XMC-G745

Rugged Graphics XMC Module with
GeForce GT 745M GPU

User's Manual



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Revision History

Revision	Release Date	Description of Change(s)
0.10	2015/09/30	Preliminary release

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Preface

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Conventions

Take note of the following conventions used throughout this manual to make sure that users perform certain tasks and instructions properly.



Additional information, aids, and tips that help users perform tasks.



Information to prevent ***minor*** physical injury, component damage, data loss, and/or program corruption when trying to complete a task.



Information to prevent ***serious*** physical injury, component damage, data loss, and/or program corruption when trying to complete a specific task.

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Table of Contents

Revision History ii

Preface iii

List of Figures vii

List of Tables ix

1 Introduction 1

1.1 Overview 1

1.2 Features 1

1.2.1 Graphics 2

1.2.2 Display Support 2

1.2.3 Cooling 2

1.2.4 Supported OS 2

1.3 Functional Block Diagram 3

1.4 Ruggedness 4

1.5 Package Contents 4

2 Specifications 5

2.1 XMC-G745 5

2.2 Power Consumption 7

2.3 Performance 8

3 Functional Description 11

3.1 GPGPU Features 11

3.2 GDDR5 Memory 12

3.3 Display Interfaces 13

4 Board Interfaces 15

4.1 XMC-G745 Board Layout (conduction cooled) 15

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4.2 XMC-G745 Board Layout (air cooled) 16
4.3 Connector Pin Assignments 17

5 Getting Started 21
5.1 Installing the Module 21
5.2 Driver Installation 22

Important Safety Instructions 23

Getting Service 25

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List of Figures

Figure 1-1: XMC-G745 Functional Block Diagram 3
Figure 4-1: XMC-G745 Board Layout (conduction cooled) 15
Figure 4-2: XMC-G745 Board Layout (air cooled) 16

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List of Tables

Table 2-1: XMC-G745 Power Consumption 7
Table 4-1: DVI-I Connector Pin Definition..... 18
Table 4-2: XMC Site Connector Pin Definition..... 19
Table 4-3: XMC I/O Connector Pin Definition 20

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1 Introduction

1.1 Overview

The ADLINK XMC-G745M is a rugged XMC module equipped with the CUDA-enabled 384-core NVIDIA GeForce GT 745M GPU, utilizing the NVIDIA "Kepler" architecture and yielding the unprecedented levels of graphics processing performance for defense and aerospace applications. The GeForce GT 745M features 2048MB of GDDR5 memory, ensuring high-capacity and high-bandwidth access to data during "massively parallel" GPGPU algorithm processing. ADLINK recognizes the trend towards implementing General Purpose computing on Graphics Processing Units (GPGPU) for parallel computing for increased processing performance and the XMC-G745M is targeted at a variety of high-performance computing application that can take advantage of this technology.

1.2 Features

- NVIDIA GeForce GT 745M GPU with "Kepler" architecture
- CUDA Compute Capability 3.0 for parallel computation and graphics processing
- High-resolution, high-performance platform for rugged video
- I/O and GPGPU applications
- Ideal for defense, radar, sonar, UAV and ground vehicles

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1.2.1 Graphics

- NVIDIA GeForce GT 745M GPU
- 384 CUDA cores
- 548 MHz base clock
- High-Bandwith Digital Content Protection (HDCP) support
- OpenCL 1.2
- OpenGL 4.4
- GPU Boost 2.0
- DirectX 11.1
- Hardware H.264 video encoding
- NVIDIA PureVideo Technology hardware decoding
- NVIDIA PhysX realtime physics engine

1.2.2 Display Support

- 1x analog output (Cconduction cooled version only)
  - 400 MHz integrated RAMDAC
  - Up to 2048x1536 30 bpp at 75 Hz
- 4x DVI-D outputs.
  - Internal single-link TMDS
  - Up to 1920x1200 32 bpp at 60 Hz

1.2.3 Cooling

- Air-cooled
- Conduction-cooled

1.2.4 Supported OS

- Windows 8.1
- Windows 8
- Windows 7
- Linux

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1.3 Functional Block Diagram

