

# » User Guide «

## **AM4150**

**Single Mid-Size AMC Module based on the  
Freescale™ QorIQ™ P5020  
Dual-Core Processor**

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



## Explanation of Symbols



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

This symbol and title warn of hazards due to electrical shocks (> 60V) when touching products or parts of them. Failure to observe the precautions indicated and/or prescribed by the law may endanger your life/health and/or result in damage to your material.

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



### ***Warning, ESD Sensitive Device!***

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

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



### ***Warning!***

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



### ***Note ...***

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



## For Your Safety

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

### High Voltage Safety Instructions



#### **Warning!**

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



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

Before installing any piggybacks or carrying out maintenance operations always ensure that your mains power is switched off.

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

Kontron grants the original purchaser of Kontron's products a **TWO YEAR LIMITED HARDWARE WARRANTY** as described in the following. However, no other warranties that may be granted or implied by anyone on behalf of Kontron are valid unless the consumer has the express written consent of Kontron.

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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).

Kontron provides for repair or replacement of any part, assembly or sub-assembly at their own discretion, or to refund the original cost of purchase, if appropriate. In the event of repair, refunding or replacement of any part, the ownership of the removed or replaced parts reverts to Kontron, and the remaining part of the original guarantee, or any new guarantee to cover the repaired or replaced items, will be transferred to cover the new or repaired items. Any extensions to the original guarantee are considered gestures of goodwill, and will be defined in the "Repair Report" issued by Kontron with the repaired or replaced item.

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*Chapter*

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**1**

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# Introduction

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# 1. Introduction

## 1.1 Board Overview

The AM4150 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™ P5020 dual-core Power Architecture® processor with integrated high-speed interconnect technology to balance processor performance with I/O system throughput for networking, storage, wireless infrastructure and general-purpose embedded applications.

The QorIQ™ P5020 processor is a highly integrated 64-bit system-on-chip (SOC) platform with up to 2.0 GHz core clock speed consisting of two e5500 cores, each with 32 kB L1 instruction cache, 32 kB L1 data cache and 512 kB backside L2 cache. Further processor features include a dual DDR3 memory interface, 2 MB shared L3 CoreNet platform cache (1 MB per memory channel), five Datapath Triple-Speed Ethernet Controllers (dTSECs), and either two x4 Serial RapidIO™ fabric interfaces or two x4 PCI Express I/O interfaces. Furthermore, one NAND flash memory (SSD) with up to 64 GB can be integrated into the AM4150 via a SATA Flash module.

The processor and the memory are soldered on the AM4150 which results in a robust design, higher Mean Time Between Failures (MTBF) and a significant improvement in cooling.

The AM4150 includes up to 8 GB unbuffered, dual-channel Double Data Rate (DDR3) memory with Error Checking and Correction (ECC) running at up to 1300 MHz. The board further provides up to 2 GB NAND flash memory via a NAND flash controller integrated in the processor.

As a “headless” AMC design (no onboard graphics controller), the AM4150 supports one standard RS-232 serial port (UART1) and up to two Gigabit Ethernet ports on the front panel as well as a variety of high-speed interconnect topologies to the system. In the Common Options Region up to two Gigabit Ethernet SerDes and up to two SATA interfaces are supported. In the Fat Pipes Region PCI Express, Serial RapidIO, and Gigabit Ethernet SerDes interfaces can be selected. In the Extended Options Region a debug port and a serial port are provided.

The AM4150 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.

Optimized for high-performance, packet-based telecom systems, the AM4150 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 AM4150 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 AM4150 is offered with various Board Support Packages such as VxWorks and Linux. Please contact Kontron for further information concerning the operation of the AM4150 with other operating systems.



