

» User Guide «

XMC402

Dual 10 Gigabit Ethernet XMC Module

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Table of Contents

<i>Disclaimer</i>	<i>ii</i>
<i>Revision History</i>	<i>iv</i>
<i>Table of Contents</i>	<i>v</i>
<i>List of Tables</i>	<i>vi</i>
<i>List of Figures</i>	<i>vi</i>
<i>Environmental Protection Statement</i>	<i>v</i>
<i>Explanation of Symbols</i>	<i>vi</i>
<i>For Your Safety</i>	<i>vii</i>
<i>High Voltage Safety Instructions</i>	<i>vii</i>
<i>Special Handling and Unpacking Instructions</i>	<i>vii</i>
<i>General Instructions on Usage</i>	<i>viii</i>
<i>Customer Support</i>	<i>ix</i>
<i>Customer Service</i>	<i>ix</i>
<i>Customer Comments</i>	<i>ix</i>
1. Introduction	1 - 3
1.1 <i>Board Overview</i>	1 - 3
1.2 <i>Board Diagrams</i>	1 - 3
1.2.1 <i>Functional Block Diagram</i>	1 - 3
1.2.2 <i>Front Panel</i>	1 - 4
1.2.3 <i>Board Layout</i>	1 - 4
1.3 <i>Technical Specification</i>	1 - 5
1.4 <i>Standards</i>	1 - 6
1.5 <i>Related Publications</i>	1 - 7
2. Functional Description	2 - 3
2.1 <i>10 Gigabit Ethernet Controller</i>	2 - 3
2.2 <i>Memory</i>	2 - 3
2.2.1 <i>Flash</i>	2 - 3
2.2.2 <i>FRU EEPROM</i>	2 - 3
2.3 <i>Board Interfaces</i>	2 - 3
2.3.1 <i>10 Gigabit Ethernet Connectors</i>	2 - 3
2.3.2 <i>XMC Interface</i>	2 - 5



3. Installation	3 - 3
3.1 <i>Hardware Installation</i>	3 - 3
3.1.1 <i>Safety Requirements</i>	3 - 3
3.1.2 <i>Installation Procedures</i>	3 - 4
3.1.3 <i>Removal Procedures</i>	3 - 6
4. Configuration	4 - 3
5. Power Considerations	5 - 3
5.1 <i>Carrier Power Supply</i>	5 - 3
5.1.1 <i>Start-Up Requirement</i>	5 - 3
5.1.2 <i>Power-Up Sequence</i>	5 - 3
5.1.3 <i>Tolerance</i>	5 - 3
5.1.4 <i>Regulation</i>	5 - 4
5.2 <i>Power Consumption</i>	5 - 4
About Kontron	6 - 2

List of Tables

1-1 <i>XMC402 Main Specifications</i>	1 - 5
1-2 <i>Standards</i>	1 - 6
1-3 <i>Related Publications</i>	1 - 7
2-1 <i>Pinout of 10 Gigabit Ethernet Connectors J1 and J2</i>	2 - 4
2-2 <i>XMC Connector J3 Pinout</i>	2 - 5
5-1 <i>Input Voltage Characteristics</i>	5 - 3
5-2 <i>Power Consumption: XMC402 with Windows® 7</i>	5 - 4

List of Figures

1-1 <i>XMC402 Functional Block Diagram</i>	1 - 3
1-2 <i>XMC402 Front Panel</i>	1 - 4
1-3 <i>XMC402 Board Layout (Top View)</i>	1 - 4
2-1 <i>10 Gigabit Ethernet Connectors J1 and J2</i>	2 - 4
2-2 <i>XMC Connector J3</i>	2 - 5
3-1 <i>XMC402 Installation / Removal Diagrams</i>	3 - 5



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.



Explanation of Symbols



Caution, Electric Shock!

This symbol and title warn of hazards due to electrical shocks (> 60V) 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.

Please refer also to the section “High Voltage Safety Instructions” on the following page.



Warning, ESD Sensitive Device!

This symbol and title inform that 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.

Please read also the section “Special Handling and Unpacking Instructions” on the following page.



Warning!

This symbol and title emphasize points which, if not fully understood and taken into consideration by the reader, may endanger your health and/or result in damage to your material.



Note ...

This symbol and title emphasize aspects the reader should read through carefully for his or her own advantage.



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



Warning!

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



Caution, Electric Shock!

Before installing a not hot-swappable Kontron product into a system always ensure that your mains power is switched off. This applies also to the installation of piggybacks.

