» User Guide «

AM4022

Single Mid-Size or Full-Size AMC Module based on 3rd Generation Intel® Core™ i7 Processors with the Mobile Intel® QM77 Express Chipset

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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.

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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!

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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.

Warning!

This product has gold conductive fingers which are susceptible to contamination. Take care not to touch the gold conductive fingers of the AMC Card-edge connector when handling the board.

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

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.

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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.

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Chapter 1

Introduction

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1. Introduction

1.1 Board Overview

The AM4022 is a highly integrated CPU board implemented as a Single Mid-size or Full-size Advanced Mezzanine Card (AMC) Module. The design is based on 3rd generation Intel® Core™ i7 processors combined with the mobile Intel® QM77 Express Chipset.

The board supports the 3rd generation Intel® Core™ i7-3612QE quad-core and the 3rd generation Intel® Core™ i7-3555LE dual-core processors in 22 nm technology. The 2.1 GHz Intel® Core™ i7-3612QE has a 4x 64 kB L1 cache, 4x 256 KB L2 cache and 6 MB L3 cache. The 2.5 GHz Intel® Core™ i7-3555LE has a 2x 64 kB L1 cache, 2x 256 KB L2 cache and 4 MB L3 cache. Both the processor and the memory are soldered resulting in a higher MTBF and a significant improvement in cooling.

The AM4022 includes up to 8 GB, dual-channel Double Data Rate (DDR3) memory with Error Checking and Correcting (ECC) running at 1600 MHz. The graphics controller and the memory controller are integrated in the processor.

One Quad Gigabit Ethernet Controller directly connected to the processor ensures maximum data throughput. The AM4022 further provides up to 64 GB Flash memory via an optional on-board Serial ATA Flash module.

The AM4022 is available with two front panel versions, one with a DisplayPort and one with a COM port. Further interfaces include one USB 2.0 host interface and two Gigabit Ethernet ports to the front as well as a variety of high-speed interconnect topologies to the system, such as Dual Gigabit SerDes connection and Dual Serial ATA storage interface in the Common Options Region, two x4 or one x8 PCI Express interfaces in the Fat Pipes Region, one Serial ATA storage interface, a DisplayPort (on request), one USB 3.0 port and three USB 2.0 ports (all on request) in the Extended Options Region, and a Debug port in the Extended Options Region. The AM4022 can provide an FCLKA PCI Express clock to the host system. The AM4022 does not, however, synchronize on an external clock input.

The AM4022 provides safety and security features via an on request Trusted Platform Module (TPM) 1.2.

The AM4022 has full hot swap capability. A dedicated Module Management Controller (MMC) is used to manage the board and support a defined subset of Intelligent Platform Management Interface (IPMI) commands and PICMG (ATCA/AMC) command extensions, which enables operators to detect and eliminate faults faster at module level. This includes monitoring several onboard temperature conditions, board voltages and the power supply status, managing hot swap operations, rebooting the board, etc. All in all, IPMI enhances the board's availability and reliability while reducing the operating costs and the mean-time-to-repair.

Optimized for high-performance, packet-based telecom systems, the AM4022 is targeted towards, but not limited to the telecom market application such as radio network controllers, media streaming, traffic processing, database management and routing. The AM4022 also fits into all applications situated in industrial environments, including I/O intensive applications. The careful design and the selection of high temperature resistant components ensure a high product availability. This, together with a high level of scalability, reliability, and stability, make this state-of-the-art product a perfect core technology for long-life embedded applications.

The board is offered with various Board Support Packages including Windows and Linux operating systems. For further information concerning the operating systems available for the AM4022, please contact Kontron.

1.2 Board-Specific Information

Due to the outstanding features of the AM4022, such as superior processing power and flexible interconnect topologies, this AMC board provides a highly scalable solution not only for a wide range of telecom and data network applications, but also for several highly integrated industrial environment applications with solid mechanical interfacing.

Some of the AM4022's outstanding features are:

- Support for the following 3rd generation Intel® Core™ quad- and dual-core processors:
  - Intel® Core™ i7-3612QE (SV) processor with ECC, 2.1 GHz, 6 MB L3 cache
  - Intel® Core™ i7-3555LE (LV) processor with ECC, 2.5 GHz, 4 MB L3 cache
- Intel® QM77 Express Chipset
- Up to 8 GB, dual-channel, DDR3 SDRAM memory with ECC running at 1600 MHz
- Integrated 3D high performance graphics controller
- Display support for resolutions up to 2560 x 1600 pixels @ 60 Hz
- AMC interconnection:
  - Dual Gigabit SerDes connection in the Common Options Region
  - Dual SATA storage interface in the Common Options Region
  - Two x4 or one x8 PCI Express interface in the Fat Pipes Region (up to 8.0 GT/s and as a root complex controller only)
  - One SATA storage interface in the Extended Options Region
  - DisplayPort interface (on request) in the Extended Options Region
  - One USB 3.0 and three USB 2.0 (all on request) in the Extended Options Region
  - Serial port in the Extended Options Region
  - PCI Express reference clock (FCLKA) either output to host or non-synchronized external input
- Full hot swap support
- One Quad Gigabit Ethernet Controller, Intel® I350
- Onboard extension connector for either an optional SATA Flash module with up to 64 GB NAND Flash memory or an optional battery module for RTC backup
- One mini USB 2.0 host port on Front I/O
- Two Gigabit Ethernet ports on Front I/O
- One Serial port (RS-232) or DisplayPort on Front I/O, depending on the front panel version
- TCG 1.2-compliant Trusted Platform Module (TPM) (on request)
- Two SPI Flash chips (2 x 8 MB) for two separate uEFI BIOS images:
  - One standard SPI boot flash
  - One recovery SPI boot flash
- Dedicated IPMI Module Management Controller with redundant Firmware Flash (2 x 512 kB)
- Watchdog Timer
- Four bicolor User-Specific LEDs (providing debugging and POST code information, etc.)
- Two onboard DIP switches SW2 and SW3 (for selecting the SPI boot flashes, overwriting E-Keying, etc.)
- Standard temperature range: - 5°C to + 55°C
- Extended temperature range: - 40°C to + 70°C (on request)
- Thermal management and passive heat sink solution for forced airflow cooling
- Single Mid-size and Full-size AMC module with or without retaining screws (Full-size and front panels with retaining screws on request)
- AMI Aptio®, a uEFI-compliant platform firmware

- Designed to be compliant with the following PICMG specifications:
  - PICMG® AMC.0 R2.0, Advanced Mezzanine Card Specification
  - PICMG® AMC.1 R2.0, PCI Express™ on AdvancedMC™
  - PICMG® AMC.2 R1.0, Ethernet Advanced Mezzanine Card Specification
  - PICMG® AMC.3 R1.0 Advanced Mezzanine Card Specification for Storage
  - PICMG® MTCA.0 R1.0 Micro Telecommunications Computing Architecture Base Specification
  - PICMG® MTCA.1 R1.0 Air Cooled Rugged MicroTCA Specification
  - IPMI - Intelligent Platform Management Interface Specification, v2.0, R1.0

1.3 System Relevant Information

The following system relevant information is general in nature but should still be considered when developing applications using the AM4022.

Table 1-1: System Relevant Information

SUBJECT	INFORMATION

Hardware Requirements	The AM4022 can be installed on any AMC-supporting carrier board or MicroTCA backplane with the following AMC Card-edge connector port mapping:
	• Common Options Region ports 0-1:
	  • Two Gigabit Ethernet SerDes ports
	• Common Options Region ports 2-3:
	  • Two Serial ATA ports
	• Fat Pipes Region ports 4-11:
	  • Two x4 or one x8 PCI Express interface
	• Extended Options Region port 12:
	  • One Serial ATA port
	• Extended Options Region port 13:
	  • One USB 3.0 port (on request)
	• Extended Options Region port 14:
	  • One Debug port
	  • One USB 2.0 (on request)
	• Extended Options Region port 15:
	  • One Serial port
	• Extended Options Region port 16:
	  • Four GPIOs (on request)
	• Extended Options Region ports 17-20:
	  • One DisplayPort (on request)
	  • Two USB 2.0 ports (on request, one on port 19 and one on port 20)
	• Clock:
	  • PCI Express reference clock, FCLKA
	For further information on the AMC interconnection, refer to Chapter 2.11, “AMC Interconnection”.

PCI Express Configuration	The AM4022 only supports the PCI Express root complex configuration; non-transparent bridge functionality is not supported.
Operating Systems	The board is offered with various Board Support Packages including Windows and Linux operating systems. For further information concerning the operating systems available for the AM4022, please contact Kontron.

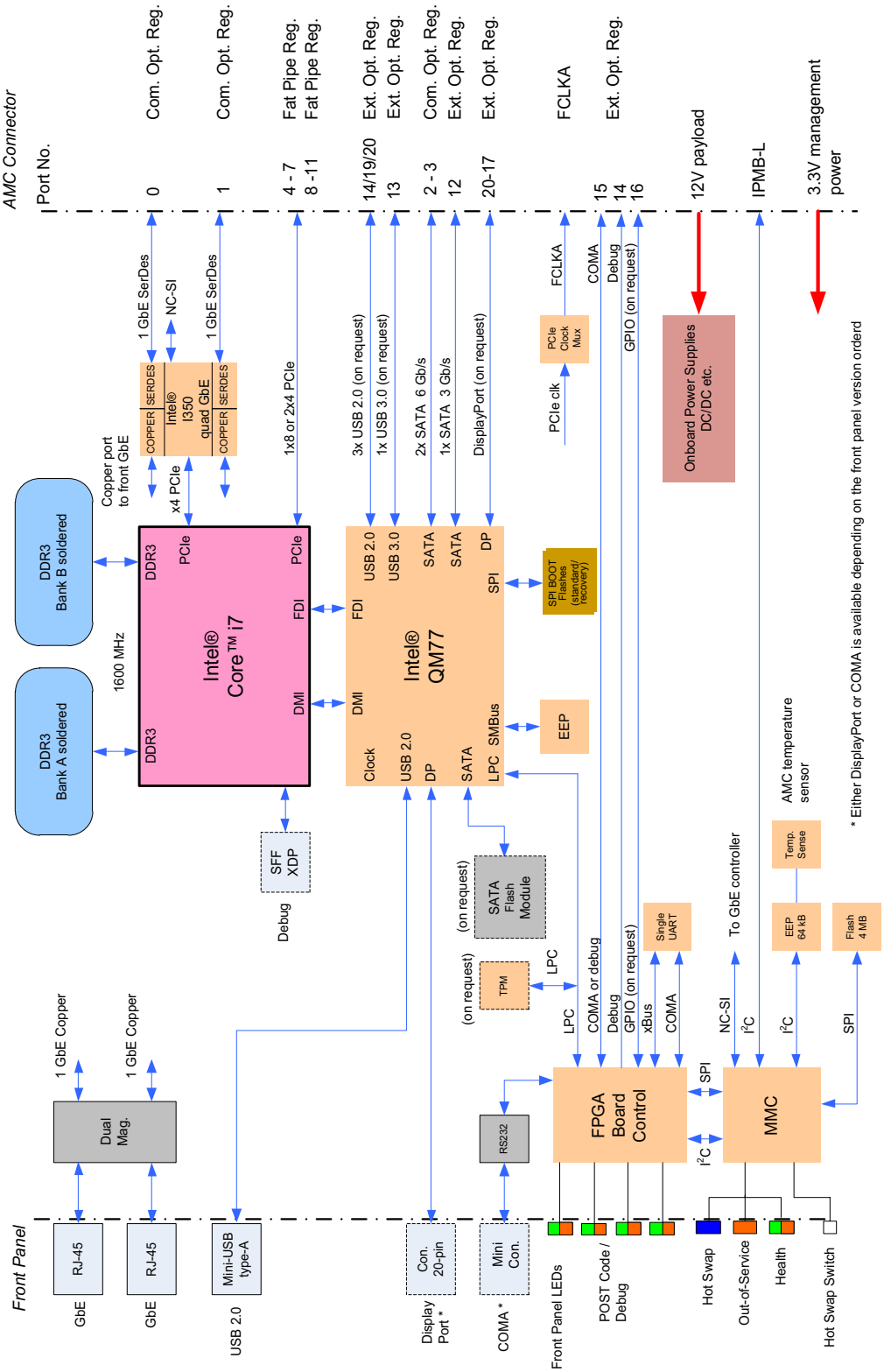
1.4 Board Diagrams

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

1.4.1 Functional Block Diagram

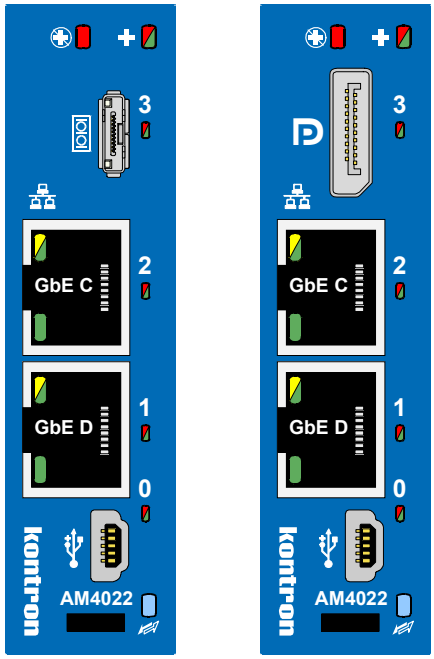
The following figure shows the block diagram of the AM4022.

Figure 1-1: AM4022 Functional Block Diagram



1.4.2 Front Panel

Figure 1-2: AM4022 Mid-size Front Panel Versions



AM4022 with COM Port | AM4022 with DisplayPort

Note ...

On request, the AM4022 is available with retaining screws on the front panel as well as in full-size versions with or without retaining screws.

Module Management LEDs

- LED1 (red): Out-of-Service LED
- LED2 (red/green/amber): Health LED
- HS LED (blue): Hot Swap LED

Connectors

- Serial Connector
- DisplayPort Connector
- Gigabit Ethernet Connector
- Mini-USB Connector

User-Specific LEDs

- 3 • ULED3 (red/green): AMC Ethernet port A link signal status, AMC port 0 (green) + POST
- 2 • ULED2 (red/green): AMC Ethernet port B link signal status, AMC port 1 (green) + POST
- 1 • ULED1 (red/green): SATA channels active (green) + POST
- 0 • ULED0 (red/green): POST

Note ...

If one or more of the ULEDs 0..3 remain lit or blinking red, a failure is indicated. For further information, please contact Kontron.

For further information on the LEDs used on the AM4022, refer to section 2.10.1, “Front Panel LEDs”.

1.4.3 Board Layouts

Figure 1-3: AM4022 Board Layout (Top View)

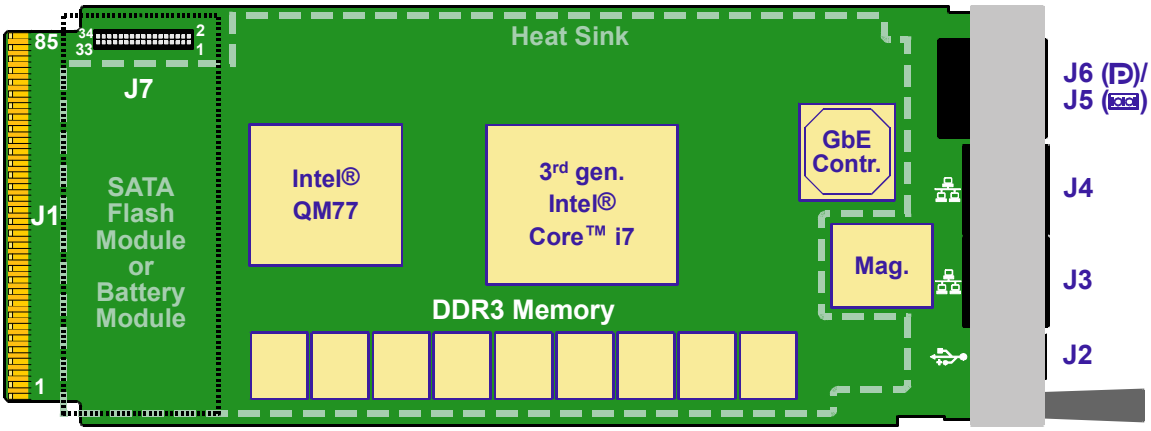
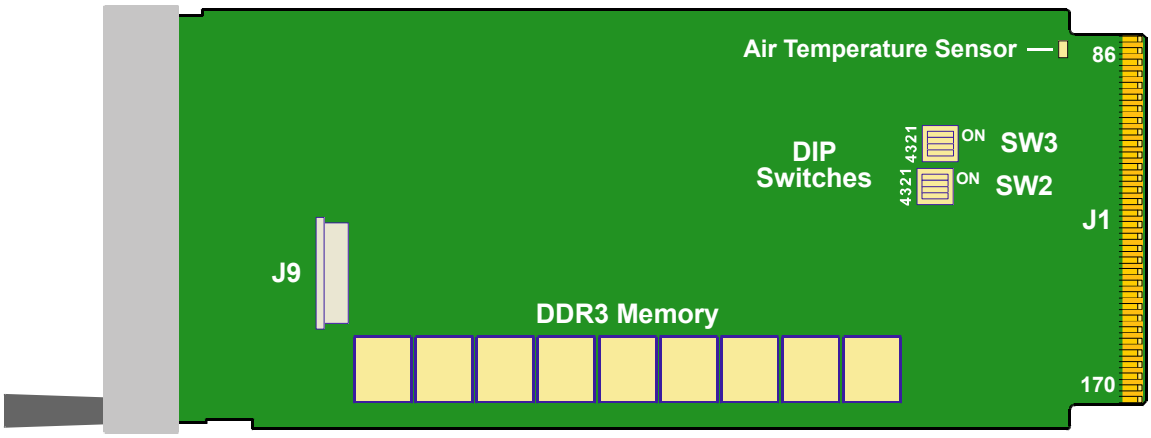


Figure 1-4: AM4022 Board Layout (Bottom View)



1.5 Technical Specification

Table 1-2: AM4022 Main Specifications

AM4022		SPECIFICATIONS
Processor and Memory	CPU	The AM4022 supports the following 3rd generation Intel® Core™ processors: • Intel® Core™ i7-3612QE (SV) processor with ECC, 2.1 GHz, 6 MB L3 cache • Intel® Core™ i7-3555LE (LV) processor with ECC, 2.5 GHz, 4 MB L3 cache Further processor features: • Up to four physical execution cores • Intel® Hyper-Threading Technology (Intel® HT Technology) • Intel® 64 Architecture • Intel® Turbo Boost Technology • Intel® Intelligent Power Sharing (IPS) • System Memory interface with optimized support for dual-channel DDR3 SDRAM memory at 1600 MHz with ECC • Integrated 2D and 3D Graphics Engines • DMI and FDI interfaces to the Intel® QM77 chipset • One x16 PCI Express port operating at up to 8.0 GT/s Please contact Kontron for further information concerning the suitability of other Intel processors for use with the AM4022.

