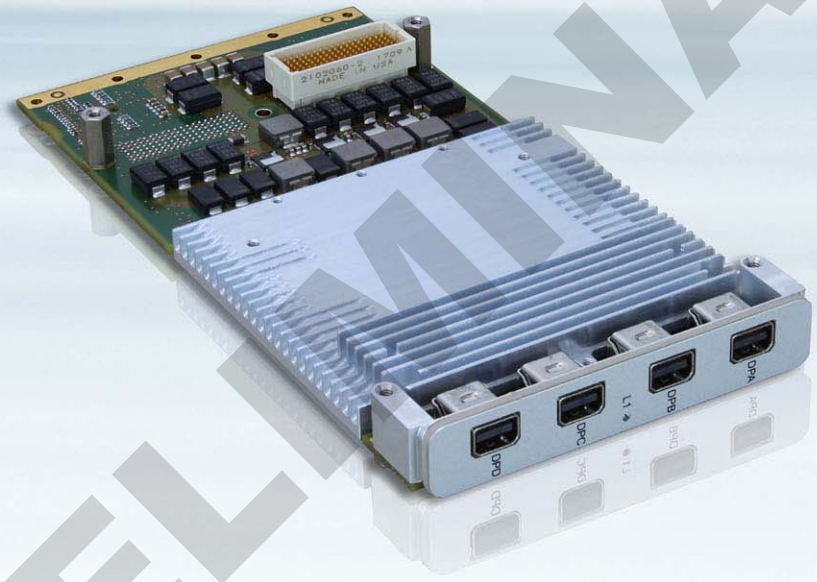
USER'S GUIDE



XMC-GPU91 Mezzanine Card

CA.DT.B40.0e - March 2018

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XMC-GPU91 User's Guide

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Symbols

The following symbols may be used in this manual:

⚠DANGER	DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.
⚠WARNING	WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠CAUTION	CAUTION indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	NOTICE indicates a property damage message.
	**Electric Shock!** This symbol and title warn of hazards due to electrical shocks (> 60 V) when touching products or parts of them. Failure to observe the precautions indicated and/or prescribed by the law may endanger your life/health and/or result in damage to your material.
	**ESD Sensitive Device!** This symbol and title inform that the electronic boards and their components are sensitive to static electricity. Care must therefore be taken during all handling operations and inspections of this product in order to ensure product integrity at all times.
	**HOT Surface!** Do NOT touch! Allow to cool before servicing.
	**Laser!** This symbol inform of the risk of exposure to laser beam from an electrical device. Eye protection per manufacturer notice shall review before servicing.
	This symbol indicates general information about the product and the user manual. This symbol also indicates detail information about the specific product configuration.
	This symbol indicates important information which must be read carefully.
	This symbol precedes helpful hints and tips for daily use.

For Your Safety

Your new Kontron product was developed and tested carefully to provide all features necessary to ensure its compliance with electrical safety requirements. It was also designed for a long fault-free life. However, the life expectancy of your product can be drastically reduced by improper treatment during unpacking and installation. Therefore, in the interest of your own safety and of the correct operation of your new Kontron product, you are requested to conform with the following guidelines.

High Voltage Safety Instructions

As a precaution and in case of danger, the power connector must be easily accessible. The power connector is the product's main disconnect device.

⚠CAUTION

Warning!
All operations on this device must be carried out by sufficiently skilled personnel only.

⚠CAUTION

Caution, Electric Shock!
Before installing a non hot-swappable Kontron product into a system always ensure that your mains power is switched off. This also applies to the installation of piggybacks. Serious electrical shock hazards can exist during all installation, repair, and maintenance operations on this product. Therefore, always unplug the power cable and any other cables which provide external voltages before performing any work on this product.
Earth ground connection to vehicle's chassis or a central grounding point shall remain connected. The earth ground cable shall be the last cable to be disconnected or the first cable to be connected when performing installation or removal procedures on this product.

Special Handling and Unpacking Instructions

ESD Sensitive Device!
Electronic boards and their components are sensitive to static electricity. Therefore, care must be taken during all handling operations and inspections of this product, in order to ensure product integrity at all times

Do not handle this product out of its protective enclosure while it is not used for operational purposes unless it is otherwise protected.

Whenever possible, unpack or pack this product only at EOS/ESD safe work stations. Where a safe work station is not guaranteed, it is important for the user to be electrically discharged before touching the product with his/her hands or tools. This is most easily done by touching a metal part of your system housing.

It is particularly important to observe standard anti-static precautions when changing piggybacks, ROM devices, jumper settings etc. If the product contains batteries for RTC or memory backup, ensure that the product is not placed on conductive surfaces, including anti-static plastics or sponges. They can cause short circuits and damage the batteries or conductive circuits on the product.

General Instructions on Usage

In order to maintain Kontron's product warranty and CE compliance, this product must not be altered or modified in any way. Changes or modifications to the product, that are not explicitly approved by Kontron and described in this manual or received from Kontron's Technical Support as a special handling instruction, will void your warranty and the CE compliance.

This product should only be installed in or connected to systems that fulfill all necessary technical and specific environmental requirements. This also applies to the operational temperature range of the specific board version, that must not be exceeded. If batteries are present, their temperature restrictions must be taken into account.

In performing all necessary installation and application operations, only follow the instructions supplied by the present manual.

Keep all the original packaging material for future storage or warranty shipments. If it is necessary to store or ship the product then re-pack it in the same manner as it was delivered.

Special care is necessary when handling or unpacking the product. See Special Handling and Unpacking Instruction.

Environmental Protection Statement

This product has been manufactured to satisfy environmental protection requirements where possible. Many of the components used (structural parts, printed circuit boards, connectors, batteries, etc.) are capable of being recycled.

Final disposition of this product after its service life must be accomplished in accordance with applicable country, state, or local laws or regulations.

Environmental protection is a high priority with Kontron.
Kontron follows the DEEE/WEEE directive.
You are encouraged to return our products for proper disposal.

The Waste Electrical and Electronic Equipment (WEEE) Directive aims to:

- Reduce waste arising from electrical and electronic equipment (EEE)
- Make producers of EEE responsible for the environmental impact of their products, especially when they become waste
- Encourage separate collection and subsequent treatment, reuse, recovery, recycling and sound environmental disposal of EEE

Improve the environmental performance of all those involved during the lifecycle of EEE

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1 / Introduction

1.1 Manual Overview

This manual describes the XMC-GPU91, a quad head graphics XMC mezzanine card from Kontron. This manual is divided in several chapters and sub-sections:

- Chapter 1: This chapter, Manual Conventions, Related Documents and XMC-G91 Overview.
- Chapter 2: Unpacking, installation and identification instructions.
- Chapter 3: Functional characteristics of the XMC.
- Chapter 4: XMC connectors.
- Appendix A: General, physical and environmental specifications, power requirements, EMC regulatory compliance and safety, flammability rating and MTBF data.
- Appendix B: Software Useful Tips.
- Appendix C: List of Abbreviations.

