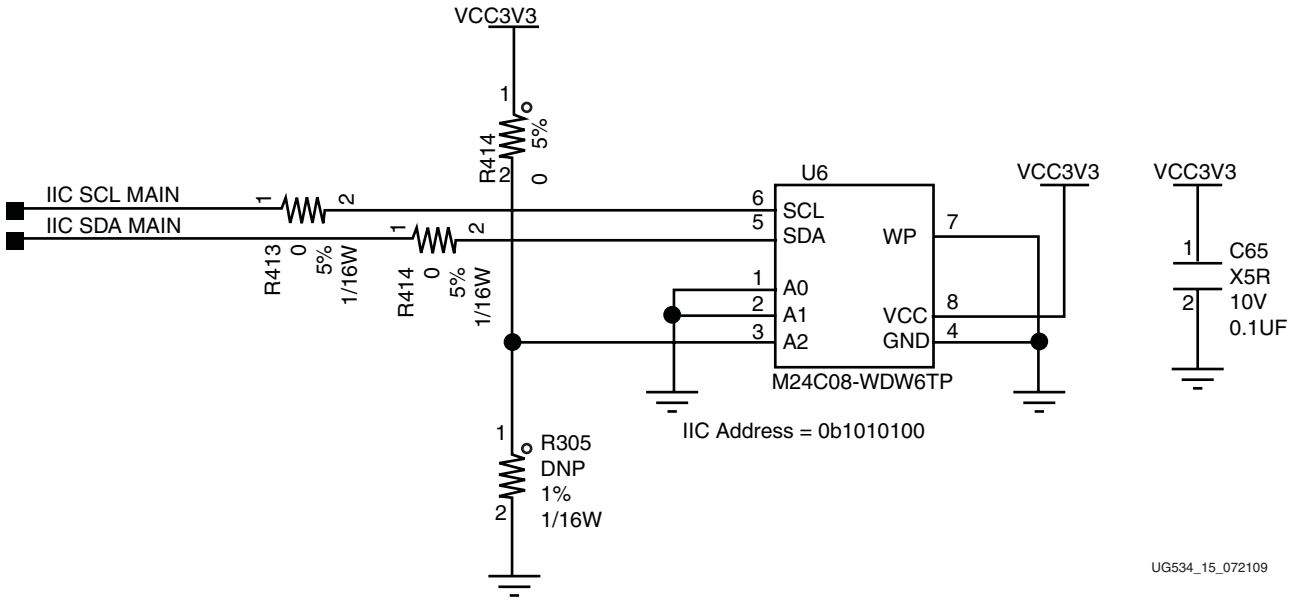


Figure 1-15: **IIC Memory U6**

Table 1-18: **IIC Memory Connections**

FPGA U1 Pin	Schematic Net Name	IIC Memory U6	
		Pin Number	Pin Name
Not Applicable	Tied to GND	1	A0
Not Applicable	Tied to GND	2	A1
Not Applicable	Pulled up (0 ohm) to VCC3V3	3	A2
N10	IIC_SDA_MAIN	5	SDA
P11	IIC_SCL_MAIN	6	SCL
Not Applicable	Tied to GND	7	WP

References

See the ST Micro *M24C08 Data Sheet* for more information. [Ref 31]

In addition, see the Xilinx *XPS IIC Bus Interface (v2.00a) Data Sheet*. [Ref 21]

16. Status LEDs

Table 1-19 defines the status LEDs.

Table 1-19: **Status LEDs**

Designator	Signal Name	Color	Label	Description
DS1	SYSACE_STAT_LED	GREEN	System ACE CF Status LED	System ACE CF Status
DS2	TI_PWRGOOD and MGT_TI_PWRGOOD	GREEN	POWER GOOD	Both UCD9240 controllers report power good
DS13	FPGA_DONE	GREEN	DONE	FPGA configured successfully
DS23	LED_GRN	GREEN	STATUS	USB JTAG Connection Status (Dual LED)
	LED_RED	RED		
DS25	12V	GREEN	12V	12V Power On
DS27	MGT_AVCC	GREEN	AVCC GD	MGT AVCC Power On
DS28	MGT_AVTT	GREEN	MGT_AVTT	MGT AVTT Power On
DS29	DDR3_VTTDDR_PWRGOOD	GREEN	DDR3 PWR GD	DDR3 VTTDDR Power Good
DS30	SYSACE_ERR_LED	RED	System ACE CF Error LED	System ACE CF Error
DS31	FPGA_INIT_B	RED	INIT	FPGA Initialization in progress
DS32	DVI_GPIO1_FMC_C2M_PG	GREEN	FMC PWR GD	FMC Power Good

Ethernet PHY Status LEDs

The Ethernet PHY status LEDs are mounted to be visible when the ML605 board is installed into a PC motherboard. They are mounted in right-angle, plastic housings and can be seen on the connector end of the board. This cluster of six LEDs is installed adjacent to the RJ45 Ethernet jack P2.

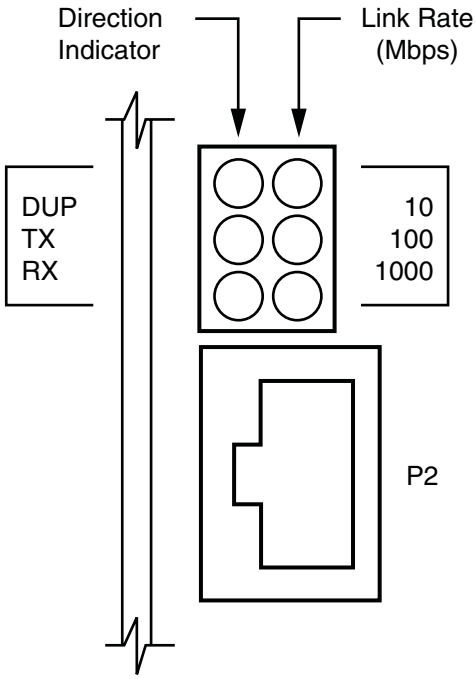


Figure 1-16: **Ethernet PHY Status LEDs**

FPGA INIT and DONE LEDs

The typical Xilinx FPGA power up and configuration status LEDs are present on the ML605.

The red INIT LED DS31 comes on momentarily after the FPGA powers up and during its internal power-on process. The DONE LED DS13 comes on after the FPGA programming bitstream has been downloaded and the FPGA successfully configured.

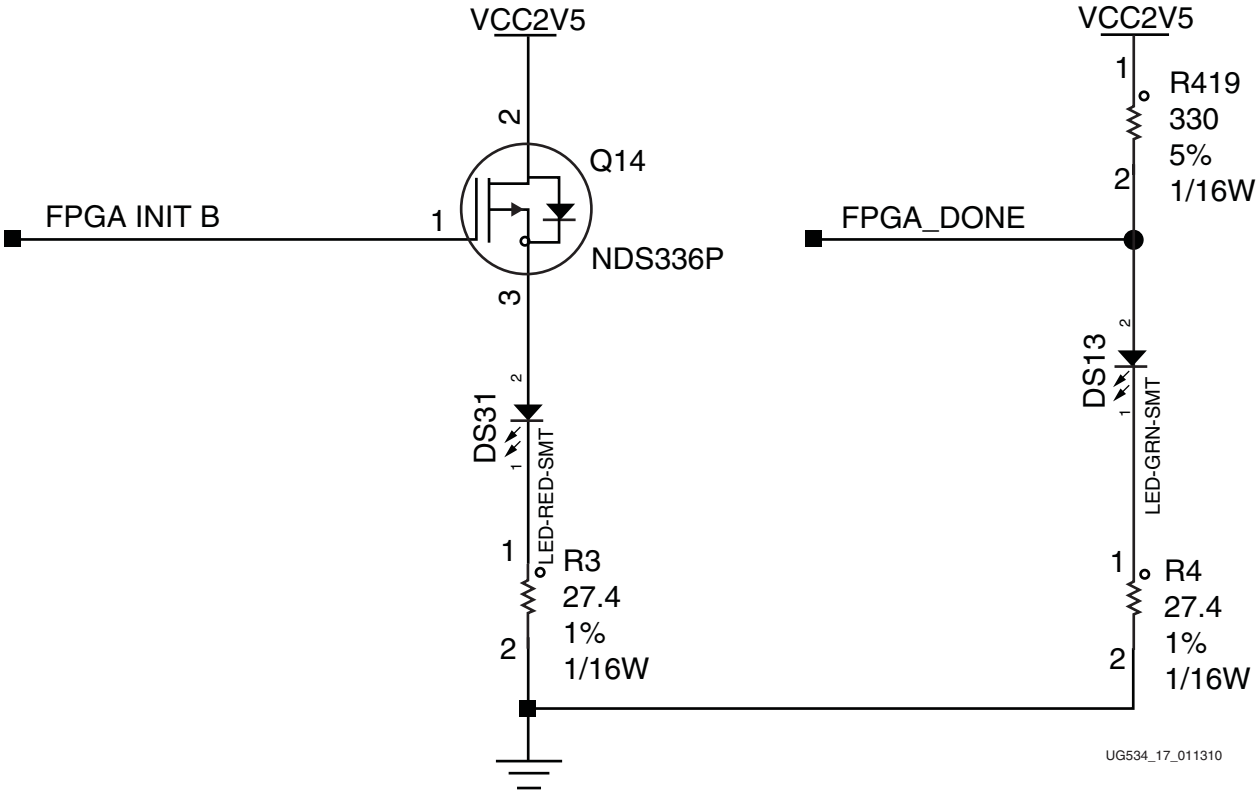


Figure 1-17: **FPGA INIT and DONE LEDs**

Table 1-20: **FPGA INIT and DONE LED Connections**

FPGA U1 Pin	Schematic Net Name	Controlled LED
P8	FPGA_INIT_B	DS31 INIT, Red
R8	FPGA_DONE	DS13 DONE, Green

17. User I/O

The ML605 provides the following user and general purpose I/O capabilities:

- User LEDs (8) with parallel wired GPIO male pin header
- User Pushbutton (5) switches with associated *direction* LEDs
- CPU Reset pushbutton switch
- User DIP switch (8-pole)
- User SMA GPIO
- LCD Display (16 char x 2 lines)

User LEDs

The ML605 provides two groups of active-High LEDs as described in Figure 1-18 and Table 1-21.

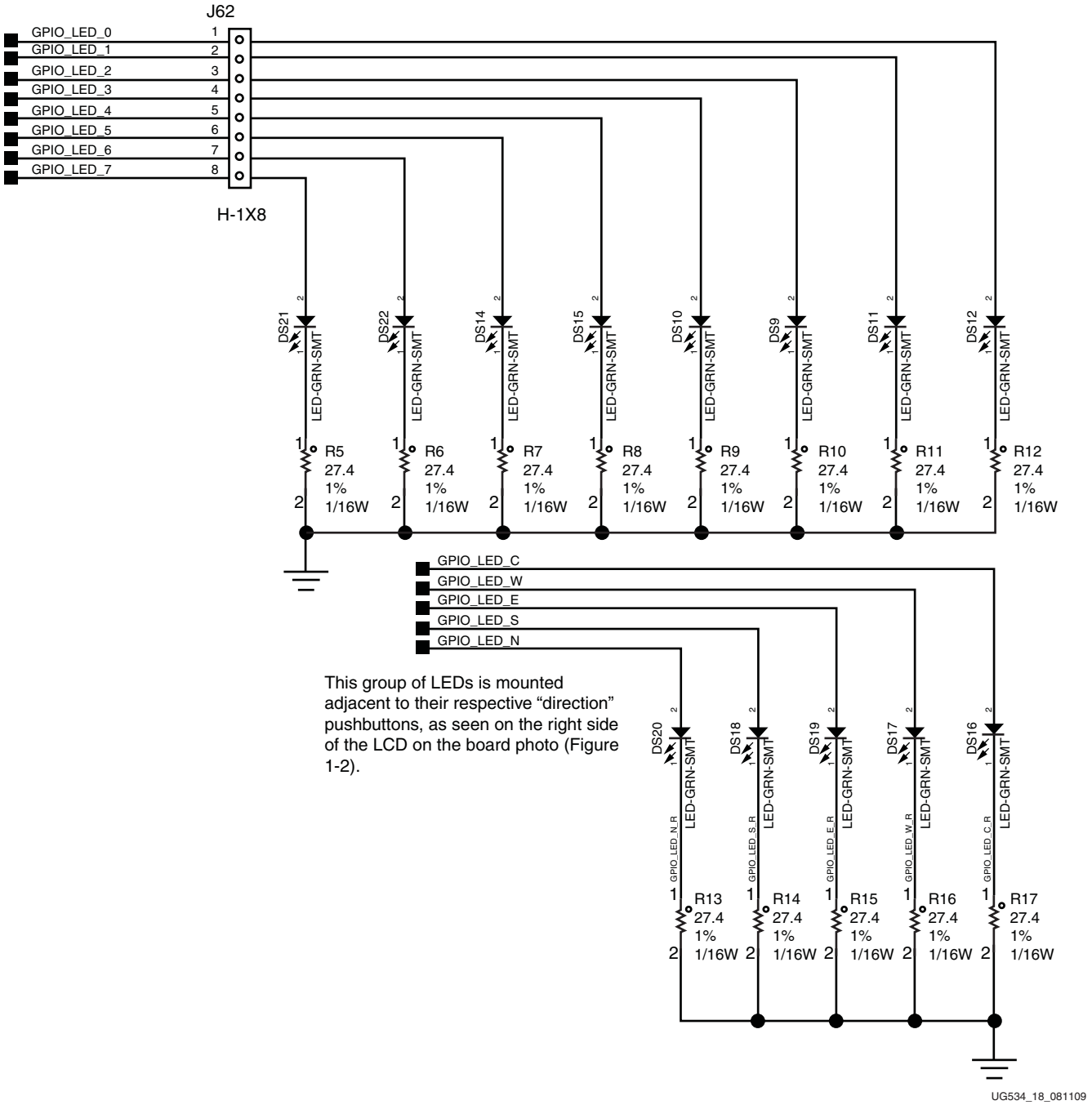


Figure 1-18: **User LEDs and GPIO Connector, Directional LEDs**

Note: See "User Pushbutton Switches," page 49 for more details about the LEDs.

Table 1-21: **User LED Connections**

FPGA U1 Pin	Schematic Net Name	GPIO J62 Pin	Controlled LED
AC22	GPIO_LED_0	1	DS12
AC24	GPIO_LED_1	2	DS11
AE22	GPIO_LED_2	3	DS9
AE23	GPIO_LED_3	4	DS10
AB23	GPIO_LED_4	5	DS15
AG23	GPIO_LED_5	6	DS14
AE24	GPIO_LED_6	7	DS22
AD24	GPIO_LED_7	8	DS21
AP24	GPIO_LED_C	–	DS16
AD21	GPIO_LED_W	–	DS17
AE21	GPIO_LED_E	–	DS19
AH28	GPIO_LED_S	–	DS18
AH27	GPIO_LED_N	–	DS20

User Pushbutton Switches

The ML605 provides six active-High pushbutton switches:

- SW5, SW6, SW7, SW8 and SW9, arranged in a diamond configuration to depict "directional" headings North, South, East, West and Center respectively
- SW10 CPU Reset pushbutton

The six pushbuttons all have the same active-High topology as the sample shown in Figure 1-19. The five *directional* pushbuttons are assigned as GPIO and the sixth is assigned as CPU_RESET. Figure 1-19 and Table 1-22, page 50 describe the pushbutton switches.

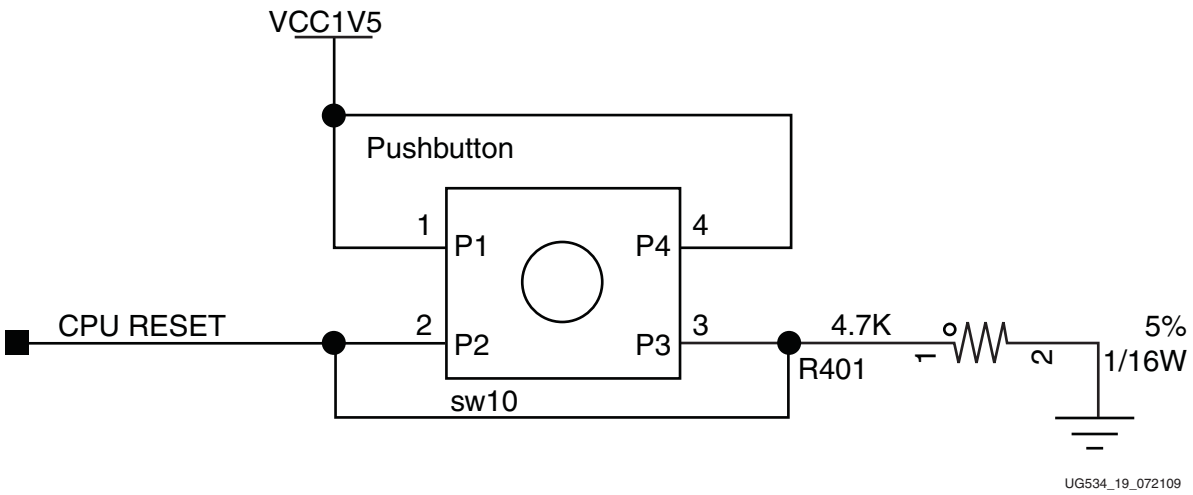


Figure 1-19: **User Pushbutton Switch (Typical)**

Table 1-22: **User Pushbutton Switch Connections**

U1 FPGA Pin	Schematic Net Name	Pushbutton Switch Pin
A19	GPIO_SW_N	SW5.2
A18	GPIO_SW_S	SW6.2
G17	GPIO_SW_E	SW7.2
H17	GPIO_SW_W	SW8.2
G26	GPIO_SW_C	SW9.2
H10	CPU_RESET	SW10.2

User DIP Switch

The ML605 includes an active-High eight pole DIP switch as described in Figure 1-20 and Table 1-23.

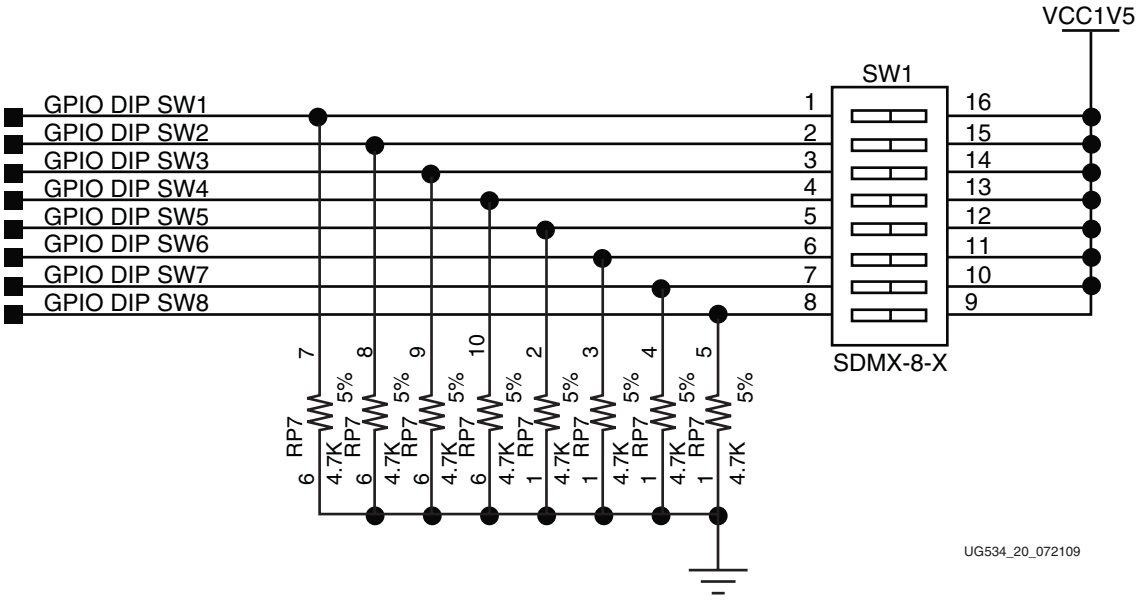


Figure 1-20: **User 8-pole DIP Switch**

Table 1-23: **User DIP Switch Connections**

U1 FPGA Pin	Schematic Net Name	DIP Switch Pin
D22	GPIO_DIP_SW1	SW1.1
C22	GPIO_DIP_SW2	SW1.2
L21	GPIO_DIP_SW3	SW1.3
L20	GPIO_DIP_SW4	SW1.4
C18	GPIO_DIP_SW5	SW1.5
B18	GPIO_DIP_SW6	SW1.6
K22	GPIO_DIP_SW7	SW1.7
K21	GPIO_DIP_SW8	SW1.8

User SMA GPIO

The ML605 includes an pair of SMA connectors for GPIO as described in Figure 1-21 and Table 1-24.