	Memory	Main Memory:
		• Up to 8 GB, dual-channel DDR3 SDRAM memory with ECC running at 1600 MHz
		Cache Structure:
		• 64 kB L1 cache for each core
		  • 32 kB instruction cache
		  • 32 kB data cache
		• 256 kB L2 shared instruction/data cache for each core
		• Up to 6 MB L3 shared instruction/data cache shared between all cores
		Flash Memory:
		• Two SPI Flash chips (2 x 8 MB) for two separate uEFI BIOS images selectable via the IPMI controller or the DIP switch SW3
		Mass Storage Device:
		• Up to 64 GB NAND Flash via an optional onboard Serial ATA Flash module
		Serial EEPROM with 64 kbit

Chipset	Intel® QM77	Mobile Intel® QM77 Express Chipset: • Eight x1 PCI Express 2.0 ports (not used on the AM4022) • SATA host controller with six ports; two with 6 Gbit/s and four with 3 Gbit/s data transfer rate and RAID 0/1/5/10 support (only four ports are used on the AM4022) • USB 2.0 host interface with 14 USB ports available (only four ports are used on the AM4022) • USB 3.0 host interface with 4 USB ports available (only one port is used on the AM4022) • SPI Flash interface support • Low Pin Count (LPC) interface

Table 1-2: AM4022 Main Specifications (Continued)

AM4022		SPECIFICATIONS
Chipset (Cont'd)	Intel® QM77	• Power management logic support • Enhanced DMA controller, interrupt controller, and timer functions • System Management Bus (SMBus) compatible with most I²C™ devices • DMI and FDI interfaces to the processor • High Definition Audio Interface (not used on the AM4022) • Analog display port (not used on the AM4022) • Three digital display ports (only two ports are used on the AM4022) • Integrated RTC
Integrated Controller	Graphics controller	High-performance 3D graphics controller integrated in the processor: • Supports resolutions up to 2560 x 1600 pixels @ 60 Hz • DisplayPort hot plug support • Dynamic Video Memory Technology When the AM4022 is populated with a COM connector on the front panel, the graphics controller is disabled.
Onboard Controller	Gigabit Ethernet	Intel® I350 Quad Gigabit Ethernet PCI Express bus controller with advanced management features such as serial redirection over LAN: • Two interfaces routed to the front I/O connectors • Two interfaces routed to the AMC Card-edge connector
	Serial	One 16550-compatible UART routed either to the front I/O (RS-232 signaling) or the AMC Card-edge connector (TTL level), depending on front panel version
AMC Interconnection	Gigabit Ethernet	Common Options Region ports 0-1: • Two Gigabit Ethernet SerDes ports
	Serial ATA	Common Options Region ports 2-3: • Two Serial ATA ports Extended Options Region port 12: • One Serial ATA port
	PCI Express	Fat Pipes Region ports 4-11: • Two x4 or one x8 PCI Express interfaces as root complex controller only and operating up to 8.0 GT/s
	Debug Interface	Extended Options Region port 14: • One Debug port
	USB Interfaces	Extended Options Region port 13: • One USB 3.0 port (on request) Extended Options Region ports 14/19/20: • Three USB 2.0 ports (on request)
	Serial Interface	Extended Options Region port 15: • One Serial port
	DisplayPort	Extended Options Region ports 17-20: • One DisplayPort (on request)
	Clock	Clock: • PCI Express clock FCLKA to the host system, does not synchronize on an external clock input

Table 1-2: AM4022 Main Specifications (Continued)

AM4022		SPECIFICATIONS
Connectors	Front Panel Connectors	• One USB 2.0 port on a 5-pin, mini USB Type A connector • Two Gigabit Ethernet ports on two RJ-45 connectors • One Serial port (COMA) with RS-232 signal level on a 10-pin mini connector (on the front panel version with a COM port) • One 20-pin DisplayPort connector (on the front panel version with a DisplayPort)
	Onboard Connector	• One extension connector for either Serial ATA Flash or an RTC Backup Battery module
	AMC Card-edge Connector	• One 170-pin AMC Card-edge connector
Switches	DIP Switches	• Two DIP switches for board configuration, SW2 and SW3, consisting of four switches each
	Hot Swap	• One Hot Swap switch
LEDs	Module Management LEDs	• LED1 (red): Out-of-Service LED • LED2 (red/green/amber): Health LED • HS LED (blue): Hot swap LED
	User-Specific LEDs	• ULED3 (red/green): AMC Ethernet port A link signal status, AMC port 0 (green) + POST code • ULED2 (red/green): AMC Ethernet port B link signal status, AMC port 1 (green) + POST code • ULED1 (red/green): SATA channels active (green) + POST code • ULED0 (red/green): POST code
	Ethernet LEDs	• Act (green): Network/Link Activity • Speed (green/yellow): Network speed
Timer	Watchdog Timer	• Software-configurable, two-stage Watchdog with programmable timeout ranging from 125 ms to 4096 s in 16 steps • Serves for generating IRQ or hardware reset
	System Timer	• The Intel® QM77 chipset contains three 8254-style counters which have fixed uses • In addition to the three 8254-style counters, the Intel® QM77 chipset includes eight individual high-precision event timers that may be used by the operating system. They are implemented as a single counter each with its own comparator and value register.
IPMI	Module Management Controller	• ARM7 microcontroller with redundant 512 kB Firmware Flash and automatic roll-back strategy • The MMC carries out IPMI commands such as monitoring several onboard temperature conditions, board voltages and the power supply status, and managing hot swap operations. • The MMC is accessible via a local IPMB (IPMB-L) and one host Keyboard Controller Style Interface (KCS) • One MMC system EEPROM for FRU data and firmware private data
	Hot Swap	The AM4022 has full hot swap capability.

Table 1-2: AM4022 Main Specifications (Continued)

AM4022		SPECIFICATIONS
Thermal	Thermal Management	CPU and board overtemperature protection is provided by: • Up to four Digital Thermal Sensors (DTS), one for each core • One Digital Thermal Sensor (DTS) for the graphics controller • Catastrophic Cooling Failure Sensor (THERMTRIP#) • One temperature sensor integrated in the Intel® QM77 chipset for monitoring the chipset • One onboard temperature sensor for monitoring the board temperature • Specially designed heat sinks
Security	TPM	Trusted Platform Module (TPM) 1.2 for enhanced hardware- and software-based data and system security (on request)
General	Power Consumption	Refer to Chapter 5, “Power Considerations” for information related to the power consumption of the AM4022.
	Temperature Range	Operational: -5°C to +55°C Standard -40°C to +70°C Extended (on request) Storage: -40°C to +70°C  ***Note ...*** When the RTC Backup Battery Module is installed, refer to the operational specifications of this module as this determines the storage temperature of the AM4022 (See "RTC Backup Battery Module" below).  ***Note ...*** When additional components are installed, refer to their operational specifications as this will influence the operational and storage temperature of the AM4022.
	RTC Backup Battery Module (on request)	Special battery mezzanine module with up to two batteries connected in parallel; uses the J7 connector for interfacing with the AM4022 If this module is installed, the SATA Flash module cannot be installed. Temperature ranges: Operational: - 5°C to + 55°C Storage: -30°C to + 60°C
	Mechanical	Single Module: • Mid-size version • Full-size version Both versions available with and without retaining screws

Table 1-2: AM4022 Main Specifications (Continued)

AM4022		SPECIFICATIONS
General	Dimensions	Dimensions of the AM4022 without retention screws on front panel: • Mid-size: 181.5 mm x 73.5 mm x 18.96 mm • Full-size: 181.5 mm x 73.5 mm x 28.95 mm
	Board Weight	Mid-size with heat sink and without SATA Flash module: 247 grams Full-size with heat sink and without SATA Flash module: 310 grams
	JTAG	Two JTAG interfaces: • One processor JTAG interface routed to the onboard debug connector for debugging purposes • One JTAG interface connected to the AMC Card-edge connector for debugging and manufacturing purposes
Software	Software uEFI BIOS	AMI Aptio®, AMI's next-generation BIOS firmware based on the uEFI Specification and the Intel Platform Innovation Framework for EFI. • Serial console redirection via the Serial port or LAN • LAN boot capability for diskless systems (standard PXE) • Redundant image; automatic fail-safe recovery in case of a damaged image • Non-volatile storage of setting in the SPI Flash (battery only required for the RTC) • Compatibility Support Module (CSM) providing legacy BIOS compatibility based on AMIBIOS8 • Command shell for diagnostics and configuration • EFI shell commands executable from mass storage device in a Pre-OS environment (open interface) • MMC support in the command shell
	Software IPMI	Module Management Controller Firmware providing the following features: • The MMC is accessible via IPMB-L and one KCS interface with interrupt support • The MMC Firmware can be updated in field through all supported onboard interfaces • Two MMC Flash banks with roll-back capability in case of an upgrade Firmware failure • Board supervision and control extensions such as board reset, power monitor and control, Host Firmware Hub Flash control, and Host boot order configuration
	Operating Systems	The board is offered with various Board Support Packages including Windows and Linux operating systems. For further information concerning the operating systems available for the AM4022, please contact Kontron.

1.6 Standards

The AM4022 complies with the requirements of the following standards.

Table 1-3: Standards

COMPLIANCE	TYPE	STANDARD	TEST LEVEL
CE	Emission	EN55022 EN61000-6-3 EN300386	--
	Immission	EN55024 EN61000-6-2 EN300386	--
	Electrical Safety	EN60950-1	--
Mechanical	Mechanical Dimensions	IEEE 1101.10	--
Environmental and Health Aspects	Vibration (sinusoidal, operating)	GR-63-CORE EN300019-2-3 IEC61131-2 IEC60068-2-6	5-150 [Hz] frequency range 1 [g] acceleration 1 [oct/min] sweep rate 10 sweeps/axis 3 directions: x, y, z
	Shock (operating)	EN300019-2-3 IEC61131-2 IEC60068-2-27	15 [g] acceleration 11 [ms] pulse duration 3 shocks per direction 5 [s] recovery time 6 directions, ±x, ±y, ±z
	Climatic Humidity	IEC60068-2-78	93% RH at 40°C, non-condensing **(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.

1.7 Related Publications

The following publications contain information relating to this product.

Table 1-4: Related Publications

PRODUCT	PUBLICATION
ATCA	PICMG® 3.0 R3.0, AdvancedTCA® Base Specification, March 24, 2008
MicroTCA	PICMG® MTCA.0 R1.0, Micro Telecommunications Computing Architecture Base Specification, July 6, 2006 PICMG MTCA.1 R1.0, Air Cooled Rugged MicroTCA Specification, March 19, 2009
AMC	PICMG® AMC.0 R2.0, Advanced Mezzanine Card Base Specification, Nov. 15, 2006 PICMG® AMC.1 R2.0, PCI Express™ on AdvancedMC™, Oct. 8, 2008 PICMG® AMC.2 R1.0, Ethernet Advanced Mezzanine Card Specification, March 1, 2007 PICMG® AMC.3 R1.0, Advanced Mezzanine Card Specification for Storage, Aug. 25, 2005
IPMI	IPMI - Intelligent Platform Management Interface Specification, v2.0 Document Revision 1.0, February 12, 2004 IPMI - Platform Management FRU Information Storage Definition, V1.0 Document Revision 1.1, September 27, 1999
PCI Express	PCI Express Base Specification Revision 3.0, Nov. 18, 2010
Serial ATA	Serial ATA Specification, Revision 3.0 Serial ATA II: Extensions to Serial ATA 1.0, Revision 1.0
Platform Firmware	Unified Extensible Firmware Interface (uEFI) specification, version 2.1
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 Processor

The AM4022 supports the low-power, high-performance, 64-bit, dual-core 3rd generation Intel® Core™ i7-3612QE processor with 2.1 GHz clock speed and the 3rd generation Intel® Core™ i7-3555LE processor with 2.5 GHz clock speed.

The 3rd generation Intel® Core™ i7 processors used on the AM4022 include an integrated high-performance graphics controller and a DDR3 dual-channel memory controller with ECC support as well as one x16 PCI Express interface operating up to 8.0 GT/s serving the Gigabit Ethernet controller and the AMC ports 4-11. They support various technologies, such as:

- Intel® Hyper-Threading Technology
- Intel® Turbo Boost Technology
- Intel® Intelligent Power Sharing (IPS)
- Intel® Streaming SIMD Extensions 4.1
- Intel® Streaming SIMD Extensions 4.2
- Intel® 64 Architecture
- Execute Disable Bit
- Intel® Advanced Vector Extensions (Intel® AVX)
- Intel® Trusted Execution Technology (Intel® TXT)
- Intel® Virtualization Technology for Directed I/O (Intel® VT-d)
- Intel® Virtualization Technology (Intel® VT-x)
- Advanced Encryption Standard New Instructions (AES-NI)

The Intel® Hyper-Threading Technology allows one execution core to function as two logical processors. When this feature is used on the AM4022, up to eight logical processors are presented to the operating system. This results in higher processing throughput and improved performance when used with multithreaded software. This feature must be enabled in the uEFI BIOS in order to be available.

The Intel® Turbo Boost Technology and the Intel® Intelligent Power Sharing technology allow the processor and the graphics controller to opportunistically and automatically run faster than its rated operating clock frequency if it is operating below power, temperature, and current limits. This feature must be enabled in the uEFI BIOS for the processor and graphics controller to operate with maximum performance.

The Intel® SpeedStep® technology enables real-time dynamic switching of the voltage and frequency between several modes. This is achieved by switching the bus ratios, the core operating voltage, and the core processor speeds without resetting the system.

The 3rd generation Intel® Core™ i7 processors used on the AM4022 have the following multi-level cache structure:

- 64 kB L1 cache for each core
  - 32 kB instruction cache
  - 32 kB data cache
- 256 kB L2 shared instruction/data cache for each core
- Up to 6 MB L3 shared instruction/data cache shared between all cores

Table 2-1: Features of the Processors Supported on the AM4022

FEATURE	Core™ i7-3612QE (SV) 2.1 GHz	Core™ i7-3555LE (LV) 2.5 GHz
Processor Cores	four	two
Processor Base Frequency	2.1 GHz	2.5 GHz
Maximum Turbo Frequency	3.3 GHz	3.2 GHz
L1 cache per core	64 kB	64 kB
L2 cache per core	256 kB	256 kB
L3 cache	6 MB	4 MB
DDR3 Memory	up to 8 GB / 1600 MHz	up to 8 GB / 1600 MHz
Graphics Base Frequency	650 MHz	550 MHz
Graphics Max. Dynamic Frequency	1000 MHz	950 MHz
Thermal Design Power	35 W	25 W
Package	BGA1023	BGA1023

2.2 Memory

The AM4022 supports a soldered, dual-channel (144-bit), Double Data Rate (DDR3) memory with Error Checking and Correcting (ECC) running at 1600 MHz (memory error detection and reporting of 1-bit and 2-bit errors and correction of 1-bit failures). The available memory configuration can be either 4 GB or 8 GB.

However, when the internal graphics controller is enabled, the amount of memory available to applications is less than the total physical memory in the system. For example, the chipset's Dynamic Video Memory Technology dynamically allocates the proper amount of system memory required by the operating system and the application.

2.3 Intel® QM77 Express Chipset

The AM4022 is equipped with the mobile Intel® QM77 Express Chipset, a highly integrated platform controller hub (PCH) with the following features:

- Eight x1 PCI Express 2.0 ports (not used on the AM4022)
- SATA host controller with six ports; two with 6 Gbit/s and four with 3 Gbit/s data transfer rate and RAID 0/1/5/10 support (only four ports are used on the AM4022)
- USB 2.0 host interface with 14 USB ports available (only four ports are used on the AM4022)
- USB 3.0 host interface with 4 USB ports available (only one port is used on the AM4022)
- SPI interface support
- Low Pin Count (LPC) interface
- Power management logic support
- Enhanced DMA controller, interrupt controller, and timer functions
- System Management Bus (SMBus) compatible with most I²C™ devices
- DMI and FDI interfaces to the processor
- Intel® High Definition Audio Interface (not used on the AM4022)
- Analog display port (not used on the AM4022)
- Three digital display ports (only two ports are used on the AM4022)
- Integrated RTC

2.4 Timer

The AM4022 is equipped with the following timers:

- Real-Time Clock

  The Intel® QM77 chipset integrates an MC146818B-compatible real-time clock with 256 Byte CMOS RAM. The AM4022 does not include an onboard battery socket for a 3 V lithium battery power source. Alternatively, the RTC can be powered from the management power. But, if the power is switched off, the RTC will lose its data. All CMOS RAM data remain stored in an additional EEPROM device to prevent data loss.

  An optional battery module for RTC backup is available. For further information, refer to chapter 2.6.

- Counter/Timer

  Three 8254-style counter/timers are included on the AM4022 as defined for the PC/AT.

- The Intel® QM77 chipset integrates eight high-precision event timers.

2.5 Watchdog Timer

The AM4022 provides a Watchdog timer that is programmable for a timeout period ranging from 125 ms to 4096 s in 16 steps. Failure to trigger the Watchdog timer in time results in a system reset or an interrupt. In dual-stage mode, a combination of both interrupt and reset if the Watchdog is not serviced. A hardware status flag will be provided to determine if the Watchdog timer generated the reset.

2.6 Battery

The AM4022 does not have any provisions for an onboard battery for backup of the RTC. There is, however, an optional mezzanine module available which does provide battery-powered backup for the RTC. This module uses the J7 connector for interfacing with the AM4022. If this module is required, the J7 interface is not available for the SATA Flash module.

Refer to Appendix B for further information concerning this module.

2.7 Power Monitor and Reset Generation

All onboard voltages on the AM4022 are supervised, which guarantees controlled power-up of the board. This is done by releasing the power-up reset signals after the threshold voltages have been passed.

2.8 Flash Memory

The AM4022 provides Flash interfaces for the uEFI BIOS and the SATA Flash module.

2.8.1 SPI Boot Flash for uEFI BIOS

The AM4022 provides two 8 MB SPI boot Flashes for two separate uEFI BIOS images, a standard SPI boot Flash and a recovery SPI boot Flash. The fail-over mechanism for the uEFI BIOS recovery can be controlled via the IPMI controller or the DIP switch SW3 on the AM4022. If the standard SPI boot Flash is corrupted, the IPMI controller automatically enables the recovery SPI boot flash and boots the system again.

The SPI boot flash includes a hardware write protection option, which can be configured via the uEFI BIOS. If write protection is enabled, the SPI Flash cannot be written to.

Note ...

The uEFI BIOS code and settings are stored in the SPI boot flashes. Changes made to the uEFI BIOS settings are available only in the currently selected SPI boot Flash.Thus, switching over to the other SPI boot Flash may result in operation with different uEFI BIOS code and settings.

2.8.2 Serial ATA Flash Module (Optional)

The AM4022 supports up to 64 GB of NAND Flash memory in combination with an optional Serial ATA Flash module, which is connected to the onboard connector J7.

The Serial ATA Flash module is an SLC-based SATA NAND Flash drive with a built-in full hard-disk emulation and a high data transfer rate (sustained read rate with up to 100 MB/s and sustained write rate with up to at least 90 MB/s). It is optimized for embedded systems providing high performance, reliability and security.

Note ...

Write protection is available for this module. Contact Kontron for further assistance if write protection is required.

2.9 Trusted Platform Module 1.2 (On Request)

The AM4022 has been designed to support the Trusted Platform Module (TPM) 1.2. This feature is available on request. TPM1.2 is a security chip specifically designed to provide enhanced hardware- and software-based data and system security. It stores sensitive data such as encryption and signature keys, certificates and passwords, and is able to withstand software attacks to protect the stored information.