Serious electrical shock hazards can exist during all installation, repair and maintenance operations with this product. Therefore, always unplug the power cable and any other cables which provide external voltages before performing work.

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 board 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 board.



General Instructions on Usage

In order to maintain Kontron's product warranty, this product must not be altered or modified in any way. Changes or modifications to the device, which 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.

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

In performing all necessary installation and application operations, please follow only 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 board, please re-pack it as nearly as possible in the manner in which it was delivered.

Special care is necessary when handling or unpacking the product. Please consult the special handling and unpacking instruction on the previous page of this manual.



Customer Support

Find Kontron contacts by visiting: <http://www.kontron.com/support>.

Customer Service

As a trusted technology innovator and global solutions provider, Kontron extends its embedded market strengths into a services portfolio allowing companies to break the barriers of traditional product lifecycles. Proven product expertise coupled with collaborative and highly-experienced support enables Kontron to provide exceptional peace of mind to build and maintain successful products.

For more details on Kontron's service offerings such as: enhanced repair services, extended warranty, Kontron training academy, and more visit <http://www.kontron.com/support-and-services/services>.

Customer Comments

If you have any difficulties using this user guide, discover an error, or just want to provide some feedback, contact Kontron support. Detail any errors you find. We will correct the errors or problems as soon as possible and post the revised user guide on our website.



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Chapter

1

Introduction



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1. Introduction

1.1 Board Overview

The XMC402 Dual 10 Gigabit Ethernet module is an XMC mezzanine card designed for use with compliant carrier boards or CPU boards which support XMC modules with PCI Express 2.1 interconnection. The XMC402 incorporates a very flexible design which allows simple and easy integration of 10 Gigabit Ethernet functionality to any compliant system.

The XMC402 provides wire-speed, dual-port 10 Gigabit Ethernet throughput and is equipped with one dual-channel 10 Gigabit Ethernet controller (Intel® X540) and two 10 Gigabit Ethernet RJ-45 connectors with integrated magnetics and status LEDs.

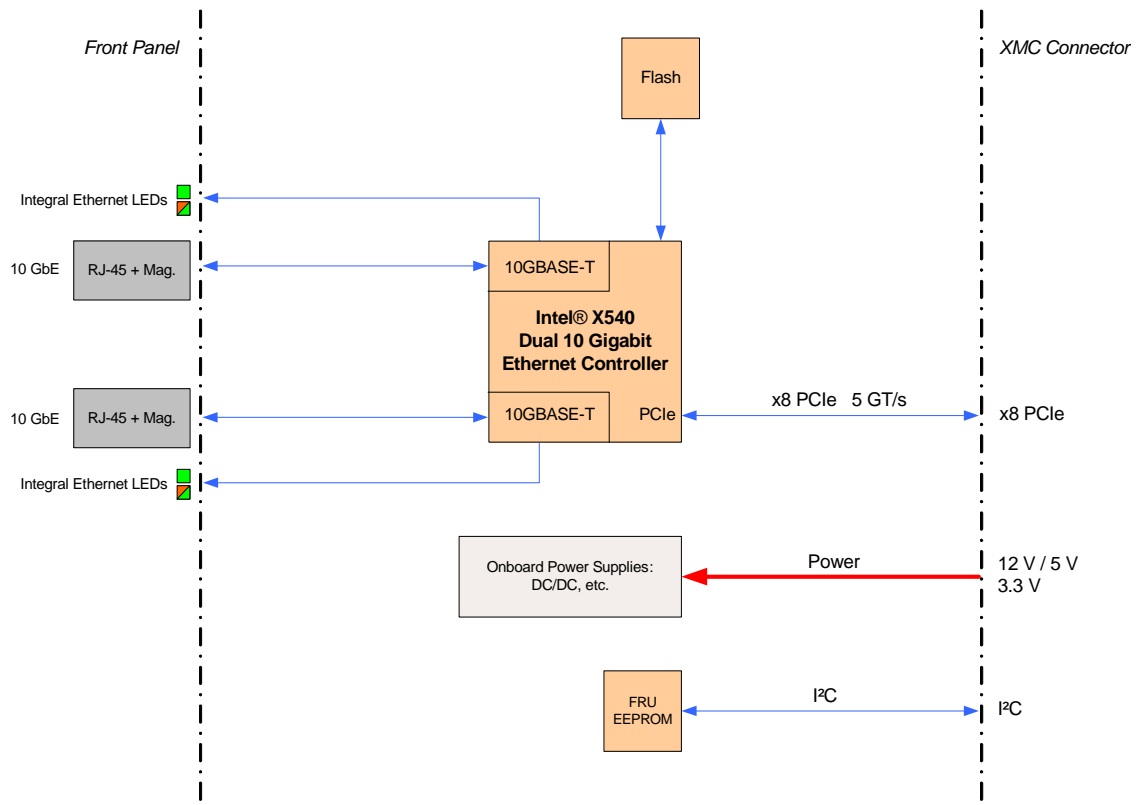
Carrier interfacing is provided by one XMC connector supporting PCI Express 2.1 (5 GT/s) with x8 lanes.

