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» User Guide «

CP6016

6U CompactPCI Processor Board based on the Intel® Core™2 Duo Processor with the Intel® 5100 MCH Chipset

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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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Special Handling and Unpacking Instructions



ESD Sensitive Device!

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

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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.

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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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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

Introduction

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1. Introduction

1.1 Board Overview

The CP6016 is a highly integrated 6U CompactPCI system controller board based on the Intel® Core™2 Duo mobile processor and the high-performance Intel® 5100 Memory Controller Hub chipset with the Intel® 82801IR I/O Controller Hub 9R (ICH9R), and uses Aptio®, AMI's next generation BIOS firmware based on the Unified Extensible Firmware Interface (uEFI) specification and the Intel® Platform Innovation Framework for EFI.

The board supports the Intel® Core™2 Duo processor, 2.53 GHz version, built on 45-nm process technology and in a 479 µFCBGA package providing 64 kB L1 and 6 MB L2 cache as well as 1066 MHz front side bus (FSB) speed.

Two SO-RDIMM sockets are available on the CP6016 to provide up to 8 GB dual-channel, registered, second-generation Double Data Rate (DDR2) memory with Error Checking and Correcting (ECC) running at 667 MHz (PC2-5300). The board also includes three Gigabit Ethernet controllers: one Intel® 82574L Gigabit Ethernet controller utilizing a x1 lane PCI Express interconnection to the ICH9R and two Intel® 82571EB Dual Gigabit Ethernet controllers each utilizing a x4 lane PCI Express interconnection to the Intel® 5100 MCH chipset.

The CP6016 further provides support for one optional USB 2.0 NAND Flash module as well as onboard SATA HDD/SSD support via the optional CP6001-EXT-SATA module.

The CP6016 comes with five Gigabit Ethernet ports (three on front I/O and two on rear I/O), six Serial ATA interfaces with RAID support (two onboard and four on the rear I/O), one high-resolution VGA interface (CRT), one 64-bit/66 MHz PCI or 64-bit/133 MHz PCI-X PMC interface, and one XMC interface utilizing a x8 lane PCI Express interconnection. In addition, seven USB 2.0 ports are available on the board, two on the front panel, one onboard for the USB 2.0 NAND Flash module, and four on rear I/O. Further interfaces include two COM ports, one RS-232 port implemented as an RJ-45 connector on the front panel and routed to rear I/O as well as one RS-232 port on the rear I/O.

The board supports a configurable 64-bit/66 MHz PCI or PCI-X, hot swap CompactPCI interface. When installed in the system slot, the interface is enabled, and when installed in a peripheral slot, the CP6016 is isolated from the CompactPCI bus.

A further feature of the CP6016 is its support of two Gigabit Ethernet interfaces on the rear I/O as defined in the PICMG CompactPCI Packet Switching Backplane Specification 2.16.

The CP6016 provides safety and security via a Trusted Platform Module (TPM) 1.2. Intelligent Platform Management Interface (IPMI) support is also provided.

Designed for stability, the board fits into applications situated in industrial environments, including I/O intensive applications where only one slot is available for the CPU, making it a perfect core technology for long-life applications. Components with high temperature tolerance have been selected from embedded technology programs, and therefore offer long-term availability.

The board is offered with the Linux®, Microsoft® Windows® XP, Windows® XP Embedded, and Microsoft® Windows® Server 2003 operating systems. Please contact Kontron for further information concerning the operation of the CP6016 with other operating systems.

1.2 Board-Specific Information

The CP6016 is a CompactPCI single-board computer based on the Intel® Core™2 Duo processor built on 45-nm process technology and specifically designed for use in highly integrated platforms with solid mechanical interfacing for a wide range of industrial environment applications.

Some of the CP6016's outstanding features are:

