FMC XM101 LVDS QSE Card User Guide

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Revision History

The following table shows the revision history for this document.

Date	Version	Revision
03/30/10	1.0	Initial Xilinx release.
09/24/10	1.1	Updated note about FMC cards in Table 1-1.

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About This Guide

This document describes the FPGA Mezzanine Card (FMC) XM101 LVDS QSE card, referred to as the *XM101* in this guide. Xilinx® supported evaluation (carrier) boards are referred to simply as *boards* in this guide.

Guide Contents

This manual contains the following chapter:

- Chapter 1, XM101.

Additional Documentation

Prior to using the XM101, users should be familiar with Xilinx resources. See the following locations for additional documentation on Xilinx tools and solutions:

- ISE® Design Suite: www.xilinx.com/ise
- Answer Browser: www.xilinx.com/support
- Intellectual Property: www.xilinx.com/ipcenter

Information about the latest *VITA 57 FMC Specification* is located at:

- www.vita.com/fmc.html

The XM101 can be used with Xilinx FMC high pin count (HPC) boards and, with limited functionality, FMC low pin count (LPC) boards. Board documentation, schematics and PCB design files are available at www.xilinx.com/fmc.

Additional Support Resources

To find additional documentation, see the Xilinx website at:

www.xilinx.com/support/documentation/index.htm

To search the Answer Database of silicon, software, and IP questions and answers, or to create a technical support WebCase, see the Xilinx website at:

www.xilinx.com/support/mysupport.htm

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Chapter 1

XM101

Overview

This document describes the FPGA Mezzanine Card (FMC) XM101 LVDS QSE card, referred to as the *XM101* in this guide. A Quick Start section and XM101 Board Technical Description are combined within this document.

Quick Start

System Requirements

Hardware

Table 1-1 details the board validated to support the XM101. The ML605 board provides one FMC high pin count (HPC) (J64) and one FMC low pin count (LPC) (J63) connector interface. The XM101 connector must be installed on the HPC J64 connector of the ML605 board to have full functionality, as shown in Figure 1-1, page 9.

Table 1-1: **FMC Supported Boards**

Xilinx Platform	Part Number	FMC HPC Connector	FMC LPC Connector
Virtex-6 FPGA ML605 Evaluation Kit	EK-V6-ML605-G	J64	J63

Notes:

While every effort has been made to comply with the *FPGA Mezzanine Card Specification*, Xilinx cannot claim nor assume full compliance with the FMC/VITA-57-1 specification. Consequently, Xilinx cannot claim nor support the usage of the XM101 on any other FMC (VITA-57.1) board.

Xilinx FMC cards are generally designed to implement expanded functionality for supported Xilinx evaluation boards (SP601, SP605, or ML605) and thus might exceed the FMC card outline dimensions discussed in the Single Width FMC Module Mechanical section of the FMC/VITA-57-1 specification. Therefore, Xilinx FMC cards might not physically fit in a non-Xilinx evaluation board environment.

The XM101 can work on LPC FMC interfaces, but with limited functionality. Xilinx boards containing LPC connectors are supported as follows:

- ML605 J63 - LA[00:33], CLK0_M2C_P/N (Si570 U1), CLK1_M2C_P/N (SMA J2/J3)
- SP605 J2 - LA[00:33], CLK0_M2C_P/N (Si570 U1), CLK1_M2C_P/N (SMA J2/J3)
- SP601 J1 - LA[00:33], CLK0_M2C_P/N (Si570 U1), CLK1_M2C_P/N (SMA J2/J3)

Software

Example designs that use this hardware are not provided.

Package Contents

The following items are included in the XM101 shipment:

- XM101 card
- Four (4) mounting screws
- Two (2) standoffs
- One (1) Samtec EQDP-028-12.00-TEU-TED-1 28-pair 12 inch loopback cable
- Welcome letter

