Reference Manual

12G-SDI FMC Card

Revision

B

2017/10/13

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Contents

1. Read This First

1.1 Important Information

READ FIRST:
- Before using this card, be sure to read this Reference Manual.
- Keep this Reference Manual so you can refer to it when necessary.
- You should sufficiently understand the card's configuration before you use it.

Card Application:
- This card is an FPGA Mezzanine Connector (hereafter FMC) daughter card that can be connected to and used with any FMC that complies with FMC standard. Combining with an FPGA evaluation board (hereafter Evaluation board), this card supports the development and verification of software and hardware for 12G-SDI I/O interfaces. Use this card correctly in line with the application.

People Who Are Expected to Use This Card:
- Only people who carefully read and understood this manual and the Getting Started manual should use this card. You need a fundamental understanding of FPGA, logic circuits, electronic circuits, and micro-computers to use this card.

Precautions When Using This Card:
- This card is a development support card used for the purpose of your hardware and software development and evaluation. This card cannot be used in your mass production products. Furthermore, when you want to use the card's sample designs for your products, please be sure to confirm if it withstands practical use at your own risk by doing necessary and sufficient tests and evaluations.
- Macnica Incorporated (hereafter Macnica Inc.) has no liability for any results arising from the use of the card.
- Macnica Inc. will attempt to provide either free or paid support to handle repair of faults or workarounds for faults with the card. This does not mean, however, that Macnica Inc. guarantees to provide a workaround or fix under all circumstances.
- Macnica Inc. cannot anticipate every possible circumstance that might involve a potential hazard. The warnings and precautions in this Reference Manual and on the card are therefore not all-inclusive. You are responsible for using the card correctly and safely.
- Even if there are faults with devices that are mounted on the card, Macnica Inc. will not replace it with a fault-fixed device.
- Each interface is not guaranteed to connect with all products.
- The card will not be replaced if you damaged or modified the card.
- The card uses lead-free parts.
- The rights to the trademarks and registered trademarks of the vendors noted in this manual belong to their respective vendors.

Improvement Policy:

- Macnica Inc. pursues a policy of continuous improvement in design, performance, and safety of the product.

  Macnica Inc. reserves the right to change, wholly or partially, specifications, designs, this Reference Manual, and other documentation at any time, without prior notice to customers.

Warranty:

- Macnica Inc. offers to exchange this card free of charge only in case of initial malfunction noticed by you within 30 days from the delivery.

  Macnica Inc. cannot exchange cards in cases where the malfunction is caused by the following reasons:

  (1) Misuse, abuse of the card or use under abnormal conditions

  (2) Remodeling or repair

  (3) A fire, earthquake, fall or other accidents

Figures:

- Some figures in this manual may differ from your purchased card.

1.2 Developer Information

The Developer of this card is:

Macnica Inc.

1-6-3 Shin-Yokohama, Kouhoku-ku, Yokohama, 222-8561 JAPAN

1.3 Inquiries

In case you have any inquiries about the use of this card, please contact sales office you purchased or make inquiries through the contact form on the following web site.

Inquiries page:

　　　http://www.m-pression.com/contact/inquiry

Inquiries to:

　　　Macnica Inc.

　　　Sales and Planning Advanced Technology

　　　1-5-5 Shin-Yokohama, Kouhoku-ku, Yokohama, 222-8563 JAPAN

　　　TEL: +81-45-470-9838

2. For Ensuring Safe Use

Be sure to follow the instructions given in this Manual which are intended to prevent harm to the user and others as well as material damage.

2.1 Legend

⚠️	**Danger**	Indicates an imminent hazardous situation which if not avoided will result in death or serious injury.
⚠️	**Warning**	Indicates a potentially hazardous situation which if not avoided could result in death or serious injury.
⚠️	**Caution**	Indicates a potentially hazardous situation which if not avoided may result in minor or moderate injury or in property damage.

2.2 Cautions

⚠️	**Danger**	If an AC adapter is needed, be sure to use the AC adapter provided in the package or one that meets the specifications described in this manual. Using an AC adapter not meeting the specifications described in this manual may cause the card to emit heat, explode, or ignite.
⚠️	**Warning**	Do not apply strong impacts or blows to the card. Doing so may cause the card to emit heat, explode, or ignite, or the equipment in the card to fail or malfunction. This may also cause fire.
		Do not put this card or the AC adapter in cooking appliances such as microwave ovens, or high-pressure containers. Doing so might cause this card or AC adapter to emit heat, explode, ignite, or emit smoke, or its parts to break or warp.
		Do not cover or wrap this card that is in use with cloth or other materials that are likely to allow heat to build up inside the wrapping. This will cause heat to build up inside the wrapping which may cause this card to ignite or malfunction.
		When disposing of this card, do not dispose of it along with general household waste. Throwing this card into fire may cause it to explode. Dispose of this card following the laws, regulations, and ordinances governing waste disposal.
		Do not pull the power supply cable with excessive force or place heavy items on it. Do not damage, break, bundle, or tamper with the power supply cable. Damaged parts of the power supply cable might cause a short circuit resulting in fire or accidents involving electrical shock.
		Do not plug or unplug the power plug with wet or moist hands. This might cause injuries or equipment malfunctions or failures due to electrical shock.