## 1.2 Board-Specific Information

Due to the outstanding features of the AM4150, 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 AM4150's outstanding features are:

- Support for the following processors:
  - Freescale™ QorIQ™ P5020 processor, 2.0 GHz, 800 MHz platform frequency
  - Freescale™ QorIQ™ P5020 processor, 1.6 GHz, 600 MHz platform frequency
- Up to 8 GB DDR3 SDRAM memory with ECC running at up to 1300 MHz
- AMC interconnection:
  - Common Options Region: up to two Gigabit Ethernet SerDes interfaces and up to two SATA ports
  - Fat Pipes Region: 8 lanes configurable for PCI Express, Serial RapidIO, and Gigabit Ethernet SerDes connections
  - Extended Options Region: serial port, debug port, two GPIs (on request), two GPOs (on request)
  - Bidirectional PCI Express reference clock (FCLKA)
- Full hot swap support
- Up to 2 GB NAND flash memory via a NAND flash controller integrated in the processor
- One serial port on front I/O (RS-232)
- Up to two Gigabit Ethernet ports on front I/O
- Up to 64 GB NAND flash memory via an optional SATA Flash module
- Two SPI boot flashes for two separate U-Boot bootloader images:
  - One standard SPI boot flash
  - One recovery SPI boot flash
- One 8 MB SPI flash for operating system use
- Dedicated IPMI Module Management Controller (MMC) with external MMC firmware flash
- Watchdog timer
- Multiple interfaces for debugging and manufacturing purposes
- Four bicolor User-Specific LEDs (providing debugging information, etc.)
- One onboard DIP switch (for selecting the SPI boot flashes, overwriting E-Keying, etc.)
- microSDHC socket
- Standard temperature range: -5°C to + 55°C
- Passive heat sink solution for forced airflow cooling
- Single Mid-size AMC module
- Denx U-Boot bootloader
- Designed to be compliant with the following 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.4 R1.0, Serial RapidIO on AdvancedMC™ Specification
  - PICMG® MTCA.0 R1.0 Micro Telecommunications Computing Architecture Base 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 AM4150.