- Intel® Core™2 Duo processor, T9400 (SV), 2.53 GHz, 1066 MHz FSB, 6 MB L2 cache
- 479-pin µFCBGA package
- 64 kB L1 and 6 MB L2 cache on-die, running at CPU speed
- Intel® 5100 Memory Controller Hub chipset with Intel® 82801IR I/O Contr. Hub 9R (ICH9R)
- Up to 8 GB registered DDR2 SDRAM memory with ECC running at 667 MHz (PC2-5300) on two SO-RDIMM sockets
- ATI ES1000 2D graphics controller with 64 MB of DDR2 memory via a 32-bit/33 MHz PCI interface
- Analog display support for up to 1600 x 1200 pixels at 16-bit and 75 Hz
- 64-bit/66 MHz PCI or PCI-X CompactPCI interface (PICMG 2.0)
- PMC interface with rear I/O support and bezel cutout on the front panel as well as PCI functionality, 64-bit/66 MHz PCI or 64-bit/133 MHz PCI-X interface
- XMC interface utilizing a x8 lane PCI Express interconnection
- Five Gigabit Ethernet interfaces:
  - Three Gigabit Ethernet interfaces on front I/O
  - Two Gigabit Ethernet interfaces on rear I/O (PICMG 2.16)
- Three Gigabit Ethernet (GbE) controllers:
  - One Intel® 82574L controller connected to one GbE port on the front panel
  - Two Intel® 82571EB Dual Gigabit Ethernet controllers connected to two GbE ports on the front panel and routed to rear I/O
- Six Serial ATA interfaces with SATA RAID 0/1/5/10 support:
  - Two onboard Serial ATA interfaces
  - Four Serial ATA interfaces on the rear I/O
- Socket for one Serial ATA 2.5" hard disk drive (HDD) or solid state drive (SSD)
- Seven USB ports:
  - Two USB 2.0 ports on the front panel
  - One onboard USB 2.0 port for the USB 2.0 NAND Flash module
  - Four USB 2.0 ports on the rear I/O
- TCG 1.2 compliant Trusted Platform Module (TPM)
- Two SPI Flash chips for redundant uEFI BIOS (2 x 4 MB)
- Watchdog timer
- Battery-backed real-time clock (RTC)
- Two COM ports (RS-232):
  - One COM port either on the front panel or on the rear I/O
  - One COM port on the rear I/O
- Hot swap capability: as system controller or as peripheral device
- Supports PICMG Packet Switching Backplane Specification 2.16
- IPMI compliant Baseboard Management Controller
- 4HP, 6U CompactPCI
- Passive heat sink solution for forced-airflow cooling
- Several rear I/O configurations
- Rear I/O on J3 and J5; optionally on J4 for PMC only
- AMI Aptio®, a uEFI-compliant platform firmware (AMIBIOS8 successor)

1.3 System Expansion Capabilities

1.3.1 PMC Module

The CP6016 has a 3.3V, rear I/O capable PMC mezzanine interface configurable for either 64-bit/66 MHz PCI or 64-bit/133 MHz PCI-X operation. This interface supports a wide range of PMC modules with PCI interface including all of Kontron's PMC modules and provides an easy and flexible way to configure the CP6016 for various application requirements.

For information on the PMC interface, refer to chapter 2.3.8, "PMC Interface".

1.3.2 XMC Module

The CP6016 has one XMC mezzanine interface for support of x1, x4 and x8 PCI Express XMC modules providing an easy and flexible way to configure the CP6016 for various application requirements.

For information on the XMC interface, refer to chapter 2.3.9, "XMC Interface".

1.3.3 CP6016-MK2.5SATA Assembly Kit

The CP6016 comes with an optional CP6016-MK2.5SATA assembly kit comprised of one CP6001-EXT-SATA module and the necessary components needed for mounting the module on the CP6016. The CP6001-EXT-SATA module is required for connecting an onboard 2.5" Serial ATA HDD or SSD to the CP6016.

For further information concerning the CP6001-EXT-SATA module, please refer to Appendix A.