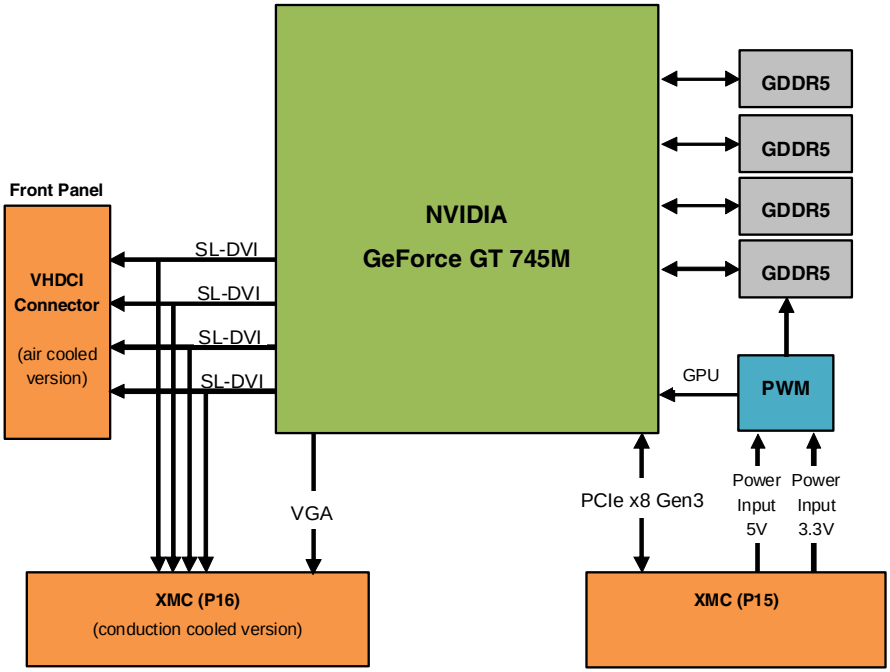


Figure 1-1: XMC-G745 Functional Block Diagram

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1.4 Ruggedness

- **R2:** Conduction cooled version supporting -40°C to +85°C at card edge
- **A1:** Air cooled version supporting 0°C to +55°C ambient temperature

1.5 Package Contents

The XMC-G745 is packaged with the following components. If any of the items on the contents list are missing or damaged, retain the shipping carton and packing material and contact the dealer for inspection. Please obtain authorization before returning any product to ADLINK.

- XMC-G745 module
- VHDCI to DVI adapter connector (air cooled version only)



This product must be protected from static discharge and physical shock. Never remove any of the components except at a static-free workstation. Use the anti-static bag shipped with the product when putting the board on a surface. Wear an anti-static wrist strap properly grounded on one of the system's ESD ground jacks when installing or servicing system components.

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2 Specifications

2.1 XMC-G745

Graphics	
GPU	NVIDIA GeForce GT 745M
CUDA Cores	384
Graphics Clock	680 MHz
Floating Point Performance	522.2 GFLOPS
Memory	
Memory Size	2GB GDDR5
Memory Clock	2000 MHz (4 Gbps)
Memory Interface Width	128-bit
Memory Bandwidth	64 GB/sec
Feature Support	
Bus Type	PCI x16 Gen3 (x16/x8/x4/x1)
OpenGL	4.4
OpenCL	1.2
DirectX	11.1
NVIDIA CUDA	CUDA Compute Capability 3.0
NVIDIA PhysX	Realtime physics engine
NVIDIA PureVideo HW Decode	MPEG-2 MPEG-4 Part 2 Advanced Simple profile H.264 SVC codec support Support for 3D Blu-ray VC1 DivX version 3.11 and later MVC
Hardware H.264 encoding	supported
DirectCompute API	supported
Operating System	Windows 8.1 Windows 8 Windows 7 Linux