1.2 Board Diagrams

The following diagrams provide additional information concerning board functionality and component layout.

1.2.1 Functional Block Diagram

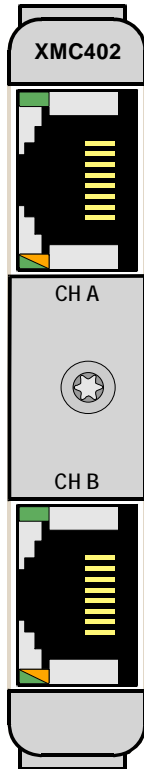
Figure 1-1: XMC402 Functional Block Diagram





1.2.2 Front Panel

Figure 1-2: XMC402 Front Panel



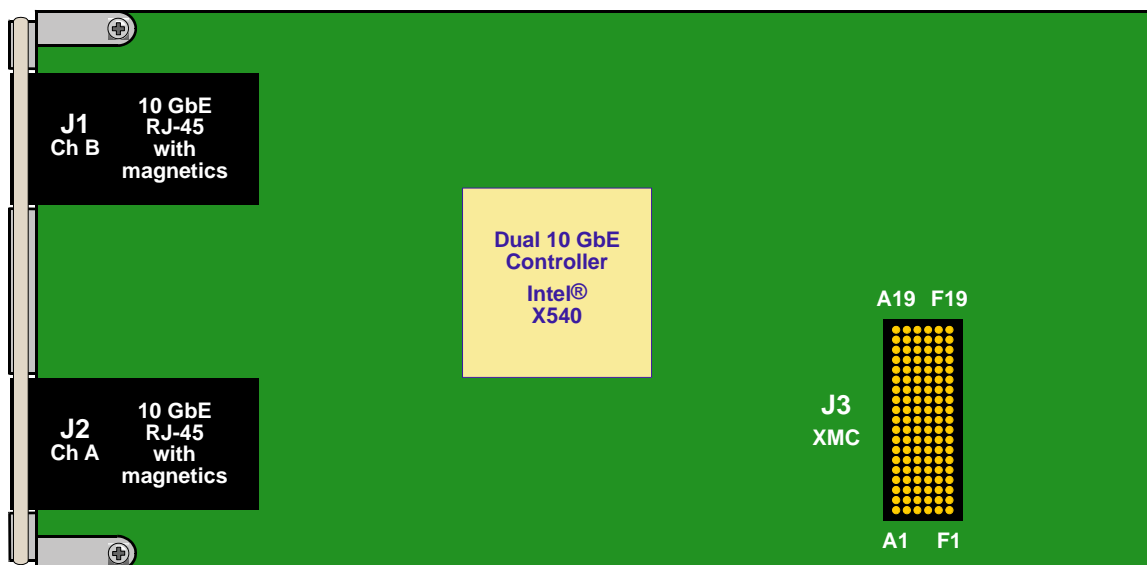
LEGEND:

Integral Ethernet LEDs

- ACT/LNK (green): Ethernet Link/Activity
- SPEED (green/amber/off): Ethernet Speed

1.2.3 Board Layout

Figure 1-3: XMC402 Board Layout (Top View)