1.2 Related Documents

This guide is written to cover a wide range of people: from installation technicians, operators, and system managers, to hardware and software engineers. To better understand how the XMC-GPU91 functions, these individuals should be familiar with the concepts of the following documents.

Table 1: Industry Specifications and User Documentation

	ORDERING INFORMATION
Standard Physical and Environmental Layers for PCI Mezzanine Cards (PMC) IEEE Std 1386.1-2001	IEEE Standards Department Order Department 445 Hoes Lane, P.O. Box 1331 Piscataway, NJ 08855-1331 www.ieee.org
Standard Mechanics for a Common Mezzanine Card Family (CMC) IEEE 1386-2001	
XMC Switched Mezzanine Card Auxiliary Standard VITA 42.0-2005 Draft 0.29	VITA Standards Organization P.O. Box 19658 Fountain Hills AZ 85269-1958 www.vita.com
XMC PCI Express Protocol Layer Standard VITA 42.3-2006	
Environments, Design and Construction, Safety, and Quality for Plug-In Units ANSI/VITA 47-2005	
Conduction Cooled PMC (CCPMC) ANSI/VITA 20-2001 (R2005)	
Digital Visual Interface, DVI, revision 1.0	Digital Display Working Group -DDWG www.ddwg.org
Display port standard	https://www.vesa.org

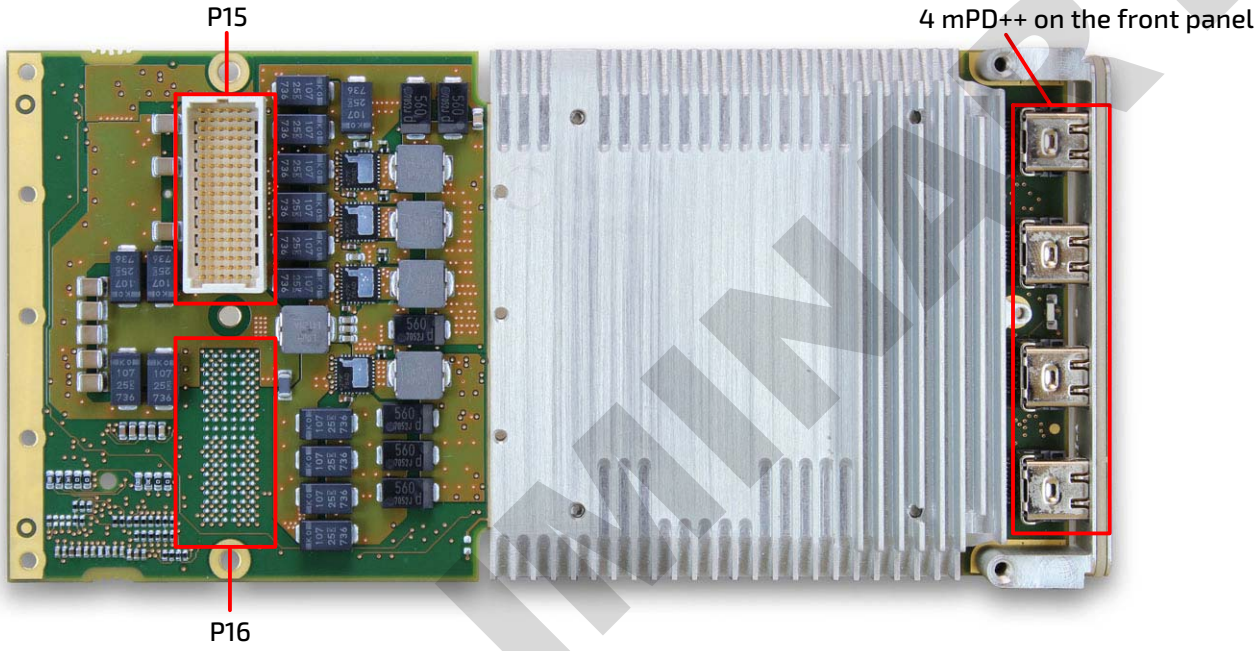
1.3 XMC-GPU91 Overview

The XMC-GPU91 benefits from the exceptional graphics performance and low power dissipation of the Polaris graphics controller E917x series from AMD. The AMD E9171 controller supports 2D and 3D acceleration with display resolution up to 5120x2880 pixel resolution in Display port 1.4 mode, 36 bits per pixel.

The XMC-GPU91 mezzanine features four independent displays through four mDP++ front connectors for the air-cooled commercial version (SA) and the rugged air-cooled version (RA).

The XMC-GPU91 rugged conduction-cooled version (RC) features four digital display ports video output on the rear P16 XMC connector.

Figure 1: XMC-GPU91/SA Overview



1.3.1 Features and Functions

- Up to four mini display port (mDP++) digital video outputs on the front panel

  Up to four independent display controllers that support up to true 36-bpp (bits per pixel) throughout the display pipe DisplayPort 1.4

  - Up to two 5120 x 2880 pixel resolution displays @ 60 Hz refresh rates with dual-cable configuration, or
  - One 5120 x 2880 pixel resolution display @ 60 Hz refresh rates with single-cable configuration, or
  - Up to five 3840 x 2160 @ 60 Hz or 4096 x 2160 @ 60 Hz displays.

  Refer to the E9171-MCM GPU datasheets for detailed information about GPU performances.

- Intergated HD-Audio Controller (Azalia) and Codec

  Each DisplayPort output supports HD audio stream independently, up to a maximum of four output streams .

- Video Decode Acceleration technology
  - Dedicated Unified Video Decoder hardware (UVD) for H.264, HEVC, VC-1,MPEG-4, MPEG-2, and MVC
  - Microsoft DirectX Video Acceleration (DXVA) application interface (API)for Windows® operating systems
  - HEVC (H.265) Video Encoding acceleration technology

- Video Processing Acceleration
  - Video scaling and YCrCb to RGB color space conversion for video playback and fully adjustable color controls
  - Motion Adaptive and Vector based deinterlacing filter eliminates video artifacts caused by displaying interlaced video on non-interlaced displays, and by analyzing image and using optimal deinterlacing function on a perpixel basis.
  - HD HQV and SD HQV support: noise removal, detail enchantment, color enhancement, cadence detection, sharpness, and advanced deinterlacing.
  - Advanced upscaling of SD content to HD resolution.
  - Multi-planes compositing engine for Blu-ray player applications.
  - Supports top-quality DVD and Blu-ray disc playback with the lowest CPU usage.

- PCI Express bus support features
  - Compliant with the PCI Express® Base Specification Revision 3.0, up to 8.0 GT/s.
  - Supports x1, x2, x4, and x8 lane widths.
  - Supports 2.5 GT/s, 5.0 GT/s, and 8.0 GT/s link-data rates.
  - Supports x8 lane reversal where the transmitters on lanes 0 to 7 on the graphics endpoint are mapped to the receivers on lanes 7 down to 0 on the root complex (requires corresponding support on the root complex).
  - Supports full-swing and low-swing transmitter output levels.