		Plug the power plug securely into the outlet. If the power plug is not securely plugged into the outlet, it may cause accidents involving electrical shock or fire due to heat emitted.
⚠️	**Warning** (Continued from previous page)	Do not connect many electrical cords to a single socket or connect an AC adapter to an outlet that is not rated for the specified voltage. Doing so may cause the equipment to malfunction or fail, or lead to accidents involving electrical shock or fire due to heat emitted.
		Periodically remove any dust accumulated on the power plug and around the outlet (socket). Do not use a power plug with dust accumulated on it because doing so will lead to insulation failure due to moisture which may lead to fire. Remove any dust on the power plug and around the outlet with a dry cloth.
		Do not place any containers, such as cups or vases, filled with water or other liquids on the card. If the card is exposed to water or other liquids, it will cause a malfunction or electric shock. If you spilled water or other liquid on this card, immediately stop using the card, turn off the power, and unplug the power plug. If you have any requests for repairs or technical consultation, please contact the sales office you purchased or Mpression inquiry URL.
		Keep the card and accessories out of the reach of children. Failure to do so may lead to injuries.
⚠️	**Caution**	Do not place the card on unstable places such as shaky stands or tilted locations. Doing so may cause injuries or cause this card to malfunction if the card should fall.
		Do not attempt to use or leave the card in places subject to strong direct sunlight or other places subject to high temperatures such as in cars in hot weather. Doing so might cause the card to emit heat, break, ignite, run out of control, warp, or malfunction. Also, some parts of the equipment might emit heat, causing burn injuries.
		Do not use the card in places subject to extremely high or low temperatures or severe temperature changes. Doing so may cause the card to fail or to malfunction. Always be sure to use the card within a temperature range of 5°C to 35°C and a humidity range of 0% to 85%.
		Unplug the power supply when doing maintenance on equipment in which the card is embedded. Failure to do so may lead to accidents involving electrical shock.
		Do not place the card in locations where excessive force might be applied to it. Doing so may cause the printed circuit board to warp, leading to breakage of the printed circuit board, missing parts or malfunctioning parts.

⚠ Caution (Continued from previous page)	When using the card together with expansion boards or other peripheral equipment, be sure to carefully read each of their manuals and to use them correctly. Developer does not guarantee the operation of specific expansion boards or peripheral devices when used in conjunction with this card unless they are specifically mentioned in this Manual or their successful operation with this card has been confirmed in separate documents.
	Turn off the power switch when moving or connecting the card. Failure to do so may cause this card to fail or lead to accidents involving electrical shock.
	Do not clean this card by using a rag containing chemicals such as benzine or thinner. Doing so could degrade the card. When using a chemically treated cloth, comply with its directions and warnings.
	Do not immediately turn on the power if you find that moisture has condensed onto this card after removing it from the box. Condensation may form if the card is cold when moved from the box into a warm room. Turning on the power while there is moisture on the card may cause it to malfunction or shorten the service life of the parts. Allow the card to reach room temperature when you first take it out of the box. If condensation or moisture has occurred on this card, first wait for the moisture to fully evaporate before installing or connecting the card to other equipment.
	Operation of the card cannot be guaranteed if it has been disassembled, dismantled, altered, modified, or rebuilt.

3. Unpacking

While unpacking, check to make sure that all required items are included, and that nothing is damaged.
If something is missing or visibly damaged, contact your sales agent within 30 days after receiving your purchase.

12G-SDI FMC Card: 1	
Hexagonal spacer (diameter of screw: M2.6, length: 37 mm): 4	
Hexagonal spacer (diameter of screw: M2.6, length: 10 mm): 2	
Pan head screw (diameter of screw: M2.6, length: 6 mm): 6	
Jumper cap (pitch: 2.54 mm): 2	
Packing list/precautions (Japanese): 1	
Packing list/precautions (English): 1	
12G-SDI FMC Card Reference Manual	You can download the documents and designs from the URL written in the Packing list.
12G-SDI FMC Card Getting Started	
12G-SDI FMC Card Reference Design	

4. Board Specifications

4.1 Overview

The 12G-SDI FMC Card (hereafter referred to as FMC card) is a daughter card that is expandable to an SDI interface with 4 channels that have multi-rates (SD-SDI/HD-SDI/3G-SDI/6G-SDI/12G-SDI). These expansions are possible by combining Intel's Arria® 10 GX FPGA Development Kit and another FPGA board that is compliant with the FPGA Mezzanine Card (FMC) Standard.

● Quad SDI inputs/outputs, a sync reference input
● Right-angle type BNC connectors are used in an input/output and a sync reference input
● External reference clock for FPGA transceiver can be supplied through an SMP connector

Verification of operation for this FMC card has been completed for Intel's Arria 10 GX FPGA Development Kit. Refer to the following links for detailed information and related details.
・Board information: https://www.altera.com/products/boards_and_kits/dev-kits/altera/kit-a10-gx-fpga.html
・FPGA family information: https://www.altera.com/products/fpga/arria-series/arria-10/overview.html

Refer to the following link regarding the Texas Instrument's SDI devices that are mounted on this FMC card.
・SDI device information: http://www.ti.com/lsds/ti/interface/video-broadcast-professional-overview.page

4.2 Product Specifications

Table 4-1 shows the product specifications for this FMC card.