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

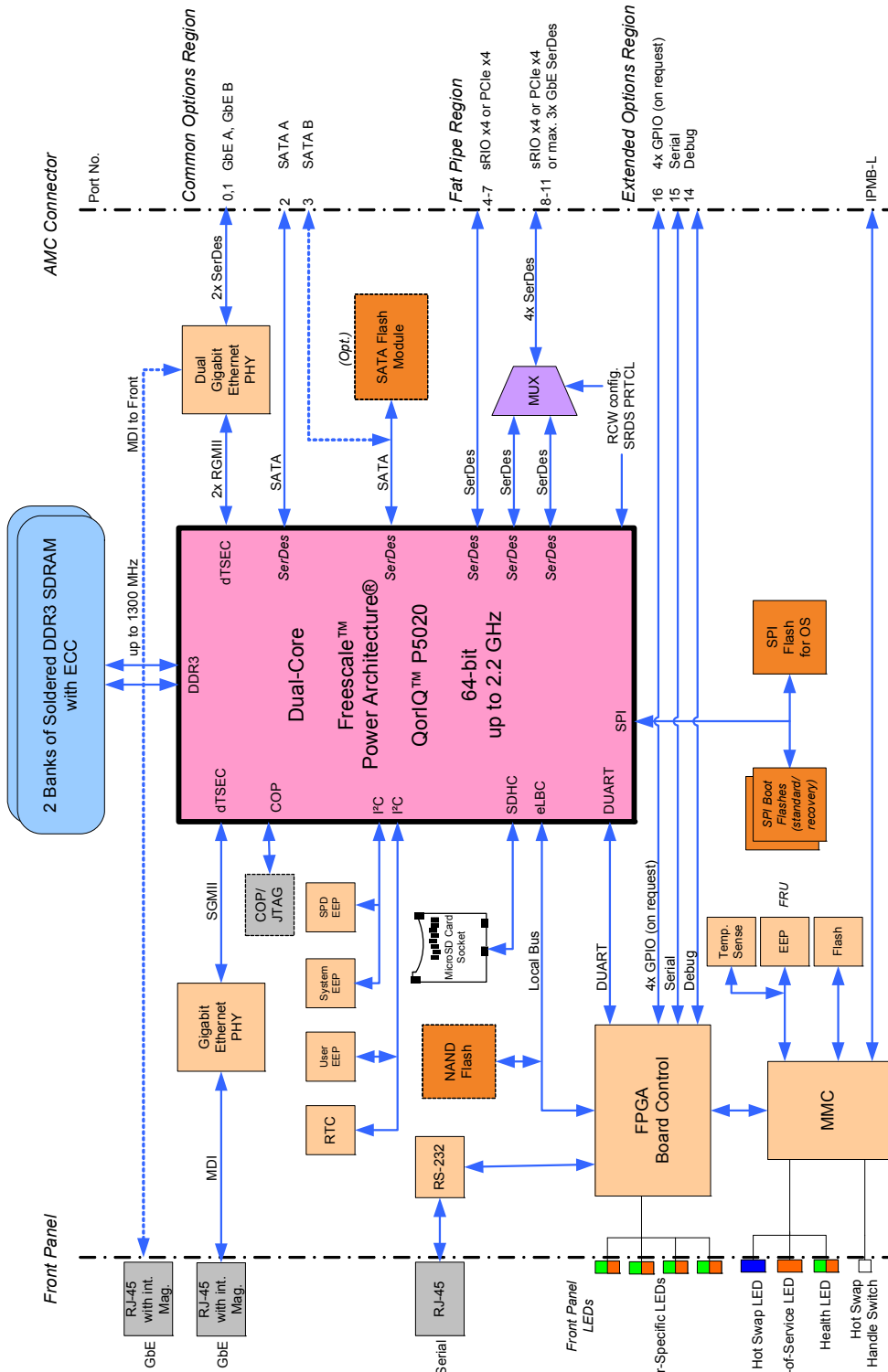
SUBJECT	INFORMATION
Hardware Requirements	<p>The AM4150 can be installed on any AMC-supporting carrier board or MicroTCA backplane with the following AMC Card-edge connector port mapping:</p> <ul style="list-style-type: none"> <li>• Common Options Region ports 0-1:               <ul style="list-style-type: none"> <li>• Up to two Gigabit Ethernet SerDes ports</li> </ul> </li> <li>• Common Options Region ports 2-3:               <ul style="list-style-type: none"> <li>• Up to two SATA ports</li> </ul> </li> <li>• Fat Pipes Region ports 4-7:               <ul style="list-style-type: none"> <li>• One x4 PCI Express interface or</li> <li>• One x4 Serial RapidIO interface</li> </ul> </li> <li>• Fat Pipes Region ports 8-11:               <ul style="list-style-type: none"> <li>• One x4 PCI Express interface or</li> <li>• One x4 Serial RapidIO interface or</li> <li>• Up to three Gigabit Ethernet SerDes ports</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>• Extended Options Region port 16:               <ul style="list-style-type: none"> <li>• Two general purpose inputs (GPI), on request</li> <li>• Two general purpose outputs (GPO), on request</li> </ul> </li> <li>• Clock:               <ul style="list-style-type: none"> <li>• Bidirectional PCI Express reference clock, FCLKA</li> </ul> </li> </ul> <p>For further information on the AMC interconnection, refer to Chapter 2.11, "AMC Interconnection".</p>
PCI Express Configuration	<p>The AM4150 only supports the PCI Express root complex configuration; non-transparent bridge functionality is not supported.</p>
Operating Systems	<p>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 AM4150, please contact Kontron.</p>

### 1.4 Board Diagrams

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

1.4.1 Functional Block Diagram

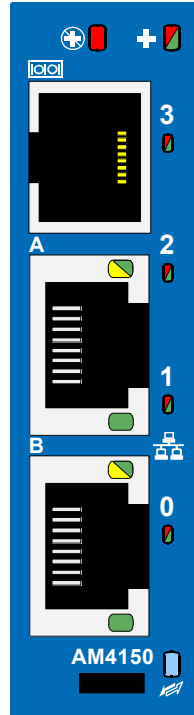
Figure 1-1: AM4150 Functional Block Diagram








1.4.2 Front Panel



Figure 1-2: AM4150 Front Panel



Module Management LEDs

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

Connectors

-  • Serial Connector
-  • Gigabit Ethernet Connector

User-Specific LEDs 3..0

- ULED3 (red/green): AMC port 0 link status (green) + user-specific debug code (green) + general purpose (red/green/red+green)
- ULED2 (red/green): AMC port 1 link status (green) + user-specific debug code (green) + general purpose (red/green/red+green)
- ULED1 (red/green): User-specific debug code (green) + general purpose (red/green/red+green)
- ULED0 (red/green): User-specific debug code (green) + general purpose (red/green/red+green)

Integral Ethernet LEDs

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



**Note ...**

If the ULED 0..3 remain lit red after power-on, a failure is indicated before the U-Boot bootloader has started. For further information, please contact Kontron.