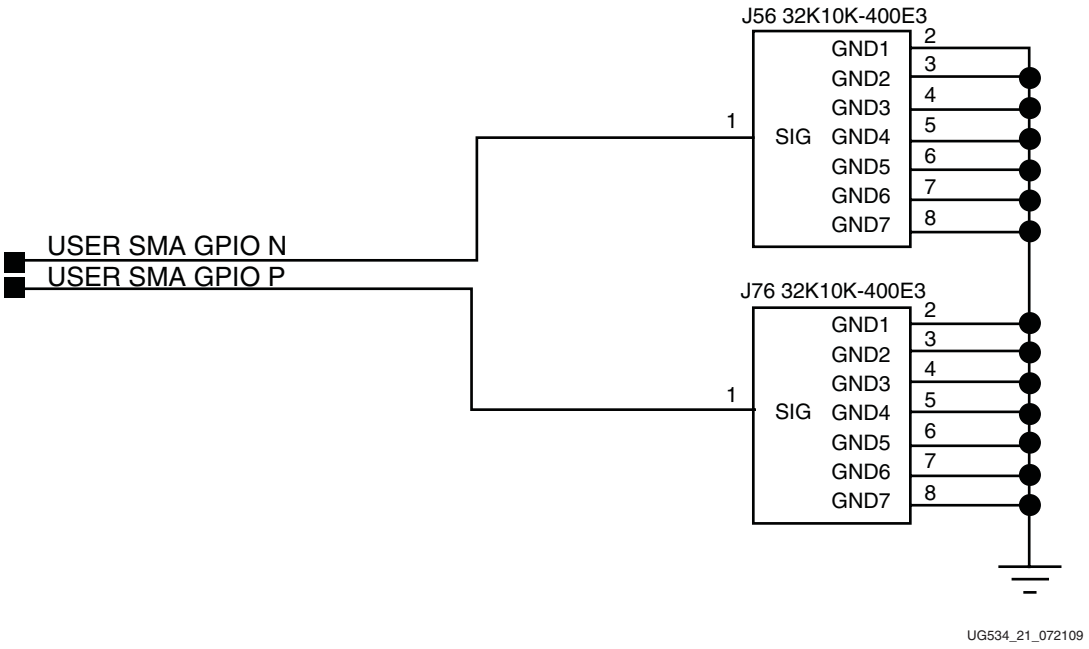


Figure 1-21: **User SMA GPIO**

Table 1-24: **User SMA Connections**

U1 FPGA Pin	Schematic Net Name	SMA Pin
W34	USER_SMA_GPIO_N	J56.1
V34	USER_SMA_GPIO_P	J57.1

LCD Display (16 Character x 2 Lines)

The ML605 board has a 16-character x 2-line LCD (Display Tech S162D BA BC, installed onto J41 2x7 header) on the board to display text information. Potentiometer R270 adjusts the contrast of the LCD. A ST2378E (U33) 2.5V-to-5V level-shifter is used to shift the voltage level between the FPGA and the LCD. The data interface to the LCD is connected to the FPGA to support 4-bit mode only. The LCD module has a connector that allows the LCD to be removed from the board to access to the components below it.

Caution! Care should be taken not to scratch or damage the surface of the LCD window.

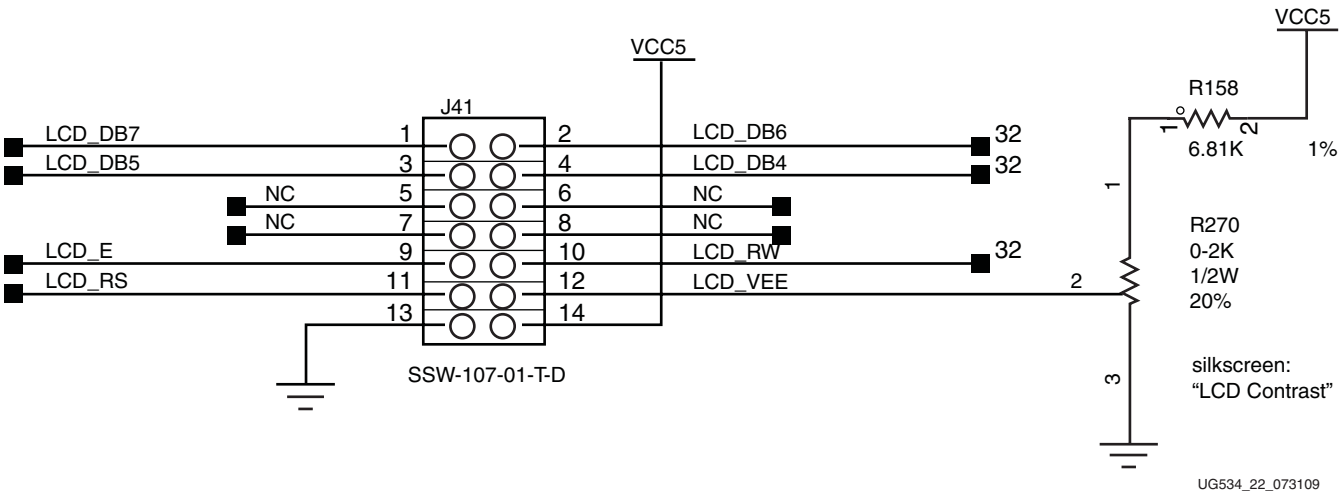


Figure 1-22: **LCD Header J41 and Contrast Trimpot R270**

Table 1-25: **LCD Header Connections**

U1 FPGA Pin	Schematic Net Name	J41 Pin
AD14	LCD_DB4_LS	4
AK11	LCD_DB5_LS	3
AJ11	LCD_DB6_LS	2
AE12	LCD_DB7_LS	1
AC14	LCD_RW_LS	10
T28	LCD_RS_LS	11
AK12	LCD_E_LS	9

18. Switches

The ML605 Evaluation board includes the following switches:

- Power On/Off Slide Switch SW2
- FPGA_PROG_B SW4 (active-Low)
- SYSACE_RESET_B SW3 (active-Low)
- System ACE CF CompactFlash Image Select DIP Switch S1 (active-High)
- MODE, Boot EEPROM Select and CCLK Osc Enable DIP switch S2 (active-High)

Power On/Off Slide Switch SW2

SW2 is the ML605 board main power on/off switch. Sliding the switch actuator from the off to on position applies 12V power from either J60 (6-pin Mini-Fit) or J25 (4-pin ATX) power connector to the VCC12_P power plane via the 1mΩ 1% 3W series current sense resistor R346. See "22. System Monitor," page 68 for further details on 12V input current sensing. Green LED DS25 will illuminate when the ML605 board power is on. See section "21. Power Management," page 65 for details on the onboard power system.

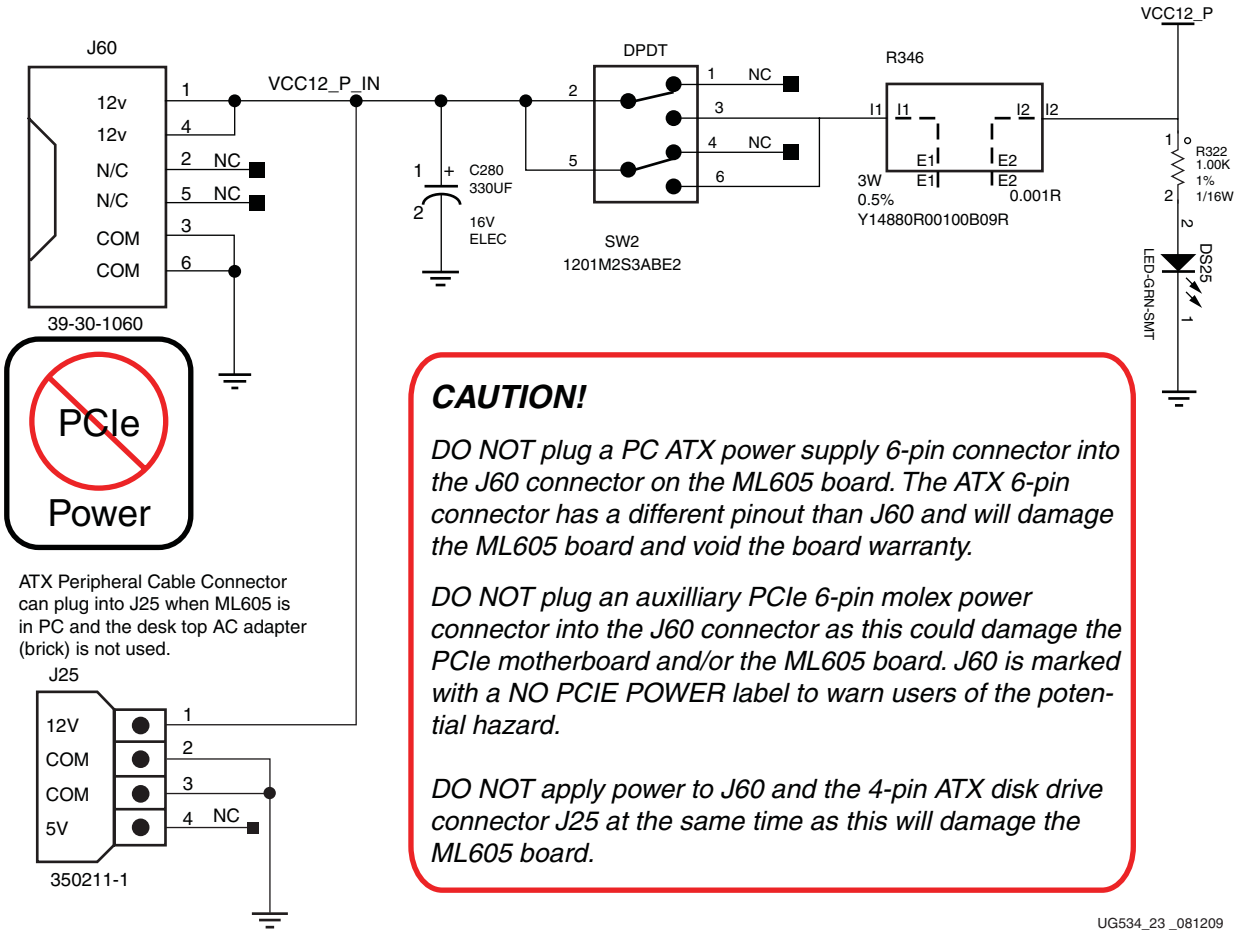


Figure 1-23: **Power On/Off Slide Switch SW2**

FPGA_PROG_B Pushbutton SW4 (Active-Low)

This switch grounds the FPGA's PROG_B pin when pressed. This action clears the FPGA. See the *Virtex-6 FPGA Data Sheet* for more information on clearing the contents of the FPGA. [Ref 4]

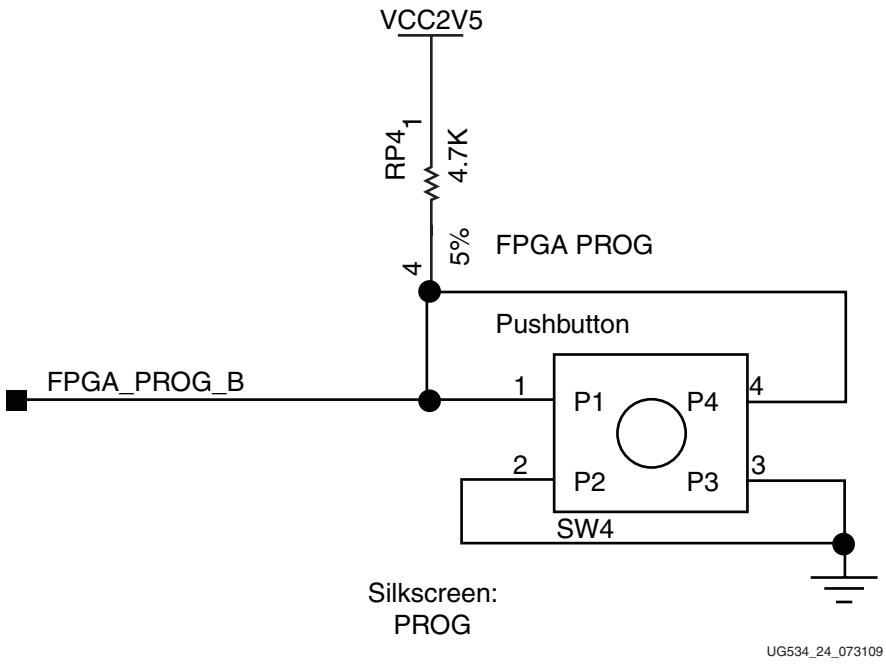


Figure 1-24: **FPGA PROG_B Pushbutton SW4**

SYSACE_RESET_B Pushbutton SW3 (Active-Low)

When the System ACE CF configuration mode pin is high (enabled by closing DIP switch S1 switch 4), the System ACE CF controller configures the FPGA from the CompactFlash card when a card is inserted or the SYSACE RESET button is pressed. See "5. System ACE CF and CompactFlash Connector," page 24 for more details.

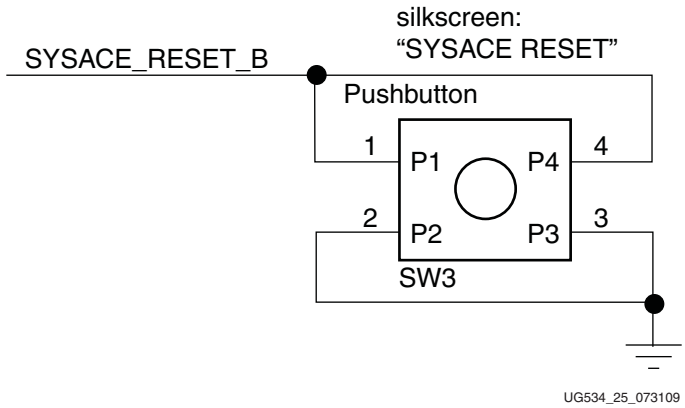


Figure 1-25: **System ACE CF RESET_B Pushbutton SW3**

System ACE CF CompactFlash Image Select DIP Switch S1

System ACE CF CompactFlash (CF) image select DIP switch S1, switches 1–3, select which CF resident bitstream image is downloaded to the FPGA (Figure 1-26). S1 switches 1–3 offer eight binary addresses. When ON (High), the S1 switch 4 enables the System ACE CF controller to configure the FPGA from the CF card when a card is inserted or when the SYSACE RESET button is pressed. See "5. System ACE CF and CompactFlash Connector," page 24 for more details about the System ACE controller.

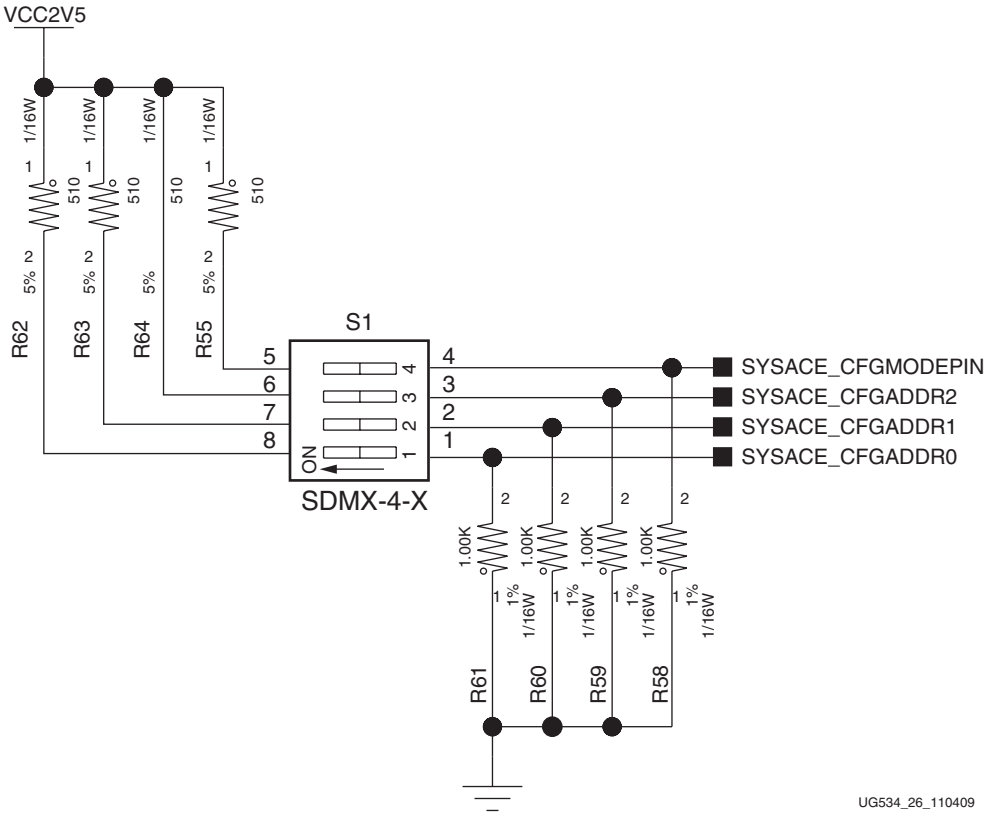


Figure 1-26: **System ACE CF CompactFlash Image Select DIP Switch S1**

Note: S1 switch 4 is the System ACE controller enable switch. When ON, this switch allows the System ACE to boot at power-on if it finds a CF card present. In order to boot from BPI Flash U4 or Xilinx Platform Flash (U27) without System ACE contention, S1 switch 4 must be OFF.

Mode, Osc Enable, Boot EEPROM Select, and Addr Select DIP Switch S2

DIP switch S2 is a multi-purpose selector switch (Figure 1-27 and Table 1-27, page 57).

FPGA Mode: S2 switches 3, 4, and 5 control the FPGA mode (Table 1-26).

Oscillator Enable: S2 switch 1, CCLK_EXTERNAL, controls the enable pin of the 47 MHz oscillator SiT8102 (X4). When switch 1 is closed (CCLK_EXTERNAL High), X4 drives a 47 MHz clock onto the FPGA_CCLK signal.

Boot EEPROM Select: S2 switch 2 is used to select the between the Xilinx Platform Flash or the Numonyx Linear BPI Flash for the FPGA boot memory device.

Upper or Lower Address Select: S2 switch 6 is used to select the upper or lower half of flash memory U4 as the source of the FPGA bitstream image. When FLASH_A23 is High, the upper half of the address is selected. When FLASH_A23 is Low, the lower half of the address is selected.

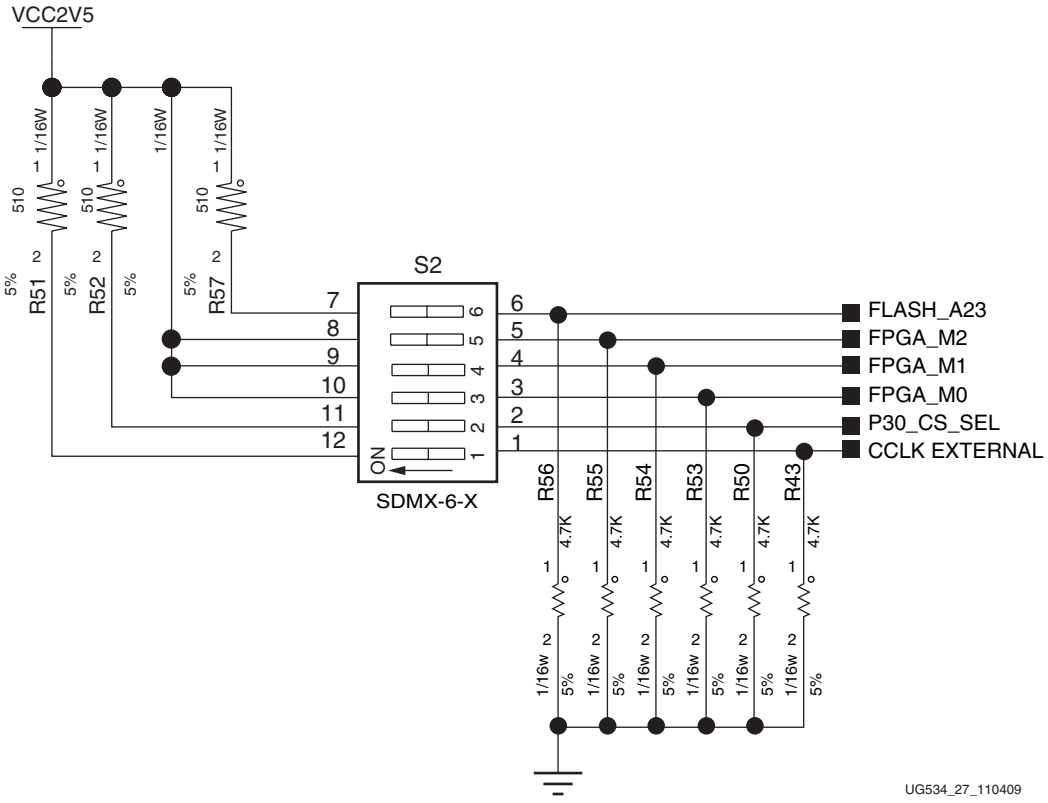


Figure 1-27: **Multi-Purpose Select DIP Switch S2**

Table 1-26 shows the FPGA configuration modes controlled by S2 switches 3, 4, and 5.