Hardware features of the TPM 1.2:

- TCG 1.2 compliant Trusted Platform Module (TPM)
- Security architecture based on the Infineon SLE66CXxxPE security controller family
- EEPROM for TCG firmware enhancements and for user data and keys
- Advanced Crypto Engine (ACE) with RSA support up to 2048-bit key length
- Hardware accelerator for SHA-1 hash algorithm
- True Random Number Generator (TRNG)
- Tick counter with tamper detection
- Protection against Dictionary Attack
- Intel® Trusted Execution Technology Support
- Full personalization with Endorsement Key (EK) and EK certificate

2.10 Board Interfaces

2.10.1 Front Panel LEDs

The AM4022 is equipped with three Module Management LEDs and four User-Specific LEDs. The User-Specific LEDs can be configured via two onboard registers (see Chapter 4.3.12, “User-Specific LED Configuration Register” and Chapter 4.3.13, “User-Specific LED Control Register”).

Figure 2-1: Front Panel LEDs

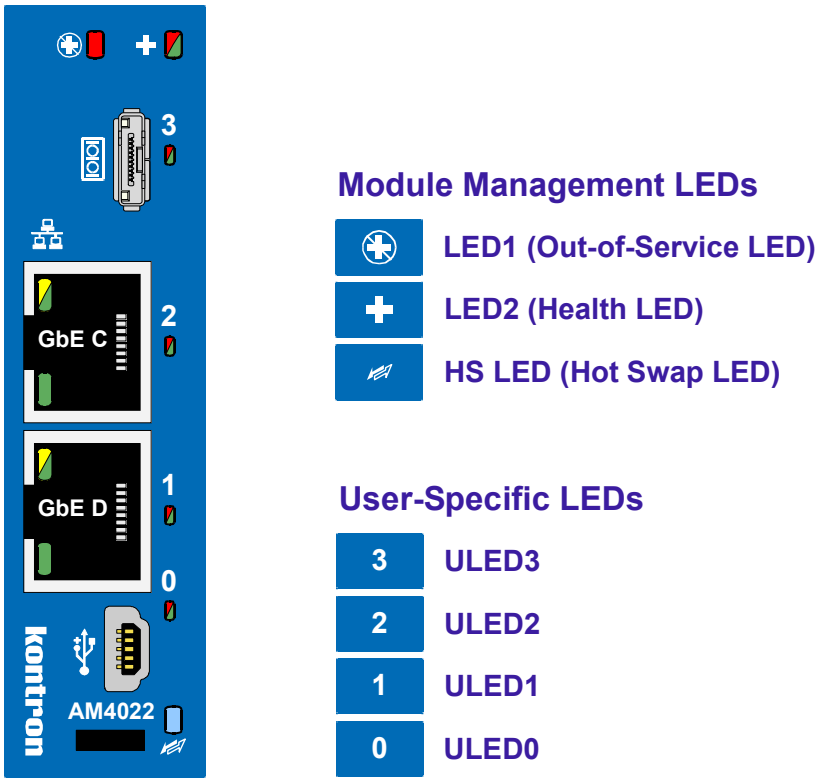


Table 2-2: Module Management LED Functions

LED	COLOR	STATE	NORMAL MODE	OVERRIDE MODE selectable by user or carrier, depending on PICMG LED command
LED1 (Out-of-Service LED)	red	off	Default	By user: • Only lamp test
		on	MMC out of service or in reset state	
		blinking	MMC firmware upgrade	
LED2 (Health LED)	green/amber/red	off	Payload is off; module is not powered	By user: • Only lamp test
		green	Module is healthy (normal operation) and all related sensors are within the specified range	
		amber	Payload is on and at least one sensor is out of range	
		red	Reserved	
HS LED (Hot Swap LED)	blue	on	a) Module ready for hot swap extraction, or b) Module has just been inserted in a powered system	By carrier: • On • Off • Slow/Fast Blinking By user: • Only lamp test
		blinking	Module hot swap in progress; module not ready for extraction	
		off	Module is in normal operation	

Note ...

For further information concerning the hot swap operation, refer to Chapter 3.3, Hot Swap Procedures.

Table 2-3: User-Specific LED Functions

LED	COLOR	FUNCTION DURING POWER-UP	FUNCTION DURING BOOT-UP (if POST code config. is enabled)	DEFAULT FUNCTION AFTER BOOT-UP
ULED3	red	When lit up during power-up, it indicates a power failure.	--	Processor overtemperature above 125 °C (blinking) and processor overtemperature above 105 °C (on)
	green	--	uEFI BIOS POST bit 3 and bit 7	AMC port 0 Ethernet link signal status
ULED2	red	When lit up during power-up, it indicates a clock failure.	--	Processor overtemperature above 125 °C (blinking)
	green	--	uEFI BIOS POST bit 2 and bit 6	AMC port 1 Ethernet link signal status
ULED1	red	When lit up during power-up, it indicates a hardware reset.	--	Processor overtemperature above 125 °C (blinking)
	green	--	uEFI BIOS POST bit 1 and bit 5	SATA channels active
ULED0	red	When lit up during power-up, it indicates a uEFI BIOS boot failure	--	Processor overtemperature above 125 °C (blinking)
	green	--	uEFI BIOS POST bit 0 and bit 4	--

How to Read the 8-Bit POST Code

Due to the fact that only 4 bits are available and 8 bits must be displayed, the User-Specific LEDs are multiplexed.

Table 2-4: POST Code Sequence

STATE	USER-SPECIFIC LEDs
0	All User-Specific LEDs are OFF; start of POST sequence
1	High nibble
2	Low nibble; state 2 is followed by state 0

The following is an example of the User-Specific LEDs' operation if uEFI BIOS POST configuration is enabled (see also Table 2-3, "User-Specific LEDs Function").

Table 2-5: POST Code Example

	LED3	LED2	LED1	LED0	RESULT
HIGH NIBBLE	off (0)	on (1)	off (0)	off (0)	0x4
LOW NIBBLE	off (0)	off (0)	off (0)	on (1)	0x1
POST CODE					0x41

Note ...

Under normal operating conditions, the User-Specific LEDs should not remain lit during boot-up. They are intended to be used only for debugging purposes. In the event that a User-Specific LED lights up during boot-up and the AM4022 does not boot, please contact Kontron.

If all User-Specific LEDs flash red on and off at regular intervals, they indicate that the processor junction temperature has reached a level beyond which permanent silicon damage may occur. Once activated, the overtemperature event remains latched until a cold restart of the AM4022 is undertaken (all power off and then on again).

2.10.2 Module Handle

At the front panel, the AM4022 provides a module handle for module extraction, securing the module in the carrier/chassis and actuating the hot swap switch.

The module handle supports a three-position operation.

Figure 2-2: Module Handle Positions

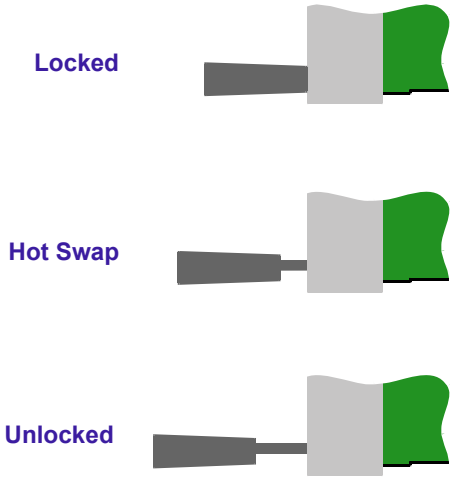


Table 2-6: Module Handle Positions

MODULE HANDLE POSITION	FUNCTION
Locked	When the AM4022 is installed, the module handle is pushed in the “Locked” position and the following actions result: • The module is locked in the carrier/chassis • The hot swap switch is actuated
Hot Swap	When an extraction process of the AM4022 is initiated, the module handle is pulled in the “Hot Swap” position and the following actions result: • The module is locked in the carrier/chassis • The hot swap switch is deactuated
Unlocked	When the module handle is pulled to the “Unlocked” position, the AM4022 can be fully extracted and the following actions result: • The module is unlocked in the carrier/chassis • The hot swap switch is deactuated

Note ...

For normal operation, the module handle must be in the “Locked” position.

2.10.3 General Purpose DIP Switches

The AM4022 is equipped with two general purpose, 4-bit DIP switches, SW2 and SW3, which are used for board configuration.

The following tables indicate the functions of the switches integrated in the DIP switches SW2 and SW3.

Table 2-7: DIP Switch SW2 Functions

SWITCH	FUNCTION
1	PCI Express, AMC Fat Pipes Region ports 4-11 configuration
2	SATA, AMC Common Options Region ports 2-3 and Extended Options Region ports 12 configuration
3	PCI Express reference clock configuration
4	

Table 2-8: DIP Switch SW3 Functions

SWITCH	FUNCTION
1	POST code display during boot-up
2	uEFI BIOS Firmware Hub configuration
3	Reserved
4	Clearing uEFI BIOS CMOS parameters

For further information on the configuration of the DIP switches SW2 and SW3, refer to Chapter 4.1, “DIP Switch Configuration”.

2.10.4 Debug Interface

The AM4022 provides several onboard options for hardware and software debugging, such as:

- Four bicolor debug LEDs for signaling hardware failures and uEFI BIOS POST code
- One optional, small form factor extended debug port (SFF XDP processor JTAG) connector, J9, to facilitate debug and uEFI BIOS software development
- One JTAG interface connected to the AMC Card-edge connector for debugging and manufacturing purposes

2.10.5 USB Host Interface

The AM4022 supports one high-speed, full-speed and low-speed capable USB 2.0 host port via the 5-pin Mini USB type A connector, J2, on the front panel. This connector allows connecting standard USB peripheral devices to the AM4022 via an adapter for Mini USB type A to USB type A connectors.

The following figure and table provide pinout information on the Mini USB Type A connector, J2.

Figure 2-3: Mini USB Type A Con. J2

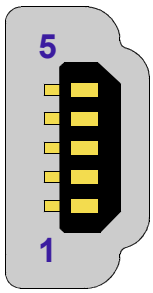


Table 2-9: Mini USB Type A Con. J2 Pinout

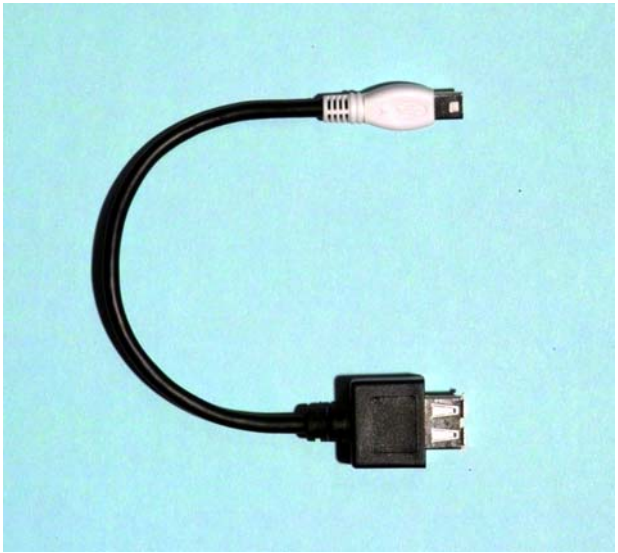
PIN	SIGNAL	FUNCTION	I/O
1	VCC	VCC signal	--
2	UV0-	Differential USB-	I/O
3	UV0+	Differential USB+	I/O
4	NC	Not Connected	--
5	GND	GND signal	--

Note ...

The AM4022 USB host interface can be used with maximum 500 mA continuous load current as specified in the Universal Serial Bus Specification, Revision 2.0. Short-circuit protection is provided. All the signal lines are EMI-filtered.

The following figure illustrates the adapter required for connecting standard USB devices to the AM4022. For further technical or ordering information on this adapter, please contact Kontron.

Figure 2-4: Adapter for Mini USB Type A to USB Type A Connector



2.10.6 Serial Ports

The AM4022 has been designed to support one serial port, COMA, fully compatible with the 16550 UART controller.

If the AM4022 is ordered with a COMA port on the front panel, COMA is implemented as a serial RS-232, 10-pin, mini connector, J5. This connector allows connecting standard serial devices to the AM4022 via a specially designed serial adapter for a 10-pin mini connector to a 9-pin, female, D-Sub connector from Kontron.

The COMA interface includes receive and transmit signals as well as additional signals for handshaking mode. Data transfer rates up to 115.2 kB/s are supported.

The COMA interface can be routed to the AMC port 15 in the Extended Options Region of the AMC Card-edge Connector as TTL 3.3 V signal level. In this event, the COMA port includes only receive and transmit signals.

Note ...

If the AM4022 is ordered with a COMA connector on the front panel, the graphics controller integrated in the 3rd generation Intel® Core™ i7 processor is disabled.

The following figure and table provide pinout information on the serial port connector J5.

Figure 2-5: Mini Con. J5 (COMA)

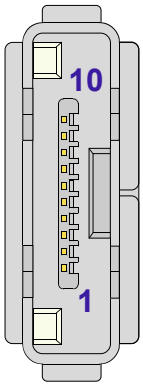


Table 2-10: Mini Con. J5 (COMA) Pinout

PIN	SIGNAL	FUNCTION	I/O
1	NC	Not connected	--
2	RXD	Receive data	I
3	TXD	Transmit data	O
4	DTR	Data terminal ready	O
5	GND	Signal ground	--
6	DSR	Data send ready	I
7	RTS	Request to send	O
8	CTS	Clear to send	I
9	NC	Not connected	--
10	NC	Not connected	--

The following figure illustrates the Kontron adapter for a 10-pin, mini connector to a 9-pin, female, D-Sub connector. For further technical or ordering information on this adapter, please contact Kontron.

Figure 2-6: Adapter for 10-Pin Mini Connector to 9-Pin D-Sub Female Connector

Table 2-11: Pinout of the Serial Adapter Connectors

PINOUT OF THE D-SUB CONNECTOR	SIGNAL	PINOUT OF THE MINI CONNECTOR
1	Not used	1
3	RXD	2
2	TXD	3
4	Not used	4
5	GND	5
6	Not used	6
7	Not used	7
8	Not used	8
9	Not used	9
--	Not used	10
Shield / Housing	Shield	Shield / Housing

Note ...

This adapter supports only RXD (receive data) and TXD (transmit data) signals.

2.10.7 Integrated Graphics Controller

The 3rd generation Intel® Core™ i7 processors include a highly integrated graphics accelerator delivering high-performance 3D and 2D graphics capabilities. The internal graphics controller has two independent display pipes allowing for support of two independent display screens.

Integrated 2D/3D graphics:

- Intel® Dynamic Video Memory Technology
- Intel® Graphics Performance Modulation Technology
- Intel® Smart 2D Display Technology
- High-performance MPEG-2 decoding
- WMV9/VC1 Hardware acceleration
- Support of DisplayPort interface
- Display support for resolution up to 2560 x 1600 pixels @ 60 Hz

2.10.7.1 Graphics Memory Usage

The 3rd generation Intel® Core™ i7 processors support the Dynamic Video Memory Technology (Intel® DVMT) with up to 352 MB memory. This technology ensures the most efficient use of all available memory for maximum 3D graphics performance. DVMT dynamically responds to application requirements allocating display and texturing memory resources as required.

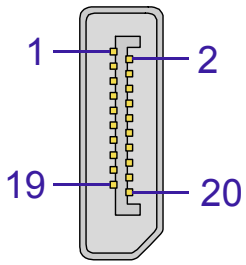
2.10.7.2 DisplayPort Interfaces

The AM4022 provides up to two DisplayPort interfaces, one implemented as a 20-pin DisplayPort connector, J6, on the front panel and one routed to the Extended Options Region of the AMC interconnection available on request. Additionally, the Intel® QM77 chipset provides DisplayPort interoperability support for CRT/DVI/HDMI displays through a cable adapter.

If the AM4022 is ordered with a DisplayPort on the front panel, one DisplayPort interface is implemented as a 20-pin DisplayPort connector, J6, on the front panel and the serial port COMA is routed to the AMC interconnection.

The following figure illustrates the DisplayPort connector J6.

Figure 2-7: DisplayPort Connector J6



The following table indicates the pinout of the DisplayPort connector J6.

Table 2-12: DisplayPort Connector J6 Pinout

I/O	FUNCTION	SIGNAL	PIN		SIGNAL	FUNCTION	I/O
--	Power 3.3 V, 0.5 A fuse protection	PWR	20	19	RETURN	Return for power	--
I	Hot Plug Detect	HP_DET	18	17	AUX_CH-	Auxiliary Channel-	I/O
--	Signal ground	GND	16	15	AUX_CH+	Auxiliary Channel+	I/O
--	Signal ground	GND	14	13	HDMI_SEL	DP/HDMI/DVI Select	I
--	Signal ground	GND	12	11	ML(3)-	Data Lane3-	O
O	Data Lane3+	ML(3)+	10	9	GND	Signal ground	--
O	Data Lane2-	ML(2)-	8	7	ML(2)+	Data Lane2+	O
--	Signal ground	GND	6	5	ML(1)-	Data Lane1-	O
O	Data Lane1+	ML(1)+	4	3	ML(0)-	Data Lane0-	O
--	Signal ground	GND	2	1	ML(0)+	Data Lane0+	O

2.10.8 Serial ATA Interfaces

The AM4022 provides up to four SATA interfaces. All four ports are logically connected to the Intel® QM77 chipset. One SATA port is routed to the Serial ATA Extension Connector, J7, which is used to connect the SATA Flash module.

Two SATA 6 Gb/s ports are connected to the AMC ports 2-3 in the Common Options Region of the AMC Card-edge Connector.

Two SATA 3 Gb/s ports are available, one connected to the AMC port 12 in the Extended Options Region of the AMC Card-edge connector, and the other to the onboard connector J7 for a SATA Flash module.

2.10.9 PCI Express Interfaces

The AM4022 provides two x4 or one x8 PCI Express interfaces operating at up to 8.0 GT/s. The PCI Express interfaces operate as root complex only and are routed to the AMC interconnection, Fat Pipes Region, ports 4-11.

2.10.10 Gigabit Ethernet Interfaces

The AM4022 supports up to four Gigabit Ethernet interfaces using one Intel® I350 Quad Gigabit Ethernet controller. Two Gigabit Ethernet copper ports (1000BASE-TX) are connected to the RJ-45 front panel connectors, J3 and J4, and two Gigabit Ethernet SerDes ports are routed to the AMC ports 0-1 in the Common Options Region of the AMC Card-edge Connector.

The Intel® I350 Quad Gigabit Ethernet controller is optimized to deliver high-performance data throughput with the lowest power consumption. The Ethernet controller is directly connected to the 3rd generation Intel® Core™ i7 processor using one x4 PCI Express port. The Boot from LAN feature is supported.

Network features of the Intel® I350 Quad Gigabit Ethernet controller include:

- Intel® I/O Acceleration Technology
- Message Signaled Interrupts (MSI)
- Support of Virtual Machines Device queues (VMDq) per port
- IEEE 1588 Precision Time Protocol support and per-packet timestamp
- Support of various manageability and power saving features

The following table indicates the Gigabit Ethernet port mapping of the AM4022.

Table 2-13: Gigabit Ethernet Port Mapping

ETHERNET CONTROLLER	PORT MAPPING
Intel® I350, port 0	AMC port 0; Ethernet port A
Intel® I350, port 1	AMC port 1; Ethernet port B
Intel® I350, port 2	Front I/O connector J4 (GbE C)
Intel® I350, port 3	Front I/O connector J3 (GbE D)

2.10.10.1 Gigabit Ethernet Connectors

The Ethernet connectors are realized as two RJ-45 connectors, J3 (GbE D) and J4 (GbE C). The interfaces provides automatic detection and switching between 10Base-T, 100Base-TX and 1000Base-T data transmission (Auto-Negotiation). Auto-wire switching for crossed cables is also supported (Auto-MDI/X).