- Dual mode on Mini DisplayPort (mDP++)

  This mode allows to transmit single-link HDMI and DVI signals through DisplayPort cabling; this requires passive external adapters which convert to the higher signal levels used by DVI/HDMI.

  Usually, Dual-mode DisplayPort chipset detects the DVI or HDMI passive adapter and switches to DVI/HDMI mode, this detection is performed by Cable Detect pin of DisplayPort connector (config1 pin)

1.3.2 Ordering Information

Table 2: XMC-GPU91 Ordering Information

ARTICLE	ORDER NUMBER	DESCRIPTION
Air-cooled version		
XMC-GPU91	XMC-GPU91-SA100	XMC VITA42 compliant "XMC-1" mezzanine AMD E9171 - 4 GB MB of integrated GDDR5 Memory Four front mDP++ , no P16 rear I/O option x8 PCIe interface SA class (0°c to 55°C)
XMC-GPU91	XMC-GPU91-SA200	XMC VITA61 compliant "XMC-2" mezzanine AMD E9171 - 4 GB MB of integrated GDDR5 Memory Four front mDP++ , no P16 rear I/O option x8 PCIe interface SA class (0°c to 55°C)

Other features supported on demand. Contact Kontron for availability.

2 / Installation

2.1 Safety Requirements

The following safety precautions must be observed when installing or operating the XMC-GPU91.

Kontron assumes no responsibility for any damage resulting from failure to comply with these requirements.

This board contains electrostatically sensitive devices. Please observe the necessary precautions to avoid damage to your board:

- Discharge your clothing before touching the assembly. Tools must be discharged before use.
- Do not touch components, connector pins or traces.
- We strongly recommend our customers to work in an environment equipped with anti-static workbenches with professional discharging equipments.

Special care shall be taken while handling the board: the heat sink can get very hot during operation.

Do not touch the heat sink when installing or removing the board.

In addition, the board should not be placed on any surface or in any form of storage container before the board and heat sink have cooled down to room temperature.

2.2 Installation

The XMC-GPU91 is shipped in an individual, reusable shipping box closed by an ESD stick-on label.

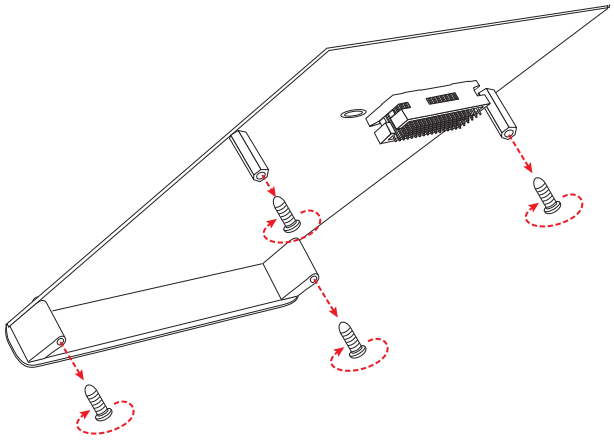
Closely inspect the board for any signs of shipment-related damages such as loose components or bent pins. If any evidence of damage is discovered, notify the carrier and Kontron immediately. The XMC-GPU91 board attaches to a host board. The attaching hardware for the XMC-GPU91 board is included with your order. Do not throw out the shipping box, it should be used to store or ship the board.

2.2.1 Installation of the Forced Air-Cooled Type

Attach the XMC-GPU91 board to the XMC host board according to the following steps.

1. Remove the XMC host board from the chassis.
2. Unscrew the four screws on the bottom of the XMC-GPU91 as described below:

Figure 2: Preparing the XMC-GPU91



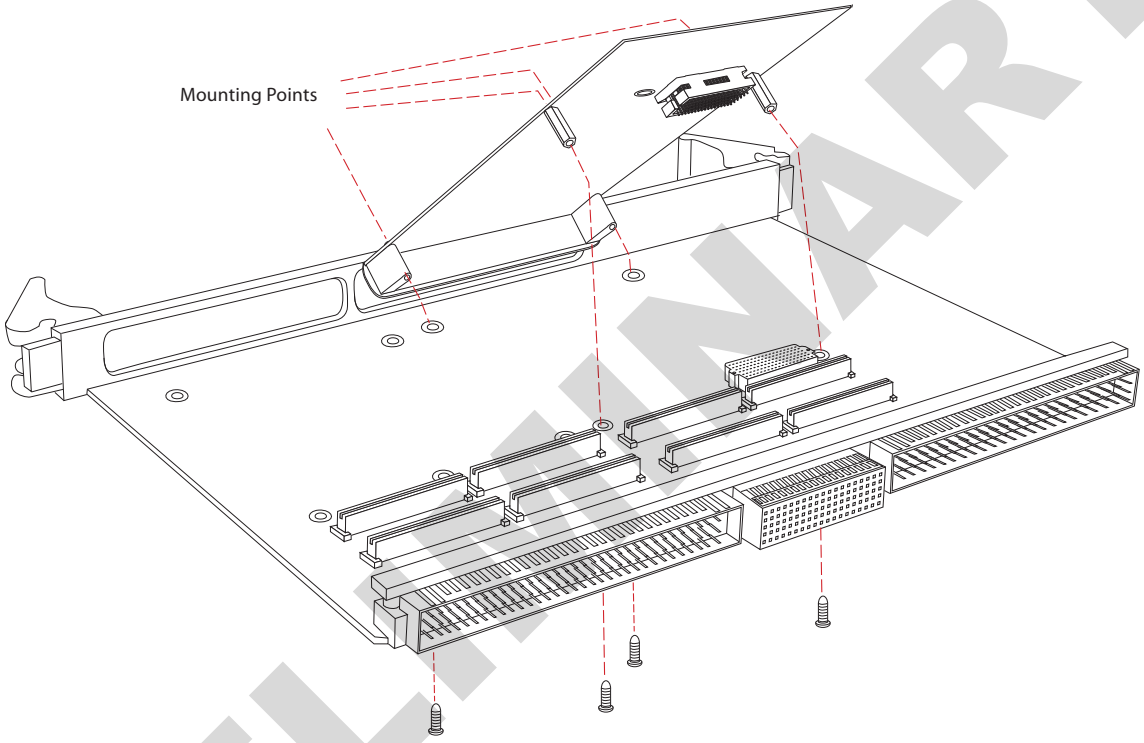
3. Install the XMC-GPU91, component-side down, aligning the connectors with their mating connectors on the host board. Press them together so that the friction from the pins holds them together. Insert the standoff plug mounted on the host board into the keyhole. The module's bezel will fill the slot and provide a connection to the module.

4. Secure the XMC-GPU91 board to the host board by inserting the 4 screws supplied with the XMC-GPU91 board through the bottom of the host board and into the standoffs and front panel holes attached to the XMC-GPU91 board.

