

# » User Guide «

## **AM4120**

**Single Mid-Size Processor AMC Module  
based on the  
QorIQ P2020 Communications Processor**

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### ***Caution, Electric Shock!***

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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 ...***

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### High Voltage Safety Instructions



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



#### **Caution, Electric Shock!**

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

### Special Handling and Unpacking Instructions



#### **ESD Sensitive Device!**

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



#### **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.



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

### **General Instructions on Usage**

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

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

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

Keep all the original packaging material for future storage or warranty shipments. If it is necessary to store or ship the board, please re-pack it as nearly as possible in the manner in which it was delivered.

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



## Two Year Warranty

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If the customer's eligibility for warranty has not been voided, in the event of any claim, he may return the product at the earliest possible convenience to the original place of purchase, together with a copy of the original document of purchase, a full description of the application the product is used on and a description of the defect. Pack the product in such a way as to ensure safe transportation (see our safety instructions).

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*Chapter*

**1**

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# Introduction

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# 1. Introduction

## 1.1 Board Overview

The AM4120 is a highly integrated CPU board implemented as a Single, Mid-size Advanced Mezzanine Card (AMC) Module. The design is based on the Freescale™ QorIQ P2020 dual-core PowerPC® processor and high-speed interconnect technology to balance processor performance with I/O system throughput for networking, storage, wireless infrastructure and general purpose embedded applications.

The P2020 is a highly integrated system-on-chip (SOC) platform that consists of two e500 cores, each having 32 kB L1 instruction cache, 32 kB L1 data cache and 512 kB L2 cache, a DDR3 memory interface, three triple speed Ethernet controllers (eTSECs), a 4x Serial RapidIO™ fabric interface or a x4 PCI Express I/O interface.

The board is capable of supporting core frequencies ranging from 1.0 GHz to 1.2 GHz providing 400 MHz platform speed. The processor and the memory are soldered on the AM4120 which results in higher Mean Time Between Failures (MTBF) and a significant improvement in cooling.

The AM4120 includes up to 4 GB unbuffered Double Data Rate (DDR3) memory with Error Checking and Correcting (ECC) running at 600 MHz. The three integrated TSECs ensure maximum data throughput between the processor and the Ethernet infrastructure. The board further provides up to 2 GB Flash memory via an onboard NAND Flash Controller.

The AM4120 has full hot swap capability, which enables the board to be replaced, monitored and controlled without having to shut down the ATCA carrier board or the MicroTCA system. 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.

As a "headless" AMC design (no onboard graphics controller), the AM4120 supports one standard RS-232 serial port (SER0) and up to two Gigabit Ethernet ports on the front panel as well as a variety of high-speed interconnect topologies to the system, such as two Gigabit Ethernet SerDes connections in the Common Options Region, x4 PCI Express connection or 4x Serial RapidIO connection in the Fat Pipes Region, as well as a debug port and a serial port in the Extended Options Region.

Optimized for high-performance, packet-based telecom systems, the AM4120 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 AM4120 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 AM4120 is offered with various Board Support Packages. Please contact Kontron for further information concerning the operation of the AM4120 with other operating systems.



## 1.2 Board-Specific Information

Due to the outstanding features of the AM4120, 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 AM4120's outstanding features are:

- Freescale™ QorIQ P2020 processor, 1.0 GHz, 400 MHz platform frequency
- Freescale™ QorIQ P2020 processor, 1.2 GHz, 400 MHz platform frequency
- Up to 4 GB DDR3 SDRAM memory with ECC running at 600 MHz
- AMC interconnection
  - Up to two Gigabit SerDes connections in the Common Options Region
  - 4 lanes of high speed serial interface in the Fat Pipes Region for PCI Express or Serial RapidIO
  - Serial port in the Extended Options Region
  - Debug port in the Extended Options Region
  - Bidirectional PCI Express reference clock (FCLKA)
- Full hot swap support
- NAND Flash Controller
- One serial port on Front I/O (RS-232)
- Up to two Gigabit Ethernet ports on Front I/O
- Two SPI NOR flash chips for the U-Boot bootloader
- Dedicated IPMI Module Management Controller (MMC) with external MMC firmware flash
- Watchdog Timer
- Multiple interfaces for debugging and manufacturing purposes
- Four bicolor debug LEDs
- Standard temperature range: -5°C to + 55°C
- Extended temperature range: -40°C to + 70°C
- Passive heat sink solution (system air flow required)
- Single Mid-size AMC module
- microSDHC socket
- Denx U-Boot bootloader
- Designed to be compliant with the following specifications:
  - PICMG® AMC.0, Advanced Mezzanine Card Specification R2.0
  - PICMG® AMC.1, PCI Express and Advanced Switching R1.0
  - PICMG® AMC.2, Gigabit Ethernet R1.0
  - PICMG® AMC.4, Serial RapidIO R1.0
  - PICMG® MTCA.0 Micro Telecommunications Computing Architecture R1.0
  - 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 AM4120.

**Table 1-1: System Relevant Information**

SUBJECT	INFORMATION
Hardware Requirements	<p>The AM4120 can be installed on any AMC-supporting carrier board or MicroTCA backplane with the following AMC Card-edge connector port mapping:</p> <ul style="list-style-type: none"> <li>• Common Options Region ports 0-1:               <ul style="list-style-type: none"> <li>• Two Gigabit Ethernet SerDes ports</li> </ul> </li> <li>• Fat Pipes Region ports 4-7:               <ul style="list-style-type: none"> <li>• One 4 lane PCI Express or Serial RapidIO interface</li> </ul> </li> <li>• Extended Options Region port 14:               <ul style="list-style-type: none"> <li>• One Debug port</li> </ul> </li> <li>• Extended Options Region port 15:               <ul style="list-style-type: none"> <li>• One Serial port</li> </ul> </li> <li>• Clock:               <ul style="list-style-type: none"> <li>• Bidirectional PCI Express reference clock, FCLKA</li> </ul> </li> </ul>
PCI Express Configuration	The AM4120 supports PCI Express root complex and endpoint configuration.
Operating Systems	The board is offered with various Board Support Packages including VxWorks and Linux operating systems. For further information concerning the operating systems available for the AM4120, please contact Kontron.