1.3 Technical Specification

Table 1-1: XMC402 Main Specifications

XMC402		SPECIFICATIONS
Controller	Intel® X540	Intel® X540 10 Gigabit Ethernet controller with PCI Express 2.1 interface and two 10 Gigabit Ethernet ports
Memory	Flash	16 Mbit of flash memory for configuration and additional data storage
	FRU EEPROM	2 kbit EEPROM for IPMI serial EEPROM FRU data storage
Connectors	10 Gigabit Ethernet	Two front panel RJ-45 connectors with integrated magnetics and status LEDs
	XMC	One onboard XMC connector supporting PCI Express 2.1 (5 GT/s) with x8 lanes for connection to a carrier board
LEDs	Ethernet Status LEDs	Integral Ethernet LEDs: <ul style="list-style-type: none"> • ACT/LNK (green): Ethernet Activity/Link • SPEED (green/amber/off): Ethernet Speed
Software	Operating Systems	There are various operating systems available for the XMC402. For information relating to the supported operating systems, please refer to the Kontron web site or contact Kontron.
General	Mechanical	XMC-compliant form factor
	Power Consumption	See Chapter 5 for details.
	Temperature Range	Operational: 0°C to +60°C Storage: -40°C to +85°C
	Recommended Airflow	Volumetric Flow Rate: > 20 cfm Sufficient airflow must be provided to ensure optimal operation and long-term reliability of the XMC402. For further information, refer to the carrier's user guide.
	Climatic Humidity	93% RH at 40°C, non-condensing (acc. to IEC 60068-2-78)
	Dimensions	74 mm x 149 mm single-height XMC card
	Board Weight	116 grams

1.4 Standards

This product complies with the requirements of the following standards:

Table 1-2: Standards

TYPE	ASPECT	STANDARD	REMARKS
CE	Emission	EN55022 EN61000-6-3	
	Immission	EN55024 EN61000-6-2	
	Electrical Safety	EN60950-1	
Mechanical	Mechanical Dimensions	IEEE 1101.10	
Environmental	Vibration (Sinusoidal)	IEC60068-2-6	Test parameters: <ul style="list-style-type: none"> • 10-300 (Hz) frequency range • 2 (g) acceleration • 1 (oct/min) sweep rate • 10 cycles/axis • 3 axis
	Permanent Shock	IEC60068-2-29	Test parameters: <ul style="list-style-type: none"> • 15 (g) acceleration • 11 (ms) pulse duration • 500 bumps per direction • 6 directions • 1 (s) recovery time
	Single Shock	IEC60068-2-27	Test parameters: <ul style="list-style-type: none"> • 30 (g) acceleration • 9 (ms) pulse duration • 3 shocks per direction • 6 directions • 5 (s) recovery time
	Climatic Humidity	IEC60068-2-78	see note below
	WEEE	Directive 2002/96/EC	Waste electrical and electronic equipment
	RoHS	Directive 2002/95/EC	Restriction of the use of certain hazardous substances in electrical and electronic equipment



Note ...

Kontron performs comprehensive environmental testing of its products in accordance with applicable standards.

Customers desiring to perform further environmental testing of Kontron products must contact Kontron for assistance prior to performing any such testing. This is necessary, as it is possible that environmental testing can be destructive when not performed in accordance with the applicable specifications.

In particular, for example, boards **without conformal coating** must not be exposed to a change of temperature exceeding 1K/minute, averaged over a period of not more than five minutes. Otherwise, condensation may cause irreversible damage, especially when the board is powered up again.

Kontron does not accept any responsibility for damage to products resulting from destructive environmental testing.



1.5 Related Publications

The following publications contain information relating to this product.

Table 1-3: Related Publications

PRODUCT	PUBLICATION
XMC	IEEE 1386-2001, IEEE Standard for a Common Mezzanine Card (CMC) Family ANSI/VITA 42.0-200x XMC Switched Mezzanine Card Auxiliary Standard ANSI/VITA 42.3-2006 XMC PCI Express Protocol Layer Standard ANSI/VITA 42.6 10 Gigabit Ethernet Subspecification
10GBase-T	IEEE 802.3an-2006
100Base-TX/1000Base-T	IEEE 802.3
All Kontron products	Product Safety and Implementation Guide, ID 1021-9142



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Chapter **2**

Functional Description



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2. Functional Description

2.1 10 Gigabit Ethernet Controller

The XMC402 provides one dual-channel 10 Gigabit Ethernet controller (Intel® X540) optimized to deliver high performance with the lowest power consumption including independent transmit and receive queues as well as a PCI Express 2.1 (5 GT/s) interface that maximizes the use of bursts for efficient bus usage.

2.2 Memory

2.2.1 Flash

The XMC402 has 16 Mbit flash memory for configuration and additional data storage. This memory is controlled by the 10 Gigabit Ethernet device but is accessible from a host CPU. As such this memory can be used for a variety of functionalities including the ability to boot a host CPU or System Master from LAN or configure iSCSI.

2.2.2 FRU EEPROM

The FRU EEPROM is a 2 kbit EEPROM for storing IPMI Serial EEPROM FRU information.

2.3 Board Interfaces

2.3.1 10 Gigabit Ethernet Connectors

The XMC402 board includes two 100Base-TX/1000Base-T/10GBase-T Ethernet ports based on one Intel® X540 10 Gigabit Ethernet controller. The controller's architecture is optimized to deliver high performance with the lowest power consumption. The controller's architecture includes independent transmit and receive queues and a PCI Express interface that maximizes the use of bursts for efficient bus usage.