Table 1-26: **ML605 Configuration Modes**

Configuration Mode	M[2:0]	Bus Width	CCLK
Master BPI-Up	010	8, 16	Output
JTAG	101	1	Input (TCK)
Slave SelectMAP	110	8, 16, 32	Input

Table 1-27: **Switch S2 Configuration Details**

Switch		Configuration Mode/Method		
Switch	**Net Name**	**JTAG System ACE CF**	**Slave SelectMAP Platform Flash XL**	**Master BPI P30 Linear Flash**
S2.1	CCLK_EXTERNAL	Off	On	Off
S2.2	P30_CS_SEL	On(1)	Off	On
S2.3	FPGA_M0	On	Off	Off
S2.4	FPGA_M1	Off	On	On
S2.5	FPGA_M2	On	On	Off
S2.6	FLASH_A23	Off	Don't Care	Off(2)

Notes:

1. In JTAG mode, S2.2 is shown as ON for FPGA access to the P30 Linear Flash. Alternatively, set S2.2 to OFF for FPGA access to the Platform Flash XL.
2. In Master BPI mode, S2.6 is shown as OFF for selecting initial configuration from BPI address `0x000000`. Alternatively, set S2.6 to ON to select initial configuration from BPI address `0x800000`.

See "3. 128 Mb Platform Flash XL," page 20 and "4. 32 MB Linear BPI Flash," page 20 for details.

19. VITA 57.1 FMC HPC Connector

The ML605 implements both the High Pin Count (HPC, J64) and Low Pin Count (LPC, J63) connector options of VITA 57.1.1 FMC specification. This section discusses the FMC HPC J64 connector.

The FMC standard calls for two connector densities: a High Pin Count (HPC) and a Low Pin Count (LPC) implementation. A common 10 x 40 position (400 pin locations) connector form factor is used for both versions. The HPC version is fully populated with 400 pins present, and the LPC version is partially populated with 160 pins.

The 10 x 40 rows of a FMC HPC connector provides connectivity for:

- 160 single-ended or 80 differential user-defined signals
- 10 MGTs
- 2 MGT clocks
- 4 differential clocks
- 159 ground, 15 power connections

Of the above signal and clock connectivity capability, the ML605 implements the following subset:

- 78 differential user defined pairs:
  - 34 LA pairs
  - 24 HA pairs
  - 20 HB pairs
- 8 MGTs
- 2 MGT clocks
- 4 differential clocks

Note: The ML605 board VADJ voltage for the FMC HPC and LPC connectors (J64 and J63) is fixed at 2.5V (non-adjustable). The 2.5V rail cannot be turned off. The ML605 VITA 57.1 FMC interfaces are compatible with 2.5V mezzanine cards capable of supporting 2.5V VADJ.

Table 1-28 shows the VITA 57.1 FMC HPC connections. The connector pinout is in Appendix B, "VITA 57.1 FMC LPC (J63) and HPC (J64) Connector Pinout."

Any signal named FMC_HPC_xxxx that is wired between a U1 FPGA pin and some other device does not appear in this table.

Table 1-28: **VITA 57.1 FMC HPC Connections**

J64 FMC HPC Pin	Schematic Net Name	U1 FPGA Pin		J64 FMC HPC Pin	Schematic Net Name	U1 FPGA Pin
A2	FMC_HPC_DP1_M2C_P	AE3		B12	FMC_HPC_DP7_M2C_P	AP5
A3	FMC_HPC_DP1_M2C_N	AE4		B13	FMC_HPC_DP7_M2C_N	AP6
A6	FMC_HPC_DP2_M2C_P	AF5		B16	FMC_HPC_DP6_M2C_P	AM5
A7	FMC_HPC_DP2_M2C_N	AF6		B17	FMC_HPC_DP6_M2C_N	AM6
A10	FMC_HPC_DP3_M2C_P	AG3		B20	FMC_HPC_GBTCLK1_M2C_P	AK6
A11	FMC_HPC_DP3_M2C_N	AG4		B21	FMC_HPC_GBTCLK1_M2C_N	AK5
A14	FMC_HPC_DP4_M2C_P	AJ3		B32	FMC_HPC_DP7_C2M_P	AP1
A15	FMC_HPC_DP4_M2C_N	AJ4		B33	FMC_HPC_DP7_C2M_N	AP2
A18	FMC_HPC_DP5_M2C_P	AL3		B36	FMC_HPC_DP6_C2M_P	AN3
A19	FMC_HPC_DP5_M2C_N	AL4		B37	FMC_HPC_DP6_C2M_N	AN4
A22	FMC_HPC_DP1_C2M_P	AD1				
A23	FMC_HPC_DP1_C2M_N	AD2				
A26	FMC_HPC_DP2_C2M_P	AF1				
A27	FMC_HPC_DP2_C2M_N	AF2				
A30	FMC_HPC_DP3_C2M_P	AH1				
A31	FMC_HPC_DP3_C2M_N	AH2				
A34	FMC_HPC_DP4_C2M_P	AK1				
A35	FMC_HPC_DP4_C2M_N	AK2				
A38	FMC_HPC_DP5_C2M_P	AM1				
A39	FMC_HPC_DP5_C2M_N	AM2				
C2	FMC_HPC_DP0_C2M_P	AB1		D4	FMC_HPC_GBTCLK0_M2C_P	AD6
C3	FMC_HPC_DP0_C2M_N	AB2		D5	FMC_HPC_GBTCLK0_M2C_N	AD5
C6	FMC_HPC_DP0_M2C_P	AC3		D8	FMC_HPC_LA01_CC_P	AK19
C7	FMC_HPC_DP0_M2C_N	AC4		D9	FMC_HPC_LA01_CC_N	AL19
C10	FMC_HPC_LA06_P	AG20		D11	FMC_HPC_LA05_P	AG22
C11	FMC_HPC_LA06_N	AG21		D12	FMC_HPC_LA05_N	AH22

Table 1-28: **VITA 57.1 FMC HPC Connections *(Cont'd)***

J64 FMC HPC Pin	Schematic Net Name	U1 FPGA Pin		J64 FMC HPC Pin	Schematic Net Name	U1 FPGA Pin
C14	FMC_HPC_LA10_P	AM20		D14	FMC_HPC_LA09_P	AM18
C15	FMC_HPC_LA10_N	AL20		D15	FMC_HPC_LA09_N	AL18
C18	FMC_HPC_LA14_P	AN19		D17	FMC_HPC_LA13_P	AP19
C19	FMC_HPC_LA14_N	AN20		D18	FMC_HPC_LA13_N	AN18
C22	FMC_HPC_LA18_CC_P	AH25		D20	FMC_HPC_LA17_CC_P	AN27
C23	FMC_HPC_LA18_CC_N	AJ25		D21	FMC_HPC_LA17_CC_N	AM27
C26	FMC_HPC_LA27_P	AP30		D23	FMC_HPC_LA23_P	AL26
C27	FMC_HPC_LA27_N	AP31		D24	FMC_HPC_LA23_N	AM26
C30	IIC_SCL_MAIN_LS(1)	AK9		D26	FMC_HPC_LA26_P	AM25
C31	IIC_SDA_MAIN_LS(1)	AE9		D27	FMC_HPC_LA26_N	AL25
				D29	FMC_HPC_TCK_BUF(2)	U88.15
				D30	FMC_TDI_BUF(2)	J17.1
				D31	FMC_HPC_TDO(2)	J17.3
				D33	FMC_TMS_BUF(2)	U88.17
E2	FMC_HPC_HA01_CC_P	AD29		F1	FMC_HPC_PG_M2C_LS(1)	J27
E3	FMC_HPC_HA01_CC_N	AC29		F4	FMC_HPC_HA00_CC_P	AE33
E6	FMC_HPC_HA05_P	AB27		F5	FMC_HPC_HA00_CC_N	AF33
E7	FMC_HPC_HA05_N	AC27		F7	FMC_HPC_HA04_P	AB28
E9	FMC_HPC_HA09_P	AB30		F8	FMC_HPC_HA04_N	AC28
E10	FMC_HPC_HA09_N	AB31		F10	FMC_HPC_HA08_P	AG31
E12	FMC_HPC_HA13_P	AE31		F11	FMC_HPC_HA08_N	AF31
E13	FMC_HPC_HA13_N	AD31		F13	FMC_HPC_HA12_P	AD32
E15	FMC_HPC_HA16_P	AC33		F14	FMC_HPC_HA12_N	AE32
E16	FMC_HPC_HA16_N	AB33		F16	FMC_HPC_HA15_P	AB32
E18	FMC_HPC_HA20_P	V32		F17	FMC_HPC_HA15_N	AC32
E19	FMC_HPC_HA20_N	V33		F19	FMC_HPC_HA19_P	U33
E21	FMC_HPC_HB03_P	AL30		F20	FMC_HPC_HA19_N	U32
E22	FMC_HPC_HB03_N	AM31		F22	FMC_HPC_HB02_P	AP32
E24	FMC_HPC_HB05_P	AN33		F23	FMC_HPC_HB02_N	AP33
E25	FMC_HPC_HB05_N	AN34		F25	FMC_HPC_HB04_P	AM33
E27	FMC_HPC_HB09_P	AL34		F26	FMC_HPC_HB04_N	AL33

Table 1-28: **VITA 57.1 FMC HPC Connections *(Cont'd)***

J64 FMC HPC Pin	Schematic Net Name	U1 FPGA Pin		J64 FMC HPC Pin	Schematic Net Name	U1 FPGA Pin
E28	FMC_HPC_HB09_N	AK34		F28	FMC_HPC_HB08_P	AK33
E30	FMC_HPC_HB13_P	AH33		F29	FMC_HPC_HB08_N	AK32
E31	FMC_HPC_HB13_N	AH32		F31	FMC_HPC_HB12_P	AJ31
E33	FMC_HPC_HB19_P	AL31		F32	FMC_HPC_HB12_N	AJ32
E34	FMC_HPC_HB19_N	AK31		F34	FMC_HPC_HB16_P	AH29
				F35	FMC_HPC_HB16_N	AH30
G2	FMC_HPC_CLK1_M2C_P	AP20		H2	FMC_HPC_PRSNT_M2C_L(1)	AP25
G3	FMC_HPC_CLK1_M2C_N	AP21		H4	FMC_HPC_CLK0_M2C_P	K24
G6	FMC_HPC_LA00_CC_P	AF20		H5	FMC_HPC_CLK0_M2C_N	K23
G7	FMC_HPC_LA00_CC_N	AF21		H7	FMC_HPC_LA02_P	AC20
G9	FMC_HPC_LA03_P	AC19		H8	FMC_HPC_LA02_N	AD20
G10	FMC_HPC_LA03_N	AD19		H10	FMC_HPC_LA04_P	AF19
G12	FMC_HPC_LA08_P	AK22		H11	FMC_HPC_LA04_N	AE19
G13	FMC_HPC_LA08_N	AJ22		H13	FMC_HPC_LA07_P	AK21
G15	FMC_HPC_LA12_P	AM21		H14	FMC_HPC_LA07_N	AJ21
G16	FMC_HPC_LA12_N	AL21		H16	FMC_HPC_LA11_P	AM22
G18	FMC_HPC_LA16_P	AP22		H17	FMC_HPC_LA11_N	AN22
G19	FMC_HPC_LA16_N	AN23		H19	FMC_HPC_LA15_P	AM23
G21	FMC_HPC_LA20_P	AK23		H20	FMC_HPC_LA15_N	AL23
G22	FMC_HPC_LA20_N	AL24		H22	FMC_HPC_LA19_P	AN25
G24	FMC_HPC_LA22_P	AP27		H23	FMC_HPC_LA19_N	AN24
G25	FMC_HPC_LA22_N	AP26		H25	FMC_HPC_LA21_P	AN29
G27	FMC_HPC_LA25_P	AN28		H26	FMC_HPC_LA21_N	AP29
G28	FMC_HPC_LA25_N	AM28		H28	FMC_HPC_LA24_P	AN30
G30	FMC_HPC_LA29_P	AL28		H29	FMC_HPC_LA24_N	AM30
G31	FMC_HPC_LA29_N	AK28		H31	FMC_HPC_LA28_P	AK27
G33	FMC_HPC_LA31_P	AL29		H32	FMC_HPC_LA28_N	AJ27
G34	FMC_HPC_LA31_N	AK29		H34	FMC_HPC_LA30_P	AJ24
G36	FMC_HPC_LA33_P	AH23		H35	FMC_HPC_LA30_N	AK24
G37	FMC_HPC_LA33_N	AH24		H37	FMC_HPC_LA32_P	AG25
				H38	FMC_HPC_LA32_N	AG26

Table 1-28: **VITA 57.1 FMC HPC Connections *(Cont'd)***

J64 FMC HPC Pin	Schematic Net Name	U1 FPGA Pin		J64 FMC HPC Pin	Schematic Net Name	U1 FPGA Pin
J2	FMC_HPC_CLK3_M2C_P(2)	U84.6		K4	FMC_HPC_CLK2_M2C_P(2)	U83.6
J3	FMC_HPC_CLK3_M2C_N(2)	U84.7		K5	FMC_HPC_CLK2_M2C_N(2)	U83.7
J6	FMC_HPC_HA03_P	AA25		K7	FMC_HPC_HA02_P	AB25
J7	FMC_HPC_HA03_N	Y26		K8	FMC_HPC_HA02_N	AC25
J9	FMC_HPC_HA07_P	AA26		K10	FMC_HPC_HA06_P	AA28
J10	FMC_HPC_HA07_N	AB26		K11	FMC_HPC_HA06_N	AA29
J12	FMC_HPC_HA11_P	AG33		K13	FMC_HPC_HA10_P	AD34
J13	FMC_HPC_HA11_N	AG32		K14	FMC_HPC_HA10_N	AC34
J15	FMC_HPC_HA14_P	AA30		K16	FMC_HPC_HA17_CC_P	V30
J16	FMC_HPC_HA14_N	AA31		K17	FMC_HPC_HA17_CC_N	W30
J18	FMC_HPC_HA18_P	T33		K19	FMC_HPC_HA21_P	U31
J19	FMC_HPC_HA18_N	T34		K20	FMC_HPC_HA21_N	U30
J21	FMC_HPC_HA22_P	U28		K22	FMC_HPC_HA23_P	U26
J22	FMC_HPC_HA22_N	V29		K23	FMC_HPC_HA23_N	U27
J24	FMC_HPC_HB01_P	AN32		K25	FMC_HPC_HB00_CC_P	AF30
J25	FMC_HPC_HB01_N	AM32		K26	FMC_HPC_HB00_CC_N	AG30
J27	FMC_HPC_HB07_P	AJ34		K28	FMC_HPC_HB06_CC_P	AF26
J28	FMC_HPC_HB07_N	AH34		K29	FMC_HPC_HB06_CC_N	AE26
J30	FMC_HPC_HB11_P	AJ29		K31	FMC_HPC_HB10_P	AF28
J31	FMC_HPC_HB11_N	AJ30		K32	FMC_HPC_HB10_N	AF29
J33	FMC_HPC_HB15_P	AE28		K34	FMC_HPC_HB14_P	AE27
J34	FMC_HPC_HB15_N	AE29		K35	FMC_HPC_HB14_N	AD27
J36	FMC_HPC_HB18_P	AD25		K37	FMC_HPC_HB17_CC_P	AG27
J37	FMC_HPC_HB18_N	AD26		K38	FMC_HPC_HB17_CC_N	AG28

Notes:

1. Signals ending with _LS are not directly connected to the FMC HPC connector. _LS signals are connected between the listed U1 FPGA pin and a level shifter device. The signal connected between the shifted side of said device and the FMC HPC pin listed has the same signal name, without the _LS on the end.
2. These signals do not connect to U1 FPGA pins. The pin numbers in the right-hand column identify the device and pin these signals are connected to (U88.17 = U88 pin 17, and so on).

Table 1-29: **Power Supply Voltages for HPC Connector**

Voltage Supply	Allowable Voltage Range	No Pins	Max Amps	Tolerance	Max Capacitive Load
VADJ	Fixed 2.5V	4	4	+/- 5%	1000 uF
VIO_B_M2C	0-VADJ	2	1.15	+/- 5%	500 uF
VREF_A_M2C	0-VADJ	1	1 mA	+/- 2%	10 uF
VREF_B_M2C	0-VIO_B_M2C	1	1 mA	+/- 2%	10 uF
3P3VAUX	3.3V	1	20 mA	+/- 5%	150 uF
3P3V	3.3V	4	3	+/- 5%	1000 uF
12P0V	12V	2	1	+/- 5%	1000 uF

20. VITA 57.1 FMC LPC Connector

The ML605 implements both the High Pin Count (HPC, J64) and Low Pin Count (LPC, J63) connector options of VITA 57.1.1 FMC specification. This section discusses the FMC LPC J63 connector.

The FMC standard calls for two connector densities: a High Pin Count (HPC) and a Low

Pin Count (LPC) implementation. A common 10 x 40 position (400 pin locations) connector form factor is used for both versions. The HPC version is fully populated with 400 pins present, and the LPC version is partially populated with 160 pins.

The 10 x 40 rows of a FMC LPC connector provides connectivity for:

- 68 single-ended or 34 differential user defined signals
- 1 MGT
- 1 MGT clock
- 2 differential clocks
- 61 ground, 10 power connections

Of the above signal and clock connectivity capability, the ML605 implements the full set:

- 34 differential user-defined pairs:
  - 34 LA pairs
- 1 MGT
- 1 MGT clock
- 2 differential clocks

Signaling Speed Ratings:

- Single-ended: 9 GHz / 18 Gb/s
- Differential
  - Optimal Vertical: 9 GHz / 18 Gb/s
  - Optimal Horizontal: 16 GHz / 32 Gb/s
  - High Density Vertical 7 GHz / 15 Gb/s

Mechanical specifications:

- Samtec SEAM/SEAF Series
- 1.27mm x 1.27mm (0.050" x 0.050") pitch

The Samtec connector system is rated for signaling speeds up to 9 GHz (18 Gb/s) based on a -3 dB insertion loss point within a two-level signaling environment.

Note: The ML605 board VADJ voltage for the FMC HPC and LPC connectors (J64 and J63) is fixed at 2.5V (non-adjustable). The 2.5V rail cannot be turned off. The ML605 VITA 57.1 FMC interfaces are compatible with 2.5V mezzanine cards capable of supporting 2.5V VADJ.

Table 1-30 shows the VITA 57.1 FMC LPC connections. The connector pinout is in Appendix B, "VITA 57.1 FMC LPC (J63) and HPC (J64) Connector Pinout."

Any signal named FMC_LPC_xxxx that is wired between a U1 FPGA pin and some other device does not appear in this table..

