



ADLINK
TECHNOLOGY INC.

XMC-G745

Rugged Graphics XMC Module with
GeForce GT 745M GPU

User's Manual



Manual Rev.: 0.10
Revision Date: September 30, 2015
Part No: 50-1Z195-1000

Advance Technologies; Automate the World.

Revision History

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

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.



NOTE:

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



CAUTION:

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



WARNING:

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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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

1.2.1 Graphics

- ▶ NVIDIA GeForce GT 745M GPU
- ▶ 384 CUDA cores
- ▶ 548 MHz base clock
- ▶ High-Bandwidth 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 (Conduction 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

1.3 Functional Block Diagram

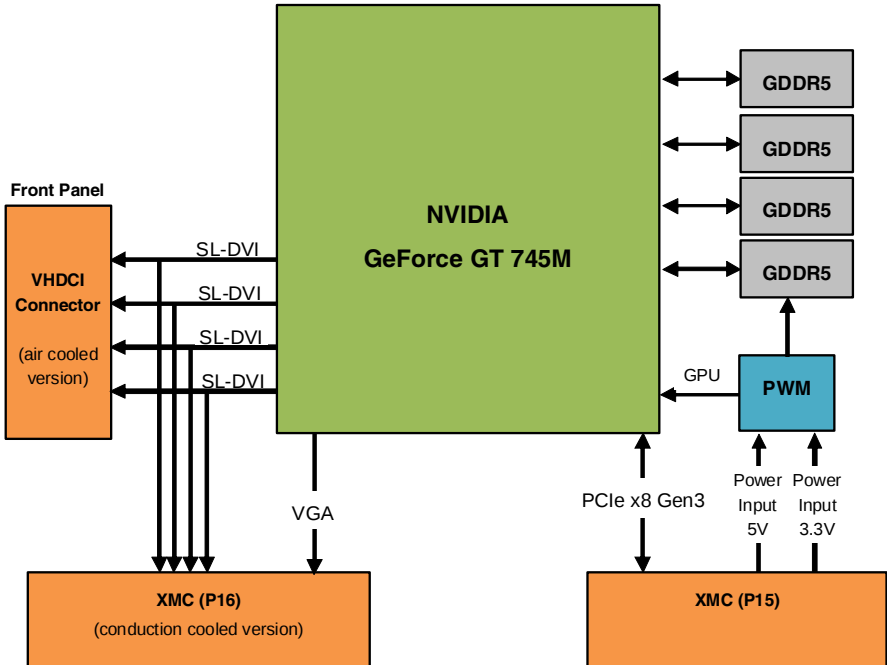


Figure 1-1: XMC-G745 Functional Block Diagram

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)



CAUTION:

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.

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

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.

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.

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

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 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

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.

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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4 Board Interfaces

This chapter illustrates the board layout and connector pin assignments.

4.1 XMC-G745 Board Layout (conduction cooled)

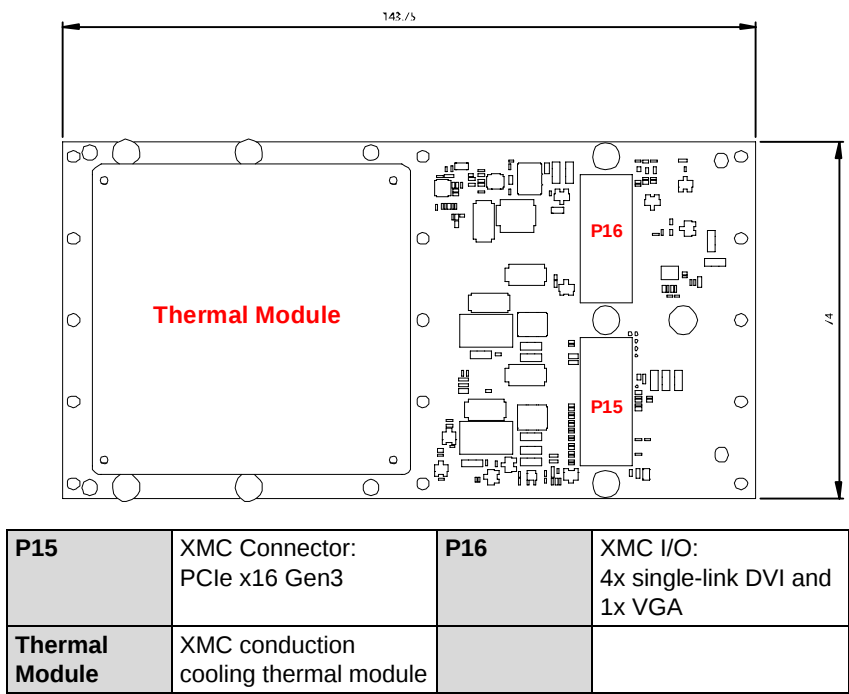
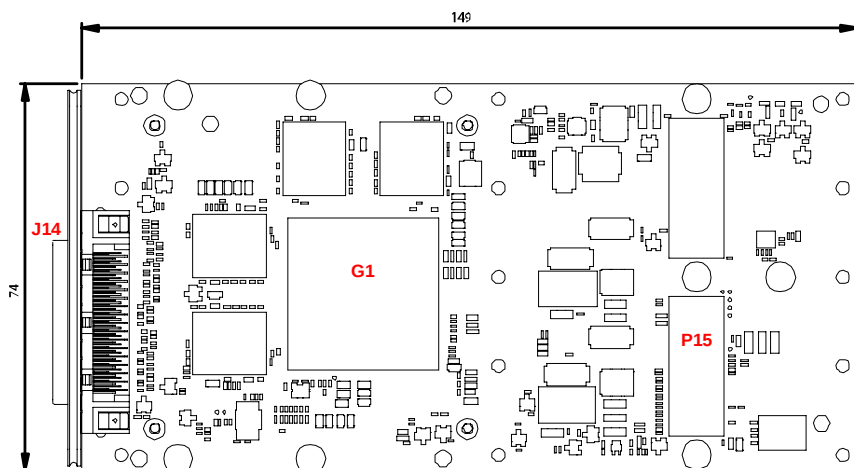