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Display Outputs	
DVI-D	4x DVI-D outputs Internal single-link TMDS Up to 1920x1200 32 bpp at 60 Hz
VGA	1x analog VGA output (conduction cooled version only) 400 MHz integrated RAMDAC Up to 2048x1536 30 bpp at 75 Hz
Independent Displays	3
Mechanical and Power	
Form Factor	XMC module
Air cooled version	149 mm x 74mm
Conduction cooled version	143.75mm x 74 mm (with conformal coating)
Power Consumption	40 W (max.)
Environmental	
Operating Temperature	Air Cooled: A1 • 0 °C to +55°C ambient Conduction Cooled: R2 • -40°C to +85°C (mounted on VPX3000/3001 blade)
Storage Temperature	-50°C to +100°C
Rel. Humidity	95%
Shock	Air Cooled: A1 • 20g peak, 11ms (air cooled: A1) Conduction Cooled: R2 • 40g peak, 11ms (conduction cooled: R2)
Vibration	Air Cooled: A1 • Random: 0.002g^2/Hz from 10 to 2000Hz; Sine: 2G, 5 to 500Hz Conduction Cooled: R2 • 15Hz-2KHz, 12Grms, random, each axis, operating (MIL-STD-810F Fig 514.4-8 for aircraft)

Note: Specifications are subject to change without notice.

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2.2 Power Consumption

The power consumption data of the XMC-G745 was measured using 3D Mark06 at different engine clock frequencies (memory clock fixed at 2000 MHz).

Configuration					
Futuremark 3DMark06 Professional Edition 1.1.0					
Engine Clock	Voltage (V)	Current (A)		Power (W)	
		Max(1)	Mean(2)	Max	Mean
679MHz	4.98	6.07	4.64	30.23	23.08
600MHz	4.98	5.72	4.34	28.47	21.63
550MHz	5.00	5.33	4.15	26.66	20.75
510MHz	5.01	5.21	4.02	26.12	20.14
496MHz	5.01	5.19	4.00	26.02	20.04

Table 2-1: XMC-G745 Power Consumption

Notes: Maximum and mean current measured using Unigine Heaven Benchmark 4.0.

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2.3 Performance

Futuremark 3DMarkX Professional was used to measure the graphics performance of the XMC-G745 while mated to an ADLINK VPX3000 3U VPX Processor Blade. The table below shows the test results under different configurations.

Processor Blade	**VPX3000**
XMC Card	**XMC-G745 conduction cooled version**
Processor	Intel® Core™ i7-3612QE Processor (6M Cache, up to 3.10 GHz)
Memory	8GB
Graphics	Intel® HD Graphics 4000 NVIDIA GeForce GT745M
HDD	ASD26-HA2032 32GB
OS	Win 7 SP1 x64
DirectX	11
BIOS	0.01(VPX3001)
Futuremark 3DMark 05	**Wedge Lock 85°C**
3DMark Score	3795
Futuremark 3DMark 06	**Wedge Lock 85°C**
3DMark Score	1913
SM2.0 Score	860
HDR/SM3.0 Score	880
CPU Score	455
Futuremark 3DMark 11 Advanced Edition (Build 1.0.3.0)	**Wedge Lock 85°C**
Performance (P)	
3DMark 11 Score	P363
Graphics Score	342
Physics Score	682
Combined Score	299

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Extreme (X) [Wedge Lock 80°C]	
3DMark 11 Score	X308
Graphics Score	275
Physics Score	3566
Combined Score	326
Futuremark 3DMark Vantage (Build 1.0.1.0)	Wedge Lock 85°C
Performance (P)	
3DMark Score	P1313
GPU Score	1044
CPU Score	5737
High (H)	
3DMark Score	H754
GPU Score	694
CPU Score	1487

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3 Functional Description

The following sections describe the VPX3G10 features and functions.

3.1 GPGPU Features

- **Kepler GPU Architecture:** NVIDIA's Kepler GPU architecture has been designed from the ground up for maximum performance with DirectX 11 and optimal performance per watt. The new SMS streaming multiprocessor is twice as efficient as the prior generation and the new geometry engine draws triangles twice as fast. The result is world class performance and the highest image quality.
- **NVIDIA CUDA Technology:** Compute Unified Device Architecture, is a parallel computing platform and programming model that unlocks the power of the GPU's processor cores to accelerate the most demanding system tasks.
- **Microsoft DirectX 11 Support:** DirectX 11 GPU with Shader Model 5.0 support designed for ultra high performance with GPU-accelerated tessellation.
- **NVIDIA PhysX Technology:** A powerful physics engine enabling real-time physics that is is optimized for hardware acceleration by massively parallel processors. GeForce GPUs with PhysX provide an exponential increase in physics processing power.
- **NVIDIA FXAA Technology:** Shader-based antialiasing technology available from the NVIDIA Control Panel that enables ultra-fast antialiasing.
- **NVIDIA Adaptive Vertical Sync:** Adaptive V-Sync is a smarter way to render frames. At high frame rates, V-sync is enabled to eliminate tearing. At low frame rates, it is disabled to minimize stuttering.
- **High-Definition Audio Bitstreaming:** Full-support for high-definition audio bitstreaming, including Dolby TrueHD and DTS-HD formats.
- **Hardware Video Decode Acceleration:** The combination of high-definition video decode acceleration and post-processing that delivers stutter-free video, stunning picture