Note ...

The Ethernet transmission can operate effectively using a CAT7 cable with a maximum length of 100 m.

The Ethernet connectors are realized as two RJ-45 connectors with integrated magnetics and status LEDs. The interfaces provide automatic detection and switching between 100Base-TX, 1000Base-T, and 10GBase-T data transmission (Auto-Negotiation). Auto-wire switching for crossed cables is also supported (Auto-MDI/X).

Ethernet LED Status

ACT / LNK (green): This LED monitors network connection and activity. The LED lights up when a valid link (cable connection) has been established. The LED blinks when network packets are sent or received through the RJ-45 port. When this LED remains off, a valid link has not been established due to a missing or a faulty cable connection.

SPEED (green/amber/off): This LED lights up to indicate a successful 1000Base-TX or 10GBase-T connection. When green it indicates a 10GBase-T connection and when amber it indicates a 1000Base-T connection. When not lit and the ACT-LED is active, the connection is operating at 100Base-T.



Figure 2-1: 10 Gigabit Ethernet Connectors J1 and J2

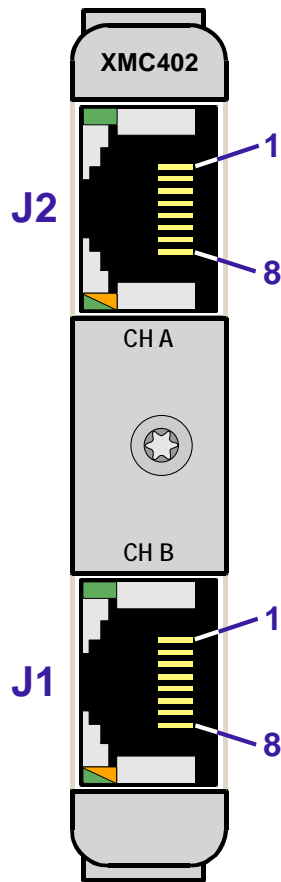


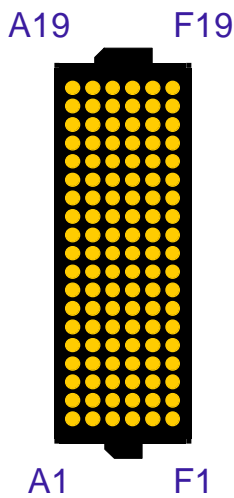
Table 2-1: Pinout of 10 Gigabit Ethernet Connectors J1 and J2

PIN	MDI / STANDARD ETHERNET CABLE					
	100BASE-TX		1000BASE-T		10GBASE-T	
	I/O	SIGNAL	I/O	SIGNAL	I/O	SIGNAL
1	0	TX+	I/O	BI_DA+	I/O	TRP1+
2	0	TX-	I/O	BI_DA-	I/O	TRP1-
3	1	RX+	I/O	BI_DB+	I/O	TRP2+
4	-	-	I/O	BI_DC+	I/O	TRP3+
5	-	-	I/O	BI_DC-	I/O	TRP3-
6	1	RX-	I/O	BI_DB-	I/O	TRP2-
7	-	-	I/O	BI_DD+	I/O	TRP4+
8	-	-	I/O	BI_DD-	I/O	TRP4-

2.3.2 XMC Interface

The XMC402 module is equipped with one onboard XMC connector, J3, for connection to the carrier board. The XMC connector provides the high-speed signals for a x8 PCI Express 2.1 (5 GT/s) interface.