Table 1-30: **VITA 57.1 FMC LPC Connections**

J63 FMC LPC Pin	Schematic Net Name	U1 FPGA Pin		J63 FMC LPC Pin	Schematic Net Name	U1 FPGA Pin
C2	FMC_LPC_DP0_C2M_P	D1		D4	FMC_LPC_GBTCLK0_M2C_P	M6
C3	FMC_LPC_DP0_C2M_N	D2		D5	FMC_LPC_GBTCLK0_M2C_N	M5
C6	FMC_LPC_DP0_M2C_P	G3		D8	FMC_LPC_LA01_CC_P	F31
C7	FMC_LPC_DP0_M2C_N	G4		D9	FMC_LPC_LA01_CC_N	E31
C10	FMC_LPC_LA06_P	K33		D11	FMC_LPC_LA05_P	H34
C11	FMC_LPC_LA06_N	J34		D12	FMC_LPC_LA05_N	H33
C14	FMC_LPC_LA10_P	F30		D14	FMC_LPC_LA09_P	L25
C15	FMC_LPC_LA10_N	G30		D15	FMC_LPC_LA09_N	L26
C18	FMC_LPC_LA14_P	C33		D17	FMC_LPC_LA13_P	D34
C19	FMC_LPC_LA14_N	B34		D18	FMC_LPC_LA13_N	C34
C22	FMC_LPC_LA18_CC_P	L29		D20	FMC_LPC_LA17_CC_P	N28
C23	FMC_LPC_LA18_CC_N	L30		D21	FMC_LPC_LA17_CC_N	N29
C26	FMC_LPC_LA27_P	R31		D23	FMC_LPC_LA23_P	R28
C27	FMC_LPC_LA27_N	R32		D24	FMC_LPC_LA23_N	R27
				D26	FMC_LPC_LA26_P	L33
				D27	FMC_LPC_LA26_N	M32
G2	FMC_LPC_CLK1_M2C_P	F33		H2	FMC_LPC_PRSNT_M2C_L	AD9
G3	FMC_LPC_CLK1_M2C_N	G33		H4	FMC_LPC_CLK0_M2C_P	A10
G6	FMC_LPC_LA00_CC_P	K26		H5	FMC_LPC_CLK0_M2C_N	B10
G7	FMC_LPC_LA00_CC_N	K27		H7	FMC_LPC_LA02_P	G31
G9	FMC_LPC_LA03_P	J31		H8	FMC_LPC_LA02_N	H30
G10	FMC_LPC_LA03_N	J32		H10	FMC_LPC_LA04_P	K28
G12	FMC_LPC_LA08_P	J30		H11	FMC_LPC_LA04_N	J29
G13	FMC_LPC_LA08_N	K29		H13	FMC_LPC_LA07_P	G32
G15	FMC_LPC_LA12_P	E32		H14	FMC_LPC_LA07_N	H32
G16	FMC_LPC_LA12_N	E33		H16	FMC_LPC_LA11_P	D31
G18	FMC_LPC_LA16_P	A33		H17	FMC_LPC_LA11_N	D32
G19	FMC_LPC_LA16_N	B33		H19	FMC_LPC_LA15_P	C32

Table 1-30: **VITA 57.1 FMC LPC Connections *(Cont'd)***

J63 FMC LPC Pin	Schematic Net Name	U1 FPGA Pin		J63 FMC LPC Pin	Schematic Net Name	U1 FPGA Pin
G21	FMC_LPC_LA20_P	P29		H20	FMC_LPC_LA15_N	B32
G22	FMC_LPC_LA20_N	R29		H22	FMC_LPC_LA19_P	M30
G24	FMC_LPC_LA22_P	N27		H23	FMC_LPC_LA19_N	N30
G25	FMC_LPC_LA22_N	P27		H25	FMC_LPC_LA21_P	R26
G27	FMC_LPC_LA25_P	P31		H26	FMC_LPC_LA21_N	T26
G28	FMC_LPC_LA25_N	P30		H28	FMC_LPC_LA24_P	N32
G30	FMC_LPC_LA29_P	N34		H29	FMC_LPC_LA24_N	P32
G31	FMC_LPC_LA29_N	P34		H31	FMC_LPC_LA28_P	N33
G33	FMC_LPC_LA31_P	M31		H32	FMC_LPC_LA28_N	M33
G34	FMC_LPC_LA31_N	L31		H34	FMC_LPC_LA30_P	M26
G36	FMC_LPC_LA33_P	K32		H35	FMC_LPC_LA30_N	M27
G37	FMC_LPC_LA33_N	K31		H37	FMC_LPC_LA32_P	N25
				H38	FMC_LPC_LA32_N	M25

References

See the data sheet for the ROHS compliant FMC HPC Samtec SEARAY connector (carrier side socket ASP-134486-01; module side plug ASP-134488-01), and the high-speed characterization report for this connector system on the Samtec website. [Ref 32]

21. Power Management

AC Adapter and Input Power Jack/Switch

The ML605 is powered from a 12V source that is connected through a 6-pin (2X3) right-angle Mini-Fit type connector J60. The AC-to-DC power supply included in the kit has a mating 6-pin plug.

When the ML605 is installed into a table top or tower PC's PCIe slot, the ML605 is typically powered from the PC ATX power supply. One of the ATX hard disk type 4-pin power connectors is plugged into ML605 connector J25. The ML605 can be powered with the AC power adapter even when plugged into a PC PCIe motherboard slot; however, users are cautioned not to also connect an ATX 4-pin power connector to J25. See the caution notes below and in Figure 1-23, page 53.

Caution! DO NOT plug a PC ATX power supply 6-pin connector into ML605 connector J60. The ATX 6-pin connector has a different pinout than ML605 J60, and connecting the ATX 6-pin connector will damage the ML605 and void the board warranty.

Caution! DO NOT apply power to J60 and the 4-pin ATX disk drive connector J25 at the same time as this will damage the ML605 board. Refer to Figure 1-23, page 53 for details.

The ML605 power can be turned on or off through the board mounted slide switch SW2. When the switch is in the on position, a green LED (DS25) is illuminated.

Onboard Power Regulation

Figure 1-28 shows the ML605 onboard power supply architecture. The ML605 uses power solutions from Texas Instruments.

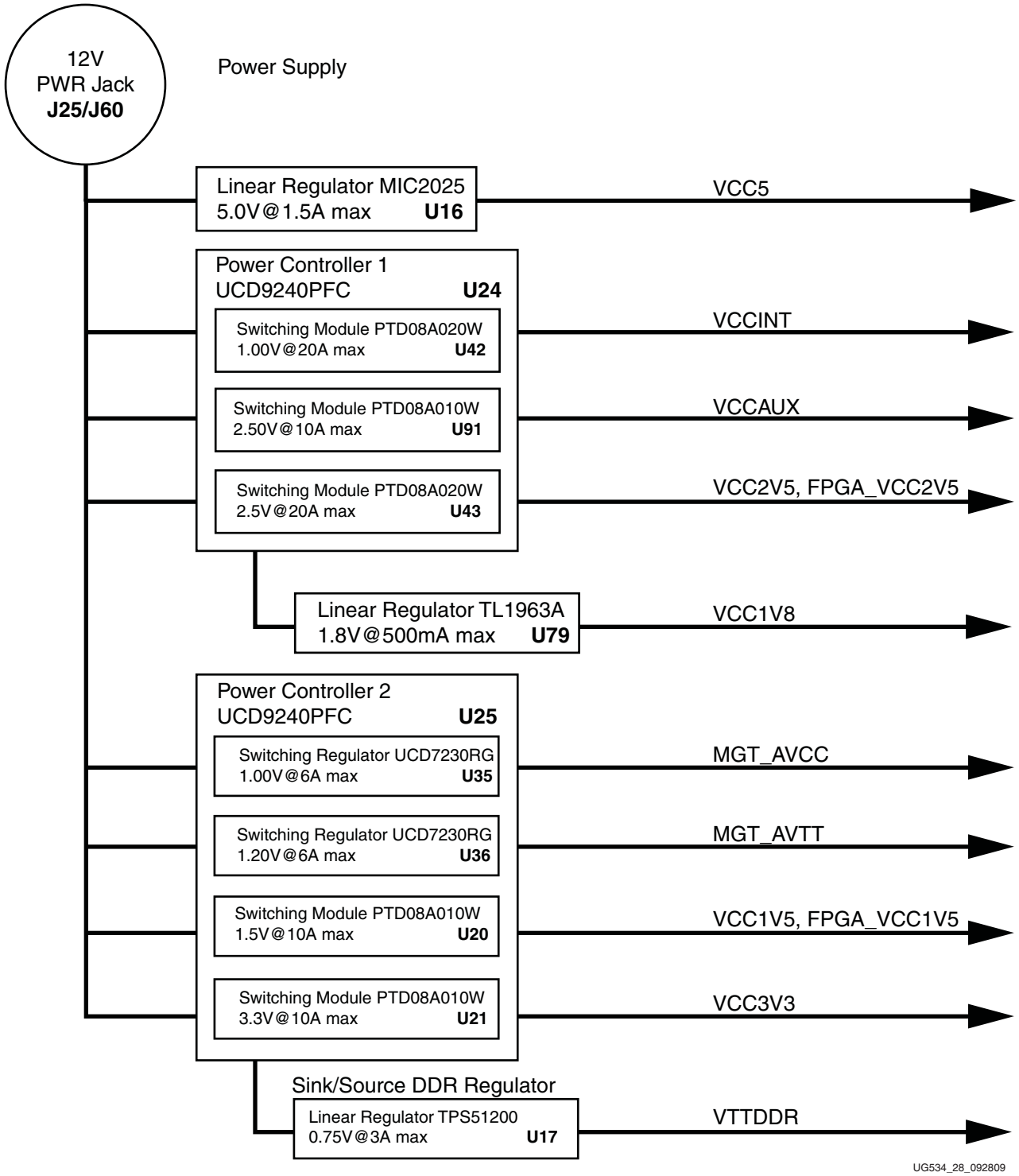


Figure 1-28: **ML605 Onboard Power Regulators**

Table 1-31: **Onboard Power System Devices**

Device Type	Reference Designator	Description	Power Rail Net Name	Power Rail Voltage	Schematic Page
UCD9240PFC	U24	PMBus Controller - Core (Addr = 52)			35
PTD08A020W	U42	20A 0.6V - 3.6V Adj. Switching Regulator	VCCINT_FPGA	1.00V	36
PTD08A020W	U43	20A 0.6V - 3.6V Adj. Switching Regulator	VCC2V5_FPGA	2.50V	37
PTD08A010W	U91	10A 0.6V - 3.6V Adj. Switching Regulator	VCCAUX	2.50V	38
UCD9240PFC	U25	PMBus Controller - Aux (Addr = 53)			40
UCD7230RGWR	U35	6A 0.6V - 3.6V Adj. Switching Regulator	MGT_AVCC	1.00V	41
UCD7230RGWR	U36	6A 0.6V - 3.6V Adj. Switching Regulator	MGT_AVTT	1.20V	42
PTD08A010W	U20	10A 0.6V - 3.6V Adj. Switching Regulator	VCC_1V5	1.50V	43
PTD08A010W	U21	10A 0.6V - 3.6V Adj. Switching Regulator	VCC_3V3	3.30V	44
TPS79518DCQR	U79	500mA Fixed Linear Regulator	VCC_1V8	1.80V	45
TPS512300DRCT	U17	3A DDR3 VTERM Tracking Linear Regulator	VTTDDR	0.75V	45
TPS512300DRCT	U17	10mA Tracking Reference output	VTTVREF	0.75V	45
MIC2025	U16	1.5A Fixed Linear Regulator	VCC5	5.00V	27

Voltage and current monitoring and control are available for selected power rails through Texas Instruments' Fusion Digital Power™ graphical user interface (GUI). Both onboard TI power controllers are wired to the same PMBus. The PMBus connector, J3, is provided for use with the TI USB Interface Adapter PMBus pod and associated TI GUI.

References

For more detailed information about this technology and the various power management controllers and regulator modules offered by Texas Instruments, visit http://www.ti.com/ww/en/analog/digital-power/index.html.

22. System Monitor

The System Monitor provides information regarding the FPGA on-chip temperature and power supply conditions via JTAG and an internal FPGA interface. The System Monitor can also be used to monitor external analog signals via 17 external analog input channels. For more information regarding this functionality, which is featured on every Virtex-6 family member, see http://www.xilinx.com/systemmonitor.

This section provides a brief overview of the System Monitor related functionality that is supported on the ML605.

Reference and Power Supply

The System Monitor has dedicated analog power supply pins and supports the use of an external 1.25V reference IC (U23) for the analog-to-digital conversion process. An option (using jumper J19) to select an on-chip reference is also provided; however, the highest accuracy over a temperature range of -40°C to +125°C is obtained using an external reference. Figure 1-29 illustrates the power supply and reference options on the ML605. For a more detailed discussion of these requirements, see the *Virtex-6 FPGA System Monitor User Guide*. [Ref 15]

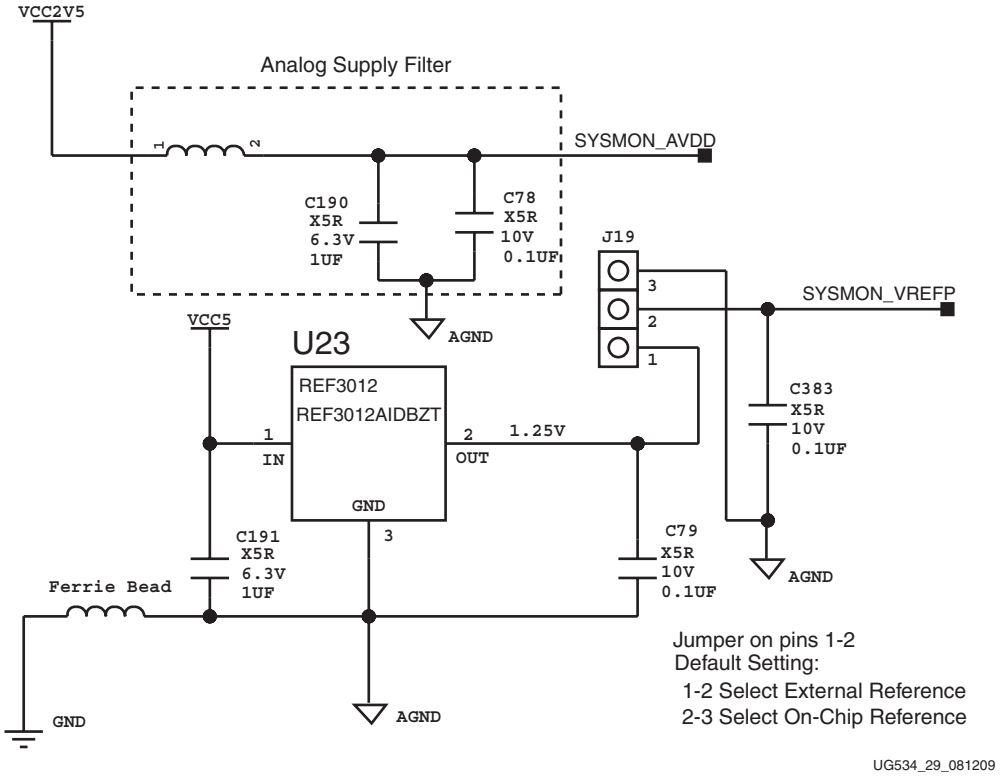


Figure 1-29: **System Monitor External Reference**

System Monitor Header (J35)

Figure 1-30 shows the pinout for the System Monitor 12-pin header. The header provides user access to the analog power supply (A_{Vdd}) and the 1.25V reference shown in Figure 1-29, page 68. Access to the FPGA thermal diode and dedicated analog input channel (Vp/Vn) is also provided on this header. The header can be used to connect user specific analog signals and sensors to the system monitor.

The kelvin points for a 5 milliohm current sensing shunt in the FPGA 1V V_{ccint} core supply are also available on this header. By connecting header pins 9 to 11 and 10 to 12 using jumpers, the system monitor can be used to monitor the FPGA core current and power consumption. This can be used to collect useful power information about a particular design or implementation.

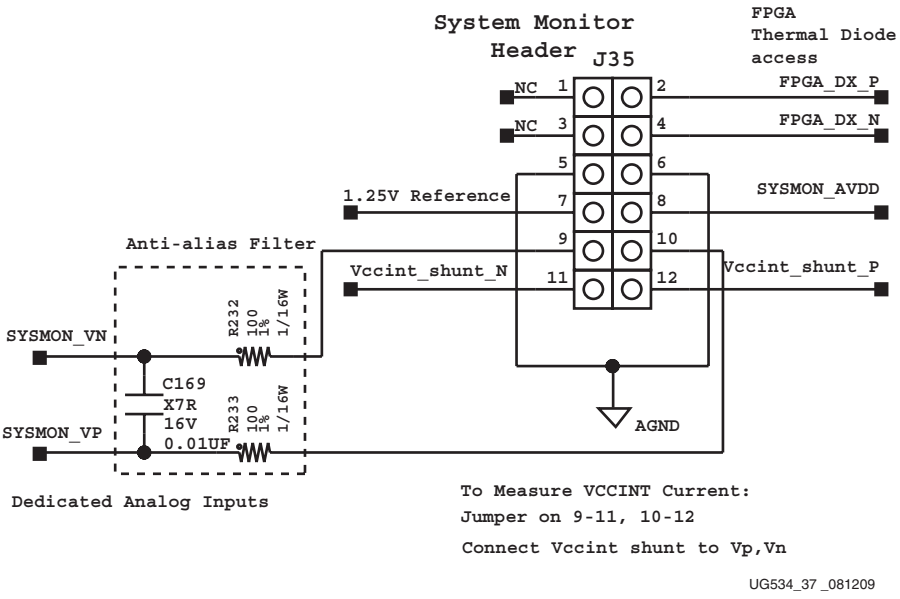


Figure 1-30: **System Monitor Header (J35)**

ML605 Board Power Monitor

In addition to monitoring the FPGA core supply power consumption, two auxiliary analog input channels (of the 16 that are available) are used to implement a power monitor for the entire ML605 board. The board power is monitored at the 12V power input connector. Figure 1-31 shows how the power monitor is implemented and connected to the System Monitor auxiliary input channels 12 and 13. A simple resistor divider is used to monitor the 12V supply voltage and to provide a reference voltage to an instrumentation amplifier (InAmp). The voltage on the auxiliary channel 12 is equal to supply voltage divided by 24 (~ 0.5V).

The InAmp is used to amplify (by a factor of 50) the voltage dropped across a 2 milliohm current sense shunt. The voltage at the output of the InAmp is proportional to the current. The voltage on auxiliary channel 13 = Current (amps) x 0.002 x 50. (e.g., 5A = 0.5V).

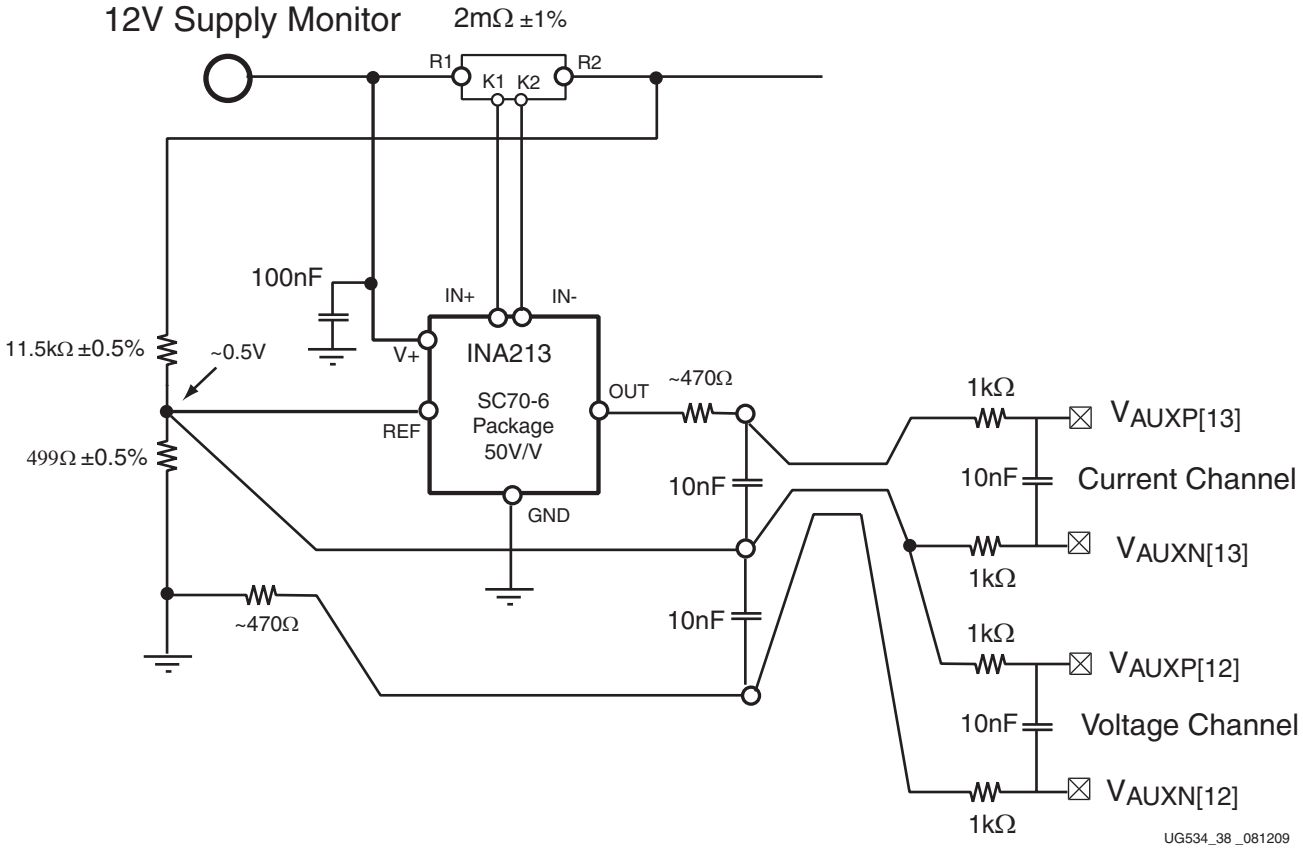


Figure 1-31: **ML605 12V Power Monitor**

Fan Controller

In highly demanding situations, active thermal management in the form of a heat sink and fan may be required. In order to support this, drive circuitry for an external fan has been provided on the ML605. A fan with tach output can be connect at header J59 as shown in Figure 1-32. The fan PWM signal is generated by the FPGA and the tach input can be used to close the control loop and regulate the fan speed. Alternatively, the FPGA temperature as recorded by the System Monitor can be used to close the PWM control loop for the fan.