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clarity, accurate color, and precise image scaling with incredible energy efficiency.

- **PCI Express 3.0 & 2.0 Support:** Designed for the PCI Express 3.0 bus architecture offering the highest data transfer speeds while maintaining backwards compatibility with earlier PCI Express revisions.

3.2 GDDR5 Memory

GDDR5 double data rate type five synchronous graphics random access memory (SGRAM) conforms to the standards which were set out in the GDDR5 specification by JEDEC and it is specifically designed for use in graphics devices for the most demanding and memory-intensive graphics applications, such as 3D gaming and HD video editing. It is a dedicated memory for the Graphic Processing Unit (GPU). Such memory not only reduces the display and graphics related load on the computer's main memory, but also serves to improve the performance of the GPU and the system's display, providing much better visual experiences than would be possible with just the computer's integrated graphics.

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3.3 Display Interfaces

Digital Output

The XMC-G745 has 4x single-link DVI-D to the P16 connector (conduction cooled version) or to a VHDCI connector (air cooled version). The maximum supported resolution is 1920 x 1200 x 32 bpp at 60 Hz.

Analog Output

The analog VGA output port is routed to the P16 connector (conduction cooled version only). The maximum supported resolutions is 2048 x 1536 x 30 bpp at 75 Hz.

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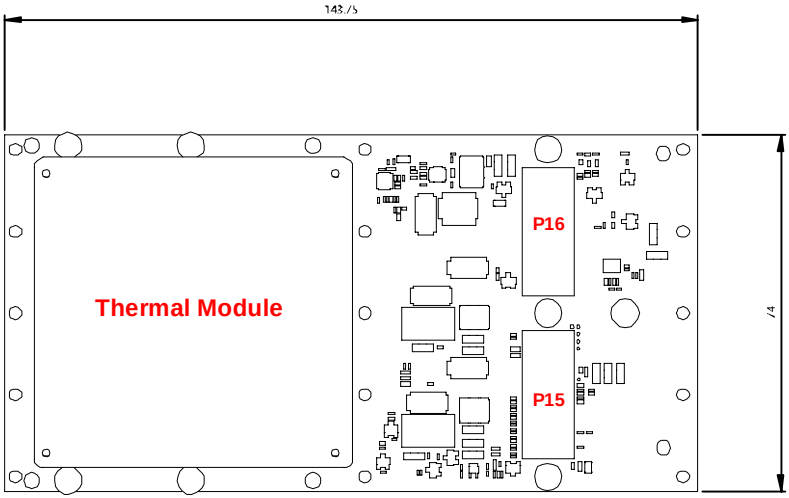
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4 Board Interfaces

This chapter illustrates the board layout and connector pin assignments.

