



# Reference Manual

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## SFP+ x4 FMC Card

Revision

**B**

2017/10/23

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# 1. Read This First

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## 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 ALTERA LPC+ standard. Combining with an FPGA evaluation board (hereafter Evaluation board), this card supports the development and verification of software and hardware for SFP+ 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

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

### 2.2 Cautions

 <b>Danger</b>	<p>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.</p>
 <b>Warning</b>	<p>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.</p>
	<p>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.</p>
	<p>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.</p>
	<p>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.</p>
	<p>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.</p>
	<p>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.</p>

 <p><b>Warning</b> (Continued from previous page)</p>	<p>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.</p> <p>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.</p> <p>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.</p> <p>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.</p> <p>Keep the card and accessories out of the reach of children. Failure to do so may lead to injuries.</p>
 <p><b>Caution</b></p>	<p>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.</p> <p>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.</p> <p>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%.</p> <p>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.</p> <p>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.</p>

 <p><b>Caution</b> (Continued from previous page)</p>	<p>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.</p> <p>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.</p>
	<p>Turn off the power switch when moving or connecting the card.</p> <p>Failure to do so may cause this card to fail or lead to accidents involving electrical shock.</p>
	<p>Do not clean this card by using a rag containing chemicals such as benzine or thinner.</p> <p>Doing so could degrade the card. When using a chemically treated cloth, comply with its directions and warnings.</p>
	<p>Do not immediately turn on the power if you find that moisture has condensed onto this card after removing it from the box.</p> <p>Condensation may form if the card is cold when moved from the box into a warm room.</p> <p>Turning on the power while there is moisture on the card may cause it to malfunction or shorten the service life of the parts.</p> <p>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.</p>
	<p>Operation of the card cannot be guaranteed if it has been disassembled, dismantled, altered, modified, or rebuilt.</p>



## 3. Unpacking

During 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.

SFP+ x4 FMC Card: 1	
37-mm spacer: 2	
10-mm spacer: 2	
Pan-head screw: 4	
Packing list/precautions(Japanese): 1	
Packing list/precautions(English): 1	
Circuit diagram	To download these files, go to the URL noted on the “Packing List and Precautions”.
Reference Manual	
Getting Started	
Reference Design	

## 4. Functions and Features of the Card

### 4.1 Main Features

This card is an FPGA Mezzanine Connector (FMC) daughter card that complies with HPC standard. By inserting this card into an FPGA evaluation board, you can use evaluate high-speed serial transceivers of the FPGA by utilizing a variety of FPGA functions.

The evaluation board which has been verified to connect with this card so far is the Altera Arria® 10 GX FPGA development kit.

Refer to the following links for more detailed information and related details.

- Information for the Arria® 10 device family  
[Documentation: Arria® 10 Devices](#)
- Materials related to the Arria® 10 GX FPGA Development Kit  
[Arria® 10 GX FPGA Development Kit](#)

### 4.2 Product Specifications

The product specifications for this card are shown below.

Product Specifications	SFP+ x4 FMC CARD
External Dimensions	69 mm x 115 mm
Printed circuit board	8-layer MEGTRON6
FMC	Samtec ASP-134488-01
Power Supply	3.3 V/VADJ (1.8 V) from FMC
Interface	SFP+ Cage & MECT (x4)

### 4.3 Block Diagram

Figure 4-1 shows the block diagram of this card.