Table 4-1. Product Specifications

Items	Specifications & parts names
Power Supply	3.3 V, 1.8 V (VADJ), 12 V
External Dimensions	69.0 mm x 154.5 mm
PCB Material/Number of Layers	FR-4/6 layers
SDI Interface	Input x4/output x4/reference input x1
I2C Connector	I2C connector pins for external PC control
SMP Connector	Clock differential input for FPGA internal transceiver x1 Samtec's SMP-PS-P-GF-ST-TH2
FMC Connector	Samtec's ASP-134488-01
BNC Connector (Right Angle Type)	Hirose Electric's BLR-PC-12G
BNC Connector (Straight Type)	Hirose Electric's BNC(75)-BPR-PC-12G
12G-SDI Cable Driver/Reclocker	Texas Instruments' LMH1218
12G-SDI Cable Equalizer/Reclocker	Texas Instruments' LMH1219
Video Clock Generator	Texas Instruments' LMH1983
Ultra-low Jitter Clock Generator	Texas Instruments' LMK03328
SD/HD Video Sync Separator	Texas Instruments' LMH1981

4.3   Block Diagram

Figure 4-1 shows the block diagram of this FMC card.
The values in (I2C : 0x**) in the diagram indicate the I2C control address (7-bit).
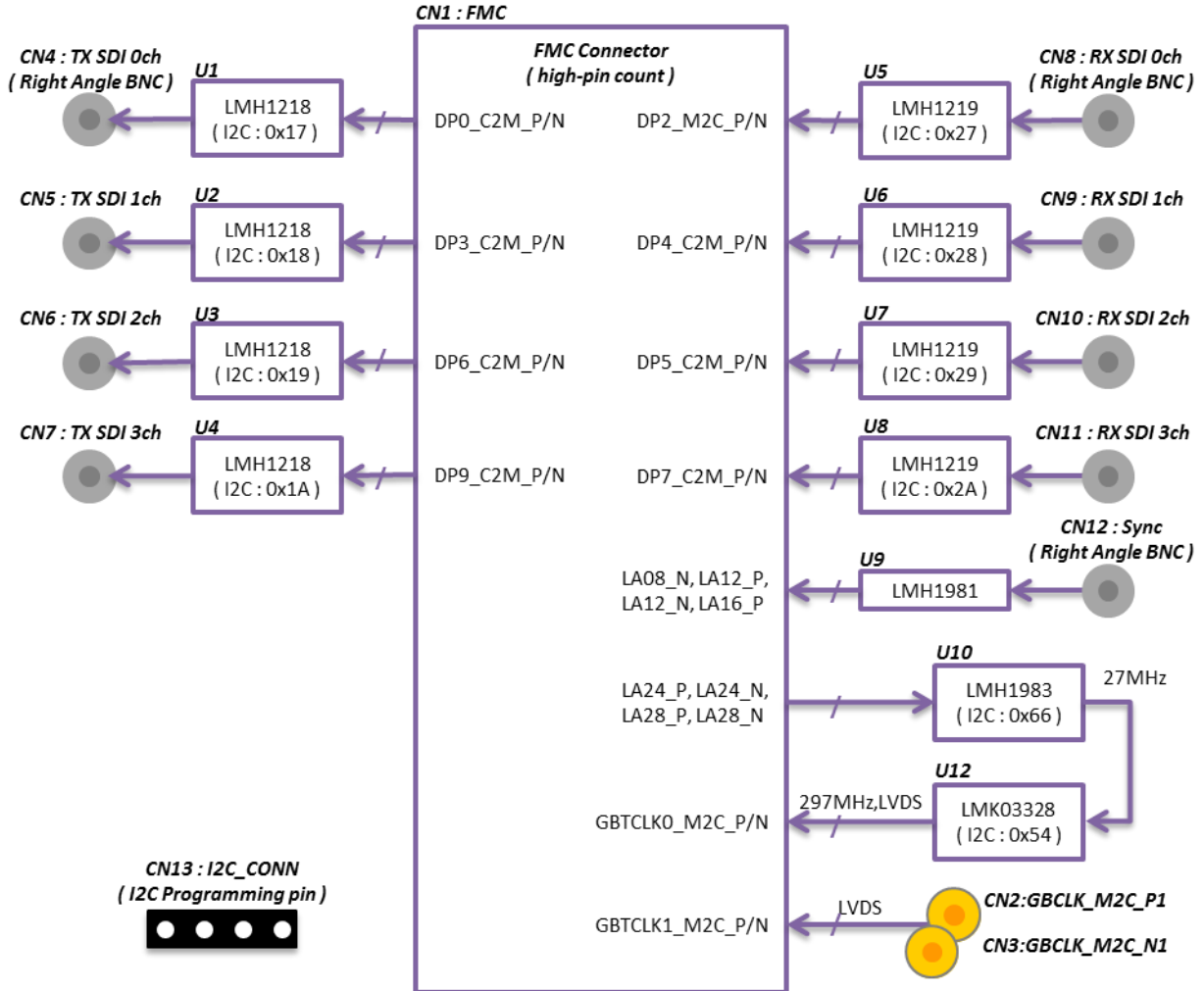

Figure 4-1. Block Diagram

4.4 Components

This section explains the FMC card's major parts, connectors, switches, and LEDs.

4.4.1 About Mounted Parts

Refer to each device data sheet to use the FMC card. It should not be used in nonstandard ways.