5. Insert the host board back into the chassis making sure it is plugged into the backplane.

6. The XMC-GPU91 board attachment is now complete.

Figure 3: Installation of an XMC-GPU91 on XMC Carrier Board



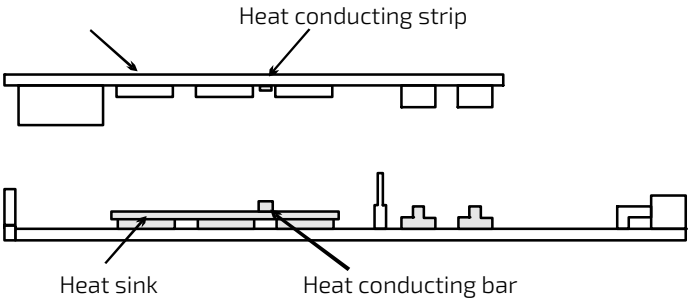
Tighten with a torque of 0.383 Nm (0.233 lbf ft)

2.2.2 Installation of the Conduction-Cooled Type (RC)

Attach the XMC-GPU91/RC board to the XMC host board according to the following steps.

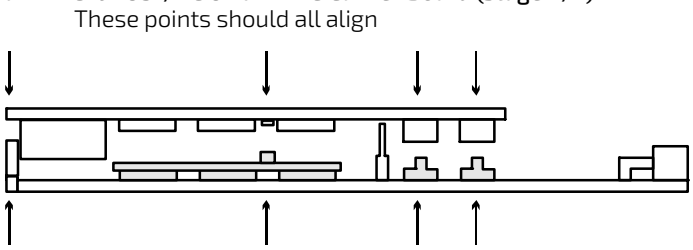
1. Check that the standoffs are attached to the XMC-GPU91/RC. Align the standoffs and the holes at the front and the middle of the XMC with the matching holes on the XMC Carrier Board. XMC-GPU91/RC Heat conducting strip

Figure 4: Installation of an XMC-GPU91/RC on an XMC Carrier Board **(stage 1/4)**



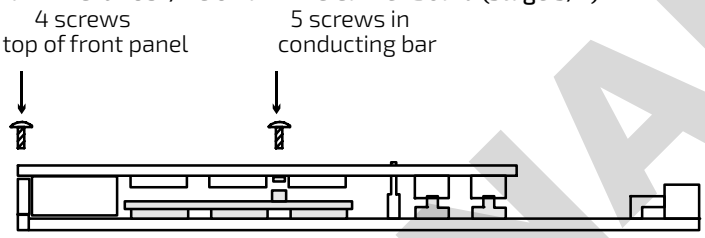
2. Lower the XMC-GPU91/RC component side down, fitting the XMC-GPU91/RC connectors into their mating connectors on the XMC Carrier Board. Press them together so that the friction from the pins holds the XMC-GPU91/RC in place.

Figure 5: Installation of an XMC-GPU91/RC on an XMC Carrier Board **(stage 2/4)**



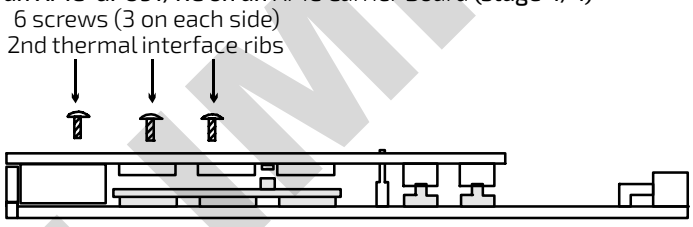
3. Screw the XMC-GPU91/RC in place using 4 mounting screws in the top of the front panel, 5 along the conduction strip. Screws dimension: M2x6mm. Tighten with a torque of 0.383 Nm (0.233 lbf ft).

Figure 6: Installation of an XMC-GPU91/RC on an XMC Carrier Board **(stage 3/4)**



4. Mount 6 screws on the optional secondary thermal interface ribs. These screws are provided by the host board manufacturer. Tighten with a torque of 0.383 Nm (0.233 lbf ft).

Figure 7: Installation of an XMC-GPU91/RC on an XMC Carrier Board **(stage 4/4)**



The two optional secondary thermal interface ribs should be used to get the specified module thermal performance.

In order to satisfy the shock and vibration specifications, foresee an additional anchorage point that could either be the 3.3V keying pin hole (1), or the central hole of the line of optional holes behind the P4 connector (2). Figure 8 shows the possible locations (1) and (2) for an additional anchorage point on the XMC-GPU91/RC board. Figure 9 shows the location (1) for an additional anchorage point on an XMC Carrier Board.

Figure 8: Additional Anchorage Point on an XMC-GPU91/RC Board

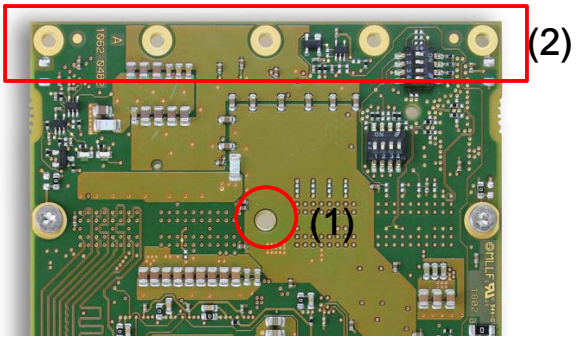
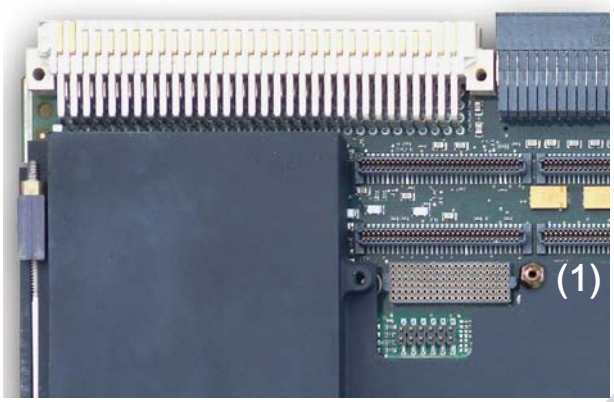


Figure 9: Additional Anchorage Point on an XMC Carrier Board



2.3 Removing the Board Assembly

Remove the XMC-GPU91 card carefully from the XMC carrier using the following procedure:

1. If applicable, remove the carrier board from system using carrier board removal procedures.
2. Remove the XMC-GPU91 retaining screws
3. Carefully disengage the XMC Connector P15 and the XMC connector on the carrier board so that no force or movement is applied to the XMC card bezel
4. Slide the XMC card away from the front panel.
5. Dispose of the XMC as required.

Due care should be exercised when handling the board due to the fact that the heat sink can get very hot.

Do not touch the heat sink when changing the board.