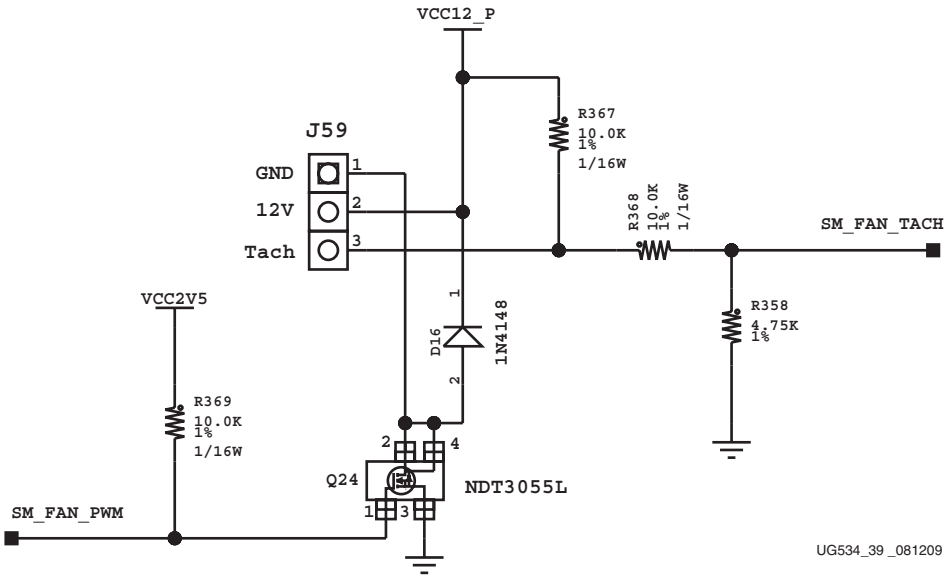


Figure 1-32: **ML605 Fan Driver**

FPGA Power Supply Margining

The PMBus (IIC), which provides access to the 2 x UDC9240 power controllers, can also be accessed via FPGA I/O in addition to a dedicated header (J3), see Figure 1-33. A full description of the UDC9240 functionality is outside the scope of this user guide. However, this useful feature can be used, for example, to margin the FPGA and board power supplies when evaluating a design. The System Monitor provides accurate measurements of the on-chip supply voltages as the FPGA supplies are margined. The PMBus (and fan) connections are shown in Figure 1-33.

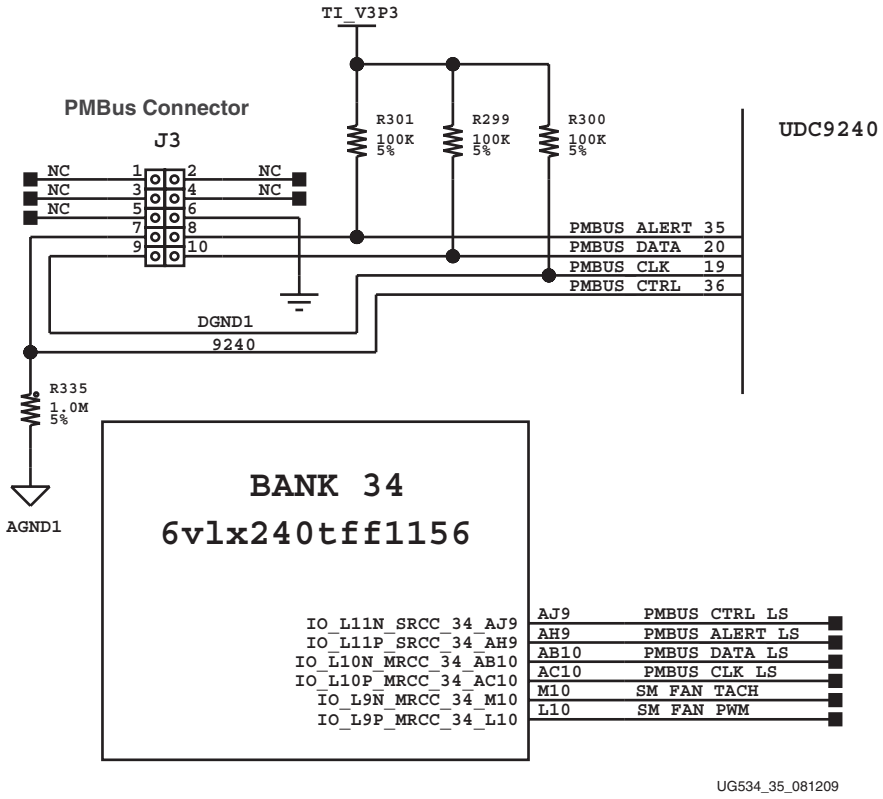


Figure 1-33: **UDC9240 PMBus Access**

System Monitor ML605 Demonstration Design

The various features described in this section are easily evaluated using a MicroBlaze™ based reference designed provided with the ML605 Evaluation Board. This reference design supports a UART based interface using a terminal program such as Hyperterminal to provide information on the FPGA power supplies, temperature, and power consumption. In addition, the UART interface can be used to margin the FPGA supplies over the PMBus.

The System Monitor functionality can also be accessed at any time via JTAG using the ChipScope Pro Analyzer tool without design modifications or cores inserted into a user design. The ChipScope Pro Analyzer tool automatically connects to the System Monitor via a JTAG cable after a connection is established.

References

For more information on using the System Monitor and an overview of the tool support for this feature, see the *Virtex-6 FPGA System Monitor User Guide*. [Ref 15]

Configuration Options

The FPGA on the ML605 Evaluation Board can be configured by the following methods:

- "3. 128 Mb Platform Flash XL," page 20
- "4. 32 MB Linear BPI Flash," page 20
- "5. System ACE CF and CompactFlash Connector"
- "6. USB JTAG," page 26

For more information, see the *Virtex-6 FPGA Configuration User Guide* at http://www.xilinx.com/support/documentation/user_guides/ug360.pdf.

Table 1-32: **Mode Switch S2 Settings**

Mode Pins (M2,M1,M0)	Configuration Mode
110	Slave SelectMAP
010	BPI Mode
101	JTAG

With the mode set to JTAG 101, the ML605 will not attempt to boot or load a bitstream from either of the Flash devices. If a CompactFlash (CF) card is installed in the CF socket U73, System ACE CF will attempt to load a bitstream from the CF card image address pointed to by the image select switch S1. With no CF card present, the ML605 can be configured via the onboard JTAG controller and USB download cable as described above.

With the mode set to either Slave SelectMAP 110, or BPI Mode 010, the FPGA will attempt to configure itself from the selected Flash device as described in "3. 128 Mb Platform Flash XL," page 20.

Note: S1 switch 4 is the System ACE controller enable switch. When ON, this switch allows the System ACE to boot at power-on if it finds a CF card present. In order to boot from BPI Flash U4 or Xilinx Platform Flash (U27) without System ACE contention, S1 switch 4 must be OFF.

Default Switch and Jumper Settings

Table A-1: **Default Switch Settings**

REFDES	Function/Type		Default
SW2	Board power slide-switch		off
SW1	User GPIO 8-pole DIP switch		
	8		off
	7		off
	6		off
	5		off
	4		off
	3		off
	2		off
	1		off
S1	System ACE CF configuration and image select 4-pole DIP switch		
	4	SysACE Mode = 1 (1)	off
	3	SysAce CFGAddr 2 = 0	off
	2	SysAce CFGAddr 1 = 0	off
	1	SysAce CFGAddr 0 = 0	off
S2	FPGA mode, boot PROM select and FPGA CCLK select 6-pole DIP switch		
	6	FLASH_A23 = 0	off
	5	M2 = 0	off
	4	M1 = 1 M[2:0] = 010 = Master BPI-Up	on
	3	M0 = 0	off
	2	CS_SEL = 1 = boot from BPI Flash	on
	1	EXT_CCLK = 0	off

Notes:

1. S1 position 4 is the System ACE controller enable switch. When ON, this switch allows the System ACE to boot at power on if it finds a CF card present. In order to boot from BPI Flash or Xilinx Platform Flash without System ACE contention, S1 switch 4 must be OFF.

Table A-2: **Default Jumper Settings**

Jumper REFDES	Function	Default
J69	System ACE CF Error LED Enable	Jump 1-2
GMII:		
J66	pins 1-2: GMII/MII to Cu pins 2-3: SGMII to Cu, no clk	Jump 1 - 2
J67	pins 1-2: GMII/MII to Cu pins 2-3: SGMII to Cu, no clk	Jump 1 - 2
J68	J66 pins 1-2, J68 ON: RGMII, modified MII in Cu	no jumper
FMC Bypass:		
J18	exclude FMC LPC connector	Jump 1 - 2
J17	exclude FMC LPC connector	Jump 1 - 2
System Monitor:		
J19	Test_mon_vrefp sourced by U23, REF3012	Jump 1 - 2
J35	measure voltage on R-kelvin on 12V rail	Jump 9 - 11, Jump 10 - 12
SFP Module:		
J54	Full BW	Jump 1 - 2
J65	SFP Enable	Jump 1 - 2
PCIe Lane Size:		
J42	1 lane	Jump 1 - 2

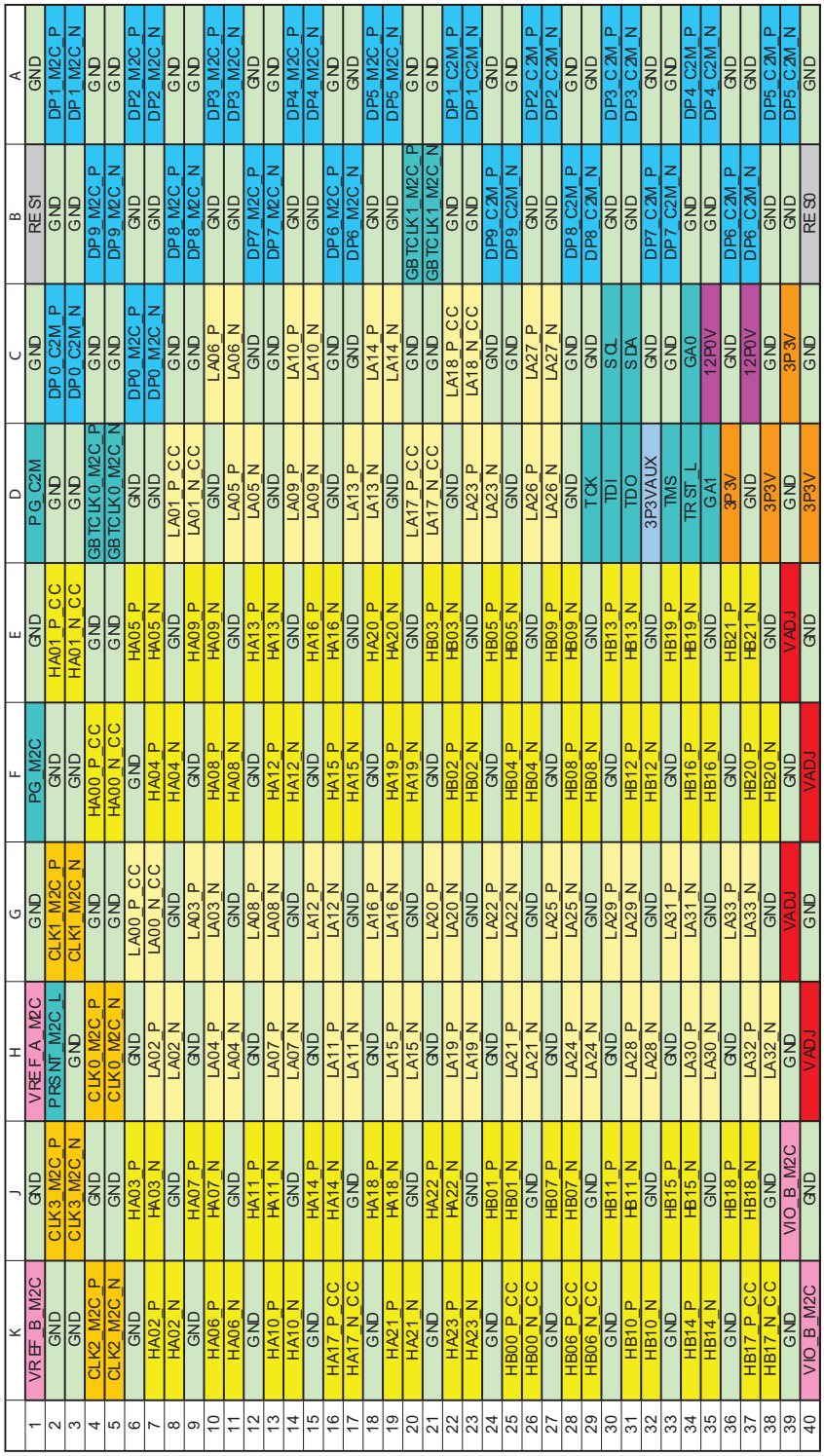
VITA 57.1 FMC LPC (J63) and HPC (J64) Connector Pinout

Figure B-1 shows the pinout of the FMC LPC connector. Pins marked NC are not connected.

	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

Figure B-1: **FMC LPC Connector Pinout**

Figure B-2 shows the pinout of the FMC HPC connector.



	K	J	H	G	F	E	D	C	B	A
1	VREF_B_M2C	GND	VREF_A_M2C	GND	PG_M2C	GND	PG_C2M	GND	RESI	GND
2	GND	CLK3_M2C_P	PRSNT_M2C_L	CLK1_M2C_P	GND	HA01_P_CC	GND	DP0_C2M_P	GND	DP1_M2C_P
3	GND	CLK3_M2C_N	GND	CLK1_M2C_N	GND	HA01_N_CC	GND	DP0_C2M_N	GND	DP1_M2C_N
4	CLK2_M2C_P	GND	CLK0_M2C_P	GND	HA00_P_CC	GND	GBTCLK0_M2C_P	GND	DP9_M2C_P	GND
5	CLK2_M2C_N	GND	CLK0_M2C_N	GND	HA00_N_CC	GND	GBTCLK0_M2C_N	GND	DP9_M2C_N	GND
6	GND	HA03_P	GND	LA00_P_CC	GND	HA05_P	GND	DP0_M2C_P	GND	DP2_M2C_P
7	HA02_P	HA03_N	LA02_P	LA00_N_CC	HA04_P	HA05_N	GND	DP0_M2C_N	GND	DP2_M2C_N
8	HA02_N	GND	LA02_N	GND	HA04_N	GND	LA01_P_CC	GND	DP8_M2C_P	GND
9	GND	HA07_P	GND	LA03_P	GND	HA09_P	LA01_N_CC	GND	DP8_M2C_N	GND
10	HA06_P	HA07_N	LA04_P	LA03_N	HA08_P	HA09_N	GND	LA06_P	GND	DP3_M2C_P
11	HA06_N	GND	LA04_N	GND	HA08_N	GND	LA05_P	LA06_N	GND	DP3_M2C_N
12	GND	HA11_P	GND	LA08_P	GND	HA13_P	LA05_N	GND	DP7_M2C_P	GND
13	HA10_P	HA11_N	LA07_P	LA08_N	HA12_P	HA13_N	GND	GND	DP7_M2C_N	GND
14	HA10_N	GND	LA07_N	GND	HA12_N	GND	LA09_P	LA10_P	GND	DP4_M2C_P
15	GND	HA14_P	GND	LA12_P	GND	HA16_P	LA09_N	LA10_N	GND	DP4_M2C_N
16	HA17_P_CC	HA14_N	LA11_P	LA12_N	HA15_P	HA16_N	GND	GND	DP6_M2C_P	GND
17	HA17_N_CC	GND	LA11_N	GND	HA15_N	GND	LA13_P	GND	DP6_M2C_N	GND
18	GND	HA18_P	GND	LA16_P	GND	HA20_P	LA13_N	LA14_P	GND	DP5_M2C_P
19	HA21_P	HA18_N	LA15_P	LA16_N	HA19_P	HA20_N	GND	LA14_N	GND	DP5_M2C_N
20	HA21_N	GND	LA15_N	GND	HA19_N	GND	LA17_P_CC	GND	GBTCLK1_M2C_P	GND
21	GND	HA22_P	GND	LA20_P	GND	HB03_P	LA17_N_CC	GND	GBTCLK1_M2C_N	GND
22	HA23_P	HA22_N	LA19_P	LA20_N	HB02_P	HB03_N	GND	LA18_P_CC	GND	DP1_C2M_P
23	HA23_N	GND	LA19_N	GND	HB02_N	GND	LA23_P	LA18_N_CC	GND	DP1_C2M_N
24	GND	HB01_P	GND	LA22_P	GND	HB05_P	LA23_N	GND	DP9_C2M_P	GND
25	HB00_P_CC	HB01_N	LA21_P	LA22_N	HB04_P	HB05_N	GND	GND	DP9_C2M_N	GND
26	HB00_N_CC	GND	LA21_N	GND	HB04_N	GND	LA26_P	LA27_P	GND	DP2_C2M_P
27	GND	HB07_P	GND	LA25_P	GND	HB09_P	LA26_N	LA27_N	GND	DP2_C2M_N
28	HB06_P_CC	HB07_N	LA24_P	LA25_N	HB08_P	HB09_N	GND	GND	DP8_C2M_P	GND
29	HB06_N_CC	GND	LA24_N	GND	HB08_N	GND	TCK	GND	DP8_C2M_N	GND
30	GND	HB11_P	GND	LA29_P	GND	HB13_P	TDI	SCL	GND	DP3_C2M_P
31	HB10_P	HB11_N	LA28_P	LA29_N	HB12_P	HB13_N	TDO	SDA	GND	DP3_C2M_N
32	HB10_N	GND	LA28_N	GND	HB12_N	GND	3P3VAUX	GND	DP7_C2M_P	GND
33	GND	HB15_P	GND	LA31_P	GND	HB19_P	TMS	GND	DP7_C2M_N	GND
34	HB14_P	HB15_N	LA30_P	LA31_N	HB16_P	HB19_N	TRST_L	GA0	GND	DP4_C2M_P
35	HB14_N	GND	LA30_N	GND	HB16_N	GND	GA1	12P0V	GND	DP4_C2M_N
36	GND	HB18_P	GND	LA33_P	GND	HB21_P	3P3V	GND	DP6_C2M_P	GND
37	HB17_P_CC	HB18_N	LA32_P	LA33_N	HB20_P	HB21_N	GND	12P0V	DP6_C2M_N	GND
38	HB17_N_CC	GND	LA32_N	GND	HB20_N	GND	3P3V	GND	GND	DP5_C2M_P
39	GND	VIO_B_M2C	GND	VADJ	GND	VADJ	GND	3P3V	GND	DP5_C2M_N
40	VIO_B_M2C	GND	VADJ	GND	VADJ	GND	3P3V	GND	RESO	GND

Figure B-2: **FMC HPC Connector Pinout**

Appendix C

ML605 Master UCF

The UCF template is provided for designs that target the ML605. Net names provided in the constraints below correlate with net names on the ML605 Rev. D schematic. On identifying the appropriate pins, the net names below should be replaced with net names in the user RTL. See the Constraints Guide for more information.