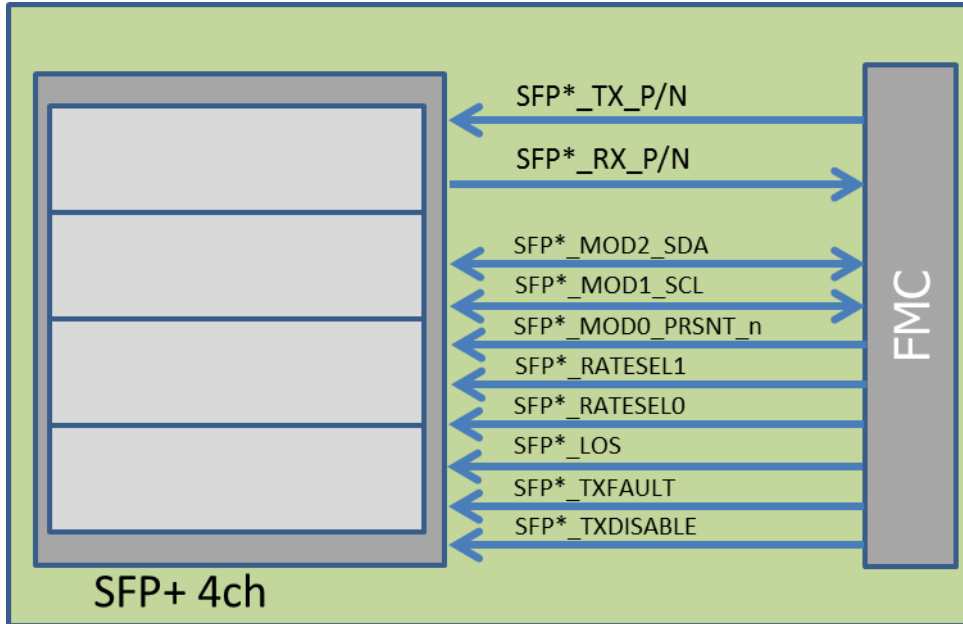


Figure 4-1 SFP+ x4 FMC Card Block Diagram

## 4.4 Card Layout

Figure 4-2 and Figure 4-3 show the layout of the card.

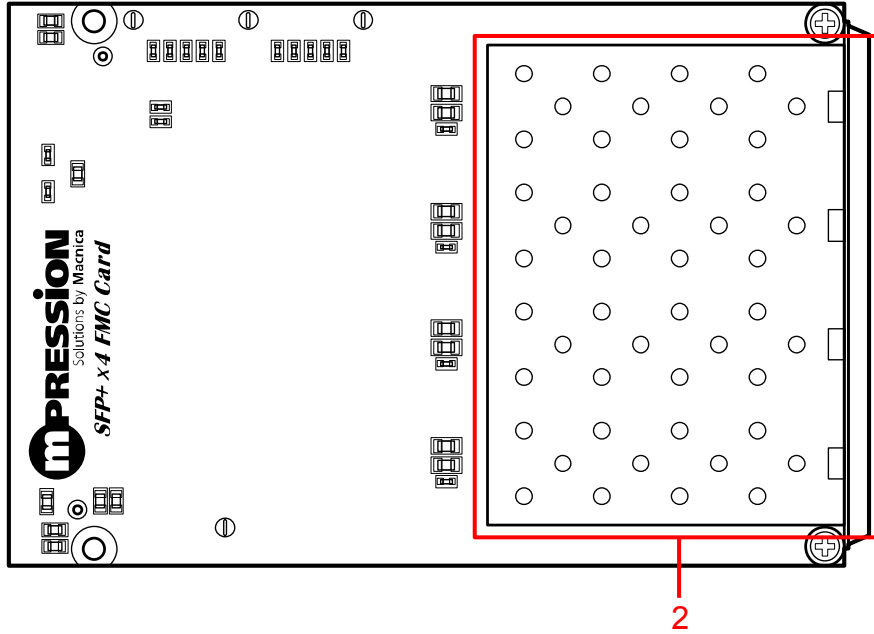


Figure 4-2 QSF+ x4 FMC Card Layout (Front)