Table 4-2. Web Pages on Which Data Sheets Are Posted

Part name	Model	Link to web page
12G-SDI Cable Driver /Reclocker	LMH1218RTWT	http://www.ti.com/product/LMH1218/description
12G-SDI Cable Equalizer /Reclocker	LMH1219RTWT	http://www.ti.com/product/LMH1219/description To get a full data sheet, you need to request the full data sheet from this web page.
Video Clock Generator	LMH1983SQE	http://www.ti.com/product/LMH1983/description
Ultra-low Jitter Clock Generator	LMK03328RHST	http://www.ti.com/product/LMK03328/description
SD/HD Video Sync Separator	LMH1981MTX	http://www.ti.com/product/LMH1981/description

4.4.2 Devices

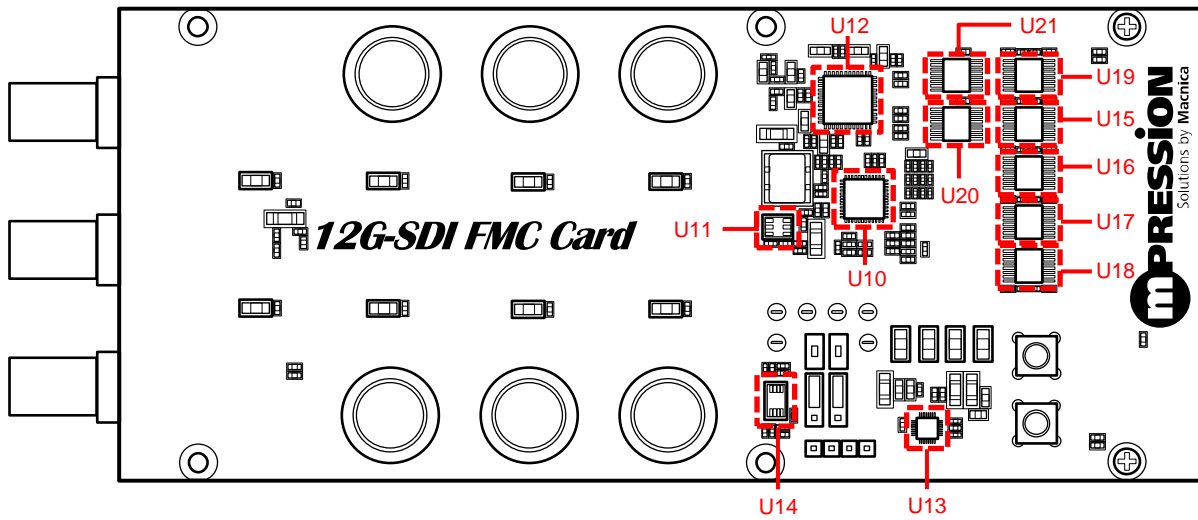Figure 4-2, Figure 4-3, and Table 4-3 show the devices mounted on the FMC card.
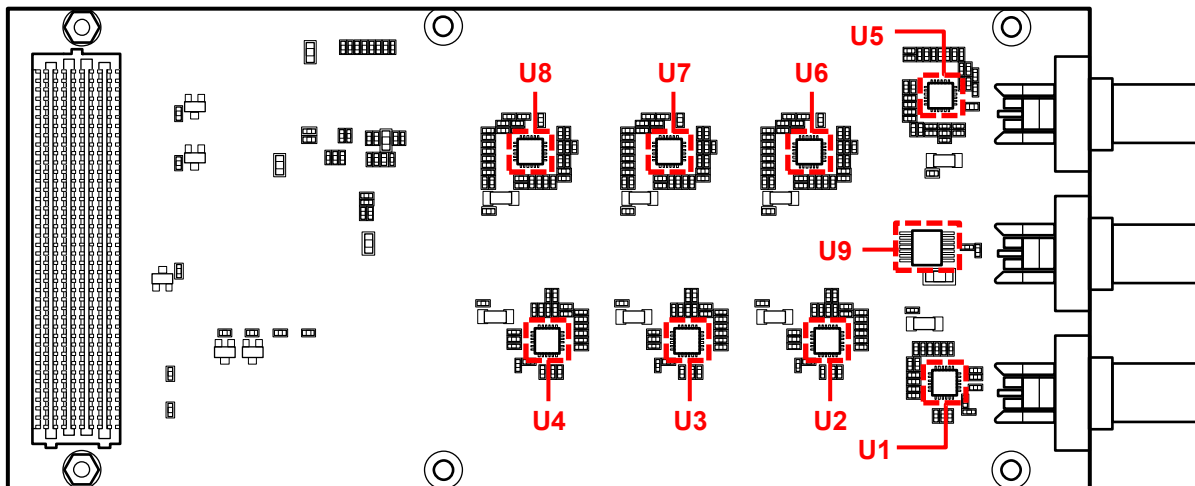

Figure 4-2. Layout of Devices (Top View)

Figure 4-3. Layout of Devices (Bottom View)

Table 4-3. Device Information

Part location	Names of devices	Device functions
U1, U2, U3, U4	LMH1218	Cable Driver/Reclocker
U5, U6, U7, U8	LMH1219	Cable Equalizer/Reclocker
U9	LMH1981	Video Sync Separator
U10	LMH1983	Clock Generator
U11	LMP7711MK	Op Amp
U12	LMK03328	Clock Generator
U13	TPS7A8400RGRT	LDO
U14	PCA9306DCUR	Level Shift
U15,U16,U17,U18,U19	SN74AVC4T245PWR	Level Shift
U20,U21	SN74LVC86APWR	Exclusive-OR Gates