Figure 2-2: XMC Con. J3 Table 2-2: XMC Connector J3 Pinout



PIN	ROW A	ROW B	ROW C	ROW D	ROW E	ROW F
1	PET0p0	PET0n0	3.3V	PET0p1	PET0n1	VPWR
2	GND	GND	NC (TRST#)	GND	GND	MRSTI#
3	PET0p2	PET0n2	3.3V	PET0p3	PET0n3	VPWR
4	GND	GND	NC (TCK)	GND	GND	NC (MRSTO#)
5	PET0p4	PET0n4	3.3V	PET0p5	PET0n5	VPWR
6	GND	GND	NC (TMS)	GND	GND	+12V
7	PET0p6	PET0n6	3.3V	PET0p7	PET0n7	VPWR
8	GND	GND	NC (TDI)	GND	GND	NC (-12V)
9	NC (RFU)	NC (RFU)	NC (RFU)	NC (RFU)	NC (RFU)	VPWR
10	GND	GND	TDO (NC)	GND	GND	GA0
11	PER0p0	PER0n0	NC (MBIST#)	PER0p1	PER0n1	VPWR
12	GND	GND	GA1	GND	GND	GND (MPRESENT#)
13	PER0p2	PER0n2	3.3V AUX	PER0p3	PER0n3	VPWR
14	GND	GND	GA2	GND	GND	MSDA
15	PER0p4	PER0n4	NC (RFU)	PER0p5	PER0n5	VPWR
16	GND	GND	MVMRO	GND	GND	MSCL
17	PER0p6	PER0n6	NC (RFU)	PER0p7	PER0n7	NC (RFU)
18	GND	GND	NC (RFU)	GND	GND	NC (RFU)
19	CLK+0	CLK-0	NC (RFU)	NC (WAKE#)	NC (ROOT0#)	NC (RFU)

Legend:

- PER0p/n[0..7] Differential Receive
These signals are used by the XMC402 to receive data from the carrier over the PCI Express interface.
- PET0p/n[0..7] Differential Transmit
These signals are used by the XMC402 to transmit data to the carrier over the PCI Express interface.
- CLK+/-0 Differential reference clock for Link 0 PCI Express interface
- VPWR Power pins
These signals carry either 12 V or 5 V power from the carrier to the XMC402.
- RFU Reserved for future use



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Chapter

3

Installation



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3. Installation

The XMC402 has been designed for easy installation. However, the following standard precautions, installation procedures, and general information must be observed to ensure proper installation and to preclude damage to the board, other system components, or injury to personnel.

3.1 Hardware Installation

The product described in this manual can be installed in any available carrier acting as a PCI Express root complex and compliant with the XMC PCI Express Protocol Layer Standard (ANSI/VITA 42.3-2006).

3.1.1 Safety Requirements

The board must be securely fastened to the carrier using appropriate retaining screws and stand-offs to ensure proper grounding and avoid loosening caused by vibration or shock.

In addition, the following safety precautions must be observed when installing or operating the XMC402. Kontron assumes no responsibility for any damage resulting from failure to comply with these requirements.



Caution, Electric Shock Hazard!

Ensure that the system main power is removed prior to installing or removing this board. Ensure that there are no other external voltages or signals being applied to this board or other boards within the system. Failure to comply with the above could endanger your life or health and may cause damage to this board or other system components including process-side signal conditioning equipment.



ESD Equipment!

This Kontron board contains electrostatically sensitive devices. Please observe the following 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.
- If working at an anti-static workbench with professional discharging equipment, please do not omit to use it.



3.1.2 Installation Procedures

To install the board proceed as follows:

1. Ensure that the safety requirements indicated above are observed.



Warning!

Failure to comply with the instruction below may cause damage to the board or result in improper system operation.