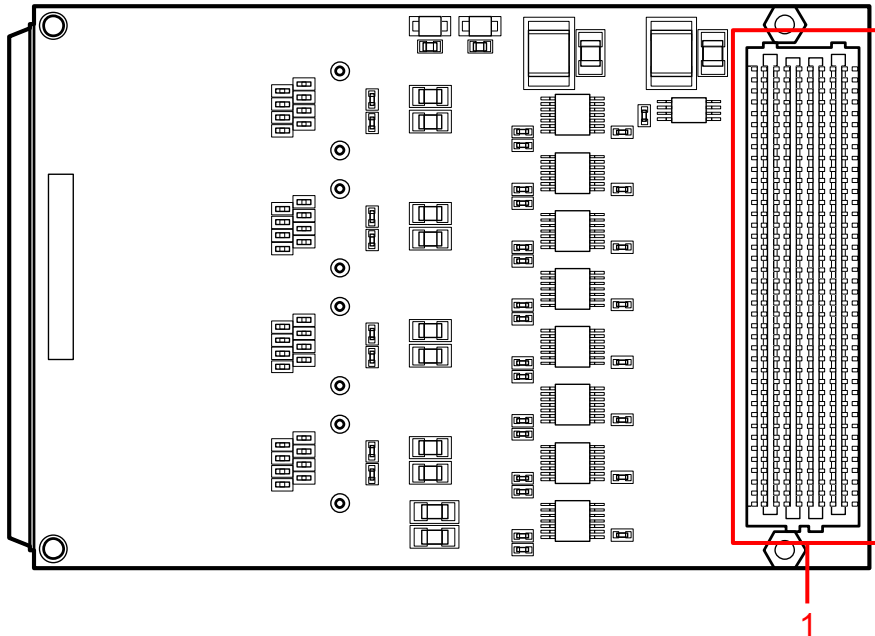


Figure 4-3 QSF+ x4 FMC Card Layout (Back)

	Reference	Functions	Details
1	CN1 (Back)	FMC	ALTERA FPGA Development Board Interface (FMC HPC)
2	CN2 CN3	CN2 MECT (x4) CN3 Cage	SPF+ 4ch

## 5. Components on the Card

### 5.1 Connector Pin Assignments

CN1 (FMC) Connector Pin Assignments 1/2

FMC Pin#	Signal Name	Function	Arria® 10 GX FPGA Development Kit FPGA Pin#	
			FMCA	FMCA
A2	SFP_RXp0	SFP+ ch0 RD+ (DP1_M2C_P)	BA7	W3
A3	SFP_RXn0	SFP+ ch0 RD- (DP1_M2C_N)	BA8	W4
A6	SFP_RXp1	SFP+ ch1 RD+ (DP2_M2C_P)	AY5	Y5
A7	SFP_RXn1	SFP+ ch1 RD- (DP2_M2C_N)	AY6	Y6
A10	SFP_RXp2	SFP+ ch2 RD+ (DP3_M2C_P)	AV5	V5
A11	SFP_RXn2	SFP+ ch2 RD- (DP3_M2C_N)	AV6	V6
A14	SFP_RXp3	SFP+ ch3 RD+ (DP4_M2C_P)	AT5	U3
A15	SFP_RXn3	SFP+ ch3 RD- (DP4_M2C_N)	AT6	U4
A22	SFP_TXp0	SFP+ ch0 TD+ (DP1_C2M_P)	BD5	Y1
A23	SFP_TXn0	SFP+ ch0 TD- (DP1_C2M_N)	BD6	Y2
A26	SFP_TXp1	SFP+ ch1 TD+ (DP2_C2M_P)	BB5	V1
A27	SFP_TXn1	SFP+ ch0 TD- (DP2_C2M_N)	BB6	V2
A30	SFP_TXp2	SFP+ ch2 TD+ (DP3_C2M_P)	BC3	T1
A31	SFP_TXn2	SFP+ ch0 TD- (DP3_C2M_N)	BC4	T2
A34	SFP_TXp3	SFP+ ch3 TD+ (DP4_C2M_P)	BB1	P1
A35	SFP_TXn3	SFP+ ch0 TD- (DP4_C2M_N)	BB2	P2
C30	SCL	SCL	AU10	J17
C31	SDA	SDA	AV10	J16
C34	GA0	-	BC16	K22
D35	GA1	-	BD16	L22
G9	SFP0_RATESEL1	SFP+ ch0 Rate Select 1	AR20	D17
G10	SFP0_RATESEL0	SFP+ ch0 Rate Select 0	AR19	D16
G12	SFP0_TXFAULT	SFP+ ch0 Module Transmitter Fault	AP18	A13
G13	SFP0_TXDISABLE	SFP+ ch0 Transmitter Disable	AN19	B13
G15	SFP1_RATESEL1	SFP+ ch1 Rate Select 1	AR16	D12
G16	SFP1_RATESEL0	SFP+ ch1 Rate Select 0	AP16	D11
G18	SFP1_TXFAULT	SFP+ ch1 Module Transmitter Fault	AT13	E12
G19	SFP1_TXDISABLE	SFP+ ch1 Transmitter Disable	AU13	F12
G21	SFP2_RATESEL1	SFP+ ch2 Rate Select 1	AU8	H20
G22	SFP2_RATESEL0	SFP+ ch2 Rate Select 0	AT8	G20
G24	SFP2_TXFAULT	SFP+ ch2 Module Transmitter Fault	AW12	H19
G25	SFP2_TXDISABLE	SFP+ ch2 Transmitter Disable	AY12	H18
G27	SFP3_RATESEL1	SFP+ ch3 Rate Select 1	AY15	M12
G28	SFP3_RATESEL0	SFP+ ch3 Rate Select 0	AY14	L13
G30	SFP3_TXFAULT	SFP+ ch3 Module Transmitter Fault	BA15	M16
G31	SFP3_TXDISABLE	SFP+ ch3 Transmitter Disable	BA14	M17
H10	SFP0_MOD0_PRSENTn	SFP+ ch0 Module Absent	AN20	K20