4.1 XMC-G745 Board Layout (conduction cooled)

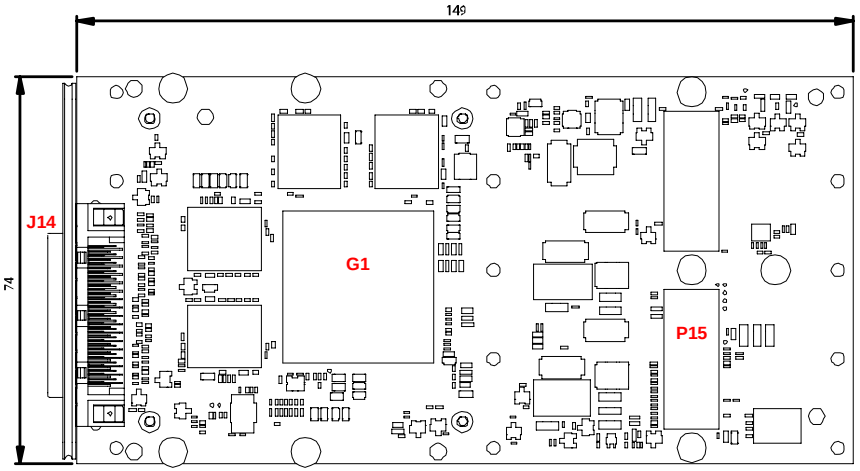


P15	XMC Connector: PCIe x16 Gen3	**P16**	XMC I/O: 4x single-link DVI and 1x VGA
Thermal Module	XMC conduction cooling thermal module		

Figure 4-1: XMC-G745 Board Layout (conduction cooled)

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4.2 XMC-G745 Board Layout (air cooled)



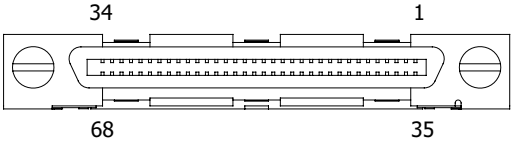
P15	XMC Connector: PCIe x16 Gen3	**J14**	VHDCI Connector: 4x single-link DVI
G1	Nvidia GT 745M		

Figure 4-2: XMC-G745 Board Layout (air cooled)

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4.3 Connector Pin Assignments

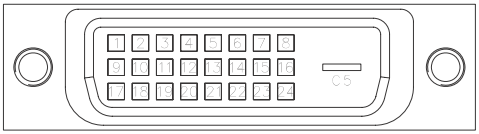
VHDCI Connector (J14, air cooled only)



Pin#	DVI4	Pin#	DVI3	Pin#	DVI2	Pin#	DVI1
1	DDC4_SCL	19	DDC3_SDA	35	DDC2_SCL	53	DDC1_SDA
2	DDC4_SDA	20	DDC3_SCL	36	DDC2_SDA	54	DDC1_SCL
3	DGND	21	DGND	37	DGND	55	DGND
4	DVI4_TX2+	22	DVI3_TX2-	38	DVI2_TX2+	56	DVI1_TX2-
5	DVI4_TX2-	23	DVI3_TX2+	39	DVI2_TX2-	57	DVI1_TX2+
6	DGND	24	DGND	40	DGND	58	DGND
7	DVI4_TX1+	25	DVI3_TX1-	41	DVI2_TX1+	59	DVI1_TX1-
8	DVI4_TX1-	26	DVI3_TX1+	42	DVI2_TX1-	60	DVI1_TX1+
9	DGND	27	DGND	43	DGND	61	DGND
10	DVI4_TX0+	28	DVI3_TX0+	44	DVI2_TX0+	62	DVI1_TX0-
11	DVI4_TX0-	29	DVI3_TX0-	45	DVI2_TX0-	63	DVI1_TX0+
12	DGND	30	DGND	46	DGND	64	DGND
13	DVI4_TXC+	31	DVI3_TXC+	47	DVI2_TXC+	65	DVI1_TXC+
14	DVI4_TXC-	32	DVI3_TXC-	48	DVI2_TXC-	66	DVI1_TXC-
15	DGND	33	DGND	49	DGND	67	DGND
16	DVI4_HPD	34	DVI3_HPD	50	DVI2_HPD	68	DVI1_HPD
17	DDC_5V						
18	DDC_5V						
51	DGND						
52	DGND						

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DVI-D Connectors on VHDCI Cable

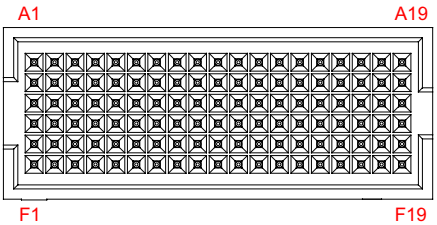


Pin #	Signal	Pin #	Signal
1	DVI_TDC2-N	16	DVI_HTPLG
2	DVI_TDC2-P	17	DVI_TDC0-N
3	GND	18	DVI_TDC0-P
4	NC	19	GND
5	NC	20	NC
6	DDCCLK_5V	21	NC
7	DDCDAT_5V	22	GND
8	NC	23	DVI_TLC-P
9	DVI_TDC1-N	24	DVI_TLC-N
10	DVI_TDC1-P	C1	NA
11	GND	C2	NA
12	NC	C3	NA
13	NC	C4	NA
14	P5V	C5	GND
15	GND		