4.4.3　Connectors

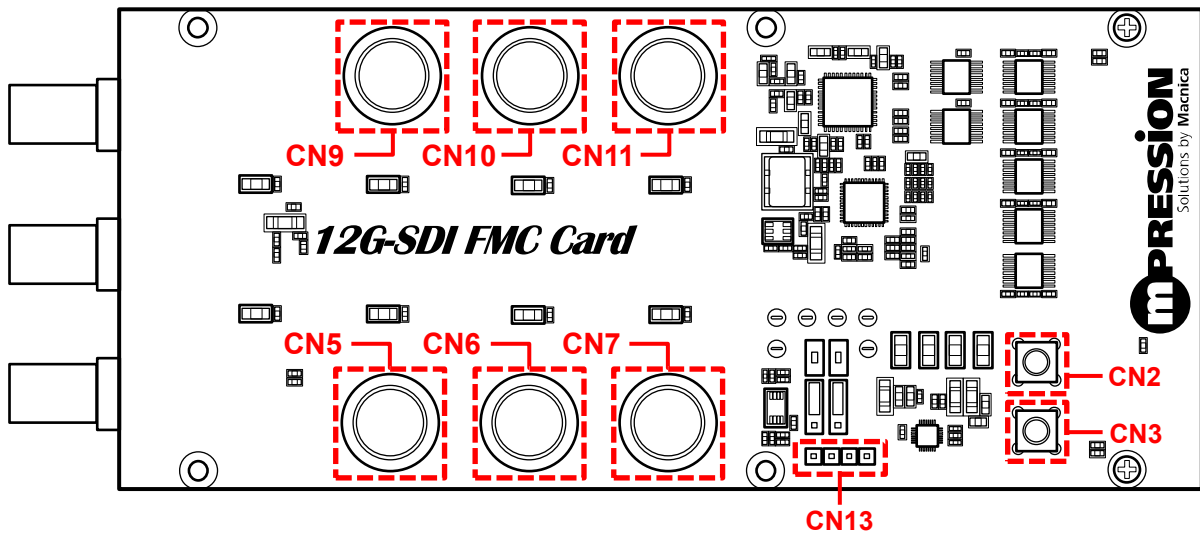Figure 4-4, Figure 4-5, and Table 4-4 show the connectors mounted on the FMC card.
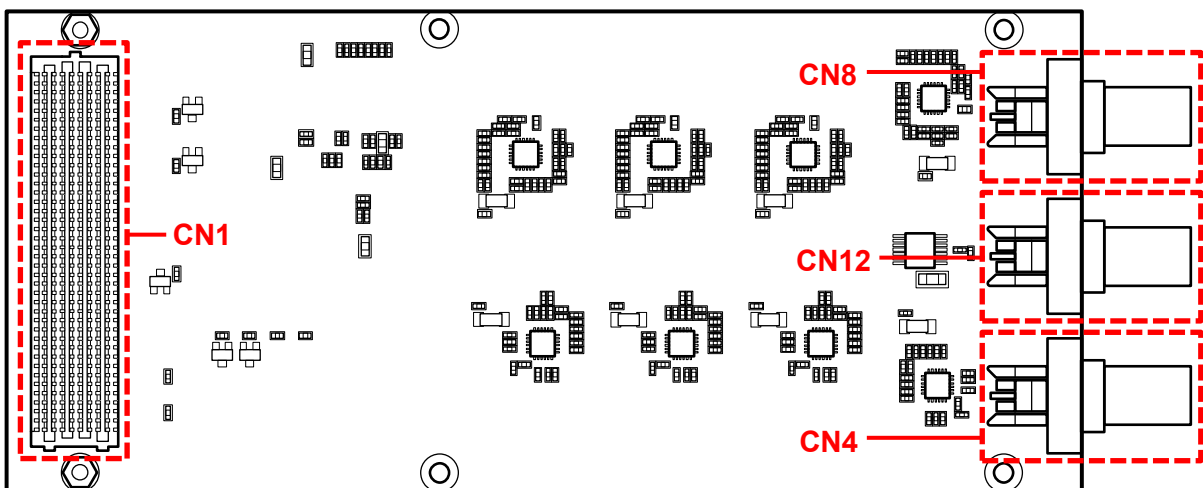

Figure 4-4. Connector Layout (Top View)

Figure 4-5. Connector Layout (Bottom View)

Table 4-4. Connector Information

Part location	Function silk	Description
CN1	FMC	FMC connector for connecting FPGA board
CN2	GBCLK_M2C_P1	SMP connector for supplying dedicated clock to FPGA internal transceiver (+ side)
CN3	GBCLK_M2C_N1	SMP connector for supplying dedicated clock to FPGA internal transceiver (- side)
CN4	SDI_TX0	SDI output connector, right angle type BNC
CN5	SDI_TX1	SDI output connector, straight type BNC
CN6	SDI_TX2	SDI output connector, straight type BNC
CN7	SDI_TX3	SDI output connector, straight type BNC
CN8	SDI_RX0	SDI input connector, right angle type BNC
CN9	SDI_RX1	SDI input connector, straight type BNC
CN10	SDI_RX2	SDI input connector, straight type BNC
CN11	SDI_RX3	SDI input connector, straight type BNC
CN12	Sync	SDI video sync reference input connector, right angle type BNC
CN13	I2C_CONN	Connector to control I2C slave device from external computer

Table 4-5 shows the pin configuration for CN1 (FMC).