CN1 (FMC) Connector Pin Assignments 2/2

FMC Pin#	Signal Name	Function	Arria® 10 GX FPGA Development Kit FPGA Pin#	
			FMCA	FMCA
H11	SFP0_LOS	SFP+ ch0 Receiver Loss of Signal Indication	AP19	L19
H13	SFP0_MOD2_SDA	SFP+ ch0 I2C SDA	AT17	D13
H14	SFP0_MOD1_SCL	SFP+ ch0 I2C SCL	AU17	C13
H16	SFP1_MOD0_PRSENTn	SFP+ ch1 Module Absent	AT14	E11
H17	SFP1_LOS	SFP+ ch1 Receiver Loss of Signal Indication	AR14	E10
H19	SFP1_MOD2_SDA	SFP+ ch1 I2C SDA	AR9	G10
H20	SFP1_MOD1_SCL	SFP+ ch1 I2C SCL	AT9	F10
H22	SFP2_MOD0_PRSENTn	SFP+ ch2 Module Absent	AU11	H11
H23	SFP2_LOS	SFP+ ch2 Receiver Loss of Signal Indication	AU12	H10
H25	SFP2_MOD2_SDA	SFP+ ch2 I2C SDA	AY10	K16
H26	SFP2_MOD1_SCL	SFP+ ch2 I2C SCL	AY11	K17
H28	SFP3_MOD0_PRSENTn	SFP+ ch3 Module Absent	BB15	M13
H29	SFP3_LOS	SFP+ ch3 Receiver Loss of Signal Indication	BC15	L14
H31	SFP3_MOD2_SDA	SFP+ ch3 I2C SDA	AY16	K20
H32	SFP3_MOD1_SCL	SFP+ ch3 I2C SCL	AW16	L19