Table 4-1: DVI-I Connector Pin Definition

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XMC Site Connector (P15)



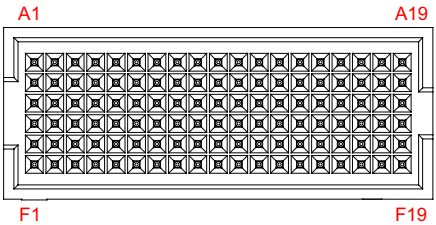
Pin#	A	B	C	D	E	F
1	PCIe_TX0+	PCIe_TX0-	+3D3V	PCIe_TX1+	PCIe_TX1-	VPWR (5V)
2	GND	GND	JTAG_TRST#	GND	GND	MRSTI#
3	PCIe_TX2+	PCIe_TX2-	+3D3V	PCIe_TX3+	PCIe_TX3-	VPWR (5V)
4	GND	GND	JTAG_TCLK	GND	GND	MRSTO#
5	PCIe_TX4+	PCIe_TX4-	+3D3V	PCIe_TX5+	PCIe_TX5-	VPWR (5V)
6	GND	GND	JTAG_TMS	GND	GND	+12V
7	PCIe_TX6+	PCIe_TX6-	+3D3V	PCIe_TX7+	PCIe_TX7-	VPWR (5V)
8	GND	GND	JTAG_TDI	GND	GND	NC
9	NC	NC	NC	NC	NC	VPWR (5V)
10	GND	GND	JTAG_TDO	GND	GND	XMC_GA0
11	PCIe_RX0+	PCIe_RX0-	NC (MBIST#)	PCIe_RX1+	PCIe_RX1-	VPWR (5V)
12	GND	GND	XMC_GA1	GND	GND	MPRESENT#
13	PCIe_RX2+	PCIe_RX2-	NC	PCIe_RX3+	PCIe_RX3-	VPWR (5V)
14	GND	GND	XMC_GA2	GND	GND	NC (MSDA)
15	PCIe_RX4+	PCIe_RX4-	NC	PCIe_RX5+	PCIe_RX5-	VPWR (5V)
16	GND	GND	NVMRO	GND	GND	NC (MSCL)
17	PCIe_RX6+	PCIe_RX6-	NC	PCIe_RX7+	PCIe_RX7-	NC
18	GND	GND	NC (FPGAIO1)	GND	GND	NC
19	PCIe_CLK+	PCIe_CLK-	NC	NC (WAKE#)	NC (ROOT#)	NC (FPGAIO2)

Table 4-2: XMC Site Connector Pin Definition

PCIe_TX
PCIe_RX
PCIe_CLK
Power
JTAG

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XMC I/O Connector (P16, conduction cooled only)



Pin#	A	B	C	D	E	F
1	DVI0_TX0+	DVI0_TX0-	NC	DVI0_TX1+	DVI0_TX1-	NC
2	DGND	DGND	NC	DGND	DGND	NC
3	DVI0_TX2+	DVI0_TX2-	NC	DVI0_TXC+	DVI0_TXC-	NC
4	DGND	DGND	NC	DGND	DGND	NC
5	DVI2_TX0+	DVI2_TX0-	NC	DVI2_TX1+	DVI2_TX1-	NC
6	DGND	DGND	NC	DGND	DGND	NC
7	DVI2_TX2+	DVI2_TX2-	NC	DVI2_TXC+	DVI2_TXC-	NC
8	DGND	DGND	NC	DGND	DGND	NC
9	DVI3_TX0+	DVI3_TX0-	DDC3_SCL	DVI3_TX1+	DVI3_TX1-	DDC3_SDA
10	DGND	DGND	DDC1_SCL	DGND	DGND	NC
11	DVI1_TX0+	DVI1_TX0-	DDC1_SDA	DVI1_TX1+	DVI1_TX1-	DVI1_HPD
12	DGND	DGND	DDC0_SCL	DGND	DGND	DDC2_SDA
13	DVI1_TX2+	DVI1_TX2-	DDC0_SDA	DVI1_TXC+	DVI1_TXC-	DDC2_SCL
14	DGND	DGND	DVI0_HPD	DGND	DGND	DVI2_HPD
15	DVI3_TX2+	DVI3_TX2-	DVI3_HPD	DVI3_TXC+	DVI3_TXC-	DDC_5V
16	DGND	DGND	RGB0_SDA	DGND	DGND	DDC_5V
17	NC	NC	RGB0_H	NC	NC	RGB0_B
18	DGND	DGND	RGB0_SCL	DGND	DGND	RGB0_G
19	NC	NC	RGB0_V	NC	NC	RBG0_R