Figure 2-8: Gigabit Ethernet Connectors J3 and J4

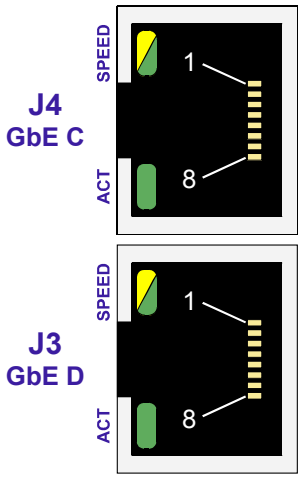


Table 2-14: Gigabit Ethernet Connectors J3 and J4 Pinout

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

Ethernet LED Status

ACT (green): This LED monitors network connection and activity. The LED lights up when a valid link (cable connection) has been established. The LED goes temporarily off if network packets are being 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/yellow): This LED lights up to indicate a successful 100Base-TX or 1000BASE-T connection. When green it indicates a 100Base-TX connection and when yellow it indicates a 1000Base-T connection. When not lit and the ACT-LED is active, the connection is operating at 10Base-T.

2.11 AMC Interconnection

The AM4022 communicates with the carrier board or the MicroTCA backplane via the AMC Card-edge connector, which is a serial interface optimized for high-speed interconnects. The AMC Card-edge connector supports a variety of fabric topologies divided into five functional groups:

- Fabric interface
- Synchronization clock interface
- System management interface
- JTAG interface
- Module power interface

The following sections provide detailed information on these interfaces.

2.11.1 Fabric Interface

The Fabric interface is the real communication path and comprises 20 high-speed ports providing point-to-point connectivity for module-to-carrier and module-to-module implementations. The high-speed ports are separated in three logical regions as follows:

- Common Options Region
- Fat Pipes Region
- Extended Options Region

The AM4022 port mapping is described below and illustrated in Figure 2-9.

- Common Options Region:
  - Ports 0-1: Two Gigabit Ethernet SerDes ports
  - Ports 2-3: Two Serial ATA ports
- Fat Pipes Region:
  - Ports 4-11: Two x4 or one x8 PCI Express interfaces operating as root-complex only
- Extended Options Region:
  - Port 12: One Serial ATA port
  - Port 13: One USB 3.0 port (on request)
  - Port 14: One debug port / one USB 2.0 port (on request)
  - Port 15: One serial port
  - Port 16: GPIO (on request) (two GPIs and two GPOs)
  - Port 17: DisplayPort (on request)
  - Port 18: DisplayPort (on request)
  - Port 19: One USB 2.0 port (on request) / DisplayPort (on request)
  - Port 20: One USB 2.0 port (on request) / DisplayPort (on request)

Figure 2-9: AM4022 Port Mapping

	Port No.	AMC Standard Port Mapping	AM4022 Port Mapping
Basic Connector	TCLKA	Clocks	System Tick (optional)
	TCLKB		not used
	FCLKA		PCIe Reference Clock (unidirectional)
	0	Common Options Region	GbE-A
	1		GbE-B
	2		SATA-A (6Gb/s)
	3		SATA-B (6Gb/s)
	4	Fat Pipes Region	2 x 4 or 1 x8 PCIe
	5		
	6		
	7		
Extended Connector	8		
	9		
	10		
	11		
	12	Extended Options Region	SATA-C (3Gb/s)
	13		USB 3.0 (on request)
	14		Debug / USB 2.0 (on request)
	15		Serial (COMA)
	TCLKC/D		not used
	16		GPIO (on request)
	17		DisplayPort (on request)
	18		DisplayPort (on request)
	19		USB 2.0 (on request) / DisplayPort (on request)
	20		USB 2.0 (on request) / DisplayPort (on request)

2.11.2 Synchronization Clock Interface

On the AM4022, two PCI Express reference clock configurations are supported in accordance with the PCI Express Base Specification Revision 3.0 as follows:

- AM4022 uses local PCI Express reference clock, and AMC (input) clock (FCLKA) is disabled. In this configuration, the clock spread spectrum modulation must be disabled.
- AM4022 uses local PCI Express reference clock, and AM4022 generates PCI Express reference clock to the AMC Card-edge connector (FCLKA)

The PCI Express reference clock configurations can be viewed in the uEFI BIOS. For further information, refer to the AM4022 uEFI BIOS User Guide.

The PCI Express reference clock configurations can be modified via the DIP Switch SW2, switches 3 and 4. For further information, refer to Chapter 4.1, DIP Switch Configuration.

2.11.3 System Management Interface

The system management interface is a port from the module to the carrier via the Local Intelligent Platform Management Bus (IPMB-L). The Module Management Controller uses this port for the communication with the carrier Intelligent Platform Management Controller (IPMC). The IPMB-L is a multi-master I²C bus.

2.11.4 JTAG Interface

JTAG support is provided on the AMC Card-edge connector. The JTAG interface is supported for vendor product test and logic update.

On the AM4022, the FPGA JTAG port is connected to the AMC JTAG port.

2.11.5 Module Power Interface

The module power interface provides the management power (MP) and payload power (PWR). These two supply voltages must have power-good indicators so that the system management can detect boot sequence events and nominal operating conditions.

The AM4022 operates with payload power in the range of 10.8 V to 13.2 V, and with management power of 3.3 V ± 5%.

The board supports removal and insertion in a powered slot as required by the AMC.0 specification.

2.11.6 Pinout of AMC Card-edge Connector J1

The AMC Card-edge connector is a high-speed serial interface with 170 pins. The following table provides the pinout of the AMC Card-edge connector J1. The shaded table cells indicate signals that are not used on the AM4022.

Table 2-15: Pinout of AMC Card-edge Connector J1

BASIC SIDE (COMPONENT SIDE 1)				EXTENDED SIDE (COMPONENT SIDE 2)			
PIN	SIGNAL	FUNCTION	DRIVEN BY	PIN	SIGNAL	FUNCTION	DRIVEN BY
1	GND	Logic Ground	-	170	GND	Logic Ground	-
2	PWR	Payload Power	Carrier	169	TDI	JTAG Test Data Input	Carrier
3	PS1#	Presence 1	AMC	168	TDO	JTAG Test Data Output	AMC
4	MP	Management Power	Carrier	167	TRST#	JTAG Test Reset Input	Carrier
5	GA0	Geographic Address 0	Carrier	166	TMS	JTAG Test Mode Select In	Carrier
6	RSV	Reserved (Optional PCIe Reset Output)	AMC	165	TCK	JTAG Test Clock Input	Carrier
7	GND	Logic Ground	-	164	GND	Logic Ground	-
8	RSV	Reserved	-	163	Tx20+	DisplayPort Data Lane 3+	AMC
9	PWR	Payload Power	Carrier	162	Tx20-	DisplayPort Data Lane 3-	AMC
10	GND	Logic Ground	-	161	GND	Logic Ground	-
11	Tx0+	GbE-A Transmitter +	AMC	160	Rx20+	USB 2.0 port 6 D+	AMC
12	Tx0-	GbE-A Transmitter -	AMC	159	Rx20-	USB 2.0 port 6 D-	AMC
13	GND	Logic Ground	-	158	GND	Logic Ground	-
14	Rx0+	GbE-A Receiver +	Carrier	157	Tx19+	DisplayPort Data Lane 2+	AMC
15	Rx0-	GbE-A Receiver	Carrier	156	Tx19-	DisplayPort Data Lane 2-	AMC
16	GND	Logic Ground	-	155	GND	Logic Ground	-
17	GA1	Geographic Address 1	Carrier	154	Rx19+	USB 2.0 port 7 D+	AMC
18	PWR	Payload Power	Carrier	153	Rx19-	USB 2.0 port 7 D-	AMC
19	GND	Logic Ground	-	152	GND	Logic Ground	-
20	Tx1+	GbE-B Transmitter +	AMC	151	Tx18+	DisplayPort Data Lane 1+	AMC
21	Tx1-	GbE-B Transmitter -	AMC	150	Tx18-	DisplayPort Data Lane 1-	AMC
22	GND	Logic Ground	-	149	GND	Logic Ground	-
23	Rx1+	GbE-B Receiver +	Carrier	148	Rx18+	DisplayPort DDC SDA	Carrier
24	Rx1-	GbE-B Receiver -	Carrier	147	Rx18-	DisplayPort DDC SCL	Carrier
25	GND	Logic Ground	-	146	GND	Logic Ground	-
26	GA2	Geographic Address 2	Carrier	145	Tx17+	DisplayPort Data Lane 0+	AMC
27	PWR	Payload Power	Carrier	144	Tx17-	DisplayPort Data Lane 0-	AMC
28	GND	Logic Ground	-	143	GND	Logic Ground	-

Table 2-15: Pinout (Continued) of AMC Card-edge Connector J1

BASIC SIDE (COMPONENT SIDE 1)				EXTENDED SIDE (COMPONENT SIDE 2)			
PIN	SIGNAL	FUNCTION	DRIVEN BY	PIN	SIGNAL	FUNCTION	DRIVEN BY
29	Tx2+	SATA-A Transmitter +	AMC	142	Rx17+	DisplayPort Auxiliary Ch.+	-
30	Tx2-	SATA-A Transmitter -	AMC	141	Rx17-	DisplayPort Auxiliary Ch.-	-
31	GND	Logic Ground	-	140	GND	Logic Ground	-
32	Rx2+	SATA-A Receiver +	Carrier	139	Tx16+	GPO0	AMC
33	Rx2-	SATA-A Receiver -	Carrier	138	Tx16-	GPO1	AMC
34	GND	Logic Ground	-	137	GND	Logic Ground	-
35	Tx3+	SATA-B Transmitter +	AMC	136	Rx16+	GPI0	Carrier
36	Tx3-	SATA-B Transmitter -	AMC	135	Rx16-	GPI1	Carrier
37	GND	Logic Ground	-	134	GND	Logic Ground	-
38	Rx3+	SATA-B Receiver +	Carrier	133	Tx15+	Serial Port Transmit	AMC
39	Rx3-	SATA-B Receiver -	Carrier	132	Tx15-	Serial Port Receive	Carrier
40	GND	Logic Ground	-	131	GND	Logic Ground	-
41	ENABLE#	AMC Enable	Carrier	130	Rx15+	USB_OC#	Carrier
42	PWR	Payload Power	Carrier	129	Rx15-	USB_EN#	AMC
43	GND	Logic Ground	-	128	GND	Logic Ground	-
44	Tx4+	PCIe-0 Transmitter +	AMC	127	Tx14+	Debug serial data output	AMC
45	Tx4-	PCIe-0 Transmitter -	AMC	126	Tx14-	Debug serial clock output	AMC
46	GND	Logic Ground	-	125	GND	Logic Ground	-
47	Rx4+	PCIe-0 Receiver +	Carrier	124	Rx14+	USB 2.0 port 1 D+	AMC
48	Rx4-	PCIe-0 Receiver -	Carrier	123	Rx14-	USB 2.0 port 1 D-	AMC
49	GND	Logic Ground	-	122	GND	Logic Ground	-
50	Tx5+	PCIe-1 Transmitter +	AMC	121	Tx13+	USB 3.0 Transmitter +	AMC
51	Tx5-	PCIe-1 Transmitter -	AMC	120	Tx13-	USB 3.0 Transmitter -	AMC
52	GND	Logic Ground	-	119	GND	Logic Ground	-
53	Rx5+	PCIe-1 Receiver +	Carrier	118	Rx13+	USB 3.0 Receiver +	Carrier
54	Rx5-	PCIe-1 Receiver -	Carrier	117	Rx13-	USB 3.0 Receiver -	Carrier
55	GND	Logic Ground	-	116	GND	Logic Ground	-
56	SCL_L	IPMB-L Clock	IPMI Agent	115	Tx12+	SATA-C Transmitter +	AMC
57	PWR	Payload Power	Carrier	114	Tx12-	SATA-C Transmitter -	AMC
58	GND	Logic Ground	-	113	GND	Logic Ground	-
59	Tx6+	PCIe-2 Transmitter +	AMC	112	Rx12+	SATA-C Receiver +	Carrier
60	Tx6-	PCIe-2 Transmitter -	AMC	111	Rx12-	SATA-C Receiver -	Carrier

Table 2-15: Pinout (Continued) of AMC Card-edge Connector J1

BASIC SIDE (COMPONENT SIDE 1)				EXTENDED SIDE (COMPONENT SIDE 2)			
PIN	SIGNAL	FUNCTION	DRIVEN BY	PIN	SIGNAL	FUNCTION	DRIVEN BY
61	GND	Logic Ground	-	110	GND	Logic Ground	-
62	Rx6+	PCIe-2 Receiver +	Carrier	109	Tx11+	PCIe-7 Transmitter +	AMC
63	Rx6-	PCIe-2 Receiver -	Carrier	108	Tx11-	PCIe-7 Transmitter -	AMC
64	GND	Logic Ground	-	107	GND	Logic Ground	-
65	Tx7+	PCIe-3 Transmitter +	AMC	106	Rx11+	PCIe-7 Receiver +	Carrier
66	Tx7-	PCIe-3 Transmitter -	AMC	105	Rx11-	PCIe-7 Receiver -	Carrier
67	GND	Logic Ground	-	104	GND	Logic Ground	-
68	Rx7+	PCIe-3 Receiver +	Carrier	103	Tx10+	PCIe-6 Transmitter +	AMC
69	Rx7-	PCIe-3 Receiver -	Carrier	102	Tx10-	PCIe-6 Transmitter -	AMC
70	GND	Logic Ground	-	101	GND	Logic Ground	-
71	SDA_L	IPMB-L Data	IPMI Agent	100	Rx10+	PCIe-6 Receiver +	Carrier
72	PWR	Payload Power	Carrier	99	Rx10-	PCIe-6 Receiver -	Carrier
73	GND	Logic Ground	-	98	GND	Logic Ground	-
74	TCLKA+	Telecom Clock A+ (optional)	Carrier	97	Tx9+	PCIe-5 Transmitter +	AMC
75	TCLKA-	Telecom Clock A- (optional)	Carrier	96	Tx9-	PCIe-5 Transmitter -	AMC
76	GND	Logic Ground	-	95	GND	Logic Ground	-
77	TCLKB+	Not Connected	AMC	94	Rx9+	PCIe-5 Receiver +	Carrier
78	TCLKB-	Not Connected	AMC	93	Rx9-	PCIe-5 Receiver -	Carrier
79	GND	Logic Ground	-	92	GND	Logic Ground	-
80	FCLKA+	PCIe Reference Clock +	Carrier	91	Tx8+	PCIe-4 Transmitter +	AMC
81	FCLKA-	PCIe Reference Clock -	Carrier	90	Tx8-	PCIe-4 Transmitter -	AMC
82	GND	Logic Ground	-	89	GND	Logic Ground	-
83	PS0#	Presence 0	Carrier	88	Rx8+	PCIe-4 Receiver +	Carrier
84	PWR	Payload Power	Carrier	87	Rx8-	PCIe-4 Receiver -	Carrier
85	GND	Logic Ground	-	86	GND	Logic Ground	-

Warning!

When handling the board, take care not to touch the gold conductive fingers of the AMC Card-edge connector.

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

The following table lists the reserved pins which must not be connected to external circuitry.

Table 2-16: Reserved Pins Description

AMC PIN	AMC PORT	FUNCTION	I/O	SIGNALING VOLTAGE
6	--	Optional PCI Express reset output	O	3.3V TTL level
8	--	Reserved for system write protect	I	3.3V TTL level

Warning!

The reserved pins listed above are reserved for optional use and must not be connected to external circuitry.

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

The following table lists the Extended Options Region pins with no differential signals:

Table 2-17: Extended Options Region Single-Ended Pins Description

AMC PIN	AMC PORT	FUNCTION	I/O	SIGNALING VOLTAGE
133	15	Tx serial port (COMA)	O	3.3V TTL level
132	15	Rx serial port (COMA)	I	3.3V TTL level
127	14	Debug serial data output	O	3.3V TTL level
126	14	Debug serial clock output	O	3.3V TTL level

Note ...

The Extended Options Region pins listed above do not have differential signals. They have 3.3V TTL signaling voltage.

The following table lists the optional single-ended GPIO pins:

Table 2-18: Optional Single-Ended GPIO Pins Description

AMC PIN	AMC PORT	FUNCTION	I/O	SIGNALING VOLTAGE
139	16	General purpose output: GPO0	O	3.3V TTL level
138	16	General purpose output: GPO1	O	3.3V TTL level
136	16	General purpose input: GPI0	I	3.3V TTL level
135	16	General purpose input: GPI1	I	3.3V TTL level

Note ...

On standard AM4022 boards, the pins listed in the table above are not available.

The following table lists the Extended Options Region pins for the AM4022 with AMC USB support:

Table 2-19: Extended Options Region Pins for the AM4022 with AMC USB Support

AMC PIN	AMC PORT	FUNCTION	I/O	SIGNALING VOLTAGE
124	14	USB 2.0 port 1 Data+	I/O	LVDS
123	14	USB 2.0 port 1 Data-	I/O	LVDS
154	19	USB 2.0 port 7 Data+	I/O	LVDS
153	19	USB 2.0 port 7 Data-	I/O	LVDS
160	20	USB 2.0 port 6 Data+	I/O	LVDS
159	20	USB 2.0 port 6 Data-	I/O	LVDS
121	13	USB 3.0 Transmitter +	O	LVDS
120	13	USB 3.0 Transmitter -	O	LVDS
118	13	USB 3.0 Receiver +	I	LVDS
117	13	USB 3.0 Receiver -	I	LVDS
130	15	USB Overcurrent Detection: USB_OC#	I	3.3V TTL level
129	15	USB Power Enable: USB_EN#	O	3.3V TTL level

Note ...

On standard AM4022 boards, the pins listed in the table above are only available on request.

Note ...

If USB 2.0 port 1 and the USB 3.0 port are both activated for use, the USB 3.0 port has priority over the USB 2.0 port 1. This means that in the event the 3.0 port has an active device attached, the USB 2.0 port 1 is deactivated.

The combination of the above-mentioned ports, USB 2.0 port 1 and the USB 3.0 port, makes it possible to support USB 3.0-compliant connectors which can be used with USB 3.0 or USB 2.0 devices.

The following table lists the Extended Options Region pins for the AM4022 with AMC DisplayPort support:

Table 2-20: Extended Options Region Pins for the AM4022 with AMC DP Support

AMC PIN	AMC PORT	FUNCTION	I/O	SIGNALING VOLTAGE
163	20	DisplayPort Data Lane 3 +	O	LVDS
162	20	DisplayPort Data Lane 3 -	O	LVDS
157	19	DisplayPort Data Lane 2 +	O	LVDS
156	19	DisplayPort Data Lane 2 -	O	LVDS
151	18	DisplayPort Data Lane 1 +	O	LVDS
150	18	DisplayPort Data Lane 1 -	O	LVDS
148	18	DisplayPort DDC SDA	I/O	3.3V TTL level
147	18	DisplayPort DDC SCL	I/O	3.3V TTL level
145	17	DisplayPort Data Lane 0 +	O	LVDS
144	17	DisplayPort Data Lane 0 -	O	LVDS
142	17	DisplayPort Auxiliary Channel +	I/O	3.3V TTL level
141	17	DisplayPort Auxiliary Channel -	I/O	3.3V TTL level

Note ...