Necessary Equipment

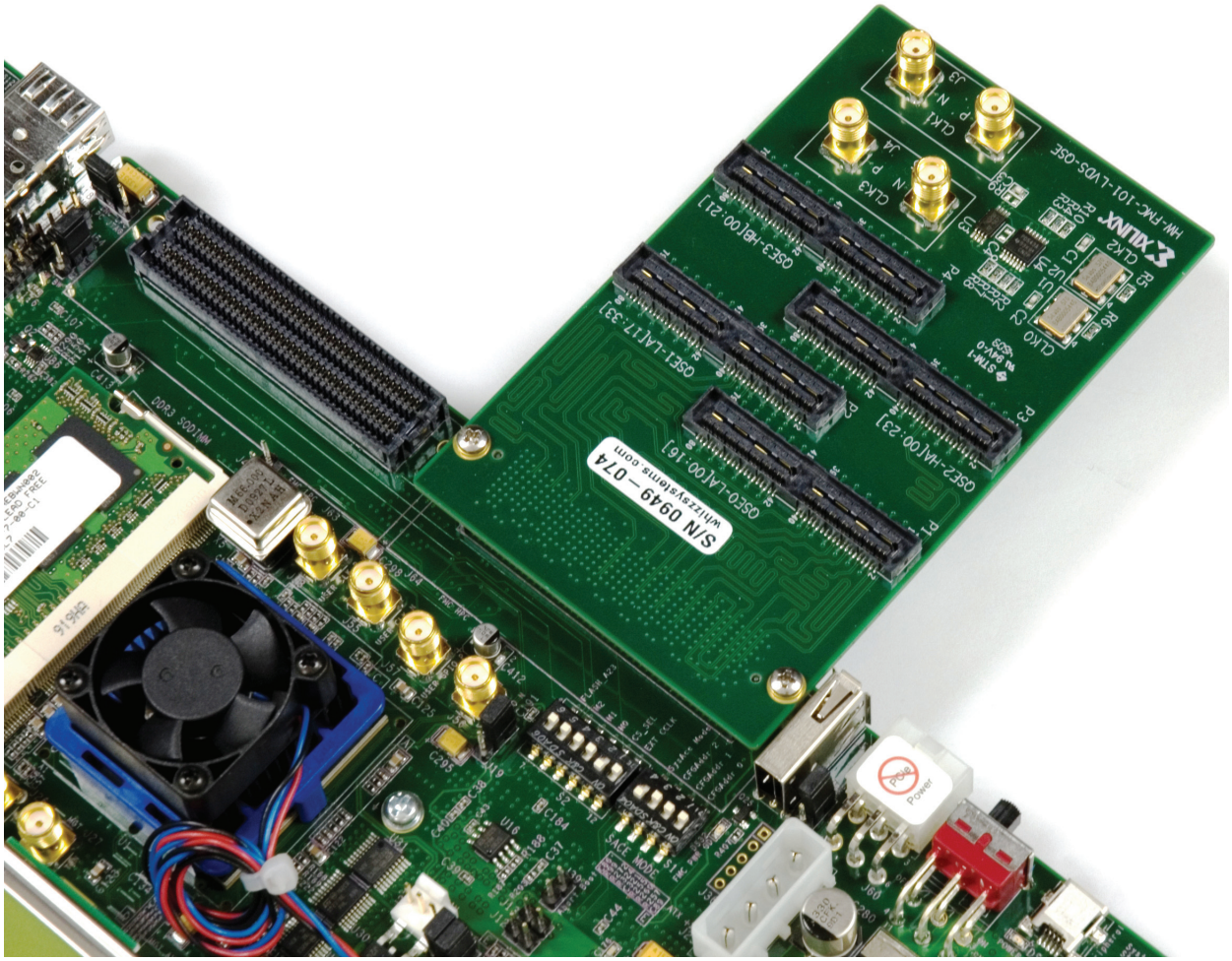
- Small Phillips screwdriver to secure the XM101 to the board
- PC with Internet access to download documentation, board files, and schematics

System Setup

Complete the following steps to install the XM101 to a Xilinx board. For additional information on Xilinx boards, refer to the particular board's user guide. See Additional Documentation, page 5.

1. Turn off the ML605 board's DC power switch and disconnect its input power source.
2. Remove the XM101 from the electrostatic device (ESD) bag.
3. Using a small Phillips screwdriver, remove the two screws from the bottom side of the two standoffs on the XM101.
4. Install the XM101 to the ML605 FMC HPC connector J64. The XM101 hangs off the edge of the ML605 board as shown in Figure 1-1, page 9.
5. Turn the ML605 and attached XM101 board over such that the ML605 FPGA is facing the table. Install two screws from the bottom side of ML605 board's FMC HPC mounting holes into the two standoffs attached to the XM101. Hand tighten the two mounting screws to the bottom of the board.
6. Turn the ML605 and attached XM101 boards over such that the Xilinx FPGA is visible.
7. Connect the input power source to the ML605 board. Turn the ML605 board power input switch to ON.

The system is now ready for use.



UG538_01_011210

Figure 1-1: **Installation of XM101 to ML605 Board FMC HPC Connector**

Technical Support

Xilinx offers technical support for this product *only* when used in conjunction with boards listed in Table 1-1. For assistance with the XM101 and other Xilinx boards, contact Xilinx for technical support at www.xilinx.com/support.