Users can refer to the UCF files generated by tools such as MIG (Memory Interface Generator for memory interfaces) and BSB (Base System Builder) for more detailed information concerning the I/O standards required for each particular interface. The FMC connectors J63 and J64 are connected to 2.5V V_{cco} banks. Because each user's FMC card implements customer-specific circuitry, the FMC bank I/O standards must be uniquely defined by each customer.

```
NET "CLK_33MHZ_SYSACE"              LOC = "AE16";   ## 93  on U19
NET "CPU_RESET"                     LOC = "H10";    ## 2   on SW10 pushbutton (active-High)
##
NET "DDR3_A0"                       LOC = "L14";    ## 98  on J1
NET "DDR3_A1"                       LOC = "A16";    ## 97  on J1
NET "DDR3_A2"                       LOC = "B16";    ## 96  on J1
NET "DDR3_A3"                       LOC = "E16";    ## 95  on J1
NET "DDR3_A4"                       LOC = "D16";    ## 92  on J1
NET "DDR3_A5"                       LOC = "J17";    ## 91  on J1
NET "DDR3_A6"                       LOC = "A15";    ## 90  on J1
NET "DDR3_A7"                       LOC = "B15";    ## 86  on J1
NET "DDR3_A8"                       LOC = "G15";    ## 89  on J1
NET "DDR3_A9"                       LOC = "F15";    ## 85  on J1
NET "DDR3_A10"                      LOC = "M16";    ## 107 on J1
NET "DDR3_A11"                      LOC = "M15";    ## 84  on J1
NET "DDR3_A12"                      LOC = "H15";    ## 83  on J1
NET "DDR3_A13"                      LOC = "J15";    ## 119 on J1
NET "DDR3_A14"                      LOC = "D15";    ## 80  on J1
NET "DDR3_A15"                      LOC = "C15";    ## 78  on J1
NET "DDR3_BA0"                      LOC = "K19";    ## 109 on J1
NET "DDR3_BA1"                      LOC = "J19";    ## 108 on J1
NET "DDR3_BA2"                      LOC = "L15";    ## 79  on J1
NET "DDR3_CAS_B"                    LOC = "C17";    ## 115 on J1
NET "DDR3_CKE0"                     LOC = "M18";    ## 73  on J1
NET "DDR3_CKE1"                     LOC = "M17";    ## 74  on J1
NET "DDR3_CLK0_N"                   LOC = "H18";    ## 103 on J1
NET "DDR3_CLK0_P"                   LOC = "G18";    ## 101 on J1
NET "DDR3_CLK1_N"                   LOC = "L16";    ## 104 on J1
NET "DDR3_CLK1_P"                   LOC = "K16";    ## 102 on J1
NET "DDR3_D0"                       LOC = "J11";    ## 5   on J1
NET "DDR3_D1"                       LOC = "E13";    ## 7   on J1
NET "DDR3_D2"                       LOC = "F13";    ## 15  on J1
NET "DDR3_D3"                       LOC = "K11";    ## 17  on J1
NET "DDR3_D4"                       LOC = "L11";    ## 4   on J1
NET "DDR3_D5"                       LOC = "K13";    ## 6   on J1
NET "DDR3_D6"                       LOC = "K12";    ## 16  on J1
NET "DDR3_D7"                       LOC = "D11";    ## 18  on J1
```

```
NET "DDR3_D8"                   LOC = "M13";    ## 21  on J1
NET "DDR3_D9"                   LOC = "J14";    ## 23  on J1
NET "DDR3_D10"                  LOC = "B13";    ## 33  on J1
NET "DDR3_D11"                  LOC = "B12";    ## 35  on J1
NET "DDR3_D12"                  LOC = "G10";    ## 22  on J1
NET "DDR3_D13"                  LOC = "M11";    ## 24  on J1
NET "DDR3_D14"                  LOC = "C12";    ## 34  on J1
NET "DDR3_D15"                  LOC = "A11";    ## 36  on J1
NET "DDR3_D16"                  LOC = "G11";    ## 39  on J1
NET "DDR3_D17"                  LOC = "F11";    ## 41  on J1
NET "DDR3_D18"                  LOC = "D14";    ## 51  on J1
NET "DDR3_D19"                  LOC = "C14";    ## 53  on J1
NET "DDR3_D20"                  LOC = "G12";    ## 40  on J1
NET "DDR3_D21"                  LOC = "G13";    ## 42  on J1
NET "DDR3_D22"                  LOC = "F14";    ## 50  on J1
NET "DDR3_D23"                  LOC = "H14";    ## 52  on J1
NET "DDR3_D24"                  LOC = "C19";    ## 57  on J1
NET "DDR3_D25"                  LOC = "G20";    ## 59  on J1
NET "DDR3_D26"                  LOC = "E19";    ## 67  on J1
NET "DDR3_D27"                  LOC = "F20";    ## 69  on J1
NET "DDR3_D28"                  LOC = "A20";    ## 56  on J1
NET "DDR3_D29"                  LOC = "A21";    ## 58  on J1
NET "DDR3_D30"                  LOC = "E22";    ## 68  on J1
NET "DDR3_D31"                  LOC = "E23";    ## 70  on J1
NET "DDR3_D32"                  LOC = "G21";    ## 129 on J1
NET "DDR3_D33"                  LOC = "B21";    ## 131 on J1
NET "DDR3_D34"                  LOC = "A23";    ## 141 on J1
NET "DDR3_D35"                  LOC = "A24";    ## 143 on J1
NET "DDR3_D36"                  LOC = "C20";    ## 130 on J1
NET "DDR3_D37"                  LOC = "D20";    ## 132 on J1
NET "DDR3_D38"                  LOC = "J20";    ## 140 on J1
NET "DDR3_D39"                  LOC = "G22";    ## 142 on J1
NET "DDR3_D40"                  LOC = "D26";    ## 147 on J1
NET "DDR3_D41"                  LOC = "F26";    ## 149 on J1
NET "DDR3_D42"                  LOC = "B26";    ## 157 on J1
NET "DDR3_D43"                  LOC = "E26";    ## 159 on J1
NET "DDR3_D44"                  LOC = "C24";    ## 146 on J1
NET "DDR3_D45"                  LOC = "D25";    ## 148 on J1
NET "DDR3_D46"                  LOC = "D27";    ## 158 on J1
NET "DDR3_D47"                  LOC = "C25";    ## 160 on J1
NET "DDR3_D48"                  LOC = "C27";    ## 163 on J1
NET "DDR3_D49"                  LOC = "B28";    ## 165 on J1
NET "DDR3_D50"                  LOC = "D29";    ## 175 on J1
NET "DDR3_D51"                  LOC = "B27";    ## 177 on J1
NET "DDR3_D52"                  LOC = "G27";    ## 164 on J1
NET "DDR3_D53"                  LOC = "A28";    ## 166 on J1
NET "DDR3_D54"                  LOC = "E24";    ## 174 on J1
NET "DDR3_D55"                  LOC = "G25";    ## 176 on J1
NET "DDR3_D56"                  LOC = "F28";    ## 181 on J1
NET "DDR3_D57"                  LOC = "B31";    ## 183 on J1
NET "DDR3_D58"                  LOC = "H29";    ## 191 on J1
NET "DDR3_D59"                  LOC = "H28";    ## 193 on J1
NET "DDR3_D60"                  LOC = "B30";    ## 180 on J1
NET "DDR3_D61"                  LOC = "A30";    ## 182 on J1
NET "DDR3_D62"                  LOC = "E29";    ## 192 on J1
NET "DDR3_D63"                  LOC = "F29";    ## 194 on J1
NET "DDR3_DM0"                  LOC = "E11";    ## 11  on J1
NET "DDR3_DM1"                  LOC = "B11";    ## 28  on J1
NET "DDR3_DM2"                  LOC = "E14";    ## 46  on J1
NET "DDR3_DM3"                  LOC = "D19";    ## 63  on J1
NET "DDR3_DM4"                  LOC = "B22";    ## 136 on J1
NET "DDR3_DM5"                  LOC = "A26";    ## 153 on J1
NET "DDR3_DM6"                  LOC = "A29";    ## 170 on J1
NET "DDR3_DM7"                  LOC = "A31";    ## 187 on J1
NET "DDR3_DQS0_N"               LOC = "E12";    ## 10  on J1
```

```
NET "DDR3_DQS0_P"                   LOC = "D12";    ## 12  on J1
NET "DDR3_DQS1_N"                   LOC = "J12";    ## 27  on J1
NET "DDR3_DQS1_P"                   LOC = "H12";    ## 29  on J1
NET "DDR3_DQS2_N"                   LOC = "A14";    ## 45  on J1
NET "DDR3_DQS2_P"                   LOC = "A13";    ## 47  on J1
NET "DDR3_DQS3_N"                   LOC = "H20";    ## 62  on J1
NET "DDR3_DQS3_P"                   LOC = "H19";    ## 64  on J1
NET "DDR3_DQS4_N"                   LOC = "C23";    ## 135 on J1
NET "DDR3_DQS4_P"                   LOC = "B23";    ## 137 on J1
NET "DDR3_DQS5_N"                   LOC = "A25";    ## 152 on J1
NET "DDR3_DQS5_P"                   LOC = "B25";    ## 154 on J1
NET "DDR3_DQS6_N"                   LOC = "G28";    ## 169 on J1
NET "DDR3_DQS6_P"                   LOC = "H27";    ## 171 on J1
NET "DDR3_DQS7_N"                   LOC = "D30";    ## 186 on J1
NET "DDR3_DQS7_P"                   LOC = "C30";    ## 188 on J1
NET "DDR3_ODT0"                     LOC = "F18";    ## 116 on J1
NET "DDR3_ODT1"                     LOC = "E17";    ## 120 on J1
NET "DDR3_RAS_B"                    LOC = "L19";    ## 110 on J1
NET "DDR3_RESET_B"                  LOC = "E18";    ## 30  on J1
NET "DDR3_S0_B"                     LOC = "K18";    ## 114 on J1
NET "DDR3_S1_B"                     LOC = "K17";    ## 121 on J1
NET "DDR3_TEMP_EVENT"               LOC = "D17";    ## 198 on J1
NET "DDR3_WE_B"                     LOC = "B17";    ## 113 on J1
##
NET "DVI_D0"                        LOC = "AJ19";   ## 63 on U38 (thru series R111 47.5 ohm)
NET "DVI_D1"                        LOC = "AH19";   ## 62 on U38 (thru series R110 47.5 ohm)
NET "DVI_D2"                        LOC = "AM17";   ## 61 on U38 (thru series R109 47.5 ohm)
NET "DVI_D3"                        LOC = "AM16";   ## 60 on U38 (thru series R108 47.5 ohm)
NET "DVI_D4"                        LOC = "AD17";   ## 59 on U38 (thru series R107 47.5 ohm)
NET "DVI_D5"                        LOC = "AE17";   ## 58 on U38 (thru series R106 47.5 ohm)
NET "DVI_D6"                        LOC = "AK18";   ## 55 on U38 (thru series R105 47.5 ohm)
NET "DVI_D7"                        LOC = "AK17";   ## 54 on U38 (thru series R104 47.5 ohm)
NET "DVI_D8"                        LOC = "AE18";   ## 53 on U38 (thru series R103 47.5 ohm)
NET "DVI_D9"                        LOC = "AF18";   ## 52 on U38 (thru series R102 47.5 ohm)
NET "DVI_D10"                       LOC = "AL16";   ## 51 on U38 (thru series R101 47.5 ohm)
NET "DVI_D11"                       LOC = "AK16";   ## 50 on U38 (thru series R100 47.5 ohm)
NET "DVI_DE"                        LOC = "AD16";   ## 2  on U38 (thru series R112 47.5 ohm)
NET "DVI_GPIO1_FMC_C2M_PG_LS"       LOC = "K9";     ## 18 on U32 (not wired to U38)
NET "DVI_H"                         LOC = "AN17";   ## 4  on U38 (thru series R113 47.5 ohm)
NET "DVI_RESET_B_LS"                LOC = "AP17";   ## 2  on U32 (DVI_RESET_B pin 13 on U38)
NET "DVI_V"                         LOC = "AD15";   ## 5  on U38 (thru series R114 47.5 ohm)
NET "DVI_XCLK_N"                    LOC = "AC17";   ## 56 on U38
NET "DVI_XCLK_P"                    LOC = "AC18";   ## 57 on U38
##
NET "FLASH_A0"                      LOC = "AL8";    ## 29 on U4, A1 on U27
NET "FLASH_A1"                      LOC = "AK8";    ## 25 on U4, B1 on U27
NET "FLASH_A2"                      LOC = "AC9";    ## 24 on U4, C1 on U27
NET "FLASH_A3"                      LOC = "AD10";   ## 23 on U4, D1 on U27
NET "FLASH_A4"                      LOC = "C8";     ## 22 on U4, D2 on U27
NET "FLASH_A5"                      LOC = "B8";     ## 21 on U4, A2 on U27
NET "FLASH_A6"                      LOC = "E9";     ## 20 on U4, C2 on U27
NET "FLASH_A7"                      LOC = "E8";     ## 19 on U4, A3 on U27
NET "FLASH_A8"                      LOC = "A8";     ## 8  on U4, B3 on U27
NET "FLASH_A9"                      LOC = "A9";     ## 7  on U4, C3 on U27
NET "FLASH_A10"                     LOC = "D9";     ## 6  on U4, D3 on U27
NET "FLASH_A11"                     LOC = "C9";     ## 5  on U4, C4 on U27
NET "FLASH_A12"                     LOC = "D10";    ## 4  on U4, A5 on U27
NET "FLASH_A13"                     LOC = "C10";    ## 3  on U4, B5 on U27
NET "FLASH_A14"                     LOC = "F10";    ## 2  on U4, C5 on U27
NET "FLASH_A15"                     LOC = "F9";     ## 1  on U4, D7 on U27
NET "FLASH_A16"                     LOC = "AH8";    ## 55 on U4, D8 on U27
NET "FLASH_A17"                     LOC = "AG8";    ## 18 on U4, A7 on U27
NET "FLASH_A18"                     LOC = "AP9";    ## 17 on U4, B7 on U27
NET "FLASH_A19"                     LOC = "AN9";    ## 16 on U4, C7 on U27
NET "FLASH_A20"                     LOC = "AF10";   ## 11 on U4, C8 on U27
```

```
NET "FLASH_A21"                     LOC = "AF9";    ## 10 on U4, A8 on U27
NET "FLASH_A22"                     LOC = "AL9";    ## 9  on U4, G1 on U27
NET "FLASH_A23"                     LOC = "AA23";   ## 26 on U4
NET "FLASH_D0"                      LOC = "AF24";   ## 34 on U4 (thru series R215 100 ohm), F2 on U27
NET "FLASH_D1"                      LOC = "AF25";   ## 36 on U4 (thru series R216 100 ohm), E2 on U27
NET "FLASH_D2"                      LOC = "W24";    ## 39 on U4 (thru series R217 100 ohm), G3 on U27
NET "FLASH_D3"                      LOC = "V24";    ## 41 on U4 (thru series R218 100 ohm), E4 on U27
NET "FLASH_D4"                      LOC = "H24";    ## 47 on U4 (thru series R219 100 ohm), E5 on U27
NET "FLASH_D5"                      LOC = "H25";    ## 49 on U4 (thru series R220 100 ohm), G5 on U27
NET "FLASH_D6"                      LOC = "P24";    ## 51 on U4 (thru series R221 100 ohm), G6 on U27
NET "FLASH_D7"                      LOC = "R24";    ## 53 on U4 (thru series R222 100 ohm), H7 on U27
NET "FLASH_D8"                      LOC = "G23";    ## 35 on U4 (thru series R223 100 ohm), E1 on U27
NET "FLASH_D9"                      LOC = "H23";    ## 37 on U4 (thru series R224 100 ohm), E3 on U27
NET "FLASH_D10"                     LOC = "N24";    ## 40 on U4 (thru series R225 100 ohm), F3 on U27
NET "FLASH_D11"                     LOC = "N23";    ## 42 on U4 (thru series R226 100 ohm), F4 on U27
NET "FLASH_D12"                     LOC = "F23";    ## 48 on U4 (thru series R227 100 ohm), F5 on U27
NET "FLASH_D13"                     LOC = "F24";    ## 50 on U4 (thru series R228 100 ohm), H5 on U27
NET "FLASH_D14"                     LOC = "L24";    ## 52 on U4 (thru series R229 100 ohm), G7 on U27
NET "FLASH_D15"                     LOC = "M23";    ## 54 on U4 (thru series R230 100 ohm), E7 on U27
NET "FLASH_WAIT"                    LOC = "J26";    ## 56 on U4
NET "FPGA_FWE_B"                    LOC = "AF23";   ## 14 on U4, G8 on U27
NET "FPGA_FOE_B"                    LOC = "AA24";   ## 32 on U4, F8 on U27
NET "FPGA_CCLK"                     LOC = "K8";     ##           F1 on U27
NET "PLATFLASH_L_B"                 LOC = "AC23";   ##           H1 on U27
NET "FPGA_FCS_B"                   LOC = "Y24";    ## 30 on U4, B4 on U27 (U10 and switch S2.2 setting
##                                                      select either U4 or U27)
##
NET "FMC_HPC_CLK0_M2C_N"            LOC = "K23";    ## H5  on J64
NET "FMC_HPC_CLK0_M2C_P"            LOC = "K24";    ## H4  on J64
NET "FMC_HPC_CLK1_M2C_N"            LOC = "AP21";   ## G3  on J64
NET "FMC_HPC_CLK1_M2C_P"            LOC = "AP20";   ## G2  on J64
NET "FMC_HPC_CLK2_M2C_IO_N"         LOC = "AC30";   ## 15  on U83
NET "FMC_HPC_CLK2_M2C_IO_P"         LOC = "AD30";   ## 16  on U83
NET "FMC_HPC_CLK2_M2C_MGT_C_N"      LOC = "AB5";    ## 2   on series C399 0.1uF
NET "FMC_HPC_CLK2_M2C_MGT_C_P"      LOC = "AB6";    ## 2   on series C398 0.1uF
NET "FMC_HPC_CLK3_M2C_IO_N"         LOC = "AF34";   ## J3  on J64
NET "FMC_HPC_CLK3_M2C_IO_P"         LOC = "AE34";   ## J2  on J64
NET "FMC_HPC_CLK3_M2C_MGT_C_N"      LOC = "AH5";    ## 2   on series C397 0.1uF
NET "FMC_HPC_CLK3_M2C_MGT_C_P"      LOC = "AH6";    ## 2   on series C396 0.1uF
NET "FMC_HPC_DP0_C2M_N"             LOC = "AB2";    ## C3  on J64
NET "FMC_HPC_DP0_C2M_P"             LOC = "AB1";    ## C2  on J64
NET "FMC_HPC_DP0_M2C_N"             LOC = "AC4";    ## C7  on J64
NET "FMC_HPC_DP0_M2C_P"             LOC = "AC3";    ## C6  on J64
NET "FMC_HPC_DP1_C2M_N"             LOC = "AD2";    ## A23 on J64
NET "FMC_HPC_DP1_C2M_P"             LOC = "AD1";    ## A22 on J64
NET "FMC_HPC_DP1_M2C_N"             LOC = "AE4";    ## A3  on J64
NET "FMC_HPC_DP1_M2C_P"             LOC = "AE3";    ## A2  on J64
NET "FMC_HPC_DP2_C2M_N"             LOC = "AF2";    ## A27 on J64
NET "FMC_HPC_DP2_C2M_P"             LOC = "AF1";    ## A26 on J64
NET "FMC_HPC_DP2_M2C_N"             LOC = "AF6";    ## A7  on J64
NET "FMC_HPC_DP2_M2C_P"             LOC = "AF5";    ## A6  on J64
NET "FMC_HPC_DP3_C2M_N"             LOC = "AH2";    ## A31 on J64
NET "FMC_HPC_DP3_C2M_P"             LOC = "AH1";    ## A30 on J64
NET "FMC_HPC_DP3_M2C_N"             LOC = "AG4";    ## A11 on J64
NET "FMC_HPC_DP3_M2C_P"             LOC = "AG3";    ## A10 on J64
NET "FMC_HPC_DP4_C2M_N"             LOC = "AK2";    ## A35 on J64
NET "FMC_HPC_DP4_C2M_P"             LOC = "AK1";    ## A34 on J64
NET "FMC_HPC_DP4_M2C_N"             LOC = "AJ4";    ## A15 on J64
NET "FMC_HPC_DP4_M2C_P"             LOC = "AJ3";    ## A14 on J64
NET "FMC_HPC_DP5_C2M_N"             LOC = "AM2";    ## A39 on J64
NET "FMC_HPC_DP5_C2M_P"             LOC = "AM1";    ## A38 on J64
NET "FMC_HPC_DP5_M2C_N"             LOC = "AL4";    ## A19 on J64
NET "FMC_HPC_DP5_M2C_P"             LOC = "AL3";    ## A18 on J64
NET "FMC_HPC_DP6_C2M_N"             LOC = "AN4";    ## B37 on J64
NET "FMC_HPC_DP6_C2M_P"             LOC = "AN3";    ## B36 on J64
```

```
NET "FMC_HPC_DP6_M2C_N"          LOC = "AM6";    ## B17 on J64
NET "FMC_HPC_DP6_M2C_P"          LOC = "AM5";    ## B16 on J64
NET "FMC_HPC_DP7_C2M_N"          LOC = "AP2";    ## B33 on J64
NET "FMC_HPC_DP7_C2M_P"          LOC = "AP1";    ## B32 on J64
NET "FMC_HPC_DP7_M2C_N"          LOC = "AP6";    ## B13 on J64
NET "FMC_HPC_DP7_M2C_P"          LOC = "AP5";    ## B12 on J64
NET "FMC_HPC_GBTCLK0_M2C_N"      LOC = "AD5";    ## D5  on J64
NET "FMC_HPC_GBTCLK0_M2C_P"      LOC = "AD6";    ## D4  on J64
NET "FMC_HPC_GBTCLK1_M2C_N"      LOC = "AK5";    ## B21 on J64
NET "FMC_HPC_GBTCLK1_M2C_P"      LOC = "AK6";    ## B20 on J64
NET "FMC_HPC_HA00_CC_N"          LOC = "AF33";   ## F5  on J64
NET "FMC_HPC_HA00_CC_P"          LOC = "AE33";   ## F4  on J64
NET "FMC_HPC_HA01_CC_N"          LOC = "AC29";   ## E3  on J64
NET "FMC_HPC_HA01_CC_P"          LOC = "AD29";   ## E2  on J64
NET "FMC_HPC_HA02_N"             LOC = "AC25";   ## K8  on J64
NET "FMC_HPC_HA02_P"             LOC = "AB25";   ## K7  on J64
NET "FMC_HPC_HA03_N"             LOC = "Y26";    ## J7  on J64
NET "FMC_HPC_HA03_P"             LOC = "AA25";   ## J6  on J64
NET "FMC_HPC_HA04_N"             LOC = "AC28";   ## F8  on J64
NET "FMC_HPC_HA04_P"             LOC = "AB28";   ## F7  on J64
NET "FMC_HPC_HA05_N"             LOC = "AC27";   ## E7  on J64
NET "FMC_HPC_HA05_P"             LOC = "AB27";   ## E6  on J64
NET "FMC_HPC_HA06_N"             LOC = "AA29";   ## K11 on J64
NET "FMC_HPC_HA06_P"             LOC = "AA28";   ## K10 on J64
NET "FMC_HPC_HA07_N"             LOC = "AB26";   ## J10 on J64
NET "FMC_HPC_HA07_P"             LOC = "AA26";   ## J9  on J64
NET "FMC_HPC_HA08_N"             LOC = "AF31";   ## F11 on J64
NET "FMC_HPC_HA08_P"             LOC = "AG31";   ## F10 on J64
NET "FMC_HPC_HA09_N"             LOC = "AB31";   ## E10 on J64
NET "FMC_HPC_HA09_P"             LOC = "AB30";   ## E9  on J64
NET "FMC_HPC_HA10_N"             LOC = "AC34";   ## K14 on J64
NET "FMC_HPC_HA10_P"             LOC = "AD34";   ## K13 on J64
NET "FMC_HPC_HA11_N"             LOC = "AG32";   ## J13 on J64
NET "FMC_HPC_HA11_P"             LOC = "AG33";   ## J12 on J64
NET "FMC_HPC_HA12_N"             LOC = "AE32";   ## F14 on J64
NET "FMC_HPC_HA12_P"             LOC = "AD32";   ## F13 on J64
NET "FMC_HPC_HA13_N"             LOC = "AD31";   ## E13 on J64
NET "FMC_HPC_HA13_P"             LOC = "AE31";   ## E12 on J64
NET "FMC_HPC_HA14_N"             LOC = "AA31";   ## J16 on J64
NET "FMC_HPC_HA14_P"             LOC = "AA30";   ## J15 on J64
NET "FMC_HPC_HA15_N"             LOC = "AC32";   ## F17 on J64
NET "FMC_HPC_HA15_P"             LOC = "AB32";   ## F16 on J64
NET "FMC_HPC_HA16_N"             LOC = "AB33";   ## E16 on J64
NET "FMC_HPC_HA16_P"             LOC = "AC33";   ## E15 on J64
NET "FMC_HPC_HA17_CC_N"          LOC = "W30";    ## K17 on J64
NET "FMC_HPC_HA17_CC_P"          LOC = "V30";    ## K16 on J64
NET "FMC_HPC_HA18_N"             LOC = "T34";    ## J19 on J64
NET "FMC_HPC_HA18_P"             LOC = "T33";    ## J18 on J64
NET "FMC_HPC_HA19_N"             LOC = "U32";    ## F20 on J64
NET "FMC_HPC_HA19_P"             LOC = "U33";    ## F19 on J64
NET "FMC_HPC_HA20_N"             LOC = "V33";    ## E19 on J64
NET "FMC_HPC_HA20_P"             LOC = "V32";    ## E18 on J64
NET "FMC_HPC_HA21_N"             LOC = "U30";    ## K20 on J64
NET "FMC_HPC_HA21_P"             LOC = "U31";    ## K19 on J64
NET "FMC_HPC_HA22_N"             LOC = "V29";    ## J22 on J64
NET "FMC_HPC_HA22_P"             LOC = "U28";    ## J21 on J64
NET "FMC_HPC_HA23_N"             LOC = "U27";    ## K23 on J64
NET "FMC_HPC_HA23_P"             LOC = "U26";    ## K22 on J64
NET "FMC_HPC_HB00_CC_N"          LOC = "AG30";   ## K26 on J64
NET "FMC_HPC_HB00_CC_P"          LOC = "AF30";   ## K25 on J64
NET "FMC_HPC_HB01_N"             LOC = "AM32";   ## J25 on J64
NET "FMC_HPC_HB01_P"             LOC = "AN32";   ## J24 on J64
NET "FMC_HPC_HB02_N"             LOC = "AP33";   ## F23 on J64
NET "FMC_HPC_HB02_P"             LOC = "AP32";   ## F22 on J64
NET "FMC_HPC_HB03_N"             LOC = "AM31";   ## E22 on J64
```