Table 4-5. Pin Configuration for FMC Connector

	K	J	H	G	F	E	D	C	B	A
1	NC	GND	NC	GND	NC	GND	NC	GND	NC	GND
2	GND	NC	(Tie to GND)	NC	GND	NC	GND	SDI_C2M_P0	GND	NC
3	GND	NC	GND	NC	GND	NC	GND	SDI_C2M_N0	GND	NC
4	NC	GND	LMH1983_CLK0_M2C_P1	GND	NC	GND	LMK03328_GBTCLK_M2C_P0	GND	NC	GND
5	NC	GND	LMH1983_CLK0_M2C_N1	GND	NC	GND	LMK03328_GBTCLK_M2C_N0	GND	NC	GND
6	GND	NC	GND	NC	GND	NC	GND	NC	GND	SDI_M2C_P0
7	NC	NC	LMH1219_M2C_LOCKN1	NC	NC	NC	GND	NC	GND	SDI_M2C_N0
8	NC	GND	LMH1218_M2C_LOCK1	GND	NC	GND	NC	GND	NC	GND
9	GND	NC	GND	LMH1219_M2C_LOCKN2	GND	NC	NC	GND	NC	GND
10	NC	NC	LMH1219_M2C_LOCKN0	LMH1218_M2C_LOCK2	NC	NC	GND	NC	GND	NC
11	NC	GND	LMH1218_M2C_LOCK0	GND	NC	GND	NC	NC	GND	NC
12	GND	NC	GND	NC	GND	NC	NC	GND	SDI_M2C_P3	GND
13	NC	NC	NC	LMH1981_M2C_HSYNC	NC	NC	GND	GND	SDI_M2C_N3	GND
14	NC	GND	LMH1218_M2C_LOS_INTN	GND	NC	GND	NC	NC	GND	SDI_M2C_P1
15	GND	NC	GND	LMH1981_M2C_VSYNC	GND	NC	NC	NC	GND	SDI_M2C_N1
16	NC	NC	NC	LMH1981_M2C_VIDFMT	NC	NC	GND	GND	NC	GND
17	NC	GND	NC	GND	NC	GND	NC	GND	NC	GND
18	GND	NC	GND	LMH1981_M2C_FLD2	GND	NC	NC	NC	GND	SDI_M2C_P2
19	NC	NC	NC	NC	NC	NC	GND	NC	GND	SDI_M2C_N2
20	NC	GND	LMH1983_M2C_NOREF	GND	NC	GND	NC	GND	SMP_GBTCLK_M2C_P1	GND
21	GND	NC	GND	LMH1219_M2C_LOCKN3	GND	NC	NC	GND	SMP_GBTCLK_M2C_N1	GND
22	NC	NC	LMH1983_M2C_NOALIGN	LMH1218_M2C_LOCK3	NC	NC	GND	NC	GND	NC
23	NC	GND	LMH1983_M2C_NOLOCK	GND	NC	GND	NC	NC	GND	NC
24	GND	NC	GND	NC	GND	NC	NC	GND	SDI_C2M_P3	GND
25	NC	NC	NC	NC	NC	NC	GND	GND	SDI_C2M_N3	GND
26	NC	GND	NC	GND	NC	GND	NC	NC	GND	NC
27	GND	NC	GND	NC	GND	NC	NC	NC	GND	NC
28	NC	NC	LMH1983_C2M_INIT	NC	NC	NC	GND	GND	NC	GND
29	NC	GND	LMH1983_C2M_FLD	GND	NC	GND	NC	GND	NC	GND
30	GND	NC	GND	NC	GND	NC	TDI (Tie to TDO)	SCL	GND	SDI_C2M_P1
31	NC	NC	LMH1983_C2M_VSYNC	NC	NC	NC	TDO (Tie to TDI)	SDA	GND	SDI_C2M_N1
32	NC	GND	LMH1983_C2M_HSYNC	GND	NC	GND	NC	GND	NC	GND
33	GND	NC	GND	NC	GND	NC	NC	GND	NC	GND
34	NC	NC	NC	NC	NC	NC	NC	NC	GND	NC
35	NC	GND	NC	GND	NC	GND	NC	FMC_12p0v	GND	NC
36	GND	NC	GND	SN74AVC4_C2M_OE	GND	NC	FMC_3p3v	GND	SDI_C2M_P2	GND
37	NC	NC	NC	NC	NC	NC	GND	FMC_12p0v	SDI_C2M_N2	GND
38	NC	GND	NC	GND	NC	GND	FMC_3p3v	GND	GND	NC
39	GND	NC	GND	FMC_1p8v	GND	FMC_1p8v	GND	FMC_3p3v	GND	NC
40	NC	NC	FMC_1p8v	GND	FMC_1p8v	GND	FMC_3p3v	GND	NC	GND

Table 4-6 shows the pin configuration for CN13 (I2C_CONN).