XM101 Board Technical Description

Figure 1-2 shows a block diagram of the XM101.

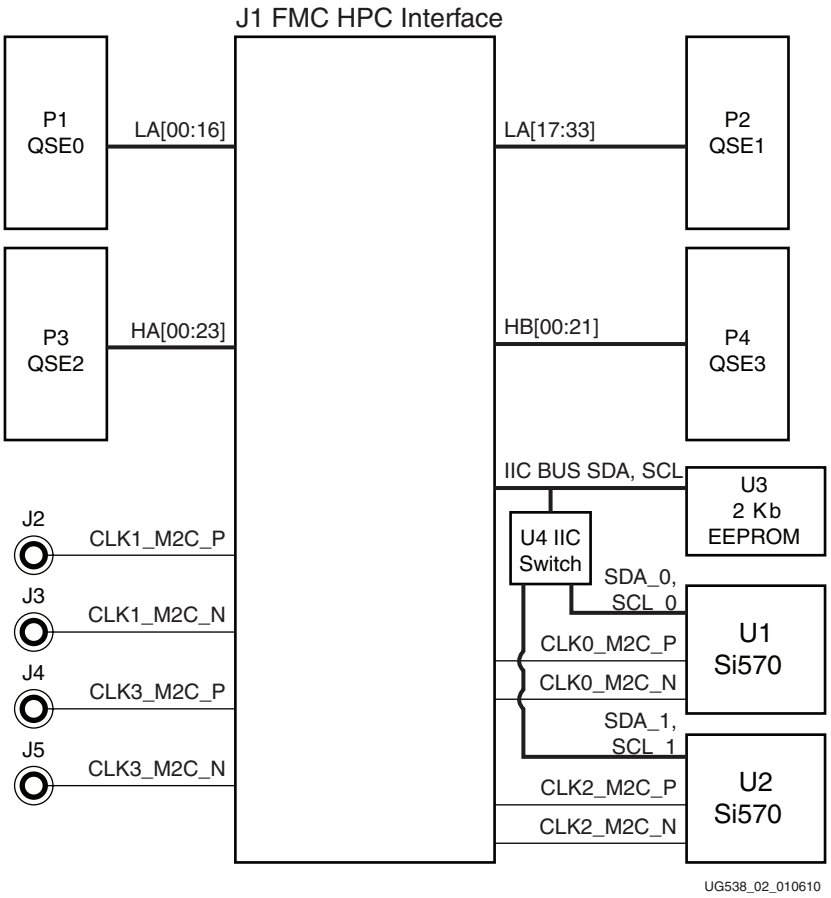


Figure 1-2: **XM101 Block Diagram**

The XM101 provides four Samtec QSE family connectors which break out a subset of the FMC HPC signal set, as shown in Detailed Description, page 11.

The FMC HPC signals are connected as length matched pairs to the QSE connectors. XM101 board users may loop back these pairs using the kit Samtec loopback cable, or create their own unique mezzanine board to plug onto the QSE connectors.

Two Silicon Laboratories Si570 serial IIC bus reprogrammable LVDS clock chips are available.

The Si570 components are connected to an IIC bus switch. The bus switch component connects to the main IIC bus implemented in the FMC HPC interface, enabling the board's FPGA to program the clock circuitry on the XM101.

A 2-Kb serial IIC EEPROM is also connected to the IIC interface of the board, providing non-volatile storage.

Detailed Description

The numbered features in Figure 1-3 correlate to the features and notes listed in Table 1-2, page 12. For full functionality, the XM101 must be installed on a board FMC connector supporting high pin count interfaces.