1.3.4 USB 2.0 NAND Flash Module

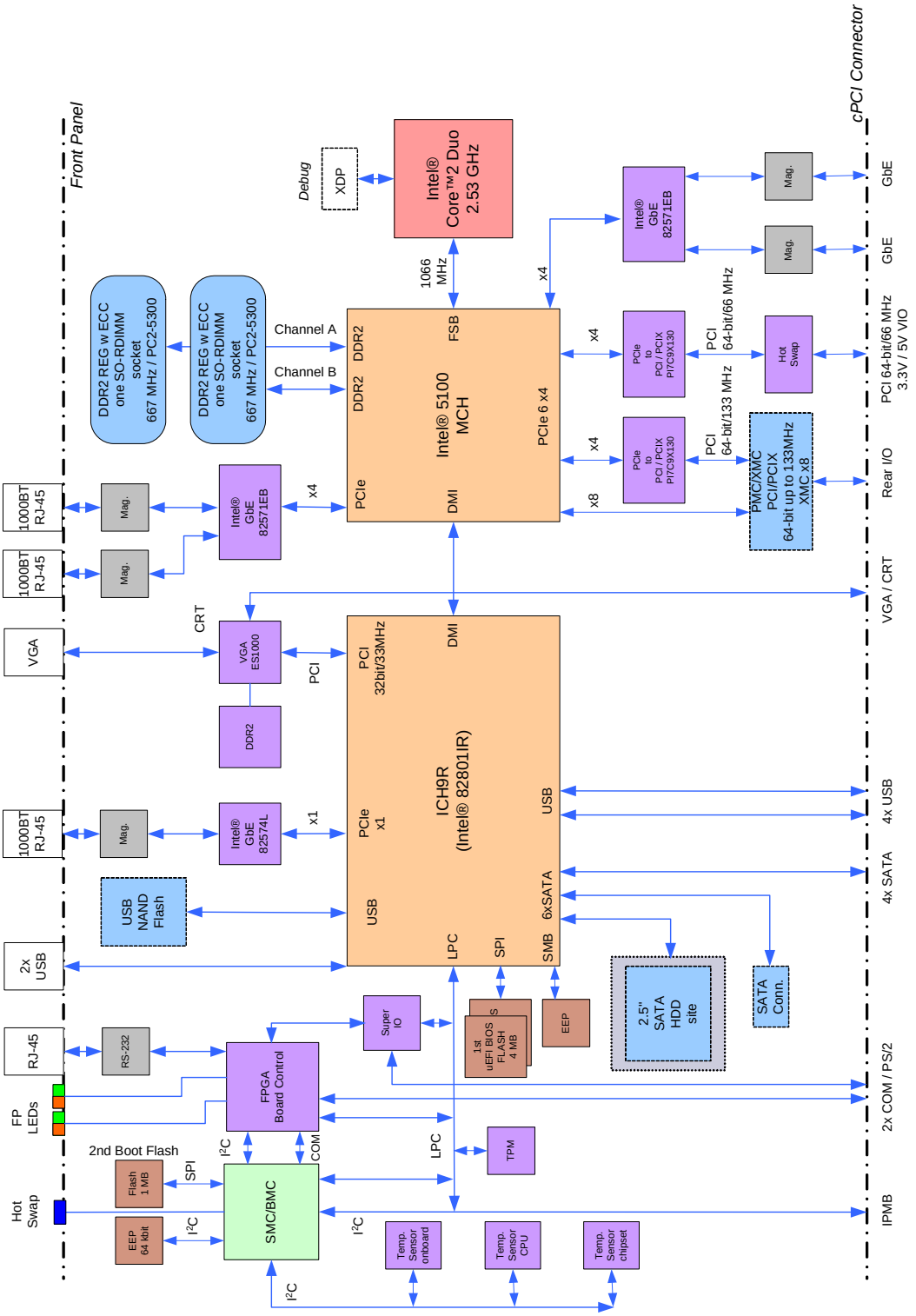
The CP6016 provides support for one optional USB 2.0 NAND Flash module. For further information, refer to chapter 2.2.6, "USB 2.0 NAND Flash Module".

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: CP6016 Functional Block Diagram



1.4.2 Front Panel

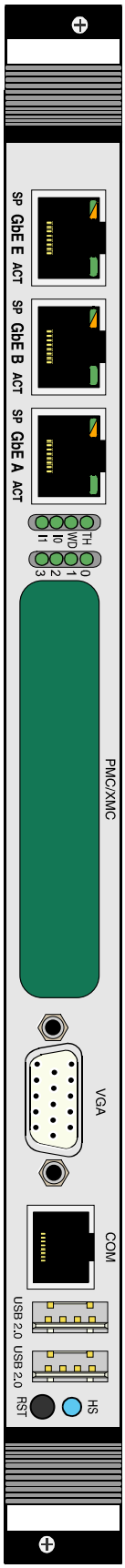


Figure 1-2: CP6016 Front Panel

Legend:

IPMI LEDs

I0/I1 (red/green): Indicate the software status of the IPMI controller

Status LEDs

WD (green): Watchdog Status

TH (red/green/amber): Temperature Status

HS (blue): Hot Swap Control

General Purpose LEDs

LED 0..3 (red/green/amber): General Purpose/POST code

Integral Ethernet LEDs

ACT (green): Ethernet Link/Activity

SPEED (green/orange): Ethernet Speed

SPEED ON (orange): 1000 Mbit

SPEED ON (green): 100 Mbit

SPEED OFF: 10 Mbit



Note ...

If the General Purpose LEDs are lit red during boot-up, a failure is indicated before the uEFI BIOS has started.