2.4 HDMI and DVI adapters

Front panel mini DisplayPort inputs are dual mode ports that allow the use of HDMI and DVI adapters.

Here a non-exhaustive list of tested adapters:

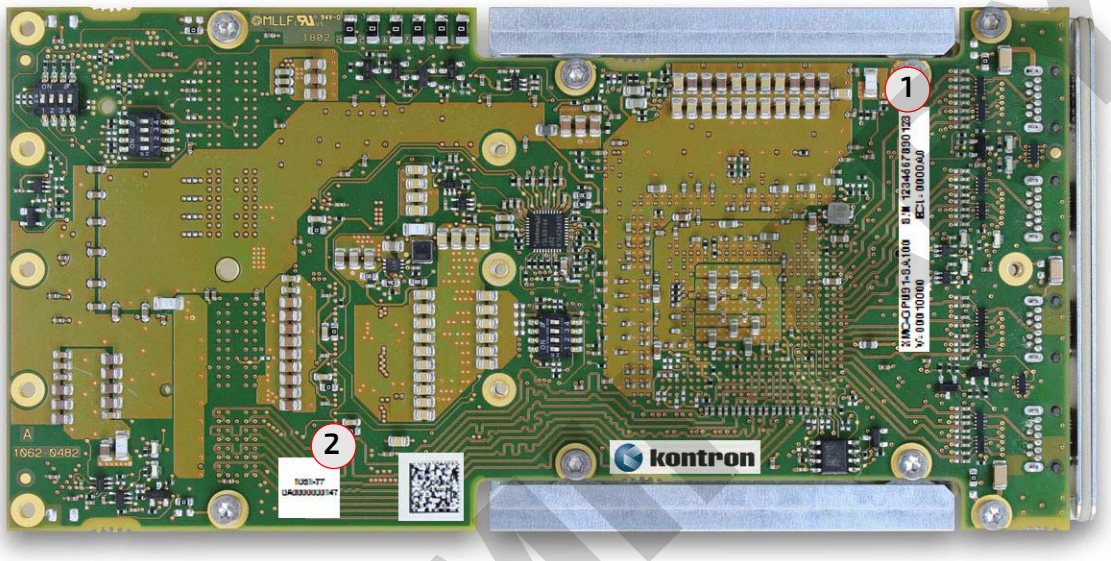
- MiniDP to HDMI adapter: Icy Box, part number IB-AC506
- MiniDP to DVI adapter: StarTech, part number MDP2DVIMM3B

2.5 Board Identification

XMC-GPU91 boards are identified by labels fitted to the bottom side of the XMC.

Labels fitted to the bottom side of the XMC-GPU91

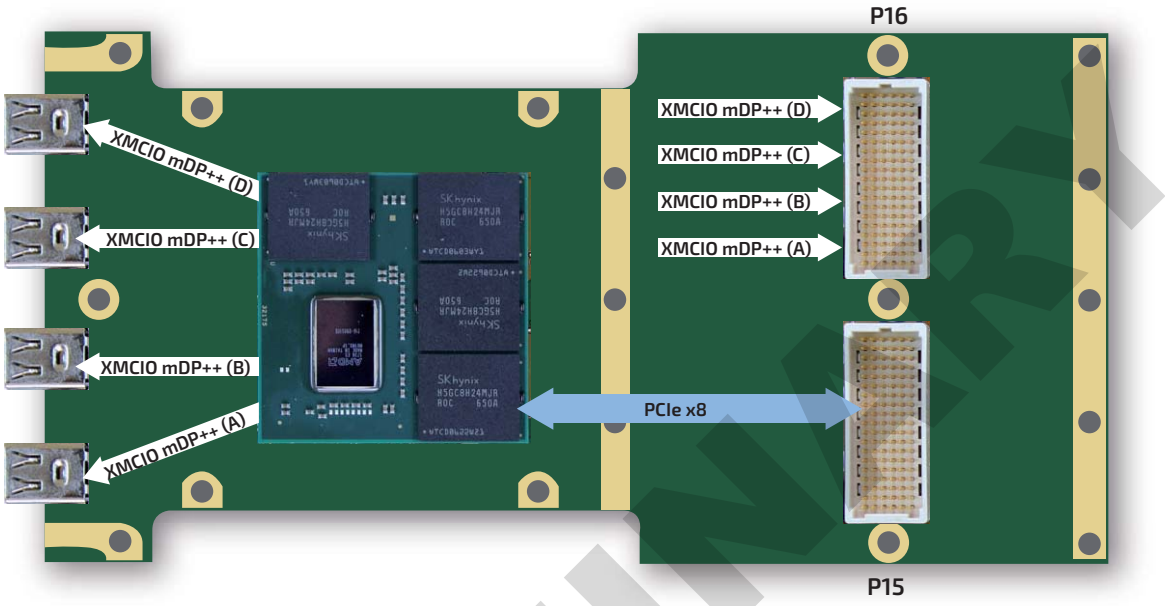
- "Order Code", "Board revision" and "Chronological serial number" label **(1)**
- SAP Label **(2)**



3 / Functional Description

Figure 10 provides a functional block diagram of the XMC-GPU91.

Figure 10: XMC-GPU91 Functional Block Diagram



Signaling on P16 connector is only available on Rugged Conduction-Cooled (RC) configuration or on customer demand.

3.1 Graphics Processing Unit (GPU)

The AMD E9171 device, with built in memory, provides the GPU function. The host communicates with the GPU using the x8 PCI-Express interface via P15 connector. The circuit also provides a link to the temperature monitor, Flash firmware, and provides the video outputs to the connectors through a pair of filters.

Table 3: Graphics Controller Snapshot

E9171-MCM	GRAPHICS CONTROLLER SNAPSHOT
GPU core Clock	Up to 921 MHz (*)
Integrated Memory	4 GB
Integrated Memory clock	Up to 625 MHz
Max GPU operating temperature	95°C

(*) TDP close to 25W

3.2 Temperature Monitoring

The temperature monitoring device is integrated in the GPU. Based on GPU temperature reported during monitoring or set through alert trip points, the software driver might change the core voltage and core speed to optimize GPU performance versus operating conditions.

AMD Embedded E9171 has an integrated thermal sensor providing GPU die temperature (accuracy ± 3°C) without the need for an external chip.

3.3 Flash EPROM

A 4Mbit SPI Flash is attached to the GPU to configure the GPU during power-on and reset phases. The EPROM is read by the GPU during initialization and contains valid video BIOS images. Write protection is normally provided by software via registers built into the EEPROM but can also be forced by NVRMO mechanism defined in XMC standards.

3.4 Board configuration

Three micro switches are available to set board configuration can be accessed on the bottom side.