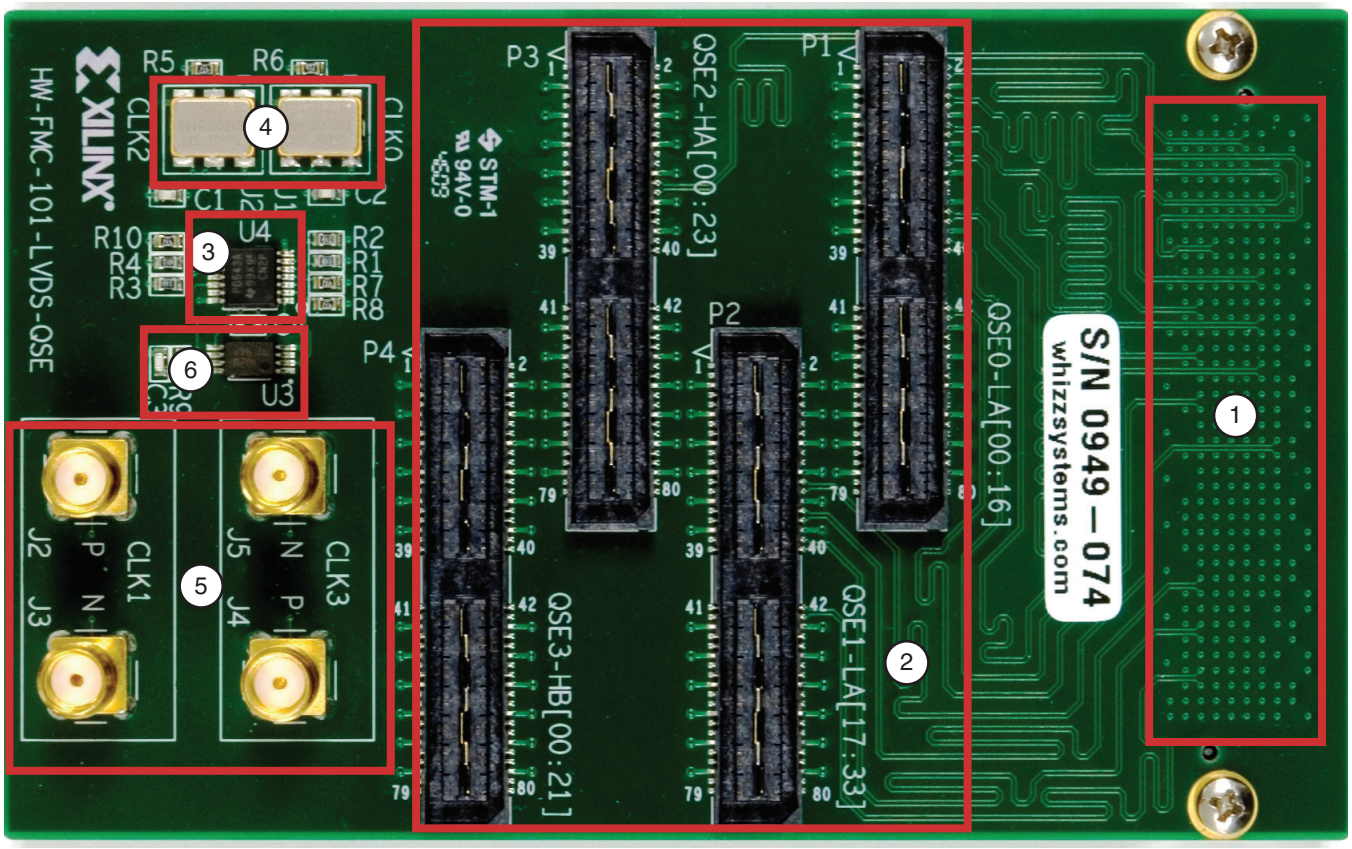


Figure 1-3: **XM101 Features**

Table 1-2: **XM101 Features**

Number	Feature	Notes	Schematic Page
1	VITA 57.1 FMC HPC connector	J1: 80 signal pairs comprised of LA[00:33], HA[00:23] and HB[00:21], four clock pairs, and the IIC bus SDA, SCL. The connector is mounted on the bottom side of the card.	3 - 6
2	Samtec QSE Connectors	P1-P4: 4 Samtec QSE connectors with length-matched signal pairs wired to the FMC HPC connector as follows: P1 QSE0 LA[00:16], P2 QSE1 LA[17:33], P3 QSE2 HA[00:23], P4 QSE3 HB[00:21].	7
3	PCA9543 IIC Bus Switch	U4: IIC bus switch is connected to the main FMC HPC IIC bus SDA and SCL signals. This component can switch its input IIC bus to one of two backside IIC bus connections. Each of the two Si570 clock chips resides on one of these backside IIC buses.	8
4	Silicon Labs Si570 Programmable XO/VCXO	U1, U2: Silicon Labs Si570 IIC serial bus programmable clock source devices with frequency range 10 MHz - 810 MHz. U1 drives signals CLK0_M2C_P/N; U2 drives CLK2_M2C_P/N	8
5	SMA Clock Connections	SMA pair J2 and J3 are connected to CLK1_M2C_P and N, respectively; SMA pair J4 and J5 are connected to CLK3_M2C_P and N, respectively.	8
6	M24C02 2Kb IIC EEPROM	U3: IIC compatible electrically erasable programmable memory (EEPROM) with 2 Kb (256 bytes) of non-volatile storage.	8

1. VITA 57.1 FMC HPC Connector J1

This connector interfaces to the board containing the Xilinx FPGA and mating FMC connector. The XM101 uses Samtec FMC HPC connector part number ASP-134488-01.