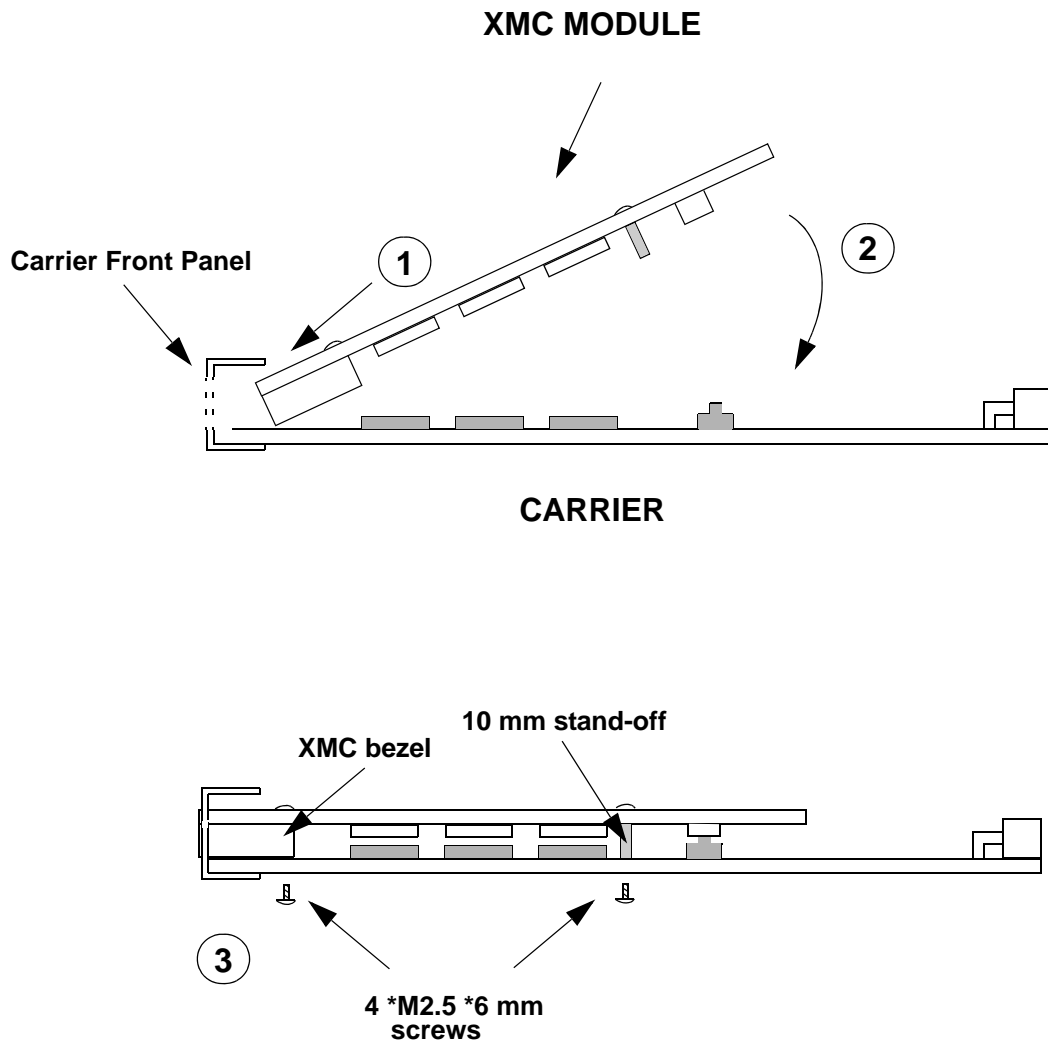
Warning!

Care must be taken when applying the procedures below to ensure that neither the XMC402 nor the carrier board is physically damaged by the application of these procedures.

2. To install the XMC402 perform the following referring to Figure 3-1 as required:
 1. Obtain carrier board and ensure that it satisfies application requirements and will allow for proper installation of the XMC402: e.g. connectors match, front panel cutout matches, holes for mounting screws are available and match, stand-offs can be properly installed, except for prescribed contact points no other contact between carrier and XMC402 after mating occurs, etc.
 2. Carefully insert the XMC402 into the front panel cutout of the carrier board ensuring that the EMC gasket is properly seated on the carrier's front panel and the contact springs on the RJ-45 connectors are not bent.
 3. Ensuring that the XMC Connector J3 is properly aligned with the XMC connector of the carrier board, press the XMC402 and carrier board together so that their connectors are completely engaged.
 4. Install the four XMC402 retaining screws ensuring that the XMC402 is properly mated to the carrier board: e.g. XMC bezel flush with front panel, no misalignment of connectors, no contact between carrier and XMC402 except as prescribed, etc.
3. For installation of the carrier board with the XMC402 mounted in a system refer to the installation procedures for the carrier board.



Figure 3-1: XMC402 Installation / Removal Diagrams





3.1.3 Removal Procedures

To remove the XMC402 from the carrier board proceed as follows:

1. Ensure that the safety requirements indicated above are observed.



Warning!

Care must be taken when applying the procedures below to ensure that neither the XMC402 nor the carrier board is physically damaged by the application of these procedures.

2. If applicable, remove the carrier board from system using carrier board removal procedures.
3. To remove the XMC402 perform the following referring to Figure 3-1 as required:
 1. Obtain carrier board.
 2. Remove the four XMC402 retaining screws.
 3. Carefully disengage the XMC Connector J3 and the XMC connector on the carrier board so that no force or movement is applied to the XMC402 bezel.
 4. Ensure that the XMC402 bezel is not jammed or hung up on the carrier board. If necessary, partially disassemble the carrier board front panel to free the XMC402 bezel.
 5. Slide the XMC402 away from the front panel.
 6. Dispose of the XMC402 as required.
4. Dispose of the carrier board as required.



Chapter **4**

Configuration



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4. Configuration

The XMC402 is designed for plug and play operation, and, as such, it does not have any user-configurable board settings which are required for operation.

For application usage of onboard functionality refer to the appropriate software documentation.



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Chapter

5

Power Considerations



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5. Power Considerations

The considerations presented in the ensuing chapters must be taken into account by system integrators when specifying the XMC402 system environment.