For further information, please contact Kontron.

1.4.3 Board Layout

Figure 1-3: CP6016 Board Layout (Top View)

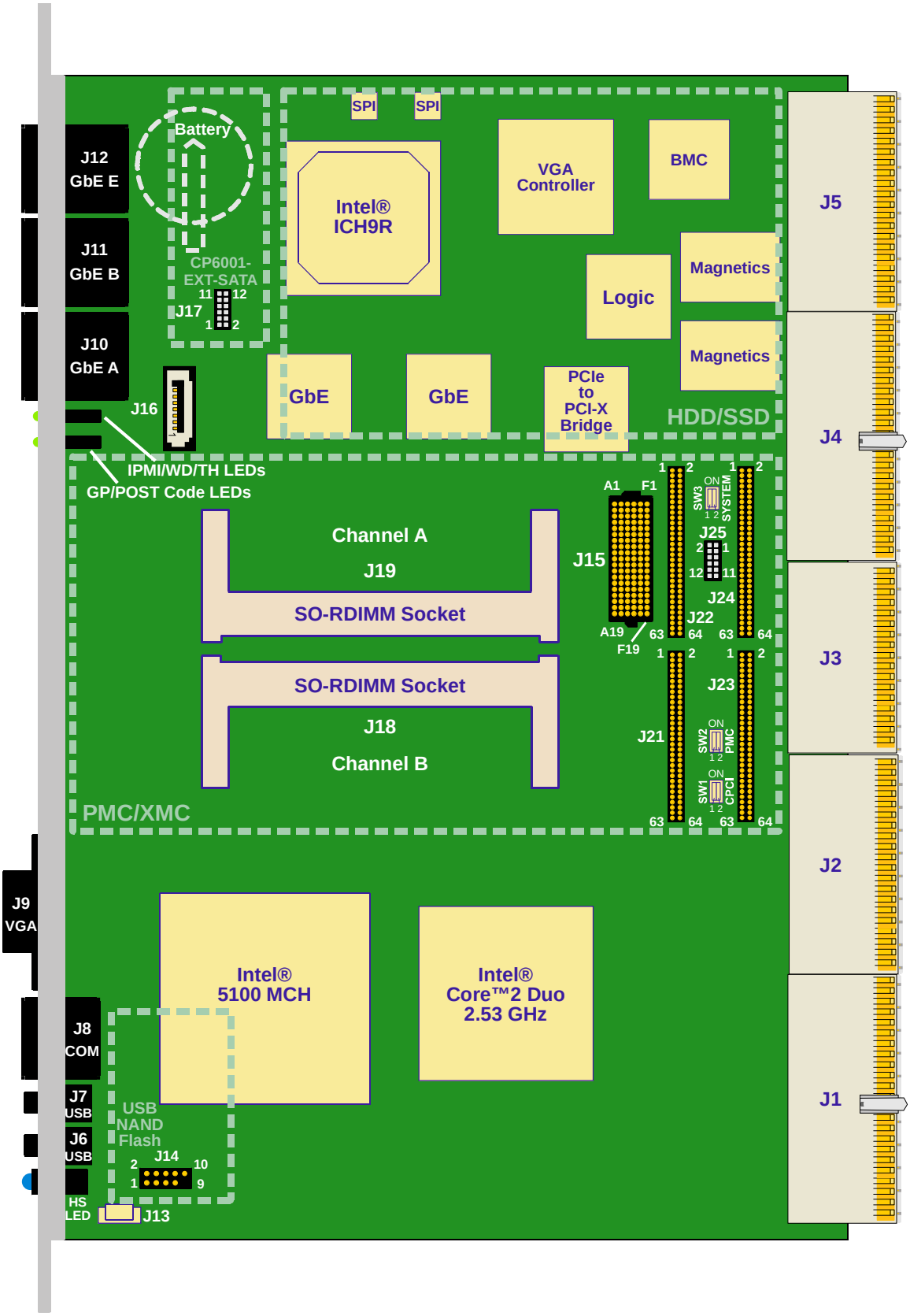
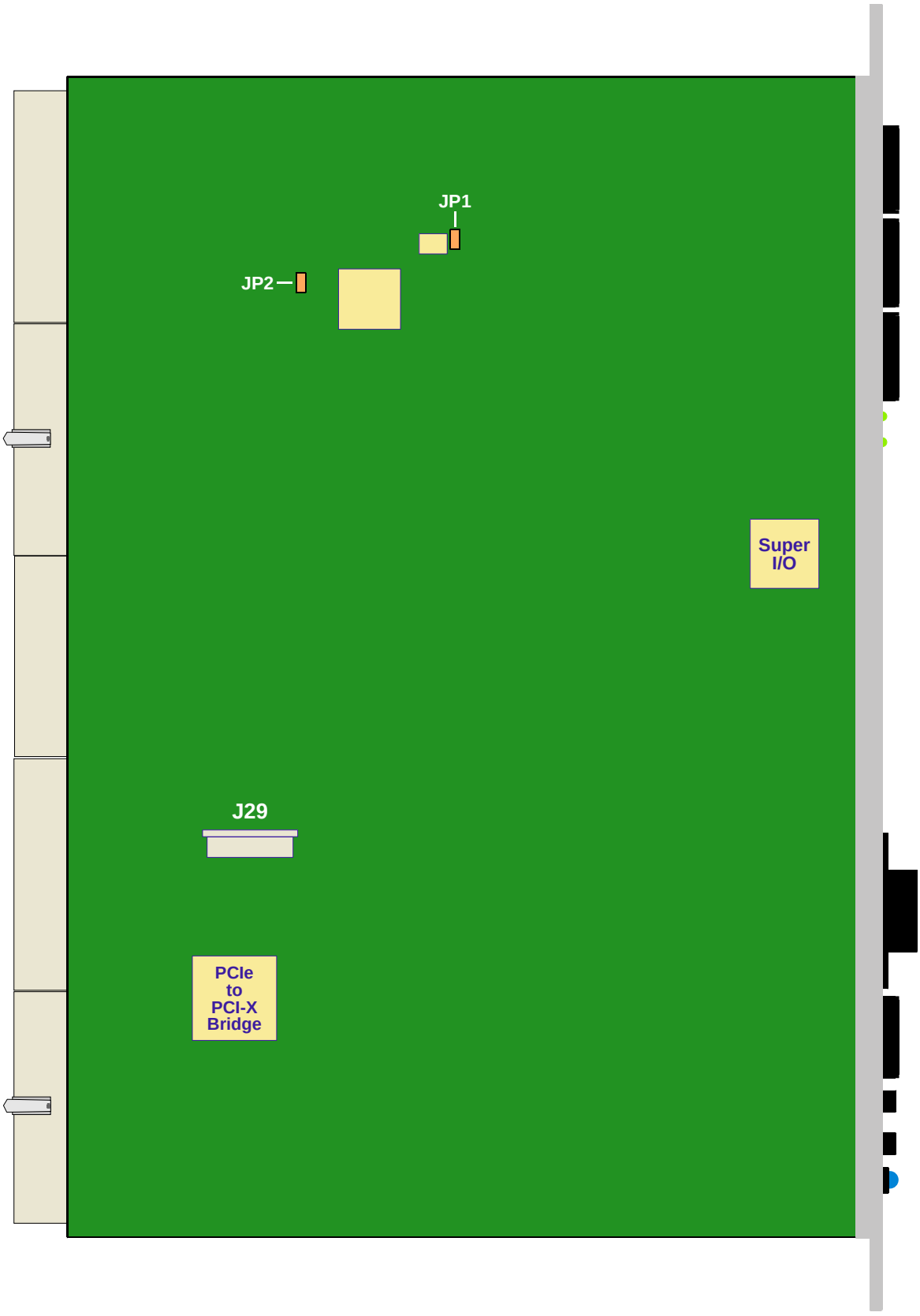