CN1 FMC pin assignment

	K	J	H	G	F	E	D	C	B	A
1	NC	GND	NC	GND	GND	GND	NC	GND	NC	GND
2	GND	NC	GND	NC	GND	NC	GND	NC	GND	SFP_RXp0
3	GND	NC	GND	NC	GND	NC	GND	NC	GND	SFP_RXn0
4	NC	GND	NC	GND	NC	GND	NC	GND	NC	GND
5	NC	GND	NC	GND	NC	GND	NC	GND	NC	GND
6	GND	NC	GND	NC	GND	NC	GND	NC	GND	SFP_RXp1
7	NC	NC	NC	NC	NC	NC	GND	NC	GND	SFP_RXn1
8	NC	GND	NC	GND	NC	GND	NC	GND	NC	GND
9	GND	NC	GND	SFP0_RATESEL1	GND	NC	NC	GND	NC	GND
10	NC	NC	SFP0_MOD0_PRSENTn	SFP0_RATESEL0	NC	NC	GND	NC	GND	SFP_RXp2
11	NC	GND	SFP0_LOS	GND	NC	GND	NC	NC	GND	SFP_RXn2
12	GND	NC	GND	SFP0_TXFAULT	GND	NC	NC	GND	NC	GND
13	NC	NC	SFP0_MOD2_SDA	SFP0_TXDISABLE	NC	NC	GND	GND	NC	GND
14	NC	GND	SFP0_MOD1_SCL	GND	NC	GND	NC	NC	GND	SFP_RXp3
15	GND	NC	GND	SFP1_RATESEL1	GND	NC	NC	NC	GND	SFP_RXn3
16	NC	NC	SFP1_MOD0_PRSENTn	SFP1_RATESEL0	NC	NC	GND	GND	NC	GND
17	NC	GND	SFP1_LOS	GND	NC	GND	NC	GND	NC	GND
18	GND	NC	GND	SFP1_TXFAULT	GND	NC	NC	NC	GND	NC
19	NC	NC	SFP1_MOD2_SDA	SFP1_TXDISABLE	NC	NC	GND	NC	GND	NC
20	NC	GND	SFP1_MOD1_SCL	GND	NC	GND	NC	GND	NC	GND
21	GND	NC	GND	SFP2_RATESEL1	GND	NC	NC	GND	NC	GND
22	NC	NC	SFP2_MOD0_PRSENTn	SFP2_RATESEL0	NC	NC	GND	NC	GND	SFP_TXp0
23	NC	GND	SFP2_LOS	GND	NC	GND	NC	NC	GND	SFP_TXn0
24	GND	NC	GND	SFP2_TXFAULT	GND	NC	NC	GND	NC	GND
25	NC	NC	SFP2_MOD2_SDA	SFP2_TXDISABLE	NC	NC	GND	GND	NC	GND
26	NC	GND	SFP2_MOD1_SCL	GND	NC	GND	NC	NC	GND	SFP_TXp1
27	GND	NC	GND	SFP3_RATESEL1	GND	NC	NC	NC	GND	SFP_TXn1
28	NC	NC	SFP3_MOD0_PRSENTn	SFP3_RATESEL0	NC	NC	GND	GND	NC	GND
29	NC	GND	SFP3_LOS	GND	NC	GND	NC	GND	NC	GND
30	GND	NC	GND	SFP3_TXFAULT	GND	NC	JTAG_TDI	SCL	GND	SFP_TXp2
31	NC	NC	SFP3_MOD2_SDA	SFP3_TXDISABLE	NC	NC	JTAG_TDO	SDA	GND	SFP_TXn2
32	NC	GND	SFP3_MOD1_SCL	GND	NC	GND	3P3VAUX	GND	NC	GND
33	GND	NC	GND	NC	GND	NC	NC	GND	NC	GND
34	NC	NC	NC	NC	NC	NC	NC	GA0	GND	SFP_TXp3
35	NC	GND	NC	GND	NC	GND	GA1	NC	GND	SFP_TXn3
36	GND	NC	GND	NC	GND	NC	3P3V	GND	NC	GND
37	NC	NC	NC	NC	NC	NC	GND	NC	NC	GND
38	NC	GND	NC	GND	NC	GND	3P3V	GND	GND	NC
39	GND	NC	GND	VADJ	GND	VADJ	GND	3P3V	GND	NC
40	NC	GND	VADJ	GND	VADJ	GND	3P3V	GND	NC	GND

## 6. Handling Precautions

### 6.1 Insertion into / Removal from FMC

Always turn off the power to the evaluation board when inserting the card into or removing it from the FMC connector on the evaluation board.

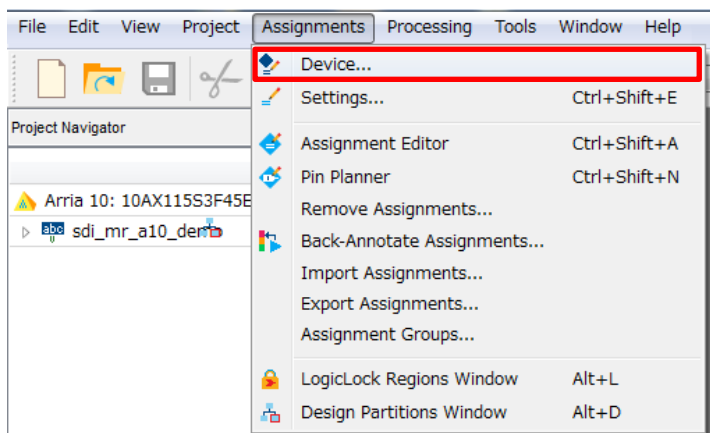
Note that inserting or removing the card while the power is on may result in damage to or destruction of the device.

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.