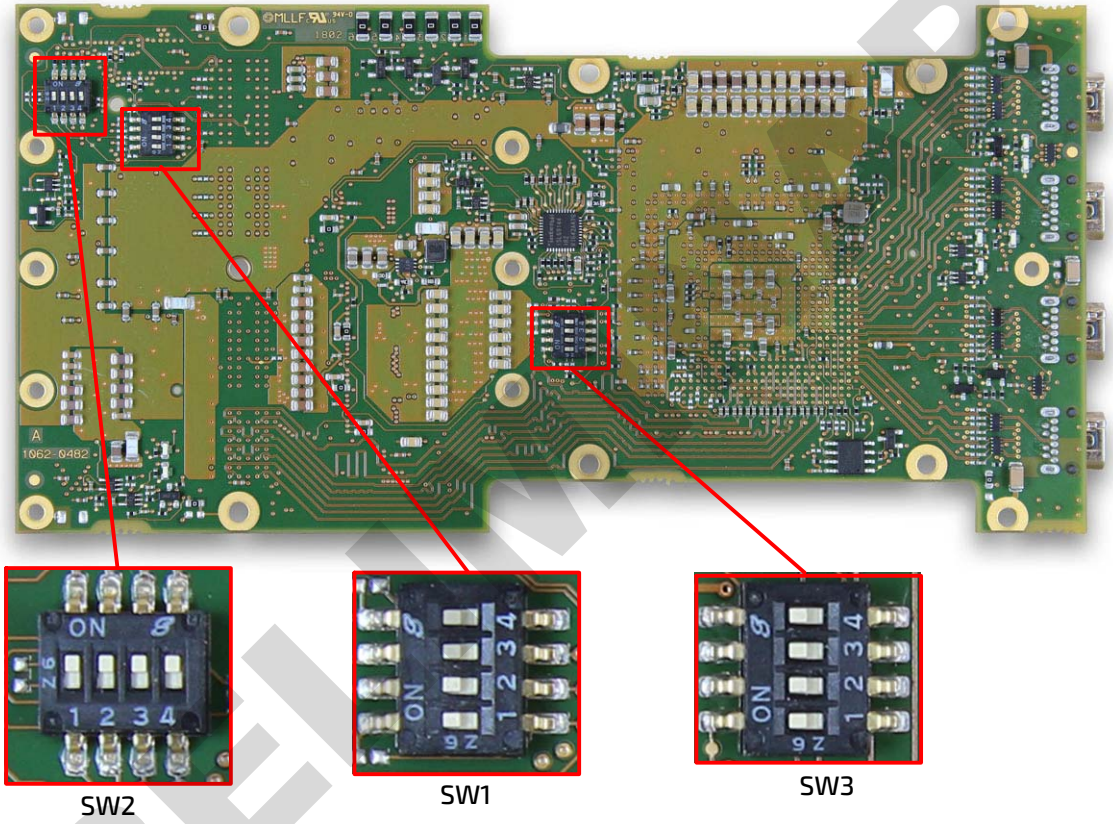


Table 4: SW1 Microswitch Description

FUNCTION	DESCRIPTION	DEFAULT POSITION
SW1-1	**OFF**: NVMRO protection according NVMRO signal level from P15 **ON**: NVMRO protection forced	**OFF**
SW1-2	**OFF**: Normal operation **ON**: Reserved	**OFF**
SW1-3	**OFF**: Normal operation **ON**: Reserved	**OFF**
SW1-4	**OFF**: Normal operation **ON**: Reserved	**OFF**

Table 5: SW2 Microswitch Description

FUNCTION	DESCRIPTION	DEFAULT POSITION
SW2-1	**OFF**: Normal operation **ON**: Reserved	**OFF**
SW2-2	**OFF**: Normal operation **ON**: Reserved	**OFF**
SW2-3	**OFF**: Normal operation **ON**: Reserved	**OFF**
SW2-4	**OFF**: Normal operation **ON**: Reserved	**OFF**

Table 6: SW3 Microswitch Description

FUNCTION	DESCRIPTION	DEFAULT POSITION
SW3-1	**OFF**: Normal operation **ON**: Reserved	**OFF**
SW3-2	**OFF**: Normal operation **ON**: Reserved	**OFF**
SW3-3	**OFF**: Normal operation **ON**: Reserved	**OFF**
SW3-4	**OFF**: Normal operation **ON**: Reserved	**OFF**

4 / Connectors

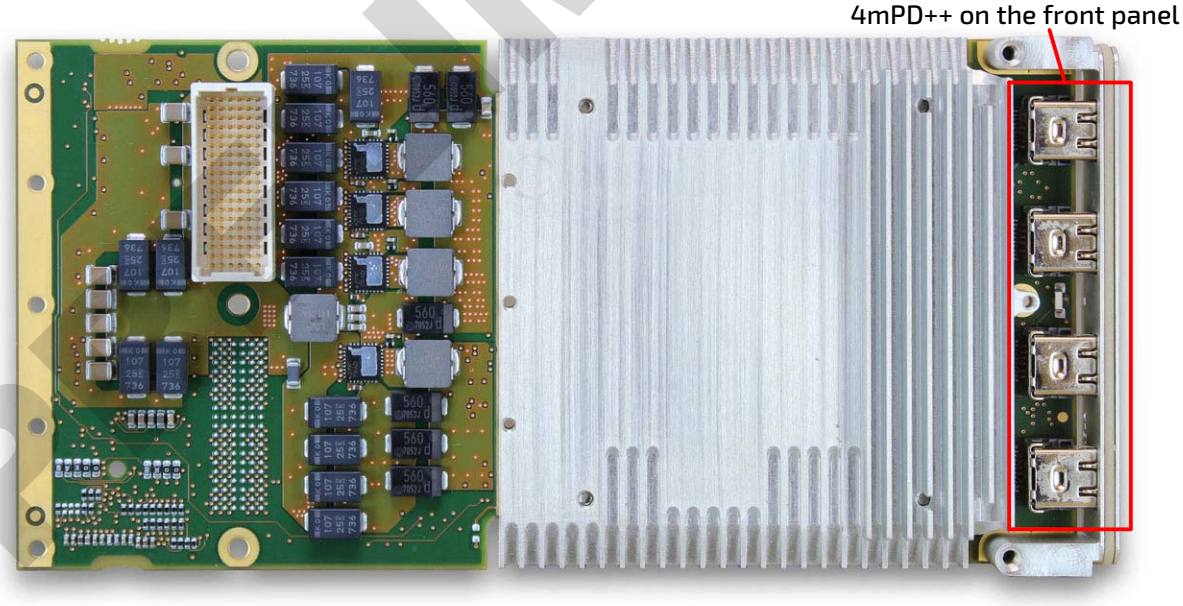
4.1 Front Panel

Front panel Mini Display ports connectors are available only in air-cooled commercial build configuration.

Figure 11: XMC-GPU91 Front Panel

DPA, DPB, DPC and DPD are equivalent mDP++ port.
L1 Led is ON during board reset (green light).