On standard AM4022 boards, the pins listed in the table above are not available.

The following table lists the JTAG pins:

Table 2-21: JTAG Pins Description

AMC PIN	SIGNAL	FUNCTION	I/O	SIGNALING VOLTAGE
169	TDI	JTAG Test Data Input	I	3.3V TTL level
168	TDO	JTAG Test Data Output	O	3.3V TTL level
167	TRST#	JTAG Test Reset Input	I	3.3V TTL level
166	TMS	JTAG Test Mode Select In	I	3.3V TTL level
165	TCK	JTAG Test Clock Input	I	3.3V TTL level

Note ...

The JTAG pins are connected to the onboard FPGA logic and can be used to update the onboard logic. For further information, please contact Kontron.

2.12 Module Management

A dedicated Module Management Controller (MMC) on the AM4022 manages the module and supports a defined subset of IPMI commands and sensors. For information on IPMI, refer to the IPMI FW User Guide for the AM4022 Module.

2.12.1 Module Management Controller

The Module Management Controller is based on the NXP® ARM7 microcontroller and provides a dual 512 kB flash implementation with automatic roll-back strategy to the back-up copy, for example, if a firmware upgrade is interrupted or corrupted.

In addition, there is an MMC system EEPROM available for firmware private data and FRU data. Access to this EEPROM is only possible via IPMI commands.

The host processor communicates with the MMC via the Keyboard Controller Style (KCS) interface. The MMC is able to communicate directly with the FPGA via the I²C interface.

The MMC is used to manage the AM4022. For example, it monitors several onboard temperature conditions, board voltages and the power supply status, manages LEDs and operations, reboots the board, etc. Additionally, the MMC can intervene in the operating status of the system by reading temperature values, shutting down systems and generating alarm signals if fault conditions occur.

The MMC provides an IPMI watchdog in compliance with the AMC specification. The watchdog can be used to reset or power cycle the payload CPU. This enhances the board's characteristics and improves the system's reliability.

The MMC firmware is designed and specially made for AMC environments, and is compliant with the PICMG® 3.0 and IPMI v2.0 rev 1.0 specifications.

Additionally, IPMI over LAN (IOL) and Serial over LAN (SOL) are supported by the AM4022. For information on IOL/SOL, refer to the IPMI FW User Guide for the AM4022 Module.

2.12.2 MMC Signals Implemented on the AM4022

The MMC implements several signals to monitor and control the different board functions. The following tables indicate the signals implemented on the AM4022.

Table 2-22: Processor and Chipset Supervision

SIGNAL	DESCRIPTION	MMC FUNCTION
PLT reset	Status of platform reset signal	Monitor reset status
Board reset	Resets the complete board	Control reset circuit
Cold reset	Resets all host registers and the complete board	Control reset circuit
S3 Sleep state	Status of chipset sleep state	Monitor sleep state
Power button	Set chipset power button	Set power button signal
SPI Flash control	SPI Flash fail-over control	Control SPI Flashes
Post Code	uEFI BIOS POST code information	Monitor uEFI BIOS

Table 2-23: AMC-Specific Signals

SIGNAL	DESCRIPTION	MMC FUNCTION
GA[0:2]	Geographic address	Monitor and control
Hot swap LED	Hot swap LED	Control LED
Hot swap switch	Status of hot swap switch	Monitor hot swap switch
Out-of-Service LED	Out-of-Service LED	Control LED
Health LED	Health LED	Control LED
PCI Express E-Keying	PCI Express E-Keying	Configure PCI Express interface
SATA E-Keying	SATA E-Keying	Configure SATA ports
PCI Express Clock E-Keying	PCI Express Clock E-Keying	Configure PCI Express clock

Table 2-24: Onboard Power Supply Supervision

SIGNAL	DESCRIPTION	MMC FUNCTION
AMC power enable	Control AMC board supply	Control power supply
Onboard power supply	Status of various onboard supply voltages	Monitor power good signals
Processor power supply	Status of processor supply voltage	Monitor power good
Voltage 3.3 V	Board 3.3 V supply (1%)	Monitor voltage
Voltage 5 V	Board 5 V supply (1%)	Monitor voltage
Voltage AMC 3.3 V	AMC management power 3.3 V (1%)	Monitor voltage
Voltage AMC 12 V	AMC payload power 12 V (1%)	Monitor voltage

Table 2-25: Temperature Signals

SIGNAL	DESCRIPTION	MMC FUNCTION
Intel® Core™ i7 temperature	Temperature of the processor die	Monitor temperature
Intel® QM77 chipset temperature	Chipset temperature	Monitor temperature
Temperature of the air temperature sensor	Air temperature sensor near the AMC Card-edge connector	Monitor temperature
Intel® Core™ i7 overtemperature	Indicates a catastrophic cooling failure, processor temperature > 125 °C	Monitor processor overtemperature signal
Intel® Core™ i7 internal thermal monitor	Status of internal thermal monitor	Monitor processor hot signal

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Chapter 3

Installation

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3. Installation

The AM4022 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 Safety Requirements

The following safety precautions must be observed when installing or operating the AM4022. Kontron assumes no responsibility for any damage resulting from failure to comply with these requirements.

Warning!

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 installing or removing the board.

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

Warning!

AMC modules require, by design, a considerable amount of force in order to (dis)engage the module from/in the AMC carrier/backplane connector. For this reason, when inserting or extracting the module, apply only as much force as required to preclude damage to either the module's handle or the front panel.

DO NOT push on the module handle to seat the module in the carrier/backplane connector. Do not use the module handle as a grip to handle the board outside of the carrier or chassis slot.

Use of excessive force, bending or rotation of the module handle will result in damage to the handle or the module's locking mechanism. Kontron disclaims all liability for damage to the module or the system as a result of failure to comply with this warning.

ESD Equipment!

This AMC module contains electrostatic 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.
- If working at an anti-static workbench with professional discharging equipment, please do not omit to use it.

Warning!

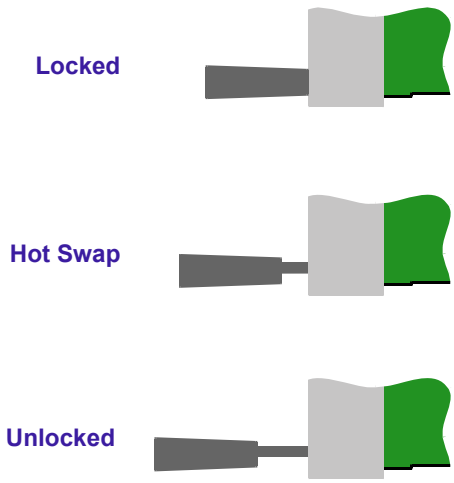
This product has gold conductive fingers which are susceptible to contamination. Take care not to touch the gold conductive fingers of the AMC Card-edge connector when handling the board.

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

3.2 Module Handle Positions

The module handle supports a three-position operation.

Figure 3-1: Module Handle Positions



Note ...

For normal operation, the module handle must be in the “Locked” position.

3.3 Hot Swap Procedures

The AM4022 is designed for hot swap operation. Hot swapping allows the coordinated insertion and extraction of modules without disrupting other operational elements within the system.

The procedures contained in this section are also applicable for “non-operating systems” with the exception of indications and functions which require power to be applied.

3.3.1 Hot Swap Insertion

To insert the AMC module proceed as follows:

1. Ensure that the safety requirements indicated section 3.1 are observed.

Warning!

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

2. Ensure that the module is properly configured for operation in accordance with the application requirements before installation. For information regarding the configuration of the AM4022 refer to Chapter 4.

Warning!

Care must be taken when applying the procedures below to ensure that neither the AM4022 nor other system boards are physically damaged by the application of these procedures.

3. Ensure that the module handle is in the “Unlocked” position.
4. Using the front panel as a grip, carefully insert the module into the slot designated by the application requirements until it makes contact with the carrier/backplane connector.
5. Apply pressure to the front panel until the module is properly seated in the carrier/backplane connector. This may require a considerable amount of force. Apply pressure only to the front panel, not the module handle. During seating in the connector, there is a noticeable “snapping” of the board into the connector. When the board is seated it should be flush with the carrier or system front panel.

   In the case of a running system, the following occurs:

   - The BLUE HS LED turns on.

     When the module is seated, the module management power is applied and the BLUE HS LED turns on. (No payload power is applied at this time).
6. Connect all external interfacing cables to the module as required and ensure that they are properly secured.
7. Push the module handle in the “Locked” position.

   When the module handle is in the “Locked” position, the module is locked and the hot swap switch is actuated.

In the case of a running system, the following occurs:

- The BLUE HS LED displays long blinks.

  When the carrier IPMI controller detects the module, it sends a command to the module to perform long blinks of the BLUE HS LED.

- The BLUE HS LED turns off.

  The Intelligent Platform Management Controller on the carrier reads the Module Current Requirements record and the AMC Point-to-Point Connectivity record.

  If the module FRU information is valid and the carrier can provide the necessary payload power, the BLUE HS LED will be turned off.

  The carrier now enables the payload power for the module.

Note ...

If the module FRU information is invalid or the carrier cannot provide the necessary payload power, the BLUE HS LED stops blinking and remains lit. Should this problem occur, please contact Kontron.

8. The AMC module is now ready for operation.

   For operation of the AM4022, refer to appropriate AM4022-specific software, application, and system documentation.

3.3.2 Hot Swap Extraction

To extract the AMC module proceed as follows:

1. Ensure that the safety requirements indicated in section 3.1 are observed. Particular attention must be paid to the warning regarding the heat sink!
2. Pull the module handle in the “Hot Swap” position.

   When the module handle is in the “Hot Swap” position, the extraction process of the module is initiated and the following occurs:

   - The BLUE HS LED displays short blinks.

     When the carrier/chassis IPMI controller receives the handle opened event, it sends a command to the MMC with a request to perform short blinks of the BLUE HS LED. This indicates that the module is waiting to be deactivated.

     Now the module waits for a permission from the higher level management (Shelf Manager or System Manager) to proceed with its deactivation.

     Once the module receives the permission to continue the deactivation, all used ports are disabled.

   - The BLUE HS LED turns on.

     The Intelligent Platform Management Controller on the carrier/chassis disables the module's payload power and the BLUE HS LED is turned on.

     Now the module is ready to be safely extracted.
3. Pull the module handle in the “Unlocked” position.
3. Disconnect any interfacing cables that may be connected to the module.
4. Disengage the module from the carrier/backplane connector by pulling on the module handle. This may require a considerable amount of force.

Warning!

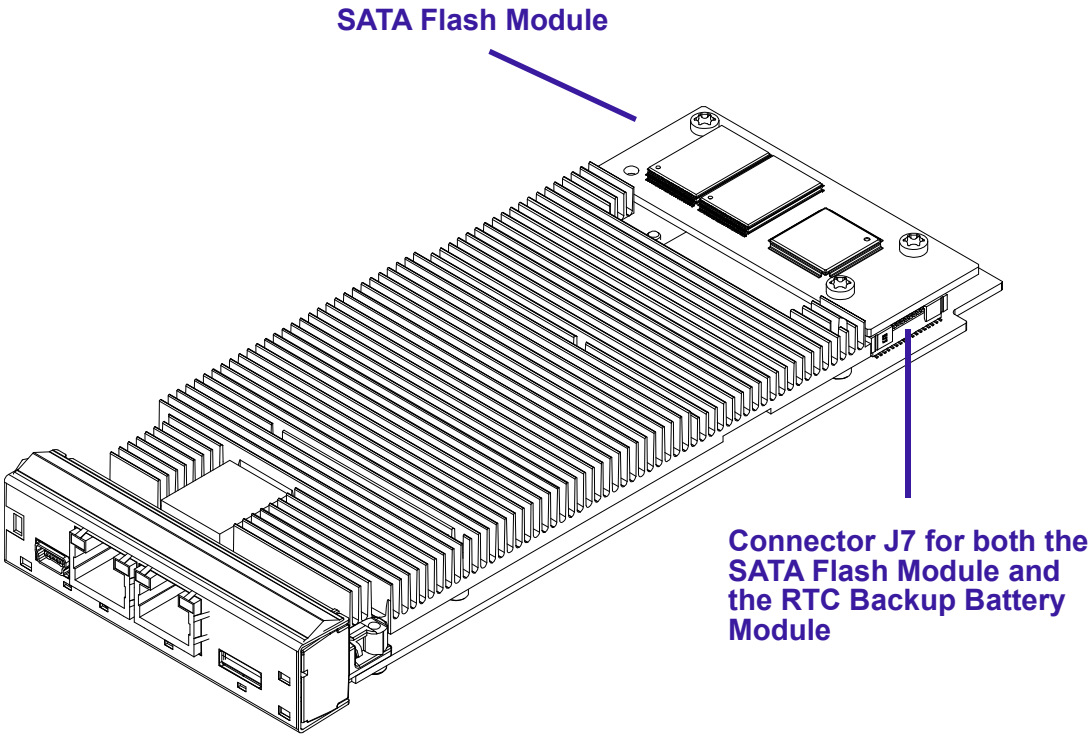
Due care should be exercised when handling the module due to the fact that the heat sink can get very hot. Do not touch the heat sink when removing the module.

5. Using the front panel as a grip, remove the module from the carrier/chassis.
6. Dispose of the module as required.

3.4 Installation of Peripheral Devices

The AM4022 is designed to accommodate several peripheral devices. The following figure shows the placement of the SATA Flash module and indicates the connector location for both the SATA Flash module as well as the RTC Backup Battery module.

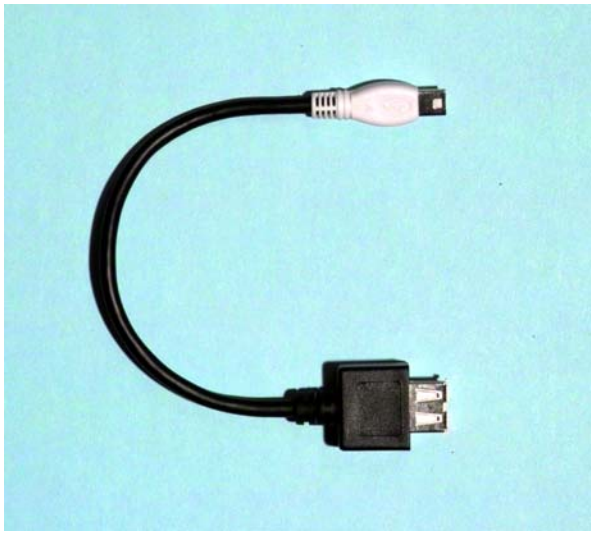
Figure 3-2: Connecting a Peripheral Device to the AM4022



3.4.1 Installation of USB Devices

The AM4022 supports the installation of standard USB peripheral devices via an adapter for Mini USB type A to USB type A connectors.

Figure 3-3: Adapter for Mini USB Type A to USB Type A Connectors



Note ...

All USB devices may be connected or removed while the host or other peripherals are powered up.

For further technical or ordering information on this adapter, please contact Kontron.

3.4.2 Installation of Serial Devices

The AM4022 supports the installation of serial devices via a specially designed adapter for a 10-pin mini connector to a 9-pin, female, D-Sub connector from Kontron.

Figure 3-4: Adapter for 10-Pin Mini Connector to 9-Pin D-Sub Female Connector

Note ...

Serial devices may be connected or disconnected only when payload power is not applied to the module.

For further technical or ordering information on this Kontron adapter, please contact Kontron.

3.4.3 SATA Flash Module Installation (Optional)

A Serial ATA Extension Module with up to 64 GB SATA NAND Flash Memory may be connected to the AM4022 via the onboard connector J7.

This optionally available module must be physically installed on the AM4022 prior to installation of the AM4022 in a system.

During installation it is necessary to ensure that the SATA Flash module is properly seated in the onboard connector J7, i.e. the pins are aligned correctly and not bent.

Before putting the AM4022 into operation, ensure that the boot priority is configured as required for the application.

If this module is installed, the RTC Backup Battery Module cannot be used.

Note ...

Only qualified SATA Flash modules from Kontron are authorized for use with the AM4022. Failure to comply with the above will void the warranty and may result in damage to the board or the system.

3.4.4 RTC Backup Battery Module Installation (Optional)

A RTC Backup Battery module is available and may be connected to the AM4022 via the onboard connector J7.

This optionally available module must be physically installed on the AM4022 prior to installation of the AM4022 in a system.

During installation it is necessary to ensure that the module is properly seated in the onboard connector J7, i.e. the pins are aligned correctly and not bent.

If this module is installed, the SATA Flash module cannot be used.

3.5 Software Installation

The installation of the Ethernet and all other onboard peripheral drivers is described in detail in the relevant Driver Kit files.

Installation of an operating system is a function of the OS software and is not addressed in this manual. Refer to the appropriate OS software documentation for installation.

Note ...

Users working with pre-configured operating system installation images for Plug and Play compliant operating systems must take into consideration that the stepping and revision ID of the chipset and/or other onboard PCI devices may change. Thus, a re-configuration of the operating system installation image deployed for a previous chipset stepping or revision ID is in most cases required. The corresponding operating system will detect new devices according to the Plug and Play configuration rules.

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Chapter 4

Configuration

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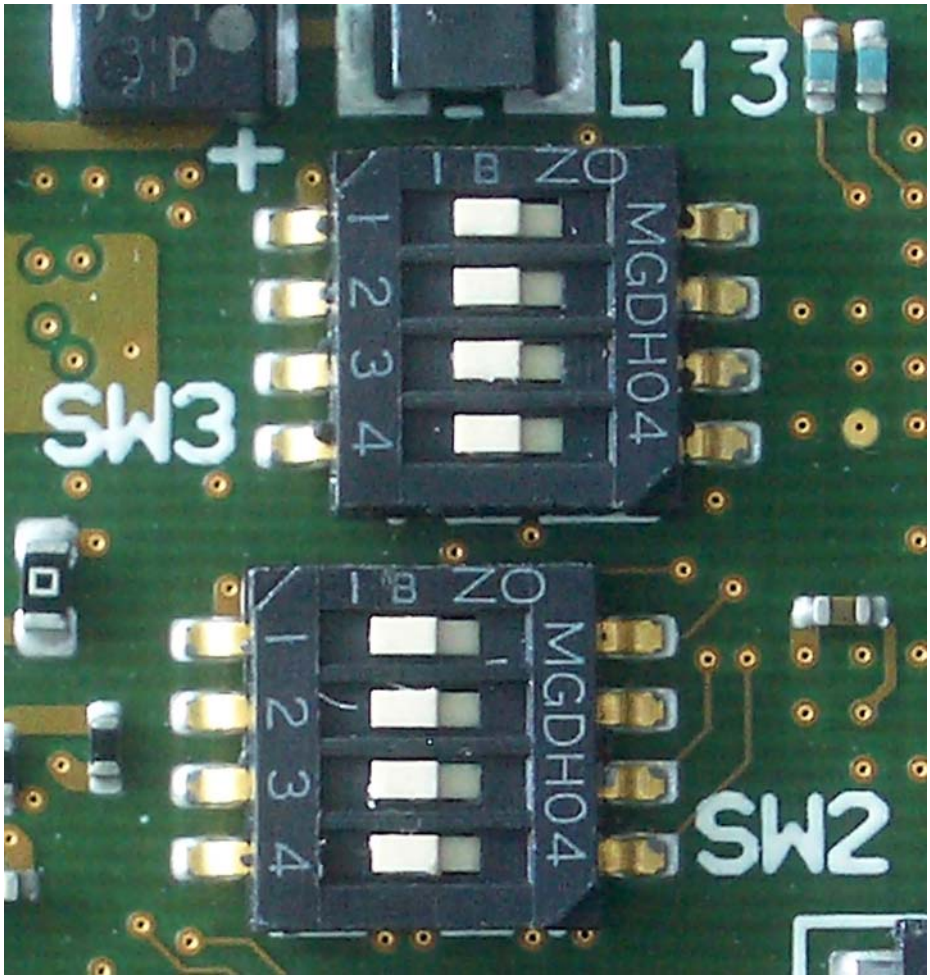
4. Configuration

4.1 DIP Switch Configuration

The AM4022 is equipped with two 4-bit DIP switches, SW2 and SW3, used for board configuration.