Table 4-6. I2C Connector Pin Information

Pin#	Signal name
1	FMC_3p3v
2	SCL_3p3v
3	SDA_3p3v
4	GND

4.4.4 Switches and LEDs
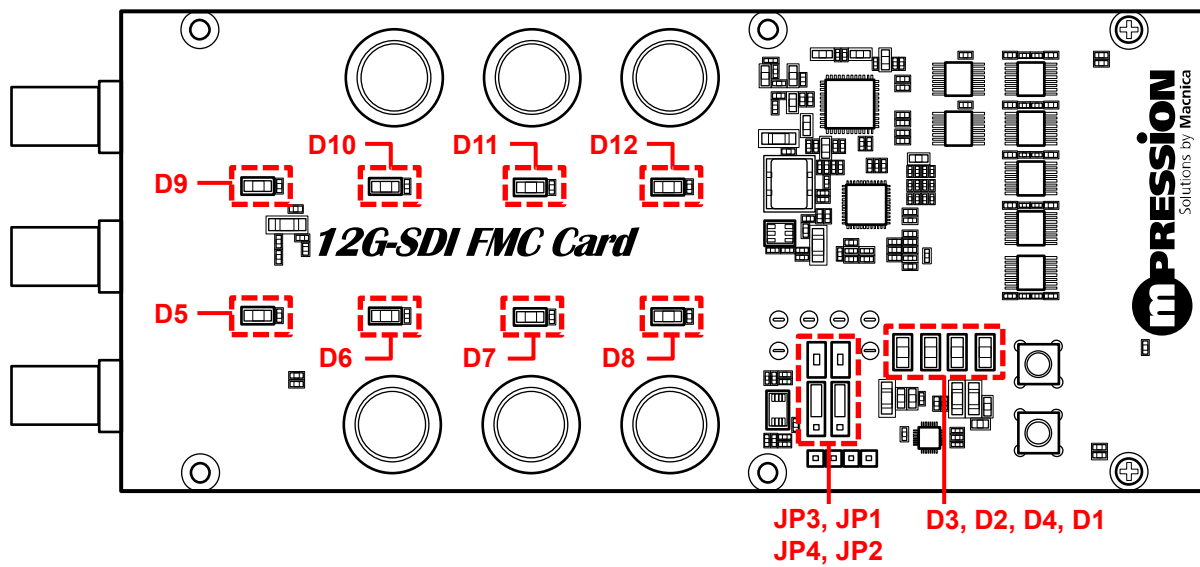
Figure 4-6 shows the switches and LEDs mounted on the FMC card.

Figure 4-6. Switches and LED Layout (Top View)

Table 4-7. Switch and LED Information

Part location	Function silk	Description
JP4	SCL_SEL2	Jumper switch for SCL (I2C) selector control ・Open: Control from I2C_CONN connector ・Other: Control from FPGA board side 1-2 short: Level shift output bypass 2-3 short: Level shift output enabled
JP3	SCL_SEL1	Jumper switch to control connection of SCL signal on FPGA board side ・Open: Level shift input bypass ・Short: Level shift input enabled
JP2	SDA_SEL2	Jumper switch for SDA (I2C) selector control ・Open: Control from I2C_CONN connector ・Other: Control from FPGA board side 1-2 short: Level shift output bypass 2-3 short: Level shift output enabled
JP1	SDA_SEL1	Jumper switch to control connection of SDA signal on FPGA board side ・Open: Level shift input bypass ・Short: Level shift input enabled
D1	FMC_1p8v	+1.8 V power LED ・Lit: On ・Off: Off
D2	FMC_3p3v	+3.3 V power LED ・Lit: On ・Off: Off
D3	FMC_12p0v	+12 V power LED ・Lit: On ・Off: Off
D4	2p5v	+2.5 V power LED ・Lit: On ・Off: Off
D5	TX0_LOCK	Lock state of each LMH1218 ・Lit: LMH1218 is locked ・Off: LMH1218 is unlocked
D6	TX1_LOCK	
D7	TX2_LOCK	
D8	TX3_LOCK	
D9	RX0_LOCK	Lock state of each LMH1219 ・Lit: LMH1219 is locked ・Off: LMH1219 is unlocked
D10	RX1_LOCK	
D11	RX2_LOCK	
D12	RX3_LOCK	

5. Handling Precautions

5.1 About Connecting/Disconnecting the FMC Card

Always turn off the power to the evaluation board when connecting or disconnecting the FMC card to the FPGA board.
Note that inserting or removing the card while the power is on may result in damage to or destruction of the device.
You need to arrange sufficient anti-static prevention measures because the act of contacting the card with a person or any object carrying a static charge may also result in damage to or destruction of the device.
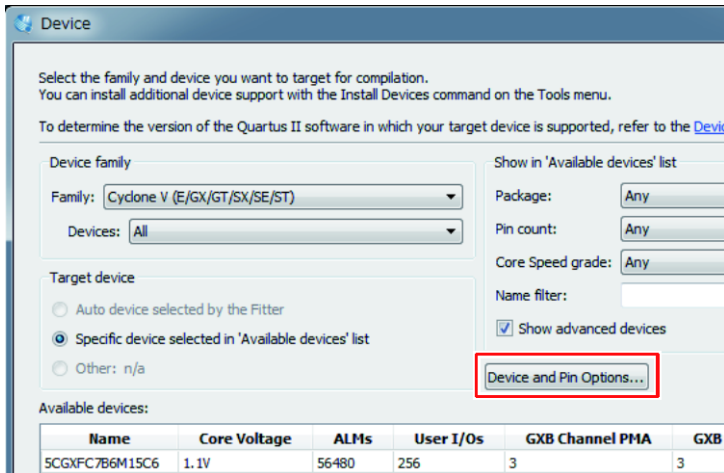
5.2 Mode Selection of Unused Pins