See Xilinx board user guides and schematics for a description of features provided by HPC interfaces contained on the board, including power supply specifications, FPGA banking connectivity, and FPGA pin assignments.

- For ML605 LPC and HPC interfaces, see UG534 *ML605 Hardware User Guide*

See the *VITA57.1 Specification* at www.vita.com/fmc.html for additional information on FMC.

2. Samtec QSE Connectors

Four Samtec QSE-028-01-L-D-DP-A low-profile, 28 differential pair connectors (P1–P4) are provided on the XM101 board (Figure 1-4). Traces from the FMC HPC connector to the QSE connectors are length-matched signal pairs.

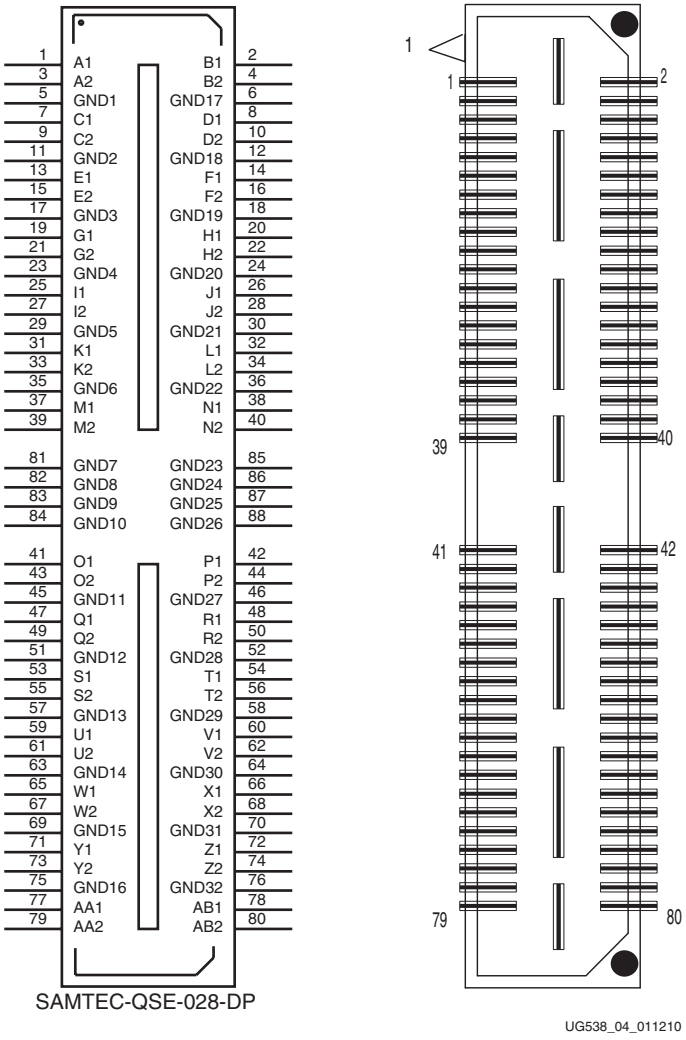


Figure 1-4: **Samtec QSE Connector Schematic Symbol and PCB Layout Footprint**

The P1–P4 QSE to J1 FMC HPC connectivity is show in Table 1-3 through Table 1-6, page 17.

Table 1-3: **P1 QSE0 to J1 FMC HPC Connections**

P1 Odd Side			J1 FMC Connector	P1 Even Side			J1 FMC Connector
Net Name	Pin Number	Pin Name	Pin Number	Net Name	Pin Number	Pin Name	Pin Number
LA02_P	1	A1	H7	LA03_P	2	B1	G9
LA02_N	3	A2	H8	LA03_N	4	B2	G10
LA04_P	7	C1	H10	LA05_P	8	D1	D11
LA04_N	9	C2	H11	LA05_N	10	D2	D12
LA06_P	13	E1	C10	LA07_P	14	F1	H13
LA06_N	15	E2	C11	LA07_N	16	F2	H14
LA08_P	19	G1	G12	LA09_P	20	H1	D14
LA08_N	21	G2	G13	LA09_N	22	H2	D15
LA00_CC_P	25	I1	G6	LA01_CC_P	26	J1	D8
LA00_CC_N	27	I2	G7	LA01_CC_N	28	J2	D9
LA10_P	31	K1	C14	LA11_P	32	L1	H16
LA10_N	33	K2	C15	LA11_N	34	L2	H17
LA12_P	37	M1	G15	LA13_P	38	N1	D17
LA12_N	39	M2	G16	LA13_N	40	N2	D18
LA14_P	41	O1	C18	LA15_P	42	P1	H19
LA14_N	43	O2	C19	LA15_N	44	P2	H20
LA16_P	47	Q1	G18				
LA16_N	49	Q2	G19				