Figure 4-1: DIP Switches SW2 and SW3



The following tables indicate the functions of the switches integrated in the DIP switches SW2 and SW3.

Table 4-1: Configuration of DIP Switch SW2, Switches 1 and 2

SWITCH	SETTING	DESCRIPTION
1	***OFF***	***MMC configures the AMC Fat Pipes Region ports 4-11, PCI Express interface, via E-Keying***
	ON	The AMC Fat Pipes Region ports 4-11, PCI Express interface, are disabled
2	***OFF***	***MMC configures the AMC Common Options Region ports 2-3 and the Extended Options Region port 12, SATA interface, via E-Keying***
	ON	The AMC Common Options Region ports 2-3 and the Extended Options Region port 12, SATA interface, are disabled

Table 4-2: Configuration of DIP Switch SW2, Switches 3 and 4

SWITCH 4	SWITCH 3	DESCRIPTION
OFF	***OFF***	***MMC configures the PCI Express reference clock (FCLKA) via E-Keying***
OFF	ON	AM4022 uses the local PCI Express reference clock; AM4022 generates PCI Express reference clock to the AMC connector (FCLKA)
ON	OFF	AM4022 uses local PCI Express reference clock; AMC clock (FCLKA) is disabled
ON	ON	Reserved

Table 4-3: DIP Switch SW3 Configuration

SWITCH	SETTING	DESCRIPTION
1	***OFF***	***Enable uEFI BIOS POST code LED output during boot-up***
	ON	Disable uEFI BIOS POST code LED output during boot-up
2	***OFF***	***Boot from the standard SPI boot Flash***
	ON	Boot from the recovery SPI boot Flash (see note below)
3	***OFF***	Reserved
	ON	
4	***OFF***	***Standard uEFI BIOS parameters***
	ON	Clear uEFI BIOS parameters

The default settings of the DIP switches are indicated by using italic bold.

Note ...

If the DIP switch SW3, switch 2, is set to ON, the SPI boot Flash selection cannot be overwritten by the IPMI controller.

To clear the uEFI BIOS settings, proceed as follows:

1. Set the DIP Switch SW3, switch 4, to the ON position.
2. Apply power to the system.
3. After 30 seconds, remove power from the system.
   During this time period of 30 seconds, no messages are displayed.
4. Set the DIP Switch SW3, switch 4 to the OFF position.

4.2 I/O Address Map

The following table sets out the AM4022-specific I/O registers. The blue-shaded table cells indicate MMC-specific registers.

Table 4-4: I/O Address Map

ADDRESS	DEVICE
0x080	uEFI BIOS POST Code Low Byte Register (POSTL)
0x081	uEFI BIOS POST Code High Byte Register (POSTH)
0x082 - 0x083	Reserved
0x084	Debug Low Byte Register (DBGL)
0x085	Debug High Byte Register (DBGH)
0x280	Status Register 0 (STAT0)
0x281 - 0x282	Reserved
0x283	Control Register 1 (CTRL1)
0x284	Device Protection Register (DPROT)
0x285	Reset Status Register (RSTAT)
0x286	Board Interrupt Configuration Register (BICFG)
0x287	Reserved
0x288	Board ID High Byte Register (BIDH)
0x289	Board and PLD Revision Register (BREV)
0x28A	Geographic Addressing Register (GEOAD)
0x28B	Reserved
0x28C	Watchdog Timer Control Register (WTIM)
0x28D	Board ID Low Byte Register (BIDL)
0x28E - 0x28F	Reserved
0x290	User-Specific LED Configuration Register (LCFG)
0x291	User-Specific LED Control Register (LCTRL)
0x292	General Purpose Output Register (GPOUT)
0x293	General Purpose Input Register (GPIN)
0x294 - 0x29F	Reserved
0xCA2; 0xCA3	MMC KCS interface

4.3 AM4022-Specific Registers

The following registers are special registers which the AM4022 uses to monitor the onboard hardware special features and the AMC control signals.

Normally, only the system uEFI BIOS uses these registers, but they are documented here for application use as required.

Note ...

Take care when modifying the contents of these registers as the system uEFI BIOS may be relying on the state of the bits under its control.

4.3.1 Status Register 0 (STAT0)

The Status Register 0 holds general onboard and AMC control signals.

Table 4-5: Status Register 0 (STAT0)

REGISTER NAME		STATUS REGISTER 0 (STAT0)		
ADDRESS		0x280		
BIT	NAME	DESCRIPTION	RESET VALUE	ACCESS
7	Res.	Reserved	0	R
6	BBEI	uEFI BIOS boot end indication: 0 = uEFI BIOS is booting 1 = uEFI BIOS boot is finished	0	R
5 - 4	BFSS	Boot Flash selection status: 00 = Standard SPI boot Flash active 01 = Recovery boot Flash active 10 = External SPI boot Flash active 11 = Reserved	N/A	R
3	DIP4	Position of DIP switch SW3, switch 4: 0 = Switch on 1 = Switch off	N/A	R
2	DIP3	Position of DIP switch SW3, switch 3: 0 = Switch on 1 = Switch off	N/A	R
1	DIP2	Position of DIP switch SW3, switch 2: 0 = Switch on 1 = Switch off	N/A	R
0	DIP1	Position of DIP switch SW3, switch 1: 0 = Switch on 1 = Switch off	N/A	R

4.3.2 Control Register 1 (CTRL1)

The Control Register 1 holds board-specific control information.

Table 4-6: Control Register 1 (CTRL1)

REGISTER NAME		CONTROL REGISTER 1 (CTRL1)		
ADDRESS		0x283		
BIT	NAME	DESCRIPTION	RESET VALUE	ACCESS
7	SRST	Reset of SATA Flash module: 0 = Reset of SATA Flash module 1 = SATA Flash module is operating	1	R/W
6	VRST	Integrated graphics controller configuration: 0 = Graphics controller disabled 1 = Graphics controller enabled	N/A	R
5	TRST	Reset of Trusted Platform Module (TPM): 0 = Reset of TPM 1 = TPM is operating	1	R/W
4 - 3	GCFG	AMC GPIO Configuration 00 = GPIO 01 = Reserved 10 = Reserved 11 = Reserved	00	R/W
2	SCOM1	COMA routing selection: 0 = Front I/O 1 = AMC Extended Options Region port 15	N/A	R/W
1 - 0	Res.	Reserved	00	R

4.3.3 Device Protection Register (DPROT)

The Device Protection Register holds the write protect signals for Flash devices.

Table 4-7: Device Protection Register (DPROT)

REGISTER NAME		DEVICE PROTECTION REGISTER (DPROT)		
ADDRESS		0x284		
BIT	NAME	DESCRIPTION	RESET VALUE	ACCESS
7 - 2	Res.	Reserved	000000	R
1	EEWP	EEPROM write protection: 0 = EEPROM not write protected 1 = EEPROM write protected Writing a '1' to this bit sets the bit. If this bit is set, it cannot be cleared.	0	R/W
0	BFWP	Boot Flash write protection: 0 = Boot Flash not write protected 1 = Boot Flash write protected Writing a '1' to this bit sets the bit. If this bit is set, it cannot be cleared.	0	R/W

4.3.4 Reset Status Register (RSTAT)

The Reset Status Register is used to determine the reset source.

Table 4-8: Reset Status Register (RSTAT)

REGISTER NAME		RESET STATUS REGISTER (RSTAT)		
ADDRESS		0x285		
BIT	NAME	DESCRIPTION	RESET VALUE	ACCESS
7	PORS	Power-on reset status: 0 = System reset generated by software (warm reset) 1 = System reset generated by power-on (cold reset) Writing a '1' to this bit clears the bit.	1	R/W
6	Res.	Reserved	0	R
5	SRST	Software reset status: 0 = Reset is logged by MMC 1 = Reset is not logged by MMC The uEFI BIOS / software sets the bit to inform the MMC that the next reset should not be logged. Writing a '1' from the host to this bit sets the bit. After this bit has been set, it may be cleared via the MMC (using the IRSTA register and an I²C access from the MMC to this register by writing a '1' to the SRST bit).	0	R/W
4	Res.	Reserved	0	R
3	IPRS	MMC controller reset: 0 = System reset not generated by MMC 1 = System reset generated by MMC Writing a '1' to this bit clears the bit.	0	R/W
2 - 1	Res.	Reserved	00	R
0	WTRS	Watchdog timer reset status: 0 = System reset not generated by Watchdog timer 1 = System reset generated by Watchdog timer Writing a '1' to this bit clears the bit.	0	R/W

Note ...

The Reset Status Register is set to the default values by power-on reset, not by a warm reset.

4.3.5 Board Interrupt Configuration Register (BICFG)

The Board Interrupt Configuration Register holds a series of bits defining the interrupt routing for the Watchdog, the UART controller, and the MMC.

Table 4-9: Board Interrupt Configuration Register (BICFG)

REGISTER NAME		BOARD INTERRUPT CONFIGURATION REGISTER (BICFG)		
ADDRESS		0x286		
BIT	NAME	DESCRIPTION	RESET VALUE	ACCESS
7	UICF	UART IRQ4 interrupt configuration: 0 = Disabled 1 = IRQ4	1	R/W
6 - 4	Res.	Reserved	000	R
3 - 2	KCICF	MMC KCS interrupt configuration: 00 = Disabled 01 = IRQ11 10 = Reserved 11 = Reserved	00	R/W
1 - 0	WICF	Watchdog interrupt configuration: 00 = Disabled 01 = IRQ5 10 = Reserved 11 = Reserved	00	R/W

4.3.6 Board ID High Byte Register (BIDH)

Each Kontron board is provided with a unique 16-bit board-type identifier in the form of a hexadecimal number. The Board ID High Byte Register is located in the address 0x288. The Board ID Low Byte Register is located in the address 0x28D.

Table 4-10: Board ID High Byte Register (BIDH)

REGISTER NAME		BOARD ID HIGH BYTE REGISTER (BIDH)		
ADDRESS		0x288		
BIT	NAME	DESCRIPTION	RESET VALUE	ACCESS
7 - 0	BIDH	Board identification: 0xB3F0 = AM4022	0xB3	R

4.3.7 Board and PLD Revision Register (BREV)

The Board and PLD Revision Register signals to the software when differences in the board and the Programmable Logic Device (PLD) require different handling by the software. It starts with the value 0x00 for the initial board prototypes and will be incremented with each change in hardware as development continues.

Table 4-11: Board and PLD Revision Register (BREV)

REGISTER NAME		BOARD AND PLD REVISION REGISTER (BREV)		
ADDRESS		0x289		
BIT	NAME	DESCRIPTION	RESET VALUE	ACCESS
7 - 4	BREV	Board revision	N/A	R
3 - 0	PREV	PLD revision	N/A	R

4.3.8 Geographic Addressing Register (GEOAD)

This register holds the AMC geographic address (site number) used to assign the Intelligent Platform Management Bus (IPMB) address to the AM4022.

Table 4-12: Geographic Addressing Register (GEOAD)

REGISTER NAME		GEOGRAPHIC ADDRESSING REGISTER (GEOAD)		
ADDRESS		0x28A		
BIT	NAME	DESCRIPTION	RESET VALUE	ACCESS
7 - 5	Res.	Reserved	000	R
4 - 0	GA	AMC geographic address	N/A	R

Note ...

The AMC geographic addressing register is set to the default values by power-on reset, not by warm reset.

4.3.9 Watchdog Timer Control Register (WTIM)

The AM4022 has one Watchdog timer provided with a programmable timeout ranging from 125 msec to 4096 sec. Failure to strobe the Watchdog timer within a set time period results in a system reset or an interrupt. The interrupt mode can be configured via the Board Interrupt Configuration Register (0x286).

There are four possible modes of operation involving the Watchdog timer:

- Timer only mode
- Reset mode
- Interrupt mode
- Dual stage mode

At power on the Watchdog is not enabled. If not required, it is not necessary to enable it. If required, the bits of the Watchdog Timer Control Register must be set according to the application requirements. To operate the Watchdog, the mode and time period required must first be set and then the Watchdog enabled. Once enabled, the Watchdog can only be disabled or the mode changed by powering down and then up again. To prevent a Watchdog timeout, the Watchdog must be retriggered before timing out. This is done by writing a ’1’ to the WTR bit. In the event a Watchdog timeout does occur, the WTE bit is set to ’1’. What transpires after this depends on the mode selected.

The four operational Watchdog timer modes can be configured by the WMD[1:0] bits, and are described as follows:

Timer only mode - In this mode the Watchdog is enabled using the required timeout period. Normally, the Watchdog is retriggered by writing a ’1’ to the WTR bit. In the event a timeout occurs, the WTE bit is set to ’1’. This bit can then be polled by the application and handled accordingly. To continue using the Watchdog, write a ’1’ to the WTE bit, and then retrigger the Watchdog using WTR. The WTE bit retains its setting as long as no power down-up is done. Therefore, this bit may be used to verify the status of the Watchdog.

Reset mode - This mode is used to force a hard reset in the event of a Watchdog timeout. In addition, the WTE bit is not reset by the hard reset, which makes it available if necessary to determine the status of the Watchdog prior to the reset.

Interrupt mode - This mode causes the generation of an interrupt in the event of a Watchdog timeout. The interrupt handling is a function of the application. If required, the WTE bit can be used to determine if a Watchdog timeout has occurred.

Dual stage mode - This is a complex mode where in the event of a timeout two things occur: 1) an interrupt is generated, and 2) the Watchdog is retriggered automatically. In the event a second timeout occurs immediately following the first timeout, a hard reset will be generated. The second timeout period is the same as the first. If the Watchdog is retriggered normally, operation continues. The interrupt generated at the first timeout is available to the application to handle the first timeout if required. As with all of the other modes, the WTE bit is available for application use.

Table 4-13: Watchdog Timer Control Register (WTIM)

REGISTER NAME		WATCHDOG TIMER CONTROL REGISTER (WTIM)		
ADDRESS		0x28C		
BIT	NAME	DESCRIPTION	RESET VALUE	ACCESS
7	WTE	Watchdog timer expired status bit 0 = Watchdog timer has not expired 1 = Watchdog timer has expired. Writing a '1' to this bit resets it to 0.	0	R/W
6 - 5	WMD	Watchdog mode 00 = Timer only mode 01 = Reset mode 10 = Interrupt mode 11 = Cascaded mode (dual-stage mode)	00	R/W
4	WEN/WTR	Watchdog enable / Watchdog trigger control bit: 0 = Watchdog timer not enabled Prior to the Watchdog being enabled, this bit is known as WEN. After the Watchdog is enabled, it is known as WTR. Once the Watchdog timer has been enabled, this bit cannot be reset to 0. As long as the Watchdog timer is enabled, it will indicate a '1'. 1 = Watchdog timer enabled Writing a '1' to this bit causes the Watchdog to be retriggered to the timer value indicated by bits WTM[3:0].	0	R/W
3 - 0	WTM	Watchdog timeout settings: 0000 = 0.125 s 0001 = 0.25 s 0010 = 0.5 s 0011 = 1 s 0100 = 2 s 0101 = 4 s 0110 = 8 s 0111 = 16 s 1000 = 32 s 1001 = 64 s 1010 = 128 s 1011 = 256 s 1100 = 512 s 1101 = 1024 s 1110 = 2048 s 1111 = 4096 s	0000	R/W

4.3.10 Board ID Low Byte Register (BIDL)

Each Kontron board is provided with a unique 16-bit board-type identifier in the form of a hexadecimal number. The Board ID Low Byte Register is located in the address 0x28D. The Board ID High Byte Register is located in the address 0x288.

Table 4-14: Board ID Low Byte Register (BIDL)

REGISTER NAME		BOARD ID LOW BYTE REGISTER (BIDH)		
ADDRESS		0x28D		
BIT	NAME	DESCRIPTION	RESET VALUE	ACCESS
7 - 0	BIDL	Board identification: 0xB3F0 = AM4022	0xF0	R

4.3.11 User-Specific LED Configuration Register (LCFG)

The User-Specific LED Configuration Register holds a series of bits defining the onboard configuration of the front panel User-Specific LEDs.

Table 4-15: User-Specific LED Configuration Register (LCFG)

REGISTER NAME		USER-SPECIFIC LED CONFIGURATION REGISTER (LCFG)		
ADDRESS		0x290		
BIT	NAME	DESCRIPTION	RESET VALUE	ACCESS
7 - 4	Res.	Reserved	0000	R
3 - 0	LCON	User-Specific LED Configuration 0000 = POST [1] 0001 = Mode A [2] 0010 = Mode B [3] (default) 0011 - 1111 = Reserved	0010	R/W

Regardless of the selected configuration, the User-Specific LEDs are used to signal a number of fatal onboard hardware errors, such as:

ULED3: Power failure (red)
ULED2: Clock failure (red)
ULED1: Hardware reset (red)
ULED0: uEFI BIOS boot failure (red)

[1] In uEFI BIOS POST mode, the User-Specific LEDs build a binary vector to display uEFI BIOS POST code during the pre-boot phase. In doing so, the higher 4-bit nibble of the 8-bit uEFI BIOS POST code is displayed followed by the lower nibble followed by a pause. uEFI BIOS POST code is displayed in general in green color.

ULED3: POST bit 3 and bit 7 (green)
ULED2: POST bit 2 and bit 6 (green)
ULED1: POST bit 1 and bit 5 (green)
ULED0: POST bit 0 and bit 4 (green)

For further information on reading the 8-bit uEFI BIOS POST Code, refer to Chapter 2.10.1, “Front Panel LEDs”.

[2] Configured for Mode A, the User-Specific LEDs are dedicated to functions as follows:

ULED3: User-Specific LED 3 (red/green/red+green)
ULED2: User-Specific LED 2 (red/green/red+green)
ULED1: User-Specific LED 1 (red/green/red+green)
ULED0: User-Specific LED 0 (red/green/red+green)

[3] Configured for Mode B, the User-Specific LEDs are dedicated to functions as follows:

ULED3: Ethernet Link Status of AMC Gigabit Ethernet channel A, AMC port 0 (green)
ULED2: Ethernet Link Status of AMC Gigabit Ethernet channel B, AMC port 1 (green)
ULED1: SATA channels active (green)
ULED0: --

4.3.12 User-Specific LED Control Register (LCTRL)

This register is used to switch on and off the front panel User-Specific LEDs.