Figure 1-4: CP6016 Board Layout (Bottom View)



1.5 Technical Specification

Table 1-1: CP6016 Main Specifications

FEATURES		SPECIFICATIONS
Processor and Memory	CPU	The CP6016 supports the Intel® Core™2 Duo 45-nm based processor, T9400 (SV), 2.53 GHz, 1066 MHz FSB, 6 MB L2 cache, in a 479 µFCBGA packaging.

	Memory	Main Memory:
		• Up to 8 GB dual-channel, registered DDR2 memory with Error Checking and Correcting (ECC) running at 667 MHz (PC2-5300) on two SO-RDIMM sockets
		Cache structure:
		• 64 kB L1 on-die full speed processor cache
		  • 32 kB for instruction cache
		  • 32 kB for data cache
		• 6 MB L2 on-die full speed processor cache
		FLASH Memory:
		• Two 4 MB SPI Flash chips for redundant uEFI BIOS
		• USB 2.0 NAND Flash memory optionally available
		• Serial ATA SSD Flash memory optionally available
		Serial EEPROM:
		• 24LC64 (64 kbit)

Chipset	Intel® 5100 MCH	Intel® 5100 Memory Controller Hub:
		• Support for a single Intel® Core™2 Duo microprocessor
		• 64-bit AGTL/AGTL+ based System Bus interface up to 1066 MHz
		• System Memory interface with optimized support for dual-channel, registered DDR2 SDRAM memory at 667 MHz (PC2-5300) with ECC
		• Two x4 PCI Express ports for the Intel® 82571EB GbE controllers
		• Two x4 PCI Express ports for the PCI Express-to-PCI/PCI-X bridges
		• One x8 PCI Express port for the XMC interface
		• RASUM (Reliability, Availability, Serviceability, Usability, and Manageability) features:
		  • Memory error detection and reporting of 1- and 2-bit errors including correction of 1-bit failures
		  • Integrated Memory Scrub Engine, which logs any uncorrectable memory errors
		  • Support for automatic read retry on uncorrectable errors

	Intel® ICH9R	Intel® 82801IR I/O Controller Hub (ICH9R): • Power management logic support • Enhanced DMA controller, interrupt controller, and timer functions • USB 2.0 host interface with twelve USB ports (only seven ports are used on the CP6016) • SATA Host Controller with six ports, 3 Gbit/s transfer rate and RAID 0/1/5/10 support • Six x1 PCI Express ports, only one x1 PCI Express port is used on the CP6016 for the Gigabit Ethernet controller Intel® 82574L • System Management Bus (SMBus) compatible with most I²C™ devices • High Definition Audio (HDA) interface routed to rear I/O • Low Pin Count (LPC) interface • SPI Flash interface support • RTC controller

Table 1-1: CP6016 Main Specifications (Continued)

	FEATURES	SPECIFICATIONS
Interfaces	CompactPCI	Compliant with CompactPCI Specification PICMG® 2.0 R 3.0: • System controller operation • 64-bit/66 MHz PCI or PCI-X master interface with dedicated PCIe-to-PCI-X bridge from Pericom (PI7C9X130) • 3.3V or 5V signaling levels (universal signaling support) Compliant with the Packet Switching Specification PICMG 2.16. When installed in a peripheral slot, the CP6016 is isolated from the CompactPCI bus. It receives power from the backplane and supports rear I/O and, if the system supports it, packet switching (in this case up to two channels of Gigabit Ethernet).
	Rear I/O	The following interfaces are routed to the rear I/O connectors J3, J4 and J5: • COM1 and COM2 (RS-232 signaling); no buffer on the rear I/O module is necessary • 4 x USB 2.0 • CRT VGA • PS/2 (mouse/keyboard) • 2 x Gigabit Ethernet (compliant with PICMG 2.16) • 4 x SATA (RAID 0/1/5/10 support) • PMC/XMC rear I/O • High Definition Audio (HDA) for codec integration
	Hot Swap Compatible	The CP6016 supports System Master hot swap functionality and application-dependent hot swap functionality when used in a peripheral slot. When used as a System Master, the CP6016 supports individual clocks for each slot and the ENUM signal handling is in compliance with the PICMG 2.1 Hot Swap Specification.
	VGA	ATI ES1000 2D graphics accelerator: • Supports resolutions of up to 1600 x 1200 by 16-bit color resolution at a 75 Hz refresh rate or up to 1280 x 1024 by 32-bit color resolution at a 75 Hz refresh rate. • The graphics controller provides 64 MB video memory. • One CRT controller capable of supporting two identical simultaneous display paths
	Gigabit Ethernet	Five 10 Base-T/100 Base-TX/1000 Base-T Gigabit Ethernet interfaces based on one Intel® 82574L and two Intel® 82571EB Ethernet PCI Express bus controllers: • Three RJ-45 connectors on the front panel • Two channels on the rear I/O • Automatic mode recognition (Auto-Negotiation) • Automatic cabling configuration recognition (Auto-MDI/X)
	USB	Seven USB ports supporting UHCI and EHCI: • Two type A USB 2.0 connectors on the front panel • One onboard USB 2.0 connector for the USB 2.0 NAND Flash module • Four USB 2.0 ports on the rear I/O interface
	Serial	Two 16C550-compatible UARTs (RS-232 signaling): • One on the front panel and routed to rear I/O • One on the rear I/O

Table 1-1: CP6016 Main Specifications (Continued)