Table 1-4: **P2 QSE1 to J1 FMC HPC Connections**

P2 Odd Side			J1 FMC Connector	P2 Even Side			J1 FMC Connector
Net Name	Pin Number	Pin Name	Pin Number	Net Name	Pin Number	Pin Name	Pin Number
LA19_P	1	A1	H22	LA20_P	2	B1	G21
LA19_N	3	A2	H23	LA20_N	4	B2	G22
LA21_P	7	C1	H25	LA22_P	8	D1	G24
LA21_N	9	C2	H26	LA22_N	10	D2	G25
LA23_P	13	E1	D23	LA24_P	14	F1	H28
LA23_N	15	E2	D24	LA24_N	16	F2	H29
LA25_P	19	G1	G27	LA26_P	20	H1	D26
LA25_N	21	G2	G28	LA26_N	22	H2	D27
LA17_CC_P	25	I1	D20	LA18_CC_P	26	J1	C22
LA17_CC_N	27	I2	D21	LA18_CC_N	28	J2	C23
LA27_P	31	K1	C26	LA28_P	32	L1	H31
LA27_N	33	K2	C27	LA28_N	34	L2	H32
LA29_P	37	M1	G30	LA30_P	38	N1	H34
LA29_N	39	M2	G31	LA30_N	40	N2	H35
LA31_P	41	O1	G33	LA32_P	42	P1	H37
LA31_N	43	O2	G34	LA32_N	44	P2	H38
LA33_P	47	Q1	G36				
LA33_N	49	Q2	G37				

Table 1-5: **P3 QSE2 to J1 FMC HPC Connections**

P3 Odd Side			J1 FMC Connector
Net Name	Pin Number	Pin Name	Pin Number
HA02_P	1	A1	K7
HA02_N	3	A2	K8
HA04_P	7	C1	F7
HA04_N	9	C2	F8
HA06_P	13	E1	K10
HA06_N	15	E2	K11
HA08_P	19	G1	F10
HA08_N	21	G2	F11
HA00_CC_P	25	I1	F4
HA00_CC_N	27	I2	F5
HA10_P	31	K1	K13
HA10_N	33	K2	K14
HA12_P	37	M1	F13
HA12_N	39	M2	F14
HA14_P	41	O1	J15
HA14_N	43	O2	J16
HA16_P	47	Q1	E15
HA16_N	49	Q2	E16
HA18_P	53	S1	J18
HA18_N	55	S2	J19
HA20_P	59	U1	E18
HA20_N	61	U2	E19
HA22_P	65	W1	J21
HA22_N	67	W2	J22

P3 Even Side			J1 FMC Connector
Net Name	Pin Number	Pin Name	Pin Number
HA03_P	2	B1	J6
HA03_N	4	B2	J7
HA05_P	8	D1	E6
HA05_N	10	D2	E7
HA07_P	14	F1	J9
HA07_N	16	F2	J10
HA09_P	20	H1	E9
HA09_N	22	H2	E10
HA01_CC_P	26	J1	E2
HA01_CC_N	28	J2	E3
HA11_P	32	L1	J12
HA11_N	34	L2	J13
HA13_P	38	N1	E12
HA13_N	40	N2	E13
HA15_P	42	P1	F16
HA15_N	44	P2	F17
HA17_CC_P	48	R1	K16
HA17_CC_N	50	R2	K17
HA19_P	54	T1	F19
HA19_N	56	T2	F20
HA21_P	60	V1	K19
HA21_N	62	V2	K20
HA23_P	66	X1	K22
HA23_N	68	X2	K23

Table 1-6: **P4 QSE3 QSE3 to J1 FMC HPC Connections**

P4 Odd Side			J1 FMC Connector
Net Name	Pin Number	Pin Name	Pin Number
HB01_P	1	A1	J24
HB01_N	3	A2	J25
HB03_P	7	C1	E21
HB03_N	9	C2	E22
HB05_P	13	E1	E24
HB05_N	15	E2	E25
HB08_P	19	G1	F28
HB08_N	21	G2	F29
HB00_CC_P	25	I1	K25
HB00_CC_N	27	I2	K26
HB10_P	31	K1	K31
HB10_N	33	K2	K32
HB12_P	37	M1	F31
HB12_N	39	M2	F32
HB14_P	41	O1	K34
HB14_N	43	O2	K35
HB16_P	47	Q1	F34
HB16_N	49	Q2	F35
HB18_P	53	S1	J36
HB18_N	55	S2	J37
HB20_P	59	U1	F37(1)
HB20_N	61	U2	F38(1)