Figure 4-1: XMC-G745 Board Layout (conduction cooled)

4.2 XMC-G745 Board Layout (air cooled)

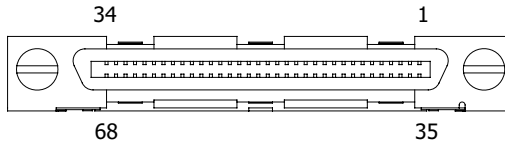


P15	XMC Connector: PCIe x16 Gen3	J14	VHDCI Connector: 4x single-link DVI
G1	Nvidia GT 745M		

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

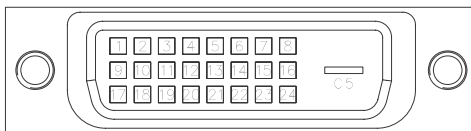
4.3 Connector Pin Assignments

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						

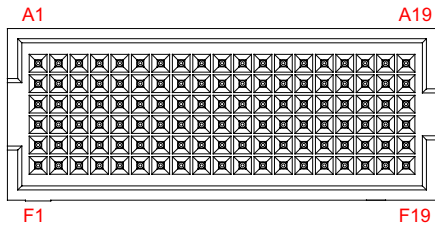
DVI-D Connectors on VHDCI Cable



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

XMC Site Connector (P15)

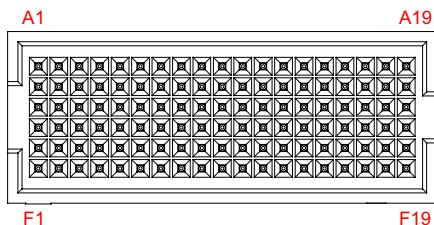


Pin#	A	B	C	D	E	F
1	PCle_TX0+	PCle_TX0-	+3D3V	PCle_TX1+	PCle_TX1-	VPWR (5V)
2	GND	GND	JTAG_TRST#	GND	GND	MRSTI#
3	PCle_TX2+	PCle_TX2-	+3D3V	PCle_TX3+	PCle_TX3-	VPWR (5V)
4	GND	GND	JTAG_TCLK	GND	GND	MRSTO#
5	PCle_TX4+	PCle_TX4-	+3D3V	PCle_TX5+	PCle_TX5-	VPWR (5V)
6	GND	GND	JTAG_TMS	GND	GND	+12V
7	PCle_TX6+	PCle_TX6-	+3D3V	PCle_TX7+	PCle_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	PCle_RX0+	PCle_RX0-	NC (MBIST#)	PCle_RX1+	PCle_RX1-	VPWR (5V)
12	GND	GND	XMC_GA1	GND	GND	MPRESENT#
13	PCle_RX2+	PCle_RX2-	NC	PCle_RX3+	PCle_RX3-	VPWR (5V)
14	GND	GND	XMC_GA2	GND	GND	NC (MSDA)
15	PCle_RX4+	PCle_RX4-	NC	PCle_RX5+	PCle_RX5-	VPWR (5V)
16	GND	GND	NVMRO	GND	GND	NC (MSCL)
17	PCle_RX6+	PCle_RX6-	NC	PCle_RX7+	PCle_RX7-	NC
18	GND	GND	NC (FPGAIO1)	GND	GND	NC
19	PCle_CLK+	PCle_CLK-	NC	NC (WAKE#)	NC (ROOT#)	NC (FPGAIO2)

Table 4-2: XMC Site Connector Pin Definition

PCle_TX
PCle_RX
PCle_CLK
Power
JTAG

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	RGB0_R

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

DVI0
DVI1
DVI2
DVI3
RGB0
Power

5 Getting Started

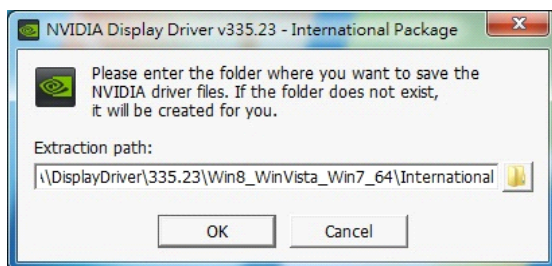
5.1 Installing the Module

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.