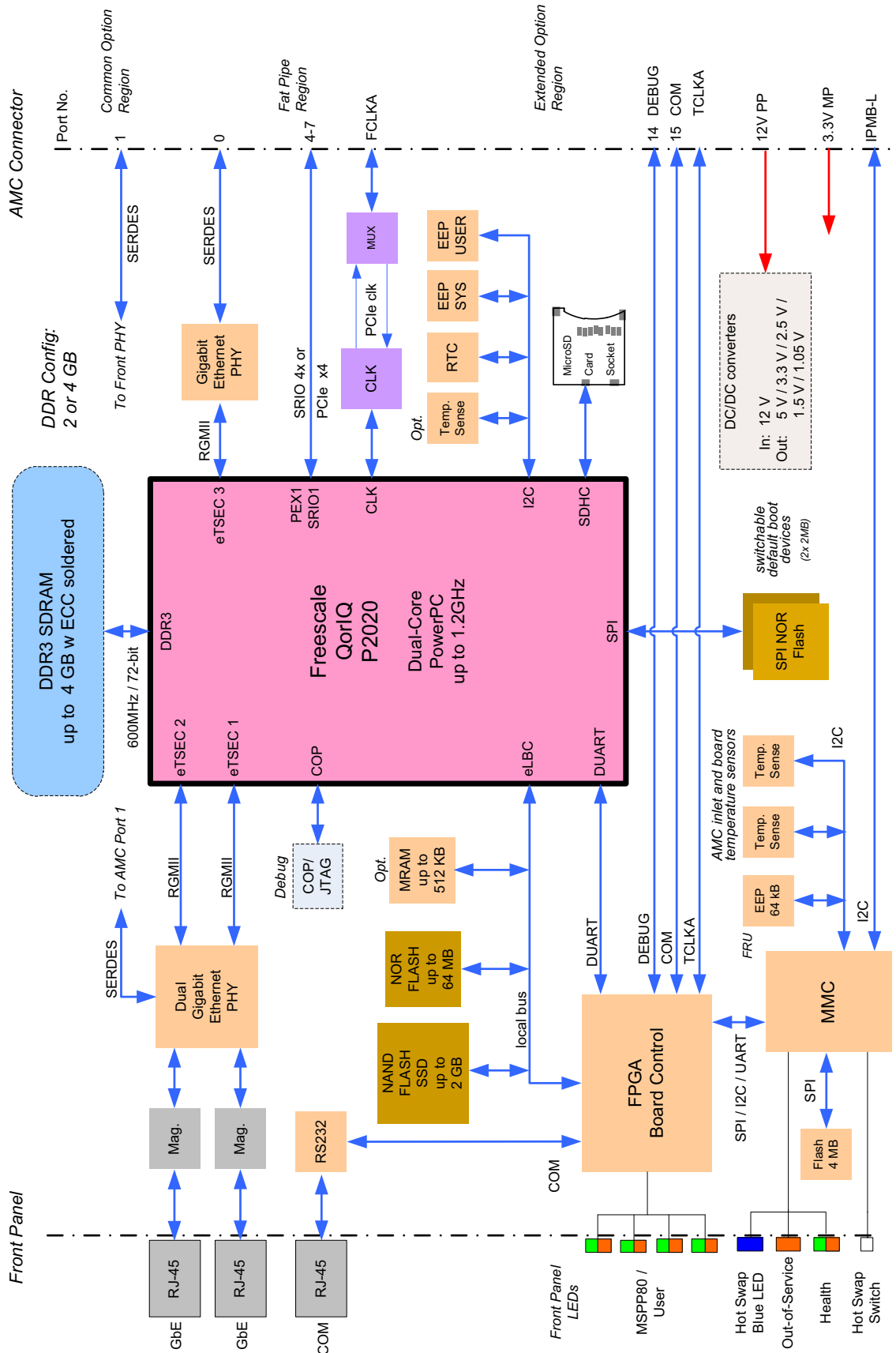
### 1.4 Board Diagrams

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 AM4120.

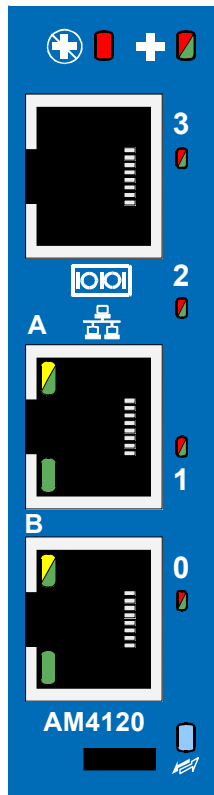
Figure 1-1: AM4120 Functional Block Diagram








## 1.4.2 Front Panel





Figure 1-2: AM4120 Front Panel



### Module Management LEDs



-  • LED1 (red): Out-of-Service LED
-  • LED2 (red/green/amber): Health LED
-  • HS LED (blue): The hot swap indicator provides basic feedback to the user on the hot swap state of the module. The HS LED states are *off*, *short blink*, *long blink*, and *on*.

### User-Specific LEDs

-  • ULED3 (red / green / red+green)
-  • ULED2 (red / green / red+green)
-  • ULED1 (red / green / red+green)
-  • ULED0 (red / green / red+green)

For further information on the ULEDs used on the AM4120, refer to section 2.8.1, “Front Panel LEDs”.