We recommend that the FPGA pins that are not used (unused pins) in the design or hardware to be set in tri-state mode to prevent malfunction. The following shows how to set the unused pins using Quartus Prime development software.
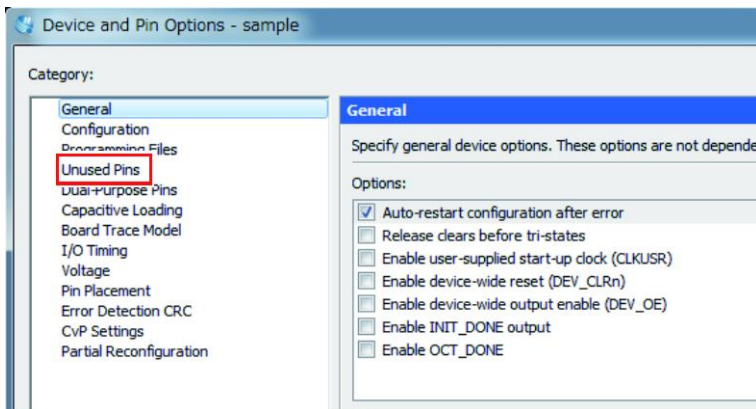
1) Select the [Assignments] menu > [Device].
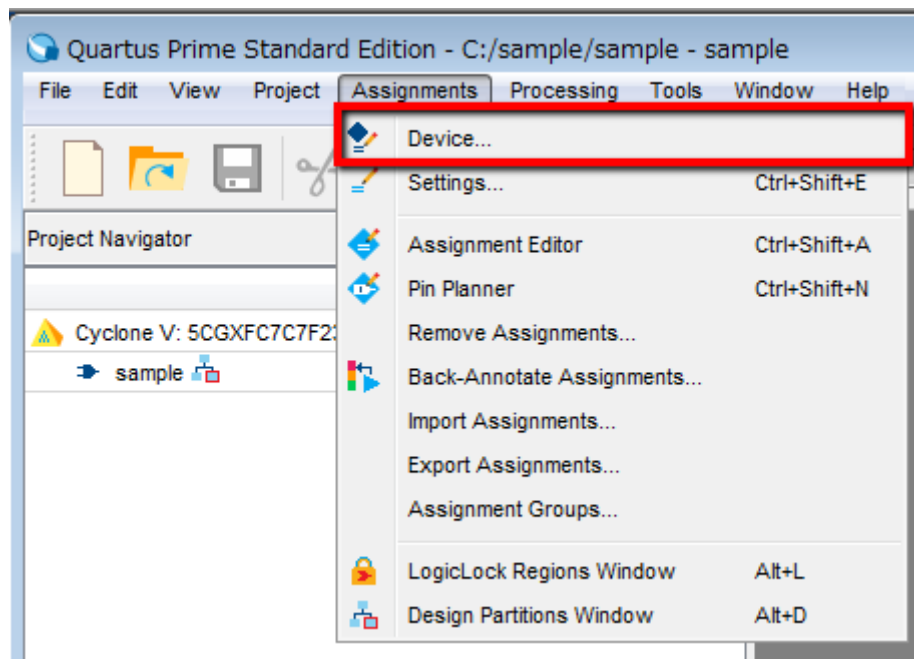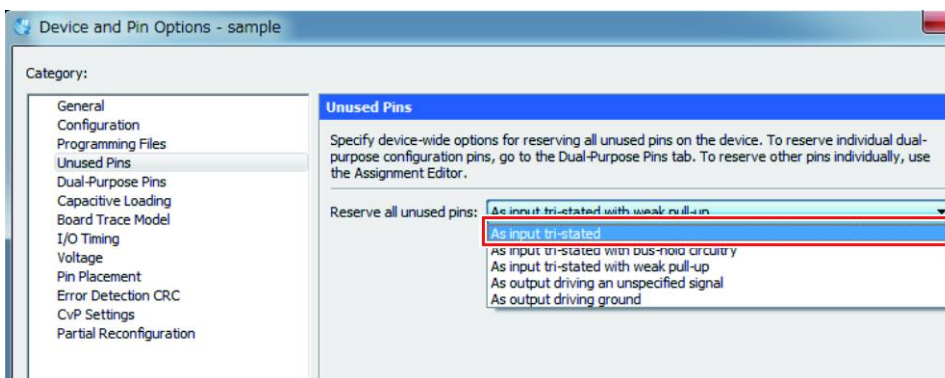
2) Click the [Device and Pin Options] button.

The [Device and Pin Options] window opens.

3) Select [Unused Pins].

4) Select [As input tri-stated] for the [Reserve all unused pins] item.

5) Click the [OK] button.
6) Click the [OK] button to close the [Device] window.

6. Document Revision History

Date	Revision	Changes
February 2, 2017	A	• First Edition
October 13, 2017	B	• Updated manual, design download URL.