5.1 Carrier Power Supply

Carrier power supplies for the XMC402 must be specified with enough reserve for the remaining system consumption. In order to guarantee a stable functionality of the system, it is recommended to provide more power than the system requires.

As the design of the XMC402 has been optimized for minimal power consumption, the carrier power supply unit must be stable even without minimum load.

5.1.1 Start-Up Requirement

Carrier power supplies must comply with the following guidelines, in order to be used with the XMC402.

- Beginning at 10% of the nominal output voltage, the voltage must rise within > 0.1 ms to < 20 ms to the specified regulation range of the voltage. Typically: > 5 ms to < 15 ms.
- There must be a smooth and continuous ramp of each DC output voltage from 10% to 90% of the regulation band.
- The slope of the turn-on waveform shall be a positive, almost linear voltage increase and have a value from 0 V to nominal V_{out} .

5.1.2 Power-Up Sequence

The VPWR (+5 or +12 V) output level must always be equal to or higher than the +3.3 VDC output during power-up and normal operation.

Both voltages must reach their minimum in-regulation level not later than 20 ms after the output power ramp start.

5.1.3 Tolerance

The tolerance of the voltage lines is described in the XMC specification. The recommended measurement point for the voltage is the XMC connector on the carrier board.

The following table provides information regarding the required characteristics for each board input voltage.

Table 5-1: Input Voltage Characteristics

VOLTAGE	NOMINAL VALUE	OPERATING RANGE	REMARKS
VPWR	+5 V	+4.75 V to +5.2 V ($\pm 5\%$)	Main voltage
	+12 V	+11.4 V to +12.6 V ($\pm 5\%$)	Main voltage
+3.3 V	+3.3 V	+3 V to +3.6 V	Main voltage
+3.3 V AUX	+3.3 V	+3 V to +3.6 V	Not required
+12 V	+12 V	+11.4 V to +12.6 V ($\pm 5\%$)	Not required
-12 V	-12 V	-11.4 V to -12.6 V ($\pm 5\%$)	Not required
GND	Ground		



5.1.4 Regulation

The carrier power supply shall be unconditionally stable under line, load, unload and transient load conditions including capacitive loads. The operation of the carrier power supply must be consistent even without the minimum load on all output lines.



Warning!

All of the input voltages must be functionally coupled to each other so that if one input voltage fails, all other input voltages must be regulated proportionately to the failed voltage. For example, if the VPWR begins to decrease, all other input voltages must decrease accordingly. This is required in order to preclude cross currents within the XMC402.

Failure to comply with above may result in damage to the board or improper system operation.



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Note ...

If the main power input is switched off, the supply voltages will not go to 0V instantly. It will take a couple of seconds until the capacitors are discharged. If the voltage rises again before it has gone below a certain level, the circuits may enter a latch-up state where even a hard RESET will not help any more. The system must be switched off for at least 3 seconds before it may be switched on again. If problems still occur, turn off the main power for 30 seconds before turning it on again.

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5.2 Power Consumption

The goal of this description is to provide a method to calculate the power consumption for the XMC402 module.

The power consumption table below lists the voltage and power specifications for the XMC402 module. The measurements were performed under Windows® 7 at a temperature of 25°C using a 100 m, 10GBase-T CAT7 cable from Harting.

Table 5-2: Power Consumption: XMC402 with Windows® 7

NOMINAL VOLTAGE	ETHERNET SPEED	CONNECTED PORTS	POWER CONSUMPTION
VPWR (12 V / 5 V)	10GBase-T	2 ports	11.0 W
		1 port	7.5 W
	1000Base-T	2 ports	6.0 W
		1 port	5.0 W
	Standby	no ports connected	4.5 W
3.3 V	--	--	max. 0.06 W
Total	--	--	max. 11.06 W



Note ...

The power consumption values indicated in the table above can vary depending on the ambient temperature or the system performance. This can result in deviations of the power consumption values of up to 15%.





About Kontron

Kontron, a global leader in embedded computing technology and trusted advisor in IoT, works closely with its customers, allowing them to focus on their core competencies by offering a complete and integrated portfolio of hardware, software and services designed to help them make the most of their applications.

With a significant percentage of employees in research and development, Kontron creates many of the standards that drive the world's embedded computing platforms; bringing to life numerous technologies and applications that touch millions of lives. The result is an accelerated time-to-market, reduced total-cost-of-ownership, product longevity and the best possible overall application with leading-edge, highest reliability embedded technology

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