### Connectors

-  • Serial Connector
-  • Gigabit Ethernet Connector



### 1.4.3 Board Layouts

Figure 1-3: AM4120 Board Layout (Top View)

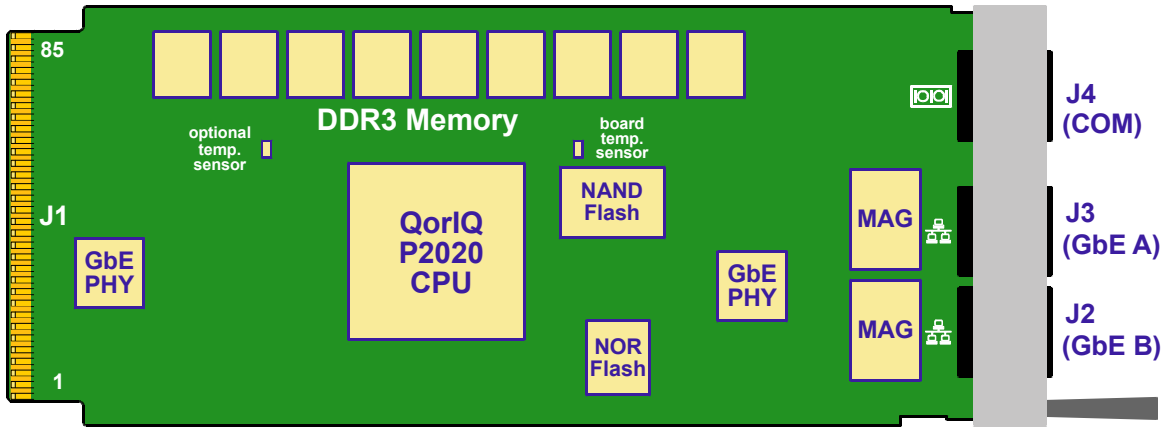
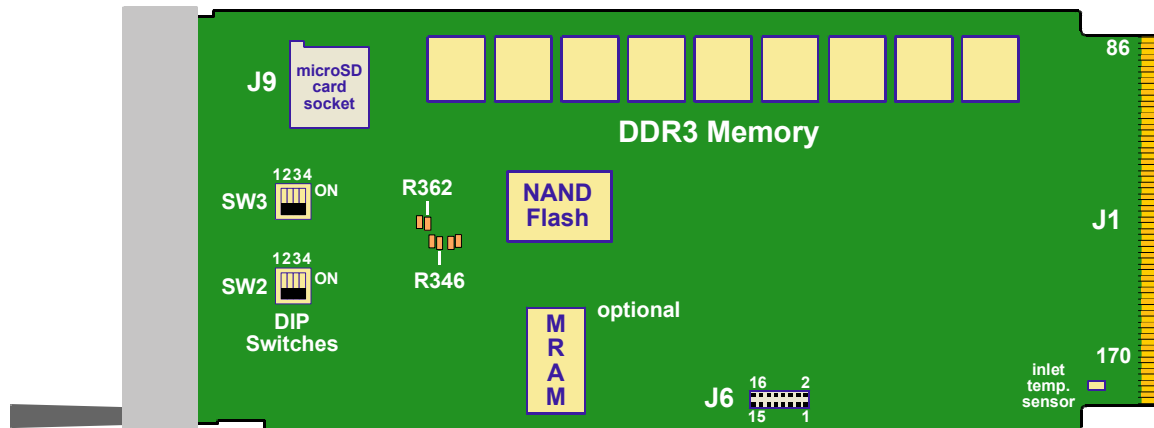


Figure 1-4: AM4120 Board Layout (Bottom View)