Table 4-16: User-Specific LED Control Register (LCTRL)

REGISTER NAME		USER-SPECIFIC LED CONTROL REGISTER (LCTRL)		
ADDRESS		0x291		
BIT	NAME	DESCRIPTION	RESET VALUE	ACCESS
7 - 4	ULCMD	User-Specific LED command: 0000 = Get User-Specific LED 0 0001 = Get User-Specific LED 1 0010 = Get User-Specific LED 2 0011 = Get User-Specific LED 3 0100 - 0111 = Reserved 1000 = Set User-Specific LED 0 1001 = Set User-Specific LED 1 1010 = Set User-Specific LED 2 1011 = Set User-Specific LED 3 1100 - 1111 = Reserved	0000	R/W
3 - 0	ULCOL	User-Specific LED color: 0000 = Off 0001 = Green 0010 = Red 0011 = Red+green 0100 - 1111 = Reserved	0000	R/W

Note ...

This register can only be used if the User-Specific LEDs indicated in the “User-Specific LED Configuration Register” (Table 4-15) are configured in Mode A.

4.3.13 General Purpose Output Register (GPOUT)

The General Purpose Output Register holds the general purpose output signals of port 16.

Table 4-17: General Purpose Output Register (GPOUT)

REGISTER NAME		General Purpose Output Register (GPOUT)		
ADDRESS		0x292		
BIT	NAME	DESCRIPTION	RESET VALUE	ACCESS
7 - 2	Res.	Reserved	0000 00	R
1	GPO1	General Purpose Output 1: 0 = Output low 1 = Output high	0	R/W
0	GPO0	General Purpose Output 0: 0 = Output low 1 = Output high	0	R/W

4.3.14 General Purpose Input Register (GPIN)

The General Purpose Input Register holds the general purpose input signals of port 16.

Table 4-18: General Purpose Input Register (GPIN)

REGISTER NAME		General Purpose Input Register (GPIN)		
ADDRESS		0x293		
BIT	NAME	DESCRIPTION	RESET VALUE	ACCESS
7 - 2	Res.	Reserved	0000 00	R
1	GPI1	General Purpose Input 1: 0 = Input low 1 = Input high	1	R
0	GPI0	General Purpose Input 0: 0 = Input low 1 = Input high	1	R

4.3.15 IPMI Keyboard Controller Style Interface

The host processor communicates with the MMC using one Keyboard Controller Style interface, which is defined in the IPMI specification. The KCS interface is on the I/O location 0xCA2 and 0xCA3, and configured as regular ISA interrupt.

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Chapter 5

Power Considerations

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5. Power Considerations

5.1 AM4022 Voltage Ranges

The AM4022 board has been designed for optimal power input and distribution. Still it is necessary to observe certain criteria essential for application stability and reliability.

The AM4022 requires two power sources, the module management power for the MMC (nominal: 3.3V DC) and a single payload power (nominal: 12V DC) for the module components.

The following table specifies the ranges for the different input power voltages within which the board is functional. The AM4022 is not guaranteed to function if the board is not operated within the operating range.

Table 5-1: DC Operational Input Voltage Ranges

INPUT SUPPLY VOLTAGE	ABSOLUTE RANGE	OPERATING RANGE
Payload Power (nominal: 12V DC)	10.0 V min. to 14.0 V max.	10.8 V min. to 13.2 V max.
Module Management Power (nominal: 3.3V DC)	3.0 V min. to 3.6 V. max.	3.135 V min. to 3.465 V max. (±5%)

Warning!

The AM4022 must not be operated beyond the absolute range indicated in the table above. Failure to comply with the above may result in damage to the board.

5.2 Carrier Power Requirements

5.2.1 Module Management Power

The module management power is used only for the Module Management Controller (MMC), which has a very low power consumption. The management power voltage measured on the AMC at the connector shall be 3.3 V ± 5% and the maximum current is 150 mA (see Table 5-1, “DC Operational Input Voltage Ranges”).

The module management power is below 0.45 W and it has therefore not been taken into consideration during the measurements.

5.2.2 Payload Power

Payload power is the power provided to the module from the carrier or the backplane for the main function of the module. The payload power voltage should be selected at the higher end of the specified voltage range. The maximum continuous current limit value is based on the AMC module's power limit of 80 W. At the minimum supply voltage of 10.8 V, the 80 W requires approximately 7.4 A.

The payload power voltage shall be at least 10.8 V and not more than 13.2 V at the module contacts during normal conditions under all loads (see Table 5-1, “DC Operational Input Voltage Ranges”). The bandwidth-limited periodic noise due to switching power supplies or any other source shall not exceed 200 mV peak to peak.

5.2.3 Payload and MMC Voltage Ramp

Power supplies must comply with the following guidelines in order to be used with the AM4022:

- 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 Vout.

5.2.4 Power Sequencing for Unmanaged Systems

If the AM4022 is installed in an unmanaged system, the module management power must be stable and in regulation before the payload power starts to ramp up.

5.3 Payload Power Consumption

The goal of this description is to provide a method to determine the payload power consumption of the AM4022 board with different configurations and applications.

Even though the measurement results indicate that the processor and the memory dissipate the majority of the payload power, integrators must still take into consideration the application as a whole when specifying AM4022 overall power requirements.

The power consumption tables below list the power specifications for the AM4022 board using the 3rd generation Intel® Core™ i7-3612QE and the Intel® Core™ i7-3555LE processors. The values were measured using an AMC carrier with two power supplies, one for the AM4022 module, and the other for the external hard disk and peripheral devices.

All measurements were conducted at an ambient temperature of 25°C. The power consumption values indicated in the tables below can vary depending on the ambient temperature. This can result in deviations of the power consumption values of up to 15%.

The operating system used was Windows® 7, 64-bit, with a nominal payload power of 12 V and with the following interfaces connected:

- Two Front Gigabit Ethernet ports
- Front DisplayPort or COM port depending on the configuration tested
- Front USB (keyboard)

The following AMC fabric interfaces were active during the measurements:

- AMC Common Options Region, ports 0-3
- AMC Fat Pipes Region, ports 4-7

The payload power consumption was measured with the following processors:

- Intel® Core™ i7-3612QE (SV) processor with ECC, 2.1 GHz, 6 MB L3 cache
- Intel® Core™ i7-3555LE (LV) processor with ECC, 2.5 GHz, 4 MB L3 cache

using various combinations of the following configurations:

- Work Load: uEFI shell

  For this measurement the processor cores were active, the graphics controller was in idle state (no application running) and Intel® Turbo Boost Technology was enabled.

- Work Load: IDLE

  For this measurement all processor cores and the graphics controller were in idle state (no application running) and Intel® Turbo Boost Technology was enabled.

- Work Load: TYPICAL

  For this measurement all processor cores were operating at maximum work load and the graphics controller was off or performing basic operation (e.g. dual screen output configuration with no 3D graphics application running) while Intel® Turbo Boost Technology was disabled. These values represent the power dissipation reached under realistic, OS-controlled applications with the processor operating at maximum performance.

- Work Load: MAXIMUM

  These values represent the maximum power dissipation achieved through the use of specific tools to heat up the processor cores and graphics controller. For this measurement Intel® Turbo Boost Technology was enabled. These values are unlikely to be reached in real applications.

Based on the front panel versions (COM or DP) the results of the measurements performed are presented in the following chapters.

5.3.1 Payload Power Consumption with COM Port on Front I/O

The following table indicates the payload power consumption of the AM4022 with a COM port on the front I/O, the internal graphics controller was in the idle state, and with 4 GB DDR3 SDRAM in dual-channel mode.

Table 5-2: Payload Power Consumption with COM Port on Front I/O

MEASUREMENT ENVIRONMENTS		PROCESSORS	
WORK LOAD	TURBO BOOST	Intel® Core™ i7-3612QE (SV) 2.1 GHz	Intel® Core™ i7-3555LE (LV) 2.5 GHz
uEFI SHELL	ON	16 W	15 W
IDLE	ON	12 W	12 W
TYPICAL	OFF	31 W	24 W
MAXIMUM	ON	44 W	30 W

Note ...

If the graphics controller is used for Intel® Quick Sync Video Media functionality this can increase power consumption by a considerable amount.

5.3.2 Payload Power Consumption with DP on Front I/O

The following table indicates the payload power consumption of the AM4022 with a DisplayPort on the front I/O, internal graphics controller enabled and with 4 GB DDR3 SDRAM in dual-channel mode.

Table 5-3: Payload Power Consumption with DP on Front I/O

MEASUREMENT ENVIRONMENTS		PROCESSORS	
WORK LOAD	TURBO BOOST	Intel® Core™ i7-3612QE (SV) 2.1 GHz	Intel® Core™ i7-3555LE (LV) 2.5 GHz
uEFI SHELL	ON	16 W	15 W
IDLE	ON	12 W	12 W
TYPICAL	OFF	31 W	24 W
MAXIMUM	ON	50 W	41 W

5.4 Payload Power Consumption of Accessories

The following table indicates the payload power consumption of AM4022 accessories.

Table 5-4: Payload Power Consumption of AM4022 Accessories

MODULE	PAYLOAD POWER
DDR3 SDRAM update from 4 GB to 8 GB	approx. 0.5 W
SATA Flash module	approx. 1.0 W
Gigabit Ethernet port connected on the front panel (per interface)	approx. 0.5 W

5.5 IPMI FRU Payload Power Consumption

The following table indicates the IPMI FRU payload power consumption.

Table 5-5: IPMI FRU Payload Power Consumption

AM4022 with COM on Front I/O Intel® Core™ i7-3555LE (LV) 2.5 GHz	AM4022 with COM on Front I/O Intel® Core™ i7-3612QE (SV) 2.1 GHz	AM4022 with DP on Front I/O Intel® Core™ i7-3555LE (LV) 2.5 GHz	AM4022 with DP on Front I/O Intel® Core™ i7-3612QE (SV) 2.1 GHz
40 W	54 W	51 W	60 W

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Chapter 6

Thermal Considerations

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6. Thermal Considerations

This chapter provides system integrators with the necessary information to satisfy thermal and airflow requirements when implementing AM4022 applications.

To ensure optimal operation and long-term reliability of the AM4022, all onboard components must remain within the maximum temperature specifications. The most critical components on the AM4022 are the processor and the chipset. Operating the AM4022 above the maximum operating limits will result in permanent damage to the board. To ensure functionality at the maximum temperature, the uEFI BIOS and the Module Management Controller support several temperature monitoring and control features.

6.1 Board Thermal Monitoring

The AM4022 includes one onboard air temperature sensor accessible via the Module Management Controller for monitoring the board temperature. For the location of the air temperature sensor, refer to Figure 1-4, AM4022 Board Layout (Bottom View).

6.2 Processor Thermal Monitoring

To allow optimal operation and long-term reliability of the AM4022, the 3rd generation Intel® Core™ i7 processor must remain within the maximum die temperature specifications. The maximum die temperature for Intel® Core™ i7-3612QE and i7-3555LE processors is 105°C.

The 3rd generation Intel® Core™ i7 processors use the Adaptive Thermal Monitor feature to protect the processor from overheating and includes the following on-die temperature sensors:

- Up to four Digital Thermal Sensors (DTS), one for each core
- One Digital Thermal Sensor (DTS) for the graphics controller
- Catastrophic Cooling Failure Sensor (THERMTRIP#)

These sensors are integrated in the processor and work without any interoperability of the Module Management Controller, the uEFI BIOS or the software application. Enabling the Thermal Control Circuit in the uEFI BIOS allows the processor to maintain a safe operating temperature without the need for special software drivers or interrupt handling routines.

6.2.1 Digital Thermal Sensor (DTS)

The 3rd generation Intel® Core™ i7 processors include on-die Digital Thermal Sensors (DTS), one for each core and one for the graphics controller. They can be read via an internal register of the processor. The temperature returned by the Digital Thermal Sensor will always be at or below the maximum operating temperature (105°C). Via the Digital Thermal Sensors, the uEFI BIOS, the Module Management Controller or the application software can measure the processor die temperature.

6.2.2 Adaptive Thermal Monitor

The Adaptive Thermal Monitor feature reduces the processor power consumption and the temperature when the processor silicon exceeds the Thermal Control Circuit (TCC) activation temperature until the processor operates at or below its maximum operating temperature. The temperature at which the Adaptive Thermal Monitor activates the Thermal Control Circuit is not user configurable.

The processor core power reduction is achieved by:

- Frequency/VID Control (by reducing the processor core voltage)
- Clock Modulation (by turning the internal processor core clocks off and on)

Adaptive Thermal Monitor dynamically selects the appropriate method and does not require any additional hardware, software drivers, or interrupt handling routines.

6.2.3 Frequency/VID Control

Frequency/VID Control reduces the processor's operating frequency (using the core ratio multiplier) and the input voltage (using VID signals). This combination of lower frequency and VID results in a reduction of the processor power consumption.

When the processor temperature reaches the TCC activation point, the event is reported to the Module Management Controller.

Running the processor at the lower frequency and voltage will reduce power consumption and should allow the processor to cool off. If the processor temperature does not drop below the TCC activation point, a second frequency and voltage transition will take place. This sequence of temperature checking and Frequency/VID reduction will continue until either the minimum frequency has been reached or the processor temperature has dropped below the TCC activation point. If the processor temperature remains above the TCC activation point even after the minimum frequency has been reached, then Clock Modulation at that minimum frequency will be initiated.

Note ...

When the ULED3 on the front panel is lit red after boot-up, it indicates that the processor die temperature is above 105°C.

6.2.4 Clock Modulation

Clock Modulation reduces power consumption by rapidly turning the internal processor core clocks off and on at a duty cycle that should reduce power dissipation (typically a 30-50% duty cycle).

Once the temperature has dropped below the maximum operating temperature, the TCC goes inactive and clock modulation ceases.

Note ...

When the ULED3 on the front panel is lit red after boot-up, it indicates that the processor die temperature is above 105°C.

6.2.5 Catastrophic Cooling Failure Sensor

The Catastrophic Cooling Failure Sensor protects the processor from catastrophic overheating. The Catastrophic Cooling Failure Sensor threshold is set well above the normal operating temperature to ensure that there are no false trips. The processor will stop all executions when the junction temperature exceeds approximately 125°C. Once activated, the event remains latched until the AM4022 undergoes a power-on restart (all power off and then on again).

This function cannot be enabled or disabled in the uEFI BIOS. It is always enabled to ensure that the processor is protected in any event.

Note ...

When all ULEDs on the front panel are blinking red, it indicates that the processor temperature is above 125°C.

6.3 Chipset Thermal Monitor Feature

The Intel® QM77 chipset includes one on-die Thermal Diode Sensor to measure the chipset die temperature.

The maximum Intel® QM77 chipset case temperature is 108°C.

6.4 System Airflow

The AM4022 is equipped with a specifically designed heat sink to ensure the best possible basis for operational stability and long-term reliability. Coupled together with system chassis, which provide variable configurations for forced airflow, controlled active thermal energy dissipation is guaranteed.

The physical size, shape, and construction of the heat sink ensures the lowest possible thermal resistance. In addition, it has been specifically designed to efficiently support forced airflow concepts as found in modern AMC carriers and MicroTCA systems.

When developing applications using the AM4022, the system integrator must be aware of the overall system thermal requirements. The MicroTCA systems must satisfy these thermal requirements.

Thermal Characteristic Diagrams

The thermal characteristic diagrams shown in the following sections illustrate the maximum ambient air temperature as a function of the volumetric flow rate for the power consumption indicated. The diagrams are intended to serve as guidance for reconciling board and system with the required computing power considering the thermal aspect. One diagram per processor version is provided. There are up to two curves representing upper level working points based on different levels of average processor work load. When operating below the corresponding curve, the processor runs steadily without any intervention of thermal supervision. When operated above the corresponding curve, various thermal protection mechanisms may take effect resulting in temporarily reduced processor performance or finally in an emergency stop in order to protect the processor and the chipset from thermal destruction. In realistic, OS-controlled applications this means that the board can be operated temporarily at a higher ambient temperature or at a reduced flow rate and still provide some margin for temporarily requested peak performance before thermal protection will be activated.

A flow rate of 20 cfm is a typical value for a standard *Kontron* MicroTCA system. For other systems the available flow rate will differ. The maximum ambient operating temperature must be recalculated and/or measured for such environments. For the calculation of the maximum ambient operating temperature, the processor and chipset junction temperature must never exceed the specified limit for the involved processor and chipset.

Thermal characteristic curves

- Thermal characteristic curve of the AM4022 with typical work load
- Thermal characteristic curve of the AM4022 with maximum work load

The above curves comply with the load values indicated in Chapter 5.3, “Payload Power Consumption”, Tables 5-2 and 5-3.

How to read the diagram

Select a specific processor and choose a specific working point. For a given flow rate there is a maximum airflow input temperature (= ambient temperature) provided. Below this operating point, thermal supervision will not be activated. Above this operating point, thermal supervision will become active protecting the processor from thermal destruction. The minimum flow rate provided must not be less than the value specified in the diagram.

Volumetric flow rate

The volumetric flow rate refers to an airflow through a fixed cross-sectional area (i.e. slot width x depth. The volumetric flow rate is specified in m^3/s (cubic-meter-per-second) or cfm (cubic-feet-per-minute) respectively.

Conversion:

1 cfm = 0.47 x 10^{-3} m^3/s = 1.7 m^3/h

1 m^3/s = 3600 m^3/h = 2118.9 cfm

The following figures illustrate the operational limits of the AM4022 taking into consideration power consumption vs. ambient air temperature vs. flow rate. The measurements were made using a Mid-size AM4022.

Note ...

The maximum airflow input temperature was measured at the bottom of the AMC module just before the air flowed over the board.

Warning!

Operating the AM4022 above the operating limits may result in damage to the board or the system and will void the warranty.