### 1.4.3 Board Layouts

Figure 1-3: AM4150 Board Layout (Top View)

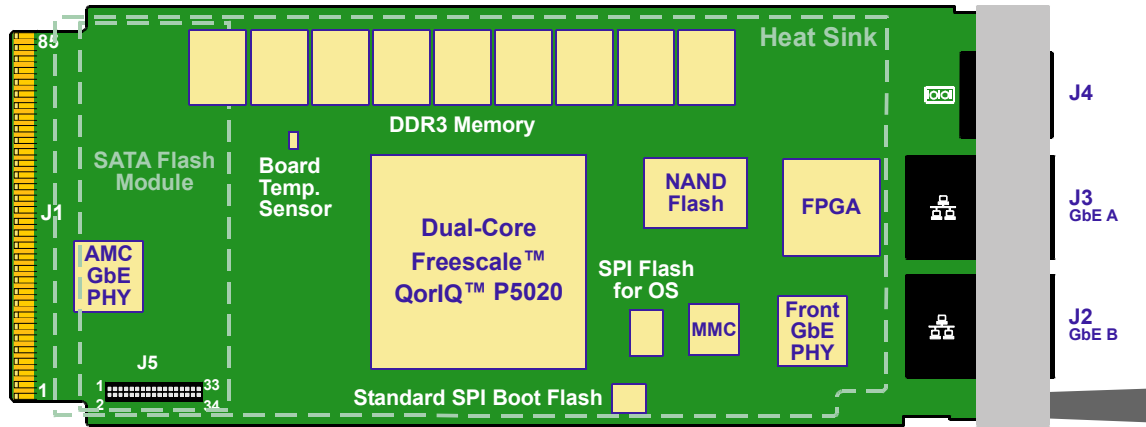
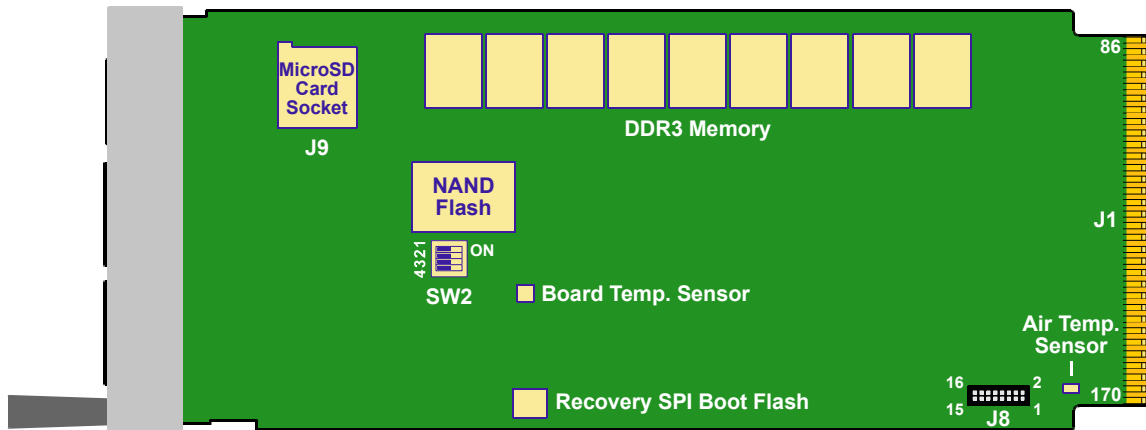


Figure 1-4: AM4150 Board Layout (Bottom View)