Figure 12: Front Panel Connectors Location



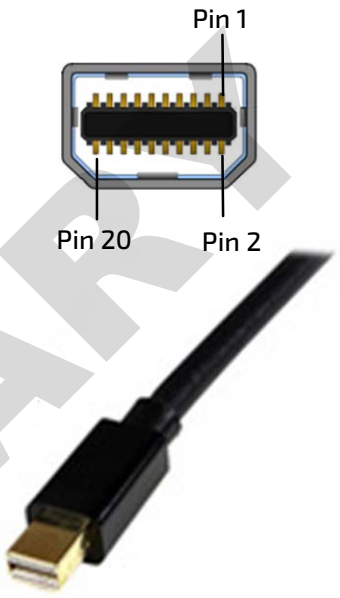
4.1.1 DPA, DPB, DPC, DPD – Mini display port connectors (mDP++)

Those are mini display port connectors wired for a mDP++ cables.

Table 7: Mini DisplayPort Pin Assignment

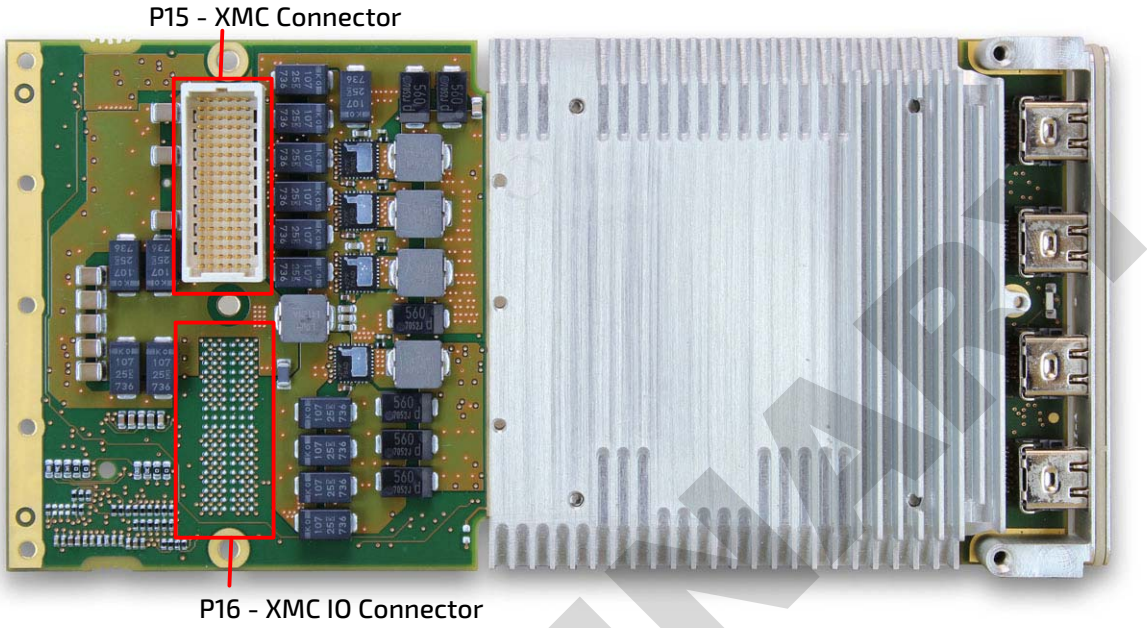
PIN	SIGNAL	FUNCTION
1	GND	Ground
2	HPD	Hot Plug Detect
3	Lane0+	Lane 0 Positive
4	Config1	Config1, dongle detect for dual-mode DP (mDP++)
5	Lane0-	Lane 0 negative
6	Config2	Config2, pulled low by XMC-GPU91
7	GND	Ground
8	GND	Ground
9	Lane1+	Lane 1 positive
10	Lane3+	Lane 3 positive
11	Lane1-	Lane 1 negative
12	Lane3-	Lane 3 negative
13	GND	Ground
14	GND	Ground
15	Lane2+	Lane 2 positive
16	Aux+	Auxilliary+
17	Lane2-	Lane 2 negative
18	Aux-	Auxilliary-
19	GND	Ground
20	PWR	Power (3.3V, 500 mA max)

Figure 13: MinI DisplayPort Cable



4.2 Onboard Connectors

Figure 14: Onboard Connectors Location



P16 XMC IO connector is only equipped on XMC-GPU91 RC boards.

4.2.1 P15 - XMC Connector

Table 8: P15 - XMC Connector Pin Assignment

PIN	ROW A	ROW B	ROW C	ROW D	ROW E	ROW F
1	PET0p0	PET0n0	3.3V	PET0p1	PET0n1	VPWR (1)
2	GND	GND	Reserved	GND	GND	MRSTI#
3	PET0p2	PET0n2	3.3V	PET0p3	PET0n3	VPWR (1)
4	GND	GND	Reserved	GND	GND	Reserved
5	PET0p4	PET0n4	3.3V	PET0p5	PET0n5	VPWR (1)
6	GND	GND	Reserved	GND	GND	+12V (2)
7	PET0p6	PET0n6	3.3V	PET0p7	PET0n7	VPWR (1)
8	GND	GND	TDI (3)	GND	GND	-12V (2)
9	N.C.	N.C.	N.C.	N.C.	N.C.	VPWR (1)
10	GND	GND	TDO (3)	GND	GND	Reserved
11	PER0p0	PER0n0	Reserved	PER0p1	PER0n1	VPWR (1)
12	GND	GND	Reserved	GND	GND	GND
13	PER0p2	PER0n2	Reserved	PER0p3	PER0n3	VPWR (1)
14	GND	GND	Reserved	GND	GND	Reserved
15	PER0p4	PER0n4	N.C.	PER0p5	PER0n5	VPWR (1)
16	GND	GND	Reserved	GND	GND	Reserved
17	PER0p6	PER0n6	N.C.	PER0p7	PER0n7	N.C.
18	GND	GND	N.C.	GND	GND	N.C.
19	REFCLK+0	REFCLK-0	N.C.	XMC_WAKE#	N.C.	N.C.

(1) VPWR: 5V or 12V
(2) Not Used
(3) TDI and TDO JTAG serial data are wired together.
Signals active when low.

Table 9: P15 - XMC Signal Description

MNEMONIC	SIGNAL DESCRIPTION
MRSTI#	XMC Reset In. The mezzanine card shall initiate itself into a known state when this signal is asserted low by the carrier.
MPRESENT#	Module Present. This signal allows the carrier to determine whether an XMC is present. Connected to GND on XMC module.
PER0p/n[0..7]	Link 0 Differential Receive. These signals are used by the XMC to receive high-speed protocol-specific data FROM the carrier over the PCI Express interface.
PET0p/n[0..7]	Link 0 Differential Transmit. These signals are used by the XMC to receive high-speed protocol-specific data TO the carrier over the PCI Express interface.