	FEATURES	SPECIFICATIONS
Interfaces	PMC	PMC interface: • Four onboard mezzanine connectors for standard PMC modules • 64-bit/66 MHz PCI or 64-bit/133 MHz PCI-X interface with dedicated PCIe-to-PCI-X bridge from Pericom (PI7C9X130) • Only 3.3V PCI signaling voltage • Rear I/O supported through the CompactPCI connector J4 • Supported voltages: 3.3 V, 5 V, +12 V, and -12 V
	XMC	XMC interface: • One onboard XMC connector • Up to x8 lanes PCI Express • Rear I/O supported through the PMC connector J23 (Jn4) to the CompactPCI connector J4
	Keyboard and Mouse	Keyboard and mouse are supported: • USB support • PS/2 (keyboard and mouse) on the rear I/O

	Mass Storage	Onboard 2.5" HDD/SSD:
		• Onboard 2.5" hard disk drive (HDD) or solid state drive (SSD) is supported via the SATA extension connector, J17, in combination with the CP6001-EXT-SATA module
		Onboard USB 2.0 NAND Flash:
		• Onboard USB 2.0 NAND Flash module supported on J14
		SATA: Integrated Serial ATA Host Controllers
		• Provide independent DMA operation on six ports:
		  • Two onboard SATA interfaces
		  • Four SATA interfaces only on rear I/O
		• Data transfer rates up to 300 MB/s
		• High-performance RAID 0/1/5/10 functionality on all SATA ports

Sockets	Front Panel Connectors	• VGA: 15-pin, D-Sub connector, J9 • USB: two 4-pin, type A connectors, J6 and J7 • Ethernet: three 8-pin, RJ-45 connectors, J10, J11 and J12 • COM: one 8-pin, RJ-45 connector, J8 • PMC/XMC front panel bezel cutout

	Onboard Connectors	• USB 2.0 NAND Flash connector, J14
		• PMC connectors J21 - J24 (Jn1 - Jn4)
		• XMC connector, J15
		• Two SATA connectors
		  • One 7-pin, standard SATA connector, J16
		  • One 12-pin, SATA extension connector, J17
		• JTAG connector, J25
		• XDP-SFF (debug) connector, J29
		• CompactPCI Connectors J1 - J5
		• Two 200-pin SO-RDIMM sockets, J18 and J19

Table 1-1: CP6016 Main Specifications (Continued)

FEATURES		SPECIFICATIONS
Switches	DIP Switches	Three, two-position, onboard DIP switches, SW1, SW2, and SW3, for board configuration
	Reset Switch	One front panel hardware reset switch
HW Monitoring	LEDs	System Status LEDs: • I0/I1 (red/green): Indicate the software status of the IPMI controller • WD (green): Watchdog Status • TH (red/green/amber): Temperature Status • HS (blue): Hot Swap Control General Purpose LEDs: • LED 0..3 (red/green/amber): General Purpose / POST code Gigabit Ethernet Status: • ACT (green): Ethernet Link/Activity • SPEED (green / orange): Ethernet Speed • SPEED ON (orange): 1000 Mbit • SPEED ON (green): 100 Mbit • SPEED OFF: 10 Mbit
	Watchdog	Software configurable Watchdog generates IRQ or hardware reset.
	Thermal Management	CPU overtemperature protection is provided by: • Internal processor temperature control unit • CPU shut down via hardware monitor
	IPMI	Baseboard Management Controller (BMC) that supports two keyboard controller-style interfaces (KCS) compliant with: • IPMI specification v1.5 • PICMG 2.9 specification IPMI supports two IPMB busses via the J1 and J2 connectors. The BMC includes an integrated system monitor for the supervision of: • Several system power voltages • Two fan speed inputs • Processor, chipset and board temperature
Security	TPM	Trusted Platform Module (TPM) 1.2 for enhanced hardware- and software-based data and system security

Table 1-1: CP6016 Main Specifications (Continued)

FEATURES		SPECIFICATIONS
Software	uEFI BIOS	AMI Aptio®, AMI's next-generation BIOS firmware based on the uEFI Specification and the Intel Platform Innovation Framework for EFI. • 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) • IPMI support in the command shell
	Software IPMI	Board Management Controller Firmware providing the following features: • The BMC is accessible via two IPMBs and two KCS interfaces with interrupt support • The BMC Firmware can be updated in field through all supported interfaces using the function "fwum..." of the open-source tool "ipmitool". For further information on the ipmitool refer to the sourceforge.net web site. • Two BMC Flash banks with automatic roll-back capability in case of an upgrade firmware failure • Board supervision and control extensions such as board reset, power and SPI Flash control, and boot order configuration
	Operating Systems	Operating systems supported: • Microsoft® Windows® XP with Service Pack 2 or higher • Microsoft® Windows® XP Embedded • Microsoft® Windows® Server 2003 R2, Service Pack 2 • Linux®