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.



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.

- ▶ 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.

Getting Service

Contact us should you require any service or assistance.

ADLINK Technology, Inc.

Address: 9F, No.166 Jian Yi Road, Zhonghe District
New Taipei City 235, Taiwan
新北市中和區建一路 166 號 9 樓
Tel: +886-2-8226-5877
Fax: +886-2-8226-5717
Email: service@adlinktech.com

Ampro ADLINK Technology, Inc.

Address: 5215 Hellyer Avenue, #110
San Jose, CA 95138, USA
Tel: +1-408-360-0200
Toll Free: +1-800-966-5200 (USA only)
Fax: +1-408-360-0222
Email: info@adlinktech.com

ADLINK Technology (China) Co., Ltd.

Address: 上海市浦东新区张江高科技园区芳春路 300 号 (201203)
300 Fang Chun Rd., Zhangjiang Hi-Tech Park
Pudong New Area, Shanghai, 201203 China
Tel: +86-21-5132-8988
Fax: +86-21-5132-3588
Email: market@adlinktech.com

ADLINK Technology Beijing

Address: 北京市海淀区上地东路 1 号盈创动力大厦 E 座 801 室(100085)
Rm. 801, Power Creative E, No. 1 Shang Di East Rd.
Beijing, 100085 China
Tel: +86-10-5885-8666
Fax: +86-10-5885-8626
Email: market@adlinktech.com

ADLINK Technology Shenzhen

Address: 深圳市南山区科技园南区高新南七道 数字技术园
A1 栋 2 楼 C 区 (518057)
2F, C Block, Bldg. A1, Cyber-Tech Zone, Gao Xin Ave. Sec. 7
High-Tech Industrial Park S., Shenzhen, 518054 China
Tel: +86-755-2643-4858
Fax: +86-755-2664-6353
Email: market@adlinktech.com

LiPPERT ADLINK Technology GmbH

Address: Hans-Thoma-Strasse 11, D-68163
Mannheim, Germany
Tel: +49-621-43214-0
Fax: +49-621 43214-30
Email: emea@adlinktech.com

ADLINK Technology, Inc. (French Liaison Office)

Address: 6 allée de Londres, Immeuble Ceylan
91940 Les Ulis, France
Tel: +33 (0) 1 60 12 35 66
Fax: +33 (0) 1 60 12 35 66
Email: france@adlinktech.com

ADLINK Technology Japan Corporation

Address: 〒101-0045 東京都千代田区神田鍛冶町 3-7-4
神田 374 ビル 4F
KANDA374 Bldg. 4F, 3-7-4 Kanda Kajicho,
Chiyoda-ku, Tokyo 101-0045, Japan
Tel: +81-3-4455-3722
Fax: +81-3-5209-6013
Email: japan@adlinktech.com

ADLINK Technology, Inc. (Korean Liaison Office)

Address: 137-881 서울시 서초구 서초대로 326, 802 (서초동, 모인터빌딩)
802, Mointer B/D, 326 Seocho-daero, Seocho-Gu,
Seoul 137-881, Korea
Tel: +82-2-2057-0565
Fax: +82-2-2057-0563
Email: korea@adlinktech.com

ADLINK Technology Singapore Pte. Ltd.

Address: 84 Genting Lane #07-02A, Cityneon Design Centre
Singapore 349584
Tel: +65-6844-2261
Fax: +65-6844-2263
Email: singapore@adlinktech.com

ADLINK Technology Singapore Pte. Ltd. (Indian Liaison Office)

Address: #50-56, First Floor, Spearhead Towers
Margosa Main Road (between 16th/17th Cross)
Malleswaram, Bangalore - 560 055, India
Tel: +91-80-65605817, +91-80-42246107
Fax: +91-80-23464606
Email: india@adlinktech.com

ADLINK Technology, Inc. (Israeli Liaison Office)

Address: 27 Maskit St., Corex Building
PO Box 12777
Herzliya 4673300, Israel
Tel: +972-54-632-5251
Fax: +972-77-208-0230
Email: israel@adlinktech.com

ADLINK Technology, Inc. (UK Liaison Office)

Tel: +44 774 010 59 65
Email: UK@adlinktech.com