P4 Even Side			J1 FMC Connector
Net Name	Pin Number	Pin Name	Pin Number
HB02_P	2	B1	F22
HB02_N	4	B2	F23
HB04_P	8	D1	F25
HB04_N	10	D2	F26
HB07_P	14	F1	J27
HB07_N	16	F2	J28
HB09_P	20	H1	E27
HB09_N	22	H2	E28
HB06_CC_P	26	J1	K28
HB06_CC_N	28	J2	K29
HB11_P	32	L1	J30
HB11_N	34	L2	J31
HB13_P	38	N1	E30
HB13_N	40	N2	E31
HB15_P	42	P1	J33
HB15_N	44	P2	J34
HB17_CC_P	48	R1	K37
HB17_CC_N	50	R2	K38
HB19_P	54	T1	E33
HB19_N	56	T2	E34
HB21_P	60	V1	E36(1)
HB21_N	62	V2	E37(1)

Notes:

1. The ML605 board FMC HPC connector J64 does not support these signals

3. PCA9543 IIC Bus Switch

The XM101 IIC bus hosts two components, U3 M24C02 2Kb EEPROM and U4 IIC bus switch (Figure 1-5).

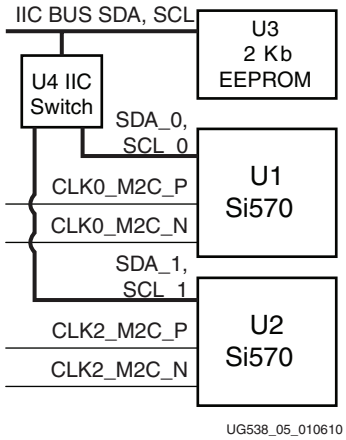


Figure 1-5: **XM101 IIC Bus Topology**

Table 1-7 shows the addresses for the IIC components.

Table 1-7: **IIC Address Table**

Component	Address
M24C02 (U3)	1010_0_GA0_GA1_RW
PCA9543 (U4)	1110_0_GA0_GA1_RW
SI570 (U1)	1011_1_0_1_RW
SI570 (U2)	1011_1_0_1_RW

The IIC bus switch provides bidirectional bus isolation and isolates the fixed addresses of the two Si570 devices from the main IIC bus of the board. The upstream side of the switch connects to the FMC HPC connector. The downstream switch ports interface to the two Silicon Laboratories clock integrated circuits.

The PCA9543 is a bidirectional translating switch, controlled by the upstream board side IIC bus. The PCA9543 must be initialized prior to attempting to communicate with the two Si570 clock circuits on the downstream IIC buses.

The PCA9543 component data sheet contains detailed application information and is available online at www.nxp.com.

The IIC address of this component is controlled by a combination of the board interface and chip enable connections to the component inputs on the XM101. Signals GA0 and GA1 from the board are connected to the two address inputs A1 and A0 of the PCA9543 component. Xilinx boards provide GA0 and GA1 signal strapping to 3.3V and GND signals creating different A0 and A1 address decodes on the PCA9543.

The IIC memory addressing protocol requires a bus master to initiate communication to a peripheral device using a start condition followed by a device select code. The device select code consists of a 4 bit Device Type Identifier and a 3-bit Address (A2, A1 and A0). A2 is internally grounded inside the PCA9543. Bit 0 is used to indicate read/write. The Device Type Identifier for the PCA9543 is 1110 binary. Table 1-8, page 19 defines the generic

PCA9543 Device Select Code as well as specific Device Code Select address when the XM101 is connected to a Xilinx board as defined in Table 1-1, page 7.

Table 1-8: **PCA9543 IIC Switch Device Select Code**

Bit 7:4 Device Type Identifier	Bit 3	Bit 2	Bit 1	Bit 0 LSB	Description
1110	0	GA0	GA1	Read/$\overline{\text{Write}}$	Connected to mezzanine FMC HPC interface

The PCA9543 has a Control register which must be initialized by the IIC bus master to enable the channel 0 downstream IIC port. Channel 0 must be enabled prior to attempting to communicate with the two downstream programmable clock devices on the XM101.

After the IIC bus master enables PCA9543 channel 0 downstream IIC bus, the bus master can communicate directly with either Si570 component without further interaction with the Control register. The Control Register can be read by the IIC bus master. Table 11 defines the PCA9543 Control Register.