6.4.1 Thermal Characteristic Diagrams for the AM4022

Figure 6-1: Mid-Size AM4022 with i7-3612QE, 2.1 GHz, COM Port

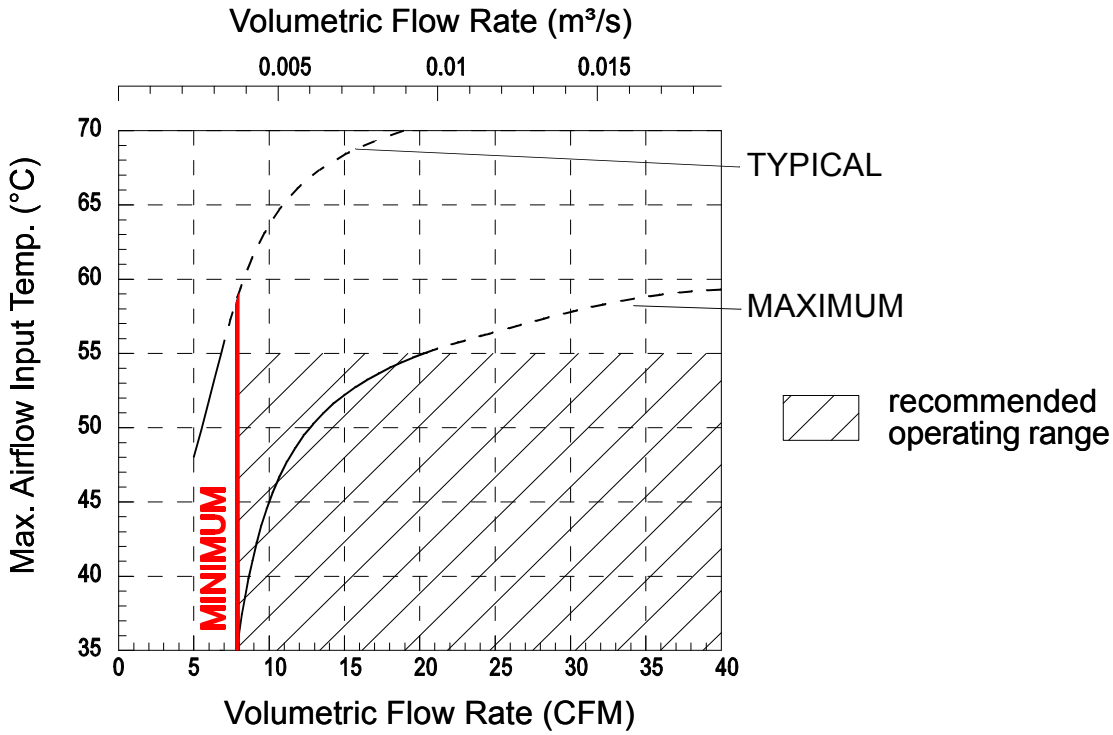


Figure 6-2: Mid-Size AM4022 with i7-3612QE, 2.1 GHz, DisplayPort

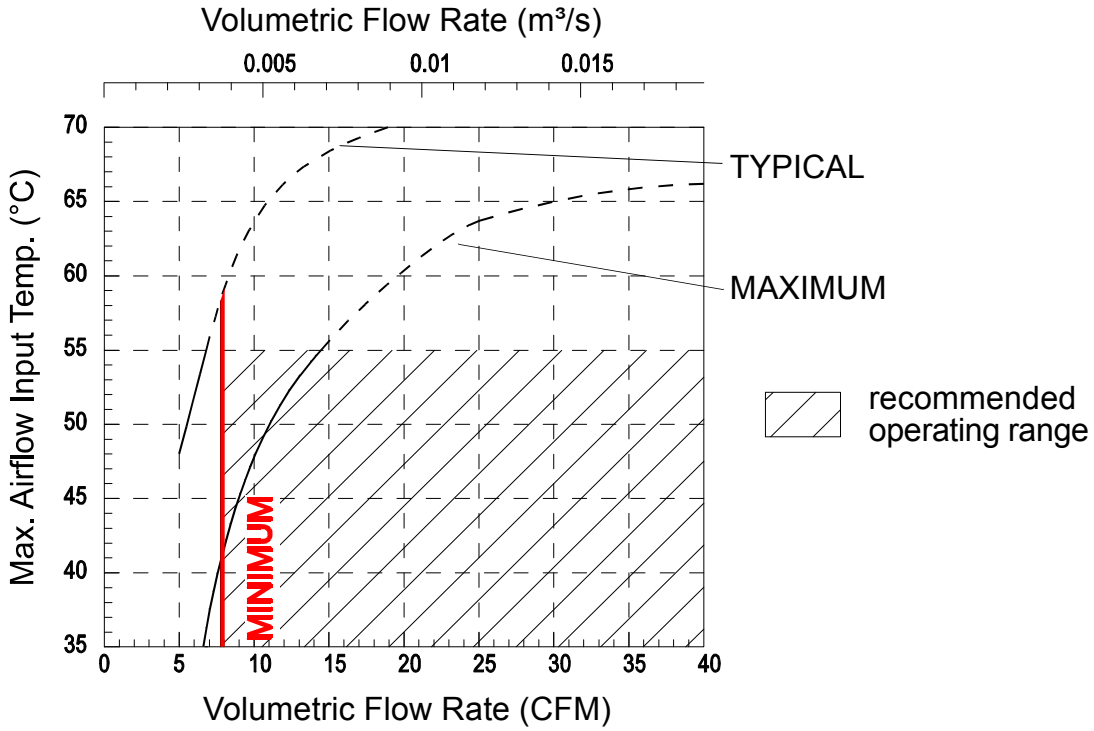


Figure 6-3: Mid-Size AM4022 with i7-3555LE, 2.5 GHz, COM Port

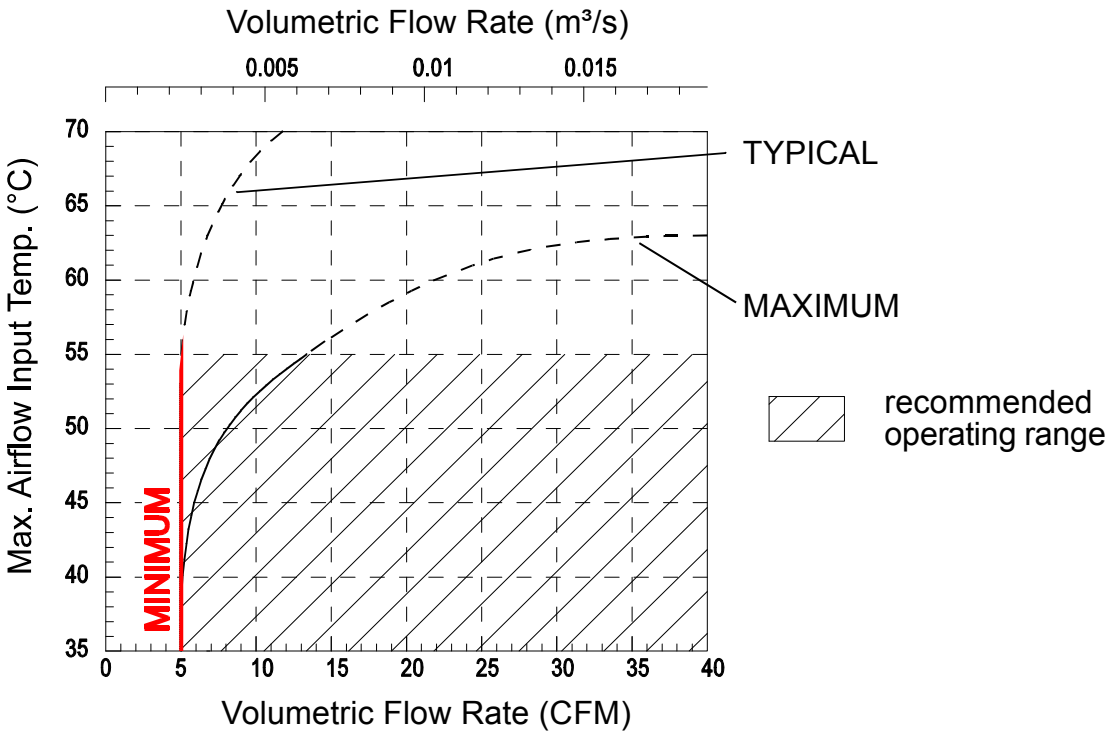
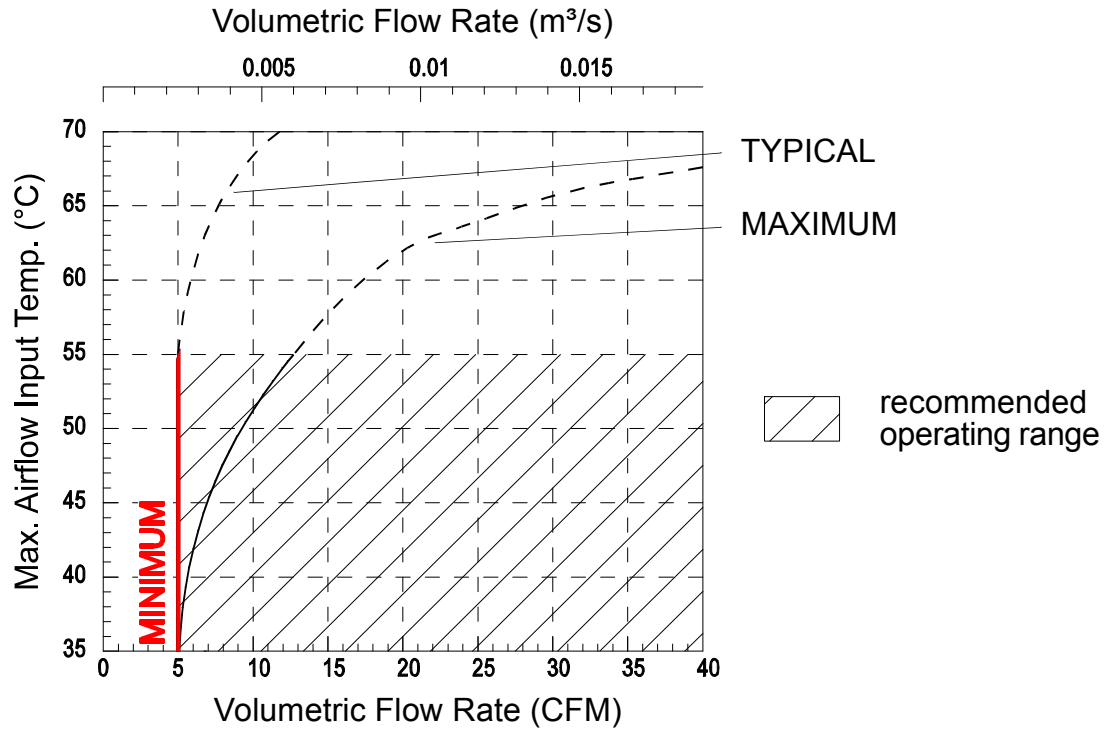


Figure 6-4: Mid-Size AM4022 with i7-3555LE, 2.5 GHz, DisplayPort

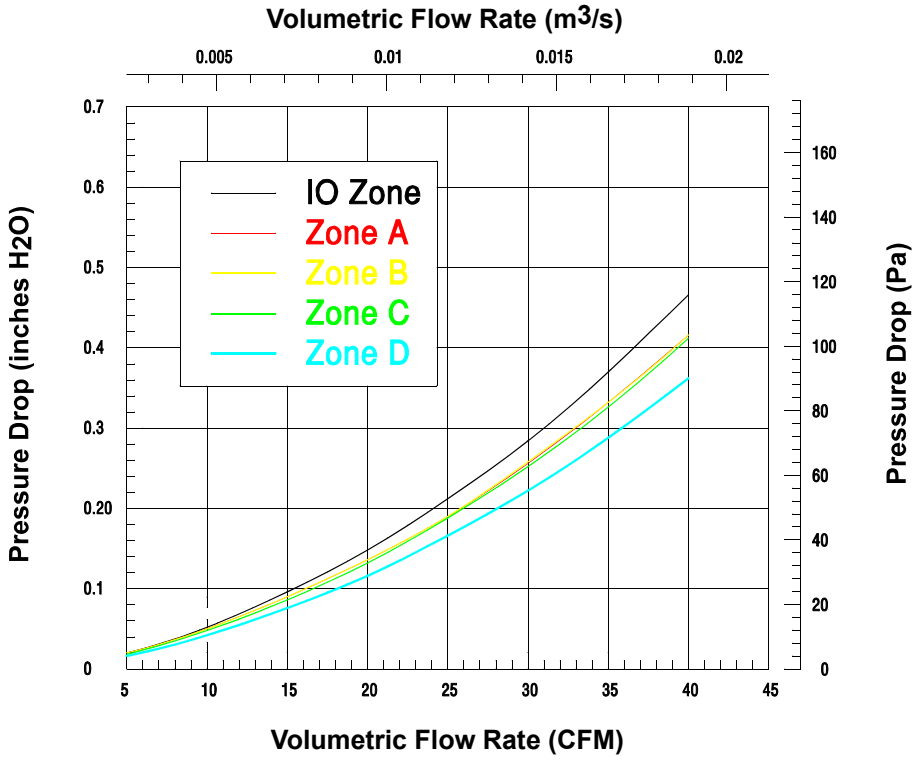


6.4.2 Airflow Impedance

The following figure shows the airflow impedance curves of a Mid-size AM4022 module.

No card guides or struts have been used for the measurements because the resulting airflow impedance depends on individual configuration of the AMC carrier or MicroTCA system.

Figure 6-5: Mid-Size AM4022 Airflow Impedance



The following table indicates the pressure drop ranging from 5 to 40 cfm volumetric flow rates.

Table 6-1: Mid-Size AM4022 Airflow Impedance by Zone [N/m²]

VOLUMETRIC FLOW RATE [CFM]	PRESSURE DROP [N/m²]				
	I/O ZONE	ZONE A	ZONE B	ZONE C	ZONE D
5	4.9	4.7	4.7	4.6	4.1
10	12.7	12.2	12.4	11.9	10.5
15	23.9	22.2	22.2	21.5	18.9
20	36.7	34.0	34.0	33.0	29.0
25	52.5	47.5	47.5	46.9	41.5
30	70.6	63.8	64.0	62.6	55.3
35	91.8	82.5	82.5	81.1	71.8
40	115.9	103.6	103.6	102.3	90.3

Table 6-2: Mid-Size AM4022 Airflow Impedance by Zone [inches H_2O]

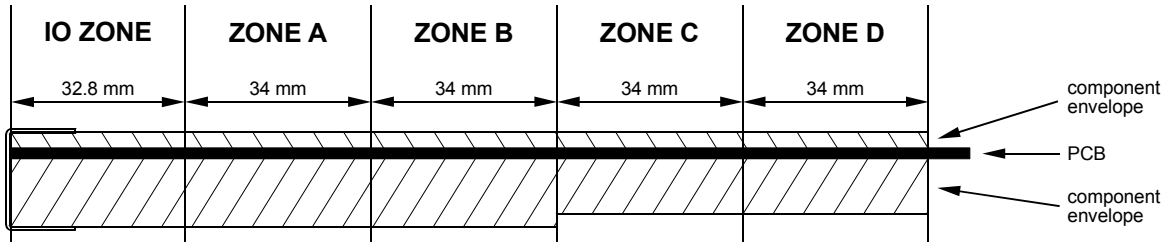
VOLUMETRIC FLOW RATE [CFM]	PRESSURE DROP [inches H_2O]				
	I/O ZONE	ZONE A	ZONE B	ZONE C	ZONE D
5	0.02	0.02	0.02	0.02	0.02
10	0.05	0.05	0.05	0.05	0.04
15	0.10	0.09	0.09	0.09	0.08
20	0.15	0.14	0.14	0.13	0.12
25	0.21	0.19	0.19	0.19	0.17
30	0.28	0.26	0.26	0.25	0.22
35	0.37	0.33	0.33	0.33	0.29
40	0.47	0.42	0.42	0.41	0.36

6.4.3 Airflow Paths

The area between the front panel and the AMC Card-edge connector is divided into five zones, one I/O zone and four uniform thermal zones, A, B, C, and D. The PICMG AMC.0 Specification states that the uniformity of the airflow paths' resistance should provide an impedance on the A, B, C, and D zones that is within ± 25% of the average value of the four thermal zones.

The following figure shows the thermal zones of a Mid-size AM4022.

Figure 6-6: Thermal Zones of the Mid-Size AM4022 Module



The following table indicates the deviation of the airflow rate on a Mid-size AM4022 module.

Table 6-3: Deviation of the Airflow Rate on a Mid-Size AM4022

VOLUMETRIC FLOW RATE [CFM]	DEVIATION OF THE AIRFLOW RATE			
	ZONE A	ZONE B	ZONE C	ZONE D
5	-1.6%	-2.5%	-0.7%	4.7%
10	-0.9%	-2.2%	-0.9%	4.0%
15	-0.6%	-2.1%	-1.2%	3.9%
20	-0.6%	-1.9%	-1.0%	3.5%
25	-0.5%	-1.9%	-1.2%	3.6%
30	-0.4%	-1.9%	-1.2%	3.5%
35	-0.3%	-1.9%	-1.2%	3.4%
40	-0.3%	-1.8%	-1.3%	3.3%

Note ...

The Mid-size AM4022 module has an airflow rate deviation of max. ± 5.0% of the average value of the four thermal zones (max. ± 25% is allowed).

Positive deviation means increased airflow.

Negative deviation means decreased airflow.

Note ...

The Mid-size AM4022 module provides an open area of 40%. According to the PICMG AMC.0 Specification, an open area of 20 to 70% perpendicular to the airflow path is recommended.

Appendix A

SATA Flash Module

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A. SATA Flash Module

The AM4022 provides an optional SATA Flash module with up to 64 GB NAND Flash memory. The SATA Flash module is connected to the AM4022 via the board-to-board connectors J7 located on the AM4022 and J2 located on the SATA Flash module. The SATA Flash module has been optimized for embedded systems providing high performance, reliability and security.

A.1 Technical Specifications

Table A-1: SATA Flash Module Main Specifications

SATA FLASH MODULE		SPECIFICATIONS
Interface	Board-to-Board Connector	One 34-pin, male, board-to-board connector, J2
Memory	Memory	Up to 64 GB SLC-based NAND Flash memory: • Built-in full hard disk emulation • Up to 100 MB/s read rate • Up to least 90 MB/s write rate
General	Power Consumption	typ. 1.0 W 3.3 V supply
	Temperature Range	Operational: - 5°C to + 55°C Extended: - 40°C to + 70°C (on request) Storage: - 40°C to + 85°C
	Climatic Humidity	93% RH at 40°C, non-condensing (acc. to IEC 60068-2-78)
	Dimensions	70 mm x 28 mm
	Board Weight	ca. 14 grams

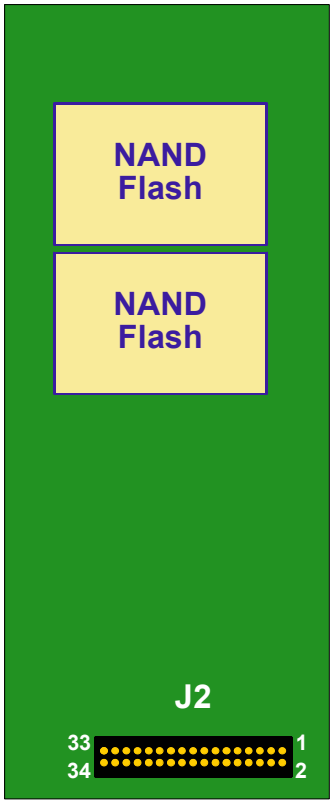
Note ...

Write protection is available for this module. Contact Kontron for further assistance if write protection is required.

A.2 SATA Flash Module Layout

The SATA Flash module includes one board-to-board connector, J2, for interfacing with the AM4022.

Figure A-1: SATA Flash Module Layout (Bottom View)



Appendix B

RTC Backup Battery Module

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B. RTC Backup Battery Module

This special battery mezzanine module is provided for applications requiring backup power for the RTC. It is supplied with up to two parallel-connected 3V lithium batteries. The module is field replaceable. The batteries themselves are not replaceable.

The RTC Backup Battery Module utilizes the SATA Flash module connector for interfacing with the AMC board. Therefore, if it is installed, the SATA Flash module cannot be used.

B.1 Technical Specifications

Table B-1: RTC Backup Battery Module Specifications

BATTERY MODULE		SPECIFICATIONS
Interface	Board-to-Board Connector	One 34-pin, male, board-to-board connector
Battery	Battery	Up to two 3.0V lithium batteries UL-approved
General	Temperature Range	Operational: - 5°C to + 55°C Storage: -30°C to + 60°C
	Climatic Humidity	93% RH at 40°C, non-condensing (acc. to IEC 60068-2-78)
	Dimensions	70 mm x 28 mm
	Board Weight	ca. 14 grams

B.2 RTC Backup Battery Module Layout

This module includes one board-to-board connector, J1, for interfacing with the AM4022.

Figure A-1: RTC Backup Battery Module Layout (Front and Rear Views)