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NET "FMC_HPC_HB03_P"                LOC = "AL30";   ## E21 on J64
NET "FMC_HPC_HB04_N"                LOC = "AL33";   ## F26 on J64
NET "FMC_HPC_HB04_P"                LOC = "AM33";   ## F25 on J64
NET "FMC_HPC_HB05_N"                LOC = "AN34";   ## E25 on J64
NET "FMC_HPC_HB05_P"                LOC = "AN33";   ## E24 on J64
NET "FMC_HPC_HB06_CC_N"             LOC = "AE26";   ## K29 on J64
NET "FMC_HPC_HB06_CC_P"             LOC = "AF26";   ## K28 on J64
NET "FMC_HPC_HB07_N"                LOC = "AH34";   ## J28 on J64
NET "FMC_HPC_HB07_P"                LOC = "AJ34";   ## J27 on J64
NET "FMC_HPC_HB08_N"                LOC = "AK32";   ## F29 on J64
NET "FMC_HPC_HB08_P"                LOC = "AK33";   ## F28 on J64
NET "FMC_HPC_HB09_N"                LOC = "AK34";   ## E28 on J64
NET "FMC_HPC_HB09_P"                LOC = "AL34";   ## E27 on J64
NET "FMC_HPC_HB10_N"                LOC = "AF29";   ## K32 on J64
NET "FMC_HPC_HB10_P"                LOC = "AF28";   ## K31 on J64
NET "FMC_HPC_HB11_N"                LOC = "AJ30";   ## J31 on J64
NET "FMC_HPC_HB11_P"                LOC = "AJ29";   ## J30 on J64
NET "FMC_HPC_HB12_N"                LOC = "AJ32";   ## F32 on J64
NET "FMC_HPC_HB12_P"                LOC = "AJ31";   ## F31 on J64
NET "FMC_HPC_HB13_N"                LOC = "AH32";   ## E31 on J64
NET "FMC_HPC_HB13_P"                LOC = "AH33";   ## E30 on J64
NET "FMC_HPC_HB14_N"                LOC = "AD27";   ## K35 on J64
NET "FMC_HPC_HB14_P"                LOC = "AE27";   ## K34 on J64
NET "FMC_HPC_HB15_N"                LOC = "AE29";   ## J34 on J64
NET "FMC_HPC_HB15_P"                LOC = "AE28";   ## J33 on J64
NET "FMC_HPC_HB16_N"                LOC = "AH30";   ## F35 on J64
NET "FMC_HPC_HB16_P"                LOC = "AH29";   ## F34 on J64
NET "FMC_HPC_HB17_CC_N"             LOC = "AG28";   ## K38 on J64
NET "FMC_HPC_HB17_CC_P"             LOC = "AG27";   ## K37 on J64
NET "FMC_HPC_HB18_N"                LOC = "AD26";   ## J37 on J64
NET "FMC_HPC_HB18_P"                LOC = "AD25";   ## J36 on J64
NET "FMC_HPC_HB19_N"                LOC = "AK31";   ## E34 on J64
NET "FMC_HPC_HB19_P"                LOC = "AL31";   ## E33 on J64
NET "FMC_HPC_LA00_CC_N"             LOC = "AF21";   ## G7  on J64
NET "FMC_HPC_LA00_CC_P"             LOC = "AF20";   ## G6  on J64
NET "FMC_HPC_LA01_CC_N"             LOC = "AL19";   ## D9  on J64
NET "FMC_HPC_LA01_CC_P"             LOC = "AK19";   ## D8  on J64
NET "FMC_HPC_LA02_N"                LOC = "AD20";   ## H8  on J64
NET "FMC_HPC_LA02_P"                LOC = "AC20";   ## H7  on J64
NET "FMC_HPC_LA03_N"                LOC = "AD19";   ## G10 on J64
NET "FMC_HPC_LA03_P"                LOC = "AC19";   ## G9  on J64
NET "FMC_HPC_LA04_N"                LOC = "AE19";   ## H11 on J64
NET "FMC_HPC_LA04_P"                LOC = "AF19";   ## H10 on J64
NET "FMC_HPC_LA05_N"                LOC = "AH22";   ## D12 on J64
NET "FMC_HPC_LA05_P"                LOC = "AG22";   ## D11 on J64
NET "FMC_HPC_LA06_N"                LOC = "AG21";   ## C11 on J64
NET "FMC_HPC_LA06_P"                LOC = "AG20";   ## C10 on J64
NET "FMC_HPC_LA07_N"                LOC = "AJ21";   ## H14 on J64
NET "FMC_HPC_LA07_P"                LOC = "AK21";   ## H13 on J64
NET "FMC_HPC_LA08_N"                LOC = "AJ22";   ## G13 on J64
NET "FMC_HPC_LA08_P"                LOC = "AK22";   ## G12 on J64
NET "FMC_HPC_LA09_N"                LOC = "AL18";   ## D15 on J64
NET "FMC_HPC_LA09_P"                LOC = "AM18";   ## D14 on J64
NET "FMC_HPC_LA10_N"                LOC = "AL20";   ## C15 on J64
NET "FMC_HPC_LA10_P"                LOC = "AM20";   ## C14 on J64
NET "FMC_HPC_LA11_N"                LOC = "AN22";   ## H17 on J64
NET "FMC_HPC_LA11_P"                LOC = "AM22";   ## H16 on J64
NET "FMC_HPC_LA12_N"                LOC = "AL21";   ## G16 on J64
NET "FMC_HPC_LA12_P"                LOC = "AM21";   ## G15 on J64
NET "FMC_HPC_LA13_N"                LOC = "AN18";   ## D18 on J64
NET "FMC_HPC_LA13_P"                LOC = "AP19";   ## D17 on J64
NET "FMC_HPC_LA14_N"                LOC = "AN20";   ## C19 on J64
NET "FMC_HPC_LA14_P"                LOC = "AN19";   ## C18 on J64
NET "FMC_HPC_LA15_N"                LOC = "AL23";   ## H20 on J64
NET "FMC_HPC_LA15_P"                LOC = "AM23";   ## H19 on J64
```

```
NET "FMC_HPC_LA16_N"                LOC = "AN23";   ## G19 on J64
NET "FMC_HPC_LA16_P"                LOC = "AP22";   ## G18 on J64
NET "FMC_HPC_LA17_CC_N"             LOC = "AM27";   ## D21 on J64
NET "FMC_HPC_LA17_CC_P"             LOC = "AN27";   ## D20 on J64
NET "FMC_HPC_LA18_CC_N"             LOC = "AJ25";   ## C23 on J64
NET "FMC_HPC_LA18_CC_P"             LOC = "AH25";   ## C22 on J64
NET "FMC_HPC_LA19_N"                LOC = "AN24";   ## H23 on J64
NET "FMC_HPC_LA19_P"                LOC = "AN25";   ## H22 on J64
NET "FMC_HPC_LA20_N"                LOC = "AL24";   ## G22 on J64
NET "FMC_HPC_LA20_P"                LOC = "AK23";   ## G21 on J64
NET "FMC_HPC_LA21_N"                LOC = "AP29";   ## H26 on J64
NET "FMC_HPC_LA21_P"                LOC = "AN29";   ## H25 on J64
NET "FMC_HPC_LA22_N"                LOC = "AP26";   ## G25 on J64
NET "FMC_HPC_LA22_P"                LOC = "AP27";   ## G24 on J64
NET "FMC_HPC_LA23_N"                LOC = "AM26";   ## D24 on J64
NET "FMC_HPC_LA23_P"                LOC = "AL26";   ## D23 on J64
NET "FMC_HPC_LA24_N"                LOC = "AM30";   ## H29 on J64
NET "FMC_HPC_LA24_P"                LOC = "AN30";   ## H28 on J64
NET "FMC_HPC_LA25_N"                LOC = "AM28";   ## G28 on J64
NET "FMC_HPC_LA25_P"                LOC = "AN28";   ## G27 on J64
NET "FMC_HPC_LA26_N"                LOC = "AL25";   ## D27 on J64
NET "FMC_HPC_LA26_P"                LOC = "AM25";   ## D26 on J64
NET "FMC_HPC_LA27_N"                LOC = "AP31";   ## C27 on J64
NET "FMC_HPC_LA27_P"                LOC = "AP30";   ## C26 on J64
NET "FMC_HPC_LA28_N"                LOC = "AJ27";   ## H32 on J64
NET "FMC_HPC_LA28_P"                LOC = "AK27";   ## H31 on J64
NET "FMC_HPC_LA29_N"                LOC = "AK28";   ## G31 on J64
NET "FMC_HPC_LA29_P"                LOC = "AL28";   ## G30 on J64
NET "FMC_HPC_LA30_N"                LOC = "AK24";   ## H35 on J64
NET "FMC_HPC_LA30_P"                LOC = "AJ24";   ## H34 on J64
NET "FMC_HPC_LA31_N"                LOC = "AK29";   ## G34 on J64
NET "FMC_HPC_LA31_P"                LOC = "AL29";   ## G33 on J64
NET "FMC_HPC_LA32_N"                LOC = "AG26";   ## H38 on J64
NET "FMC_HPC_LA32_P"                LOC = "AG25";   ## H37 on J64
NET "FMC_HPC_LA33_N"                LOC = "AH24";   ## G37 on J64
NET "FMC_HPC_LA33_P"                LOC = "AH23";   ## G36 on J64
NET "FMC_HPC_PG_M2C_LS"             LOC = "J27";    ## F1  on J64
NET "FMC_HPC_PRSNT_M2C_L"           LOC = "AP25";   ## H2  on J64
##
NET "FMC_LPC_CLK0_M2C_N"            LOC = "B10";    ## H5  on J63
NET "FMC_LPC_CLK0_M2C_P"            LOC = "A10";    ## H4  on J63
NET "FMC_LPC_CLK1_M2C_N"            LOC = "G33";    ## G3  on J63
NET "FMC_LPC_CLK1_M2C_P"            LOC = "F33";    ## G2  on J63
NET "FMC_LPC_DP0_C2M_N"             LOC = "D2";     ## C3  on J63
NET "FMC_LPC_DP0_C2M_P"             LOC = "D1";     ## C2  on J63
NET "FMC_LPC_DP0_M2C_N"             LOC = "G4";     ## C7  on J63
NET "FMC_LPC_DP0_M2C_P"             LOC = "G3";     ## C6  on J63
NET "FMC_LPC_GBTCLK0_M2C_N"         LOC = "M5";     ## D5  on J63
NET "FMC_LPC_GBTCLK0_M2C_P"         LOC = "M6";     ## D4  on J63
NET "FMC_LPC_IIC_SCL_LS"            LOC = "AF13";   ## 2   of Q26
NET "FMC_LPC_IIC_SDA_LS"            LOC = "AG13";   ## 2   of Q27
NET "FMC_LPC_LA00_CC_N"             LOC = "K27";    ## G7  on J63
NET "FMC_LPC_LA00_CC_P"             LOC = "K26";    ## G6  on J63
NET "FMC_LPC_LA01_CC_N"             LOC = "E31";    ## D9  on J63
NET "FMC_LPC_LA01_CC_P"             LOC = "F31";    ## D8  on J63
NET "FMC_LPC_LA02_N"                LOC = "H30";    ## H8  on J63
NET "FMC_LPC_LA02_P"                LOC = "G31";    ## H7  on J63
NET "FMC_LPC_LA03_N"                LOC = "J32";    ## G10 on J63
NET "FMC_LPC_LA03_P"                LOC = "J31";    ## G9  on J63
NET "FMC_LPC_LA04_N"                LOC = "J29";    ## H11 on J63
NET "FMC_LPC_LA04_P"                LOC = "K28";    ## H10 on J63
NET "FMC_LPC_LA05_N"                LOC = "H33";    ## D12 on J63
NET "FMC_LPC_LA05_P"                LOC = "H34";    ## D11 on J63
NET "FMC_LPC_LA06_N"                LOC = "J34";    ## C11 on J63
NET "FMC_LPC_LA06_P"                LOC = "K33";    ## C10 on J63
```

```
NET "FMC_LPC_LA07_N"                LOC = "H32";    ## H14 on J63
NET "FMC_LPC_LA07_P"                LOC = "G32";    ## H13 on J63
NET "FMC_LPC_LA08_N"                LOC = "K29";    ## G13 on J63
NET "FMC_LPC_LA08_P"                LOC = "J30";    ## G12 on J63
NET "FMC_LPC_LA09_N"                LOC = "L26";    ## D15 on J63
NET "FMC_LPC_LA09_P"                LOC = "L25";    ## D14 on J63
NET "FMC_LPC_LA10_N"                LOC = "G30";    ## C15 on J63
NET "FMC_LPC_LA10_P"                LOC = "F30";    ## C14 on J63
NET "FMC_LPC_LA11_N"                LOC = "D32";    ## H17 on J63
NET "FMC_LPC_LA11_P"                LOC = "D31";    ## H16 on J63
NET "FMC_LPC_LA12_N"                LOC = "E33";    ## G16 on J63
NET "FMC_LPC_LA12_P"                LOC = "E32";    ## G15 on J63
NET "FMC_LPC_LA13_N"                LOC = "C34";    ## D18 on J63
NET "FMC_LPC_LA13_P"                LOC = "D34";    ## D17 on J63
NET "FMC_LPC_LA14_N"                LOC = "B34";    ## C19 on J63
NET "FMC_LPC_LA14_P"                LOC = "C33";    ## C18 on J63
NET "FMC_LPC_LA15_N"                LOC = "B32";    ## H20 on J63
NET "FMC_LPC_LA15_P"                LOC = "C32";    ## H19 on J63
NET "FMC_LPC_LA16_N"                LOC = "B33";    ## G19 on J63
NET "FMC_LPC_LA16_P"                LOC = "A33";    ## G18 on J63
NET "FMC_LPC_LA17_CC_N"             LOC = "N29";    ## D21 on J63
NET "FMC_LPC_LA17_CC_P"             LOC = "N28";    ## D20 on J63
NET "FMC_LPC_LA18_CC_N"             LOC = "L30";    ## C23 on J63
NET "FMC_LPC_LA18_CC_P"             LOC = "L29";    ## C22 on J63
NET "FMC_LPC_LA19_N"                LOC = "N30";    ## H23 on J63
NET "FMC_LPC_LA19_P"                LOC = "M30";    ## H22 on J63
NET "FMC_LPC_LA20_N"                LOC = "R29";    ## G22 on J63
NET "FMC_LPC_LA20_P"                LOC = "P29";    ## G21 on J63
NET "FMC_LPC_LA21_N"                LOC = "T26";    ## H26 on J63
NET "FMC_LPC_LA21_P"                LOC = "R26";    ## H25 on J63
NET "FMC_LPC_LA22_N"                LOC = "P27";    ## G25 on J63
NET "FMC_LPC_LA22_P"                LOC = "N27";    ## G24 on J63
NET "FMC_LPC_LA23_N"                LOC = "R27";    ## D24 on J63
NET "FMC_LPC_LA23_P"                LOC = "R28";    ## D23 on J63
NET "FMC_LPC_LA24_N"                LOC = "P32";    ## H29 on J63
NET "FMC_LPC_LA24_P"                LOC = "N32";    ## H28 on J63
NET "FMC_LPC_LA25_N"                LOC = "P30";    ## G28 on J63
NET "FMC_LPC_LA25_P"                LOC = "P31";    ## G27 on J63
NET "FMC_LPC_LA26_N"                LOC = "M32";    ## D27 on J63
NET "FMC_LPC_LA26_P"                LOC = "L33";    ## D26 on J63
NET "FMC_LPC_LA27_N"                LOC = "R32";    ## C27 on J63
NET "FMC_LPC_LA27_P"                LOC = "R31";    ## C26 on J63
NET "FMC_LPC_LA28_N"                LOC = "M33";    ## H32 on J63
NET "FMC_LPC_LA28_P"                LOC = "N33";    ## H31 on J63
NET "FMC_LPC_LA29_N"                LOC = "P34";    ## G31 on J63
NET "FMC_LPC_LA29_P"                LOC = "N34";    ## G30 on J63
NET "FMC_LPC_LA30_N"                LOC = "M27";    ## H35 on J63
NET "FMC_LPC_LA30_P"                LOC = "M26";    ## H34 on J63
NET "FMC_LPC_LA31_N"                LOC = "L31";    ## G34 on J63
NET "FMC_LPC_LA31_P"                LOC = "M31";    ## G33 on J63
NET "FMC_LPC_LA32_N"                LOC = "M25";    ## H38 on J63
NET "FMC_LPC_LA32_P"                LOC = "N25";    ## H37 on J63
NET "FMC_LPC_LA33_N"                LOC = "K31";    ## G37 on J63
NET "FMC_LPC_LA33_P"                LOC = "K32";    ## G36 on J63
NET "FMC_LPC_PRSNT_M2C_L"           LOC = "AD9";    ## H2  on J63
##
## NET "FPGA_CCLK"                  LOC = "K8";     ## SEE NET "FLASH_NN" GROUP
NET "FPGA_DONE"                     LOC = "R8";     ## 2   on "DONE" LED DS13
NET "FPGA_DX_N"                     LOC = "W17";    ## 4   on J35
NET "FPGA_DX_P"                     LOC = "W18";    ## 2   on J35
## NET "FPGA_FCS_B"                 LOC = "Y24";    ## SEE NET "FLASH_NN" GROUP
## NET "FPGA_FOE_B"                 LOC = "AA24";   ## SEE NET "FLASH_NN" GROUP
## NET "FPGA_FWE_B"                 LOC = "AF23";   ## SEE NET "FLASH_NN" GROUP
##
NET "FPGA_INIT_B"                   LOC = "P8";     ## 1   on Q14 ("INIT" LED DS31 driver)
```