## 1.5 Technical Specification

Table 1-2: AM4120 Main Specifications

AM4120		SPECIFICATIONS
Processor and Memory	CPU	<p>The AM4120 supports the following microprocessors:</p> <ul style="list-style-type: none"> <li>• Freescale QorIQ P2020 processor 1.0GHz</li> <li>• Freescale QorIQ P2020 processor 1.2GHz</li> </ul> <p>Further processor features:</p> <ul style="list-style-type: none"> <li>• Two execution cores</li> <li>• System Memory interface with optimized support for single-channel DDR3 SDRAM memory at 600 MHz with ECC</li> </ul>
	Memory	<p>Main Memory:</p> <ul style="list-style-type: none"> <li>• Up to 8 GB, single-channel DDR3 SDRAM memory with ECC running at 600 MHz</li> </ul> <p>Cache Structure:</p> <ul style="list-style-type: none"> <li>• 64 kB L1 cache for each core                             <ul style="list-style-type: none"> <li>• 32 kB instruction cache</li> <li>• 32 kB data cache</li> </ul> </li> <li>• 512 kB L2 shared instruction/data cache</li> </ul> <p>FLASH Memory:</p> <ul style="list-style-type: none"> <li>• Two SPI NOR flash chips (2 x 2 MB) for U-Boot controlled by the MMC</li> </ul> <p>Mass Storage Device:</p> <ul style="list-style-type: none"> <li>• Up to 2GB NAND Flash via integrated/embedded NAND Flash controller</li> <li>• Up to 64MB NOR Flash via integrated/embedded local bus controller</li> <li>• Up to 32 GB microSDHC Flash via integrated SDHC controller</li> <li>• Up to 512 KB non-volatile MRAM (optional)</li> </ul> <p>Serial EEPROM with 64 kbit</p> <ul style="list-style-type: none"> <li>• One for system data storage</li> <li>• One free for user data storage</li> </ul>
Integrated Controller	On-chip interfaces	On-chip interfaces utilized by the AM4120: eSDHC, eLBC, DUART, eTSEC, PCIe, sRIO, SPI, I2C, SEC 3.1
AMC Interconnection	Gigabit Ethernet	<p>Common Options Region ports 0-1:</p> <ul style="list-style-type: none"> <li>• Two Gigabit Ethernet SerDes ports (port 1 switchable to front)</li> </ul>
	SRIO	<p>Fat Pipes Region ports 4-7:</p> <ul style="list-style-type: none"> <li>• One 4x Serial RapidIO interface operating in host or agent configuration</li> </ul>
	PCI Express	<p>Fat Pipes Region ports 4-7:</p> <ul style="list-style-type: none"> <li>• One x4 PCI Express interface operating in root complex or endpoint</li> </ul>
	Debug Interface	<p>Extended Options Region port 14:</p> <ul style="list-style-type: none"> <li>• One Debug port</li> </ul>
	Serial Interface	<p>Extended Options Region port 15:</p> <ul style="list-style-type: none"> <li>• One Serial port</li> </ul>
	Clock	<p>Clock:</p> <ul style="list-style-type: none"> <li>• Bidirectional PCI express reference clock (FCLKA)</li> </ul>

Table 1-2: AM4120 Main Specifications (Continued)

AM4120		SPECIFICATIONS
Connectors	Front Panel Connectors	<ul style="list-style-type: none"> <li>Two Gigabit Ethernet ports on two RJ-45 connectors</li> <li>One serial port (SER0) with RS-232 signal level on RJ-45 connector</li> </ul>
	Onboard Connector	<ul style="list-style-type: none"> <li>COP/JTAG, 16-pin (2 x 8) pinrow 1.27mm raster connector, J6</li> </ul>
	microSD card socket	<ul style="list-style-type: none"> <li>Standard microSD socket, accepts microSD and microSDHC cards, J9</li> </ul>
	AMC Card-edge Connector	<ul style="list-style-type: none"> <li>One 170-pin AMC Card-edge connector</li> </ul>
Switches	DIP Switches	Two DIP switches for board configuration, SW2 and SW3, consisting of four switches each
LEDs	Module Management LEDs	<ul style="list-style-type: none"> <li>LED1 (red): Out-of-Service LED</li> <li>LED2 (red/green/amber): Health LED</li> <li>HS LED (blue): The hot swap indicator provides basic feedback to the user on the hot swap state of the module. The HS LED states are <i>off</i>, <i>short blink</i>, <i>long blink</i>, and <i>on</i>.</li> </ul>
	User-Specific LEDs	ULED3 ... ULED0 (red/green/red + green) Display on mode and type of operation selected. Refer to chapter 2.8.1 for further information.
	Ethernet LEDs	<ul style="list-style-type: none"> <li>Act (green): Network/Link Activity</li> <li>Speed (green/yellow): Network speed</li> </ul>
Timer	Watchdog Timer	<ul style="list-style-type: none"> <li>Software-configurable, two-stage Watchdog with programmable timeout ranging from 125 ms to 4096 s in 16 steps</li> <li>Serves for generating IRQ or hardware reset</li> </ul>
	System Timer	There are several timers implemented in the CPU. For further information regarding these timers, refer to the CPU reference manual from Freescale.
IPMI	Module Management Controller	<ul style="list-style-type: none"> <li>NXP® ARM7 microcontroller with a 4MB external firmware flash and automatic roll-back strategy</li> <li>The MMC carries out IPMI commands such as monitoring several on-board temperature conditions, board voltages and the power supply status, and managing hot swap operations.</li> <li>The MMC is accessible via a local IPMB (IPMB-L) and one host Keyboard Controller Style Interface (KCS).</li> <li>One MMC system EEPROM for FRU data and firmware private data</li> </ul>
	Hot Swap	The AM4120 has full hot swap capability.
	Thermal Management	CPU and board overtemperature protection is provided by: <ul style="list-style-type: none"> <li>One onboard temperature sensor for monitoring the board temperature</li> <li>Specially designed heat sink</li> </ul>