4.2.2 P16 - XMC Connector

Table 10: P16 - XMC Connector Pin Assignment

PIN	ROW A	ROW B	ROW C	ROW D	ROW E	ROW F
1	DP-A 0+	DP-A 0-	DP-A AUX+	DP-A 1+	DP-A 1-	DP-A HPD
2	GND	GND		GND	GND	
3	DP-A 2+	DP-A 2-	DP-A AUX-	DP-A 3+	DP-A 3-	DP-A MODE
4	GND	GND		GND	GND	
5	DP-C 0+	DP-C 0-	DP-C AUX+	DP-C 1+	DP-C 1-	DP-C HPD
6	GND	GND		GND	GND	
7	DP-C 2+	DP-C 2-	DP-C AUX-	DP-C 3+	DP-C 3-	DP-C MODE
8	GND	GND		GND	GND	
9						
10	GND	GND		GND	GND	
11	DP-B 0+	DP-B 0-	DP-B AUX+	DP-B 1+	DP-B 1-	DP-B HPD
12	GND	GND		GND	GND	
13	DP-B 2+	DP-B 2-	DP-B AUX-	DP-B 3+	DP-B 3-	DP-B MODE
14	GND	GND		GND	GND	
15	DP-D 0+	DP-D 0-	DP-D AUX+	DP-D 1+	DP-D 1-	DP-D HPD
16	GND	GND		GND	GND	
17	DP-D 2+	DP-D 2-	DP-D AUX-	DP-D 3+	DP-D 3-	DP-D MODE
18	GND	GND	DP-B AUX+	GND	GND	*DP-A AUX+*
19	DP-B AUX+	DP-D AUX-	DP-B AUX-	DP-A AUX+	DP-A AUX-	*DP-A AUX-*

Appendix A - Specifications

Appendix A lists the general, physical and environmental specifications. It also covers items such as power requirements, EMC regulatory compliance and safety, and flammability rating.

A.1 General Specifications

- Model XMC-GPU91 Mezzanine Card
- Form Factor IEEE P1386
- Certification: EU label

A.2 Physical Specifications

- Dimension: 75 mm x 150 mm x 8.2 mm
- Weight: 82 g without mechanics, 135 g with mechanics (SA build with aluminum heatsink)
- Form Factor: P1386

A.3 Environmental Specifications

Table 11: Environmental Specifications

	SA - STANDARD COMMERCIAL	RA - RUGGED AIR-COOLED	RC - RUGGED CONDUCTION-COOLED
Conformal Coating	Optional	Standard	Standard
Airflow	See Note 1	NA	NA
Cooling Method	Convection	Convection	Conduction
Operating	0°C to +55°C	TBD	TBD
Storage	TBD	TBD	TBD
Vibration Sine (Operating)	TBD	TBD	TBD
Random (Operating)	TBD	TBD	TBD
Shock (Operating)	TBD	TBD	TBD
Altitude (Operating)	TBD	TBD	TBD
Relative Humidity	90% non-condensing	95% non-condensing	95% non-condensing

Note 1: Minimum inlet airflow depends on XMC integration, and cannot be defined at an XMC mezzanine level. Maximum E9171-MCM GPU junction temperature shall never exceed 95°C. Use E9171-MCM temperature monitoring software to ensure that E9171-MCM part is cooled enough when operating.

A.4 Power Requirements

The XMC input power requirements are 5V or 12V VPWR and +3.3V from the P15 XMC connector.

POWER STATE		VPWR PIN VOLTAGE = 12V		VPWR PIN VOLTAGE = = 5 V		CURRENT MEASUREMENTS CONDITIONS
		I TYP.	I MAX	I TYP.	I MAX	
Idle power requirement	P15 VPWR pins	0.6 A	0.7 A	TBD	TBD	No activity, frozen display
	P15 3V3 pins	0.6 A	0.7 A	TBD	TBD	
Typical power requirement	P15 VPWR pins	1.25 A	1.8 A	TBD	TBD	GPU100% SCLK @ 734 Mhz MCLK @ 300 Mhz
	P15 3V3 pins	-	0.7 A	TBD	TBD	
Maximal power requirement	P15 VPWR pins	2 A	2.5 A	TBD	TBD	GPU100% SCLK @ 921 Mhz MCLK @ 625 Mhz
	P15 3V3 pins	0.6 A	0.7 A	TBD	TBD	

A.5 EMC Regulatory Compliance and Safety

The XMC-GPU91 is designed for use in systems meeting:

- EMC qualifications EN55082 (Ed. 09/95)
- EN55022 (Ed. 22/94) class A

A.6 Flammability Rating

TBD

A.7 MTBF Data

Calculations are made according to the standard MIL-HDBK217F-2 for eight types of environment:

- Ground Benign (GB),
- Air Inhabited Cargo (AIC),
- Naval Sheltered (NS),
- Air Rotary Wing (ARW),

Table 12: XMC-GPU91 MTBF Data

MTBF	MILHDBK217F-2						
	GB (HOURS)		NS (HOURS)		ARW (HOURS)	AIC (HOURS)	
	25°C	40°C	25°C	40°C	55°C	40°C	55°C
XMC-GPU91	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Appendix B - Software Useful Tips

- The XMC-GPU91 uses a Video BIOS (VBIOS) which automatically configures the VPU (Visual Processing Unit) during the initialization of the system. There is no additional program to develop on the host board to configure the GPU to allow users to have a display at the start up of the system.

- The XMC-GPU91 has been implemented on a host board using Ubuntu Linux distribution and native AMD driver version supporting AMD E9171-MCM

An optimized driver for Linux has been released by the graphics chipset manufacturer. It is recommended to use this driver when 3D accelerations or management of the features of the VPU (Visual Processing Unit).

- The XMC-GPU91 has been implemented on a host board using Windows operating system and native AMD driver version supporting AMD E9171-MCM

An optimized driver for windows has been released by the graphics chipset manufacturer. It is recommended to use this driver when 3D accelerations or management of the features of the VPU (Visual Processing Unit).

Appendix C - List of Abbreviations

AC	Alternating Current
ANSI	American National Standards Institute
CRT	Cathode Ray Tube
DVI	Digital Video Input
DVI-I	Digital Video Interface - Integrated
EPROM	Erasable Programmable Read Only Memory
EEPROM	Electrically Erasable Programmable Read Only Memory
ESD	Electrostatic Sensitive Device
FLASH	Bulk Electrically Erasable Programmable Read Only Memory
GPU	Graphics Processing Unit
IEEE	Institute of Electrical and Electronic Engineers
JTAG	Joint Test Action Group
MTBF	Mean Time Between Failures
PCI	Peripheral Component Interface
PICMG	PCI Industrial Computer Manufacturers Group
PIM	PCI Interface Module
PMC	PCI Mezzanine Card
RGB	Red Green Blue
RHEL	Red Hat Enterprise Linux
TMDS	Transition Minimized Differential Signaling
UXGA	Ultra eXtended Graphics Array
VBIOS	Video BIOS
VGA	Video Graphics Adapter
VPU	Visual Processing Unit
WEEE	Waste Electrical and Electronics Equipment
XMC	Express Mezzanine Card (VITA)

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