Table 4-3: XMC I/O Connector Pin Definition

DVI0
DVI1
DVI2
DVI3
RGB0
Power

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5 Getting Started

5.1 Installing the Module

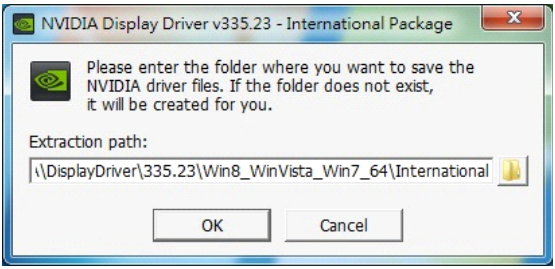
1. Remove the XMC slot filler faceplate from the front panel of the host board (air cooled version only).
2. Insert the faceplate of the XMC module into the XMC slot in the front panel of the host board (air cooled version only).
3. Carefully align the male connectors of the XMC module (component-side down) to the female connectors of the host board and firmly press down.
4. Secure the XMC module with the four screws provided from the bottom side of the host board.

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5.2 Driver Installation

Validated Windows 7 drivers for the XMC-G745 can be downloaded from the ADLINK website: **http://www.adlinktech.com/PD/web/PD_detail.php?cKind=&pid=1419**. Driver installation procedures are described below.

1. Install the Windows operating system before installing any driver. Most standard I/O device drivers are installed during Windows installation.



2. Install the chipset driver by extracting the contents of **NVIDIA_Graphic_WIN7_64_V_R340.52.zip** and running the program **setup.exe**.

3. The driver package will auto-extract to the default location. Change the path if desired.



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Important Safety Instructions

For user safety, please read and follow all **instructions**, **WARNINGS**, **CAUTIONS,** and **NOTES** marked in this manual and on the associated equipment before handling/operating the equipment.

- Read these safety instructions carefully.
- Keep this user's manual for future reference.
- Read the specifications section of this manual for detailed information on the operating environment of this equipment.
- When installing/mounting or uninstalling/removing equipment:
  - Turn off power and unplug any power cords/cables.
- To avoid electrical shock and/or damage to equipment:
  - Keep equipment away from water or liquid sources;
  - Keep equipment away from high heat or high humidity;
  - Keep equipment properly ventilated (do not block or cover ventilation openings);
  - Make sure to use recommended voltage and power source settings;
  - Always install and operate equipment near an easily accessible electrical socket-outlet;
  - Secure the power cord (do not place any object on/over the power cord);
  - Only install/attach and operate equipment on stable surfaces and/or recommended mountings; and,
  - If the equipment will not be used for long periods of time, turn off and unplug the equipment from its power source.

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- Never attempt to fix the equipment. Equipment should only be serviced by qualified personnel.

A Lithium-type battery may be provided for uninterrupted, backup or emergency power.



Risk of explosion if battery is replaced with one of an incorrect type. Dispose of used batteries appropriately.

- Equipment must be serviced by authorized technicians when:
  - The power cord or plug is damaged;
  - Liquid has penetrated the equipment;
  - It has been exposed to high humidity/moisture;
  - It is not functioning or does not function according to the user's manual;
  - It has been dropped and/or damaged; and/or,
  - It has an obvious sign of breakage.

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Getting Service

Contact us should you require any service or assistance.

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