## 1.5 Technical Specification

Table 1-2: AM4150 Main Specifications

AM4150		SPECIFICATIONS
Processor	CPU	<p>The AM4150 supports the following microprocessors:</p> <ul style="list-style-type: none"> <li>• Freescale™ QorIQ™ P5020 processor, 2.0 GHz, 800 MHz platform freq.</li> <li>• Freescale™ QorIQ™ P5020 processor, 1.6 GHz, 600 MHz platform freq.</li> </ul> <p>Further processor features:</p> <ul style="list-style-type: none"> <li>• Two 64-bit execution cores</li> <li>• System Memory interface with optimized support for dual-channel DDR3 SDRAM memory at 1300 MHz with ECC for the QorIQ™ P5020 processor with 2.0 GHz CPU frequency</li> <li>• System Memory interface with optimized support for dual-channel DDR3 SDRAM memory at 1200 MHz with ECC for the QorIQ™ P5020 processor with 1.6 GHz CPU frequency</li> </ul>
	Integrated controllers	<p>Controllers integrated in the CPU and utilized by the AM4150: eSDHC, eLBC, DUART, dTSEC, PCIe, sRIO, SPI, I<sup>2</sup>C.</p>
Memory	Memory	<p>Main memory:</p> <ul style="list-style-type: none"> <li>• Up to 8 GB, dual-channel DDR3 SDRAM memory with ECC running at up to 1300 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 backside L2 cache for each core</li> <li>• 2 MB shared L3 CoreNet platform cache (1 MB per memory channel)</li> </ul> <p>Flash memory:</p> <ul style="list-style-type: none"> <li>• Two SPI boot flashes (2 x 2 MB) for U-Boot selectable via the DIP switch or the MMC</li> <li>• One 8 MB SPI flash for operating system use</li> </ul> <p>Mass storage device:</p> <ul style="list-style-type: none"> <li>• Up to 2 GB NAND flash via an integrated/embedded NAND flash controller</li> <li>• Up to 32 GB microSDHC flash via an integrated SDHC controller</li> <li>• Up to 64 GB NAND flash memory (SSD) via an optional onboard SATA Flash module</li> </ul> <p>Two serial EEPROMs 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>

Table 1-2: AM4150 Main Specifications (Continued)

AM4150		SPECIFICATIONS
AMC Interconnection	Gigabit Ethernet	Common Options Region ports 0-1: <ul style="list-style-type: none"> <li>Two Gigabit Ethernet SerDes ports (AMC port 1 switchable to front)</li> </ul> Fat Pipes Region ports 8-10: <ul style="list-style-type: none"> <li>Up to three Gigabit Ethernet SerDes ports</li> </ul>
	SATA	Common Options Region ports 2-3: <ul style="list-style-type: none"> <li>Up to two SATA ports</li> </ul>
	SRIO	Fat Pipes Region ports 4-7: <ul style="list-style-type: none"> <li>One 4x Serial RapidIO interface operating in host or agent configuration, depending on configuration</li> </ul> Fat Pipes Region ports 8-11: <ul style="list-style-type: none"> <li>One 4x Serial RapidIO interface operating in host or agent configuration, depending on configuration</li> </ul>
	PCI Express	Fat Pipes Region ports 4-7: <ul style="list-style-type: none"> <li>One x4 PCI Express interface operating in root complex configuration</li> </ul> Fat Pipes Region ports 8-11: <ul style="list-style-type: none"> <li>One x4 PCI Express interface operating in root complex configuration</li> </ul>
	Debug Interface	Extended Options Region port 14: <ul style="list-style-type: none"> <li>One debug port</li> </ul>
	Serial Interface	Extended Options Region port 15: <ul style="list-style-type: none"> <li>One serial port</li> </ul>
	GPIO	Extended Options Region port 16: <ul style="list-style-type: none"> <li>Two general purpose inputs (GPI), on request</li> <li>Two general purpose outputs (GPO), on request</li> </ul>
	Clock	Clock: <ul style="list-style-type: none"> <li>Bidirectional PCI express reference clock (FCLKA)</li> </ul>
Connectors	Front Panel Connectors	<ul style="list-style-type: none"> <li>Two Gigabit Ethernet ports on two RJ-45 connectors, J2 and J3</li> <li>One serial port (UART1) with RS-232 signal level on RJ-45 connector, J4</li> </ul>
	Onboard Connectors	<ul style="list-style-type: none"> <li>Common on-chip processor (COP) debug port via 16-pin (2 x 8) pinrow 1.27 mm connector, J8</li> </ul>
		<ul style="list-style-type: none"> <li>One extension connector, J5, for the SATA Flash module</li> </ul>
	microSD card Socket	<ul style="list-style-type: none"> <li>Standard microSD socket, J9, accepts microSD and microSDHC cards</li> </ul>
AMC Card-edge Connector	<ul style="list-style-type: none"> <li>One 170-pin AMC Card-edge connector, J1</li> </ul>	
Switch	DIP Switch	One DIP switch for board configuration, SW2, consisting of four switches