**Table 1-2: AM4120 Main Specifications (Continued)**

AM4120		SPECIFICATIONS
General	Power Consumption	Refer to Chapter 5, “Power Considerations” for information related to the power consumption of the AM4120.
	Temperature Range	Operational: -5°C to +55°C Standard -40°C to +70°C Extended, depending on processor version and airflow in the system Storage: -40°C to +70°C
	Mechanical	Single Module: <ul style="list-style-type: none"> <li>Mid-size version</li> </ul>
	Dimensions	Dimensions of the AM4120: Mid-size: 181.5 mm x 73.5 mm x 18.96 mm
	Board Weight	Mid-size with heat sink: 240 grams
	COP/JTAG	Two interfaces: <ul style="list-style-type: none"> <li>One processor JTAG interface routed to the onboard debug connector for debugging purposes</li> <li>One JTAG interface connected to the AMC Card-edge connector for debugging and manufacturing purposes</li> </ul>
Software	Bootloader: U-Boot	DENX “U-Boot” (Universal Boot Loader) with Kontron specific modifications to support the AM4120 requirements
	Management: IPMI	Module Management Controller Firmware providing the following features: <ul style="list-style-type: none"> <li>The MMC is accessible via IPMB-L and one KCS interface with interrupt support</li> <li>The MMC Firmware can be updated in the field through all supported onboard interfaces using the function “fwum...” of the open-source tool “ipmitool”. For further information on the ipmitool refer to the sourceforge.net website.</li> <li>Two MMC flash images with automatic roll-back capability in case of an upgrade Firmware failure</li> <li>Board supervision and control extensions such as board reset, power and Firmware Flash control, etc</li> </ul>
	Operating Systems	The board is offered with various Board Support Packages including VxWorks and Linux operating systems. For further information concerning the operating systems available for the AM4120, please contact Kontron.

## 1.6 Standards

The AM4120 complies with the requirements of the following standards.

**Table 1-3: Standards**

COMPLIANCE	TYPE	STANDARD	TEST LEVEL
CE	Emission	EN55022 EN61000-6-3 EN300386	--
	Immision	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, $\pm x$ , $\pm y$ , $\pm z$
	Climatic Humidity	IEC60068-2-78	93% RH at 40°C, non-condensing <b>(see note below)</b>
	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.4 R1.0, Advanced Mezzanine Card Specification for Serial RapidIO, Jul. 11, 2009
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 1.0a
RapidIO	RapidIO Specification, Revision 1.2
Platform Firmware	DENX “U-Boot” (Universal Boot Loader) on-line documentation at <a href="http://www.denx.de">www.denx.de</a> Kontron’s “U-Boot” Bootloader User Guide, ID 1046-1856
All Kontron Products	Product Safety and Implementation Guide, ID 1021-9142



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