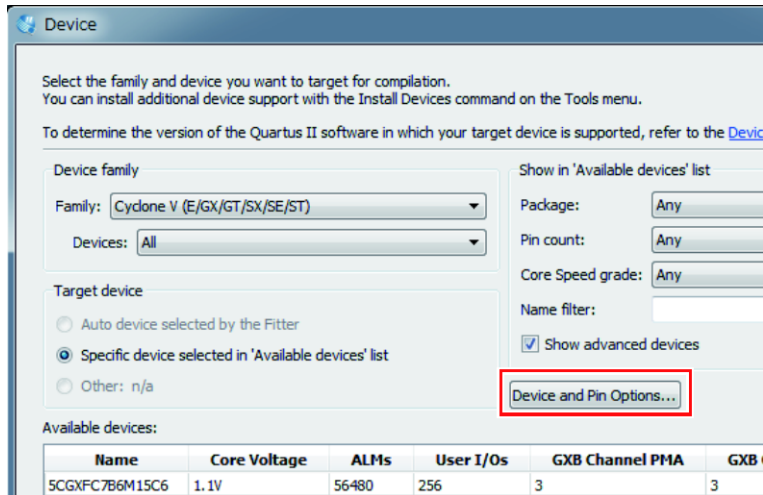
### 6.2 Mode Selection of Unused Pins

We recommend that pins of FPGA 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].

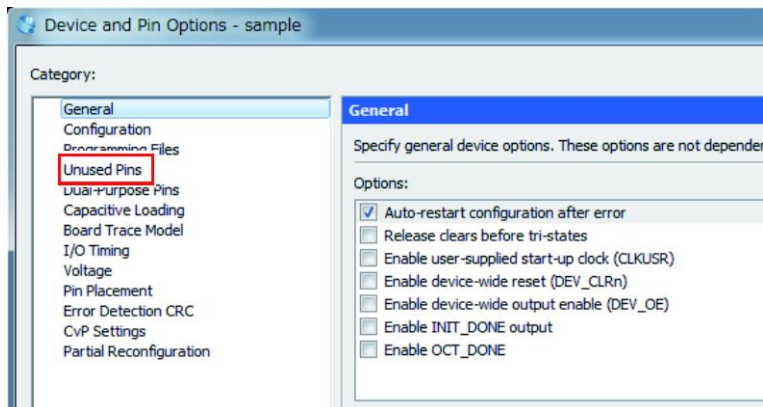


- 2) Click the [Device and Pin Options] button.

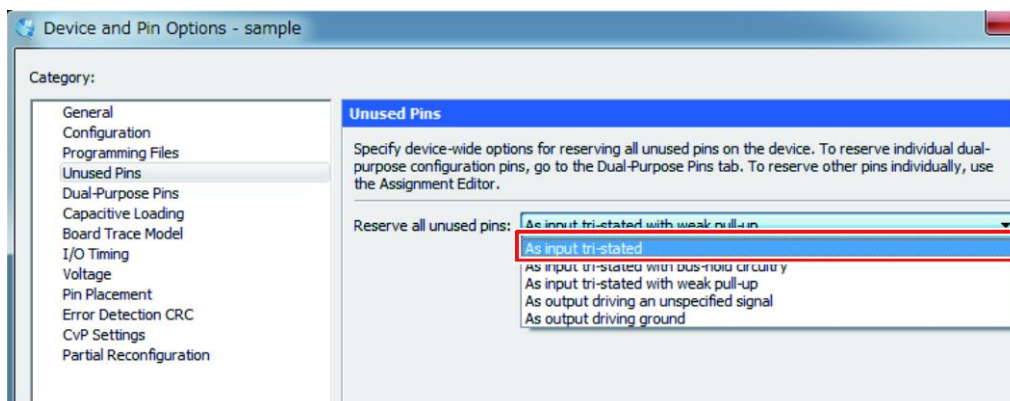


The [Device and Pin Options] window opens.

- 3) Select [Unused Pins].



- 4) For the [Reserve all unused pins] item, select [As input tri-stated].



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



## 7. Document Revision History

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Date	Revision	Changes
January 27, 2017	A	<ul style="list-style-type: none"><li>• First Edition</li></ul>
October 23, 2017	B	<ul style="list-style-type: none"><li>• Change URL</li></ul>