Table 1-9: **PCA9543 Control Register**

Bit 7:4	Bit 3:2	Bit 1	Bit 0
XXXX	XX	Channel 1 Enable(1)	Channel 0 Enable(2)

Notes:

1. Channel 1 must be set to a logic 1 state by IIC bus master prior to attempting to communicate with the Si570 U2.
2. Channel 0 must be set to a logic 1 state by IIC bus master prior to attempting to communicate with the Si570 U1.

The two downstream IIC devices connected to the PCA9543 are at the same IIC address:

- Si570 U1 IIC address is at 0x5D, PCA9543 control register bits CR[1:0] = 01
- Si570 U2 IIC address is at 0x5D, PCA9543 control register bits CR[1:0] = 10

The U4 PCA9543 IIC bus switch to J1 FMC HPC connections are shown in Table 1-10.

Table 1-10: **IIC Bus Switch to J1 FMC HPC Connections**

U4 PCA9543 IIC Bus Switch		J1 FMC Connector
Net Name	**Pin Number**	**Pin Number**
SDA	U4.13	C31
SCL	U4.12	C30

4. Silicon Labs Si570 Clock Sources

The Silicon Labs Si570 serial IIC bus programmable clock source provides a low-jitter clock with a user-programmable output frequency from 10 to 810 MHz.

U1 and U2 Si570 are located at IIC address 0x5D and are accessed through the U4 PCA9543 IIC bus switch as described in 3. PCA9543 IIC Bus Switch.

U1 and U2 Si570 components are factory programmed with parameters in Table 1-11.

Table 1-11: **Characteristics of Si570 Component**

Si570 Characteristic	XM101
Output Format	LVDS
Output Enable Polarity	High
Temperature Stability	50 ppm
Frequency Range	10–810 MHz
Six-Digit Startup Frequency	156.250 MHz
Power Supply	3.3V
IIC Address	x5D

For additional information on this component, including reprogramming the clock frequency through the IIC serial bus interface, consult the manufacturer's data sheet at: www.silabs.com.

The U1 and U2 Si570 output clocks to J1 FMC HPC connections are shown in Table 1-12.

Table 1-12: **Si570 to FMC HPC Connections**

Si570		J1 FMC Connector
Net Name	Pin Number	Pin Number
CLK0_M2C_P	U1.4	H4
CLK0_M2C_N	U1.5	H5
CLK2_M2C_P	U2.4	K4
CLK2_M2C_N	U2.5	K5

5. SMA Clock Connections

Four SMA connectors (J2 - J5) are provided on the XM101 board.

The SMA to J1 FMC HPC connections are shown in Table 1-13.

Table 1-13: **SMA to FMC HPC Connections**

SMA		J1 FMC Connector
Net Name	**Pin Number**	**Pin Number**
CLK1_M2C_P	J2.1	G2
CLK1_M2C_N	J3.1	G3
CLK3_M2C_P	J4.1	J2
CLK3_M2C_N	J5.1	J3

6. M24C02 2 Kb IIC EEPROM

An STMicroelectronics M24C02 2 Kb serial IIC bus EEPROM (U3) component provides a small amount of non-volatile memory storage on the XM101. The IIC interface is connected directly to the board's IIC interface as shown in Figure 1-2, page 10.

The IIC address of this component is controlled by a combination of the board's interface and chip enable connections to the component inputs on the XM101. Signals GA0 and GA1 from the board are connected to the chip enable inputs of the M24C02 component enables E0 and E1. Xilinx boards provide GA0 and GA1 signal strapping to 3.3V and GND signals creating different E0 and E1 chip enable decodes on the E1 and E0 inputs of the EEPROM.

The IIC memory addressing protocol requires a bus master to initiate communication to a peripheral device using a start condition followed by a device select code. The device select code consists of a 4 bit Device Type Identifier and a 3-bit Chip Enable Address (E2, E1 and E0). Bit 0 is used to indicate read/write. The Device Type Identifier for the EEPROM is 1010 binary. Table 1-14 defines the generic EEPROM Device Select Code as well as specific Device Code Select addresses of the EEPROM when the XM101 is connected to a Xilinx board defined in Table 1-1, page 7.

Table 1-14: **EEPROM IIC Device Select Code**

Bit 7:4 Device Type Identifier	Bit 3	Bit 2	Bit 1	Bit 0 LSB	Description
1010	0	GA0	GA1	Read/$\overline{\text{Write}}$	Connected to mezzanine FMC HPC interface

The M24C02 component data sheet is available online at www.st.com.