Table 1-2: AM4150 Main Specifications (Continued)

AM4150		SPECIFICATIONS
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	<ul style="list-style-type: none"> <li>ULED3 (red/green): AMC port 0 link status (green) + user-specific debug code (green) + general purpose (red/green/red+green)</li> <li>ULED2 (red/green): AMC port 1 link status (green) + user-specific debug code (green) + general purpose (red/green/red+green)</li> <li>ULED1 (red/green): User-specific debug code (green) + general purpose (red/green/red+green)</li> <li>ULED0 (red/green): User-specific debug code (green) + general purpose (red/green/red+green)</li> </ul>
	Integral Ethernet LEDs	<ul style="list-style-type: none"> <li>Act (green): Ethernet Link/Activity</li> <li>Speed (green/yellow/off): Ethernet 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 redundant 512 kB 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 AM4150 has full hot swap capability.
Thermal	Thermal Management	CPU and board overtemperature protection is provided by: <ul style="list-style-type: none"> <li>Three onboard temperature sensors for monitoring the board temperature</li> <li>CPU temperature diode integrated in the QorIQ™ P5020 processor</li> <li>Specially designed heat sink</li> </ul>
General	Power Consumption	Refer to Chapter 5, “Power Considerations” for information related to the power consumption of the AM4150.
	Temperature Range	Operational: -5°C to +55°C Storage: -40°C to +70°C
	Mechanical	Single Mid-size module
	Dimensions	181.5 mm x 73.5 mm x 18.96 mm
	Board Weight	244 grams (with heat sink and front panel)


**Table 1-2: AM4150 Main Specifications (Continued)**

AM4150		SPECIFICATIONS
Software	Bootloader	DENX U-Boot (Universal Boot Loader) with Kontron-specific modifications to support the AM4150 requirements
	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 the KCS interface using the U-Boot bootloader and through all supported onboard interfaces using the update functions of the open-source tool "ipmitool". For further information on the ipmitool refer to the sourceforge.net web site.</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 AM4150, please contact Kontron.

## 1.6 Standards

The AM4150 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, $\pm x$ , $\pm y$ , $\pm z$
	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
<b>ATCA</b>	PICMG® 3.0 R3.0, AdvancedTCA® Base Specification, March 24, 2008
<b>MicroTCA</b>	PICMG® MTCA.0 R1.0, Micro Telecommunications Computing Architecture Base Specification, July 6, 2006
<b>AMC</b>	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, Serial RapidIO on AdvancedMC™ Specification, July 11, 2009
<b>IPMI</b>	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
<b>PCI Express</b>	PCI Express Base Specification Revision 2.0, Dec. 20, 2006
<b>Serial RapidIO</b>	RapidIO™ Interconnect Specification Part 6: LP-Serial Physical Layer Specification, Rev. 2.0.1, March 2008
<b>Serial ATA</b>	Serial ATA International Organization: Serial ATA Revision 2.6, 15th February 2007
<b>Platform Firmware</b>	DENX "U-Boot" (Universal Boot Loader) online documentation at <a href="http://www.denx.de">www.denx.de</a>
<b>Kontron</b>	Kontron's Product Safety and Implementation Guide, ID 1021-9142
	Kontron's AM4150 U-Boot Bootloader User Guide, ID 1052-0281
	Kontron's AM4150 IPMI Firmware User Guide, ID 1052-5679