```
NET "FPGA_M0"                   LOC = "U8";     ## 3   on  S2 DIP switch (active-High)
NET "FPGA_M1"                   LOC = "W8";     ## 4   on  S2 DIP switch (active-High)
NET "FPGA_M2"                   LOC = "V8";     ## 4   on  S2 DIP switch (active-High)
NET "FPGA_PROG_B"               LOC = "L8";     ## 1   on SW4 pushbutton (active-Low)
NET "FPGA_TCK"                  LOC = "AE8";    ## 80  on U19
NET "FPGA_TDI"                  LOC = "AD8";    ## 82  on U19
NET "FPGA_TMS"                  LOC = "AF8";    ## 85  on U19
NET "FPGA_VBATT"                LOC = "N8";     ## 1   on B1 (battery + terminal)
##
NET "GPIO_DIP_SW1"              LOC = "D22";    ## 1   on SW1 DIP switch (active-High)
NET "GPIO_DIP_SW2"              LOC = "C22";    ## 2   on SW1 DIP switch (active-High)
NET "GPIO_DIP_SW3"              LOC = "L21";    ## 3   on SW1 DIP switch (active-High)
NET "GPIO_DIP_SW4"              LOC = "L20";    ## 4   on SW1 DIP switch (active-High)
NET "GPIO_DIP_SW5"              LOC = "C18";    ## 5   on SW1 DIP switch (active-High)
NET "GPIO_DIP_SW6"              LOC = "B18";    ## 6   on SW1 DIP switch (active-High)
NET "GPIO_DIP_SW7"              LOC = "K22";    ## 7   on SW1 DIP switch (active-High)
NET "GPIO_DIP_SW8"              LOC = "K21";    ## 8   on SW1 DIP switch (active-High)
##
NET "GPIO_LED_0"                LOC = "AC22";   ## 2   on LED DS12, 1 on J62
NET "GPIO_LED_1"                LOC = "AC24";   ## 2   on LED DS11, 2 on J62
NET "GPIO_LED_2"                LOC = "AE22";   ## 2   on LED DS9,  3 on J62
NET "GPIO_LED_3"                LOC = "AE23";   ## 2   on LED DS10, 4 on J62
NET "GPIO_LED_4"                LOC = "AB23";   ## 2   on LED DS15, 5 on J62
NET "GPIO_LED_5"                LOC = "AG23";   ## 2   on LED DS14, 6 on J62
NET "GPIO_LED_6"                LOC = "AE24";   ## 2   on LED DS22, 7 on J62
NET "GPIO_LED_7"                LOC = "AD24";   ## 2   on LED DS21, 8 on J62
##
NET "GPIO_LED_C"                LOC = "AP24";   ## 2   on LED DS16
NET "GPIO_LED_E"                LOC = "AE21";   ## 2   on LED DS19
NET "GPIO_LED_N"                LOC = "AH27";   ## 2   on LED DS20
NET "GPIO_LED_S"                LOC = "AH28";   ## 2   on LED DS18
NET "GPIO_LED_W"                LOC = "AD21";   ## 2   on LED DS17
##
NET "GPIO_SW_C"                 LOC = "G26";    ## 2   on SW9 pushbutton (active-High)
NET "GPIO_SW_E"                 LOC = "G17";    ## 2   on SW7 pushbutton (active-High)
NET "GPIO_SW_N"                 LOC = "A19";    ## 2   on SW5 pushbutton (active-High)
NET "GPIO_SW_S"                 LOC = "A18";    ## 2   on SW6 pushbutton (active-High)
NET "GPIO_SW_W"                 LOC = "H17";    ## 2   on SW8 pushbutton (active-High)
##
NET "IIC_SCL_DVI"               LOC = "AN10";   ## 2   on Q5, 15 on U38
NET "IIC_SCL_MAIN_LS"           LOC = "AK9";    ## 2   on Q19
NET "IIC_SCL_SFP"               LOC = "AA34";   ## 2   on Q23
NET "IIC_SDA_DVI"               LOC = "AP10";   ## 2   on Q6, 14 on U38
NET "IIC_SDA_MAIN_LS"           LOC = "AE9";    ## 2   on Q20
NET "IIC_SDA_SFP"               LOC = "AA33";   ## 2   on Q21
##
NET "LCD_DB4_LS"                LOC = "AD14";   ## 4   on J41
NET "LCD_DB5_LS"                LOC = "AK11";   ## 3   on J41
NET "LCD_DB6_LS"                LOC = "AJ11";   ## 2   on J41
NET "LCD_DB7_LS"                LOC = "AE12";   ## 1   on J41
NET "LCD_E_LS"                  LOC = "AK12";   ## 9   on J41
NET "LCD_RS_LS"                 LOC = "T28";    ## 11  on J41
NET "LCD_RW_LS"                 LOC = "AC14";   ## 10  on J41
##
NET "P30_CS_SEL"                LOC = "AJ12";   ## 2   on S2 DIP switch (active-High),1 on U10
##
NET "PCIE_100M_MGT0_N"          LOC = "P5";     ## 15  on U14
NET "PCIE_100M_MGT0_P"          LOC = "P6";     ## 16  on U14
NET "PCIE_250M_MGT1_N"          LOC = "V5";     ## 18  on U9
NET "PCIE_250M_MGT1_P"          LOC = "V6";     ## 17  on U9
NET "PCIE_PERST_B_LS"           LOC = "AE13";   ## 4   on U32
NET "PCIE_RX0_N"                LOC = "J4";     ## B15 on P1
NET "PCIE_RX0_P"                LOC = "J3";     ## B14 on P1
NET "PCIE_RX1_N"                LOC = "K6";     ## B20 on P1
NET "PCIE_RX1_P"                LOC = "K5";     ## B19 on P1
```

```
NET "PCIE_RX2_N"                LOC = "L4";     ## B24 on P1
NET "PCIE_RX2_P"                LOC = "L3";     ## B23 on P1
NET "PCIE_RX3_N"                LOC = "N4";     ## B28 on P1
NET "PCIE_RX3_P"                LOC = "N3";     ## B27 on P1
NET "PCIE_RX4_N"                LOC = "R4";     ## B34 on P1
NET "PCIE_RX4_P"                LOC = "R3";     ## B33 on P1
NET "PCIE_RX5_N"                LOC = "U4";     ## B38 on P1
NET "PCIE_RX5_P"                LOC = "U3";     ## B37 on P1
NET "PCIE_RX6_N"                LOC = "W4";     ## B42 on P1
NET "PCIE_RX6_P"                LOC = "W3";     ## B41 on P1
NET "PCIE_RX7_N"                LOC = "AA4";    ## B46 on P1
NET "PCIE_RX7_P"                LOC = "AA3";    ## B45 on P1
NET "PCIE_TX0_N"                LOC = "F2";     ## A17 on P1
NET "PCIE_TX0_P"                LOC = "F1";     ## A16 on P1
NET "PCIE_TX1_N"                LOC = "H2";     ## A22 on P1
NET "PCIE_TX1_P"                LOC = "H1";     ## A21 on P1
NET "PCIE_TX2_N"                LOC = "K2";     ## A26 on P1
NET "PCIE_TX2_P"                LOC = "K1";     ## A25 on P1
NET "PCIE_TX3_N"                LOC = "M2";     ## A30 on P1
NET "PCIE_TX3_P"                LOC = "M1";     ## A29 on P1
NET "PCIE_TX4_N"                LOC = "P2";     ## A36 on P1
NET "PCIE_TX4_P"                LOC = "P1";     ## A35 on P1
NET "PCIE_TX5_N"                LOC = "T2";     ## A40 on P1
NET "PCIE_TX5_P"                LOC = "T1";     ## A39 on P1
NET "PCIE_TX6_N"                LOC = "V2";     ## A44 on P1
NET "PCIE_TX6_P"                LOC = "V1";     ## A43 on P1
NET "PCIE_TX7_N"                LOC = "Y2";     ## A48 on P1
NET "PCIE_TX7_P"                LOC = "Y1";     ## A47 on P1
NET "PCIE_WAKE_B_LS"            LOC = "AD22";   ## B11 on P1
##
NET "PHY_COL"                   LOC = "AK13";   ## 114 on U80
NET "PHY_CRS"                   LOC = "AL13";   ## 115 on U80
NET "PHY_INT"                   LOC = "AH14";   ## 32  on U80
NET "PHY_MDC"                   LOC = "AP14";   ## 35  on U80
NET "PHY_MDIO"                  LOC = "AN14";   ## 33  on U80
NET "PHY_RESET"                 LOC = "AH13";   ## 36  on U80
NET "PHY_RXCLK"                 LOC = "AP11";   ## 7   on U80
NET "PHY_RXCTL_RXDV"            LOC = "AM13";   ## 4   on U80
NET "PHY_RXD0"                  LOC = "AN13";   ## 3   on U80
NET "PHY_RXD1"                  LOC = "AF14";   ## 128 on U80
NET "PHY_RXD2"                  LOC = "AE14";   ## 126 on U80
NET "PHY_RXD3"                  LOC = "AN12";   ## 125 on U80
NET "PHY_RXD4"                  LOC = "AM12";   ## 124 on U80
NET "PHY_RXD5"                  LOC = "AD11";   ## 123 on U80
NET "PHY_RXD6"                  LOC = "AC12";   ## 121 on U80
NET "PHY_RXD7"                  LOC = "AC13";   ## 120 on U80
NET "PHY_RXER"                  LOC = "AG12";   ## 9   on U80
NET "PHY_TXCLK"                 LOC = "AD12";   ## 10  on U80
NET "PHY_TXCTL_TXEN"            LOC = "AJ10";   ## 16  on U80
NET "PHY_TXC_GTXCLK"            LOC = "AH12";   ## 14  on U80
NET "PHY_TXD0"                  LOC = "AM11";   ## 18  on U80
NET "PHY_TXD1"                  LOC = "AL11";   ## 19  on U80
NET "PHY_TXD2"                  LOC = "AG10";   ## 20  on U80
NET "PHY_TXD3"                  LOC = "AG11";   ## 24  on U80
NET "PHY_TXD4"                  LOC = "AL10";   ## 25  on U80
NET "PHY_TXD5"                  LOC = "AM10";   ## 26  on U80
NET "PHY_TXD6"                  LOC = "AE11";   ## 28  on U80
NET "PHY_TXD7"                  LOC = "AF11";   ## 29  on U80
NET "PHY_TXER"                  LOC = "AH10";   ## 13  on U80
##
## NET "PLATFLASH_L_B"           LOC = "AC23";   ## SEE NET "FLASH_NN" GROUP
##
NET "PMBUS_ALERT_LS"            LOC = "AH9";    ## 2   on Q15
NET "PMBUS_CLK_LS"              LOC = "AC10";   ## 2   on Q18
NET "PMBUS_CTRL_LS"             LOC = "AJ9";    ## 2   on Q16
```

```
NET "PMBUS_DATA_LS"                LOC = "AB10";   ## 2   on Q17
##
NET "SFP_LOS"                      LOC = "V23";    ## 8   on P4
NET "SFP_RX_N"                     LOC = "E4";     ## 12  on P4
NET "SFP_RX_P"                     LOC = "E3";     ## 13  on P4
NET "SFP_TX_DISABLE_FPGA"          LOC = "AP12";   ## 1   on Q22
NET "SFP_TX_N"                     LOC = "C4";     ## 19  on P4
NET "SFP_TX_P"                     LOC = "C3";     ## 18  on P4
##
NET "SGMIICLK_QO_N"                LOC = "H5";     ## 2   on series C55 0.1uF
NET "SGMIICLK_QO_P"                LOC = "H6";     ## 2   on series C56 0.1uF
NET "SGMII_RX_N"                   LOC = "B6";     ## 1   on series C163 0.01uF
NET "SGMII_RX_P"                   LOC = "B5";     ## 1   on series C162 0.01uF
NET "SGMII_TX_N"                   LOC = "A4";     ## 1   on series C164 0.01uF
NET "SGMII_TX_P"                   LOC = "A3";     ## 1   on series C165 0.01uF
##
NET "SMA_REFCLK_N"                 LOC = "F5";     ## 1   on series C61 0.1uF
NET "SMA_REFCLK_P"                 LOC = "F6";     ## 1   on series C62 0.1uF
NET "SMA_RX_N"                     LOC = "D6";     ## 1   on series C57 0.1uF
NET "SMA_RX_P"                     LOC = "D5";     ## 1   on series C58 0.1uF
NET "SMA_TX_N"                     LOC = "B2";     ## 1   on J27 SMA
NET "SMA_TX_P"                     LOC = "B1";     ## 1   on J26 SMA
##
NET "SM_FAN_PWM"                   LOC = "L10";    ## 1   on Q24
NET "SM_FAN_TACH"                  LOC = "M10";    ## 2   on R368
##
NET "SYSACE_CFGTDI"                LOC = "AC8";    ## 81  on U19
NET "SYSACE_D0"                    LOC = "AM15";   ## 66  on U19
NET "SYSACE_D1"                    LOC = "AJ17";   ## 65  on U19
NET "SYSACE_D2"                    LOC = "AJ16";   ## 63  on U19
NET "SYSACE_D3"                    LOC = "AP16";   ## 62  on U19
NET "SYSACE_D4"                    LOC = "AG16";   ## 61  on U19
NET "SYSACE_D5"                    LOC = "AH15";   ## 60  on U19
NET "SYSACE_D6"                    LOC = "AF16";   ## 59  on U19
NET "SYSACE_D7"                    LOC = "AN15";   ## 58  on U19
NET "SYSACE_MPA00"                 LOC = "AC15";   ## 70  on U19
NET "SYSACE_MPA01"                 LOC = "AP15";   ## 69  on U19
NET "SYSACE_MPA02"                 LOC = "AG17";   ## 68  on U19
NET "SYSACE_MPA03"                 LOC = "AH17";   ## 67  on U19
NET "SYSACE_MPA04"                 LOC = "AG15";   ## 45  on U19
NET "SYSACE_MPA05"                 LOC = "AF15";   ## 44  on U19
NET "SYSACE_MPA06"                 LOC = "AK14";   ## 43  on U19
NET "SYSACE_MPBRDY"                LOC = "AJ15";   ## 39  on U19
NET "SYSACE_MPCE"                  LOC = "AJ14";   ## 42  on U19
NET "SYSACE_MPIRQ"                 LOC = "L9";     ## 41  on U19
NET "SYSACE_MPOE"                  LOC = "AL15";   ## 77  on U19
NET "SYSACE_MPWE"                  LOC = "AL14";   ## 76  on U19
##
NET "SYSCLK_N"                     LOC = "H9";     ## 5   on U11, 5 on U89 (DNP)
NET "SYSCLK_P"                     LOC = "J9";     ## 4   on U11, 4 on U89 (DNP)
##
NET "USB_1_CTS"                    LOC = "T24";    ## 22  on U34
NET "USB_1_RTS"                    LOC = "T23";    ## 23  on U34
NET "USB_1_RX"                     LOC = "J25";    ## 24  on U34
NET "USB_1_TX"                     LOC = "J24";    ## 25  on U34
##
NET "USB_A0_LS"                    LOC = "Y32";    ## 14  on U30
NET "USB_A1_LS"                    LOC = "W26";    ## 2   on U29
NET "USB_CS_B_LS"                  LOC = "W27";    ## 18  on U29
NET "USB_D0_LS"                    LOC = "R33";    ## 8   on U31
NET "USB_D1_LS"                    LOC = "R34";    ## 14  on U31
NET "USB_D2_LS"                    LOC = "T30";    ## 6   on U31
NET "USB_D3_LS"                    LOC = "T31";    ## 16  on U31
NET "USB_D4_LS"                    LOC = "T29";    ## 4   on U31
NET "USB_D5_LS"                    LOC = "V28";    ## 18  on U31
```

```
NET "USB_D6_LS"                 LOC = "V27";    ## 2   on U31
NET "USB_D7_LS"                 LOC = "U25";    ## 12  on U30
NET "USB_D8_LS"                 LOC = "Y28";    ## 14  on U29
NET "USB_D9_LS"                 LOC = "W32";    ## 8   on U29
NET "USB_D10_LS"                LOC = "W31";    ## 12  on U29
NET "USB_D11_LS"                LOC = "Y29";    ## 2   on U30
NET "USB_D12_LS"                LOC = "W29";    ## 18  on U30
NET "USB_D13_LS"                LOC = "Y34";    ## 4   on U30
NET "USB_D14_LS"                LOC = "Y33";    ## 16  on U30
NET "USB_D15_LS"                LOC = "Y31";    ## 6   on U30
NET "USB_INT_LS"                LOC = "Y27";    ## 6   on U29
NET "USB_RD_B_LS"               LOC = "W25";    ## 16  on U29
NET "USB_RESET_B_LS"            LOC = "T25";    ## 8   on U30
NET "USB_WR_B_LS"               LOC = "V25";    ## 4   on U29
##
NET "USER_CLOCK"                LOC = "U23";    ## 5   on X5
NET "USER_SMA_CLOCK_N"          LOC = "M22";    ## 1   on J55 SMA
NET "USER_SMA_CLOCK_P"          LOC = "L23";    ## 1   on J58 SMA
NET "USER_SMA_GPIO_N"           LOC = "W34";    ## 1   on J56 SMA
NET "USER_SMA_GPIO_P"           LOC = "V34";    ## 1   on J57 SMA
##
NET "VAUX_CURR_N"               LOC = "P26";    ## 1   on series R373 1.00K
NET "VAUX_CURR_P"               LOC = "P25";    ## 1   on series R370 1.00K
NET "VAUX_VOLT_N"               LOC = "M28";    ## 1   on series R371 1.00K
NET "VAUX_VOLT_P"               LOC = "L28";    ## 1   on series R372 1.00K
```

Appendix D

References

This section provides references to documentation supporting Virtex-6 FPGAs, tools, and IP. For additional information, see www.xilinx.com/support/documentation/index.htm.

Documents supporting the ML605 Evaluation Board:

1. UG535, *ML605 Reference Design User Guide*
2. UG525, *Getting Started with the Xilinx Virtex-6 FPGA ML605 Evaluation Kit*
3. DS150, *Virtex-6 Family Overview*
4. DS152, *Viretx-6 FPGA Data Sheet: DC and Switching Characteristics*
5. UG360, *Virtex-6 FPGA Configuration User Guide*
6. UG406, *Virtex-6 FPGA Memory Interface Solutions User Guide*
7. UG361, *Virtex-6 FPGA SelectIO Resources User Guide*
8. UG362, *Virtex-6 FPGA User Guide: Clocking Resources*
9. UG363, *Virtex-6 FPGA Memory Resources User Guide*
10. UG364, *Virtex-6 FPGA Configurable Logic Block User Guide*
11. UG365, *Virtex-6 FPGA Packaging and Pinout Specifications*
12. UG366, *Virtex-6 FPGA GTX Transceivers User Guide*
13. UG369, *Virtex-6 FPGA DSP48E1 Slice User Guide*
14. DS186, *Virtex-6 FPGA Memory Interface Solutions Data Sheet*
15. UG370, *Virtex-6 FPGA System Monitor User Guide*
16. DS715, *Virtex-6 FPGA Integrated Block v1.2 for PCI Express Data Sheet*
17. DS617, *Platform Flash XL High-Density Configuration and Storage Device Data Sheet*
18. DS080, *System ACE CompactFlash Solution Data Sheet*
19. UG138, *LogiCORE™ IP Tri-Mode Ethernet MAC v4.2 User Guide*
20. DS581, *XPS External Peripheral Controller (EPC) v1.02a Data Sheet*
21. DS606, *XPS IIC Bus Interface (v2.00a) Data Sheet*

Additional documentation:

22. Micron Technology, Inc., *DDR3 SODIMM Specification* (MT4JSF6464HY-1G1)
23. Winbond, *Serial Flash Memory Data Sheet* (W25Q64VSFIG)
24. Numonyx, *Embedded Flash Memory Data Sheet* (TE28F128J3D-75)
25. Epson Toyocom, *Oscillator Data Sheet* (EG-2121CA-200.0000M-LHPA)
26. MMD Components, *MBH Series Data Sheet* (MBH2100H-66.000 MHz)
27. PCI SIG, *PCI Express Specifications*
28. Marvell, *Alaska Gigabit Ethernet Transceivers Product Page*
29. Cypress Semiconductor, *CY7C67300 Data Sheet*
30. USB Implementers Forum, Inc., *USB Specifications*
31. ST Micro, *M24C08 Data Sheet*
32. Samtec, Inc.