Table 1-1: CP6016 Main Specifications (Continued)

FEATURES		SPECIFICATIONS
General	Mechanical	6U, 4HP, CompactPCI-compliant form factor
	Power Consumption	See Chapter 5 for details.
	Temperature Ranges	Operational: 0°C to +60°C Standard Storage: -55°C to +85°C Without hard disk and without battery  *Note ...* When a battery is installed, refer to the operational specifications of the battery as this determines the storage temperature of the CP6016 (See "Battery" below).  *Note ...* When additional components are installed, refer to their operational specifications as this will influence the operational and storage temperature of the CP6016.
	Battery	3.0V lithium battery for RTC with battery socket. Recommended type: CR2025 Temperature ranges: Operational: -20°C to +70°C typical (refer to the battery manufacturer's specifications for exact range) Storage: -55°C to +70°C typical (no discharge)
	Climatic Humidity	93% RH at 40 °C, non-condensing (acc. to IEC 60068-2-78)
	Dimensions	233.35 mm x 160 mm
	Board Weight	837 g (with two CompactPCI connectors, heat sink and SO-RDIMM modules but without mezzanine cards) 880 g (with five CompactPCI connectors, heat sink and SO-RDIMM modules but without mezzanine cards)

1.6 Kontron Software Support

Kontron is one of the few CompactPCI and VME manufacturers providing inhouse support for most of the industry-proven real-time operating systems that are currently available. Due to its close relationship with the software manufacturers, *Kontron* is able to produce and support BSPs and drivers for the latest operating system revisions thereby taking advantage of the changes in technology.

1.7 Standards

This product complies with the requirements of the following standards:

Table 1-2: Standards

TYPE	ASPECT	STANDARD
CE	Emission	EN55022 EN61000-6-3
	Immission	EN55024 EN61000-6-2
	Electrical Safety	EN60950-1
Mechanical	Mechanical Dimensions	IEEE 1101.10
Environmental	Climatic Humidity	IEC60068-2-78 (see note below)
	WEEE	Directive 2002/96/EC Waste electrical and electronic equipment
	RoHS	Directive 2002/95/EC Restriction of the use of certain hazardous substances in electrical and electronic equipment



Note ...

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

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

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

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

In addition, boards ordered with the ruggedized service comply with the following standards as well.

Table 1-3: Additional Standards for Boards Ordered with Ruggedized Service

TYPE	ASPECT	STANDARD	REMARKS
Environmental	Vibration (Sinusoidal)	IEC60068-2-6	Ruggedized version test parameters: • 5-150 (Hz) frequency range • 1 (g) acceleration • 1 (oct/min) sweep rate • 10 cycles/axis • 3 axis
	Single Shock	IEC60068-2-27	Ruggedized version test parameters: • 15 and 30 (g) acceleration • 9 (ms) pulse duration • 3 shocks per direction • 6 directions • 5 (s) recovery time



Note ...

The values indicated in the table above are valid for the CP6016 equipped with the heat sink illustrated in Figure 1-3.

1.8 Related Publications

The following publications contain information relating to this product.

Table 1-4: Related Publications

PRODUCT	PUBLICATION
CompactPCI Systems and Boards	CompactPCI Specification PICMG 2.0, Rev. 3.0 CompactPCI Packet Switching Backplane Specification PICMG 2.16 Rev. 1.0 CompactPCI System Management Specification PICMG 2.9 Rev. 1.0 CompactPCI Hot Swap Specification PICMG 2.1 Rev. 2.0
	IPMI - Intelligent Platform Management Interface Specification v1.5
	Kontron CompactPCI Backplane Manual, ID 24229
PMC Module	IEEE 1386-2001, IEEE Standard for a Common Mezzanine Card (CMC) Family IEEE 1386.1-2001, IEEE Standard Physical and Environmental Layers for PCI Mezzanine Cards (PMC)
XMC Module	ANSI/VITA 42.0-200x XMC Switched Mezzanine Card Auxiliary Standard ANSI/VITA 42.3-2006 XMC PCI Express Protocol Layer Standard
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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