CPC1600

PC/104-*Plus*
Intel Pentium M Based
Processor Module

User Manual

Rev. 001 E

July 2008

P r e l i m i n a r y

The product described in this manual is compliant to all related CE standards.

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Notation Conventions

Warning, ESD Sensitive Device!

This symbol draws your attention to the information related to electro static sensitivity of your product and its components. To keep product safety and operability it is necessary to handle it with care and follow the ESD safety directions.

Warning!

This sign marks warnings about hot surfaces. The surface of the heatsink and some components can get very hot during operation. Take due care when handling, avoid touching hot surfaces!

Caution: Electric Shock!

This symbol warns about danger of electrical shock (> 60 V) when touching products or parts of them. Failure to observe the indicated precautions and directions may expose your life to danger and may lead to damage to your product.

Warning!

Information marked by this symbol is essential for human and equipment safety.
Read this information attentively, be watchful.

Note...

This symbol and title marks important information to be read attentively for your own benefit.

General Safety Precautions

This product was developed for fault-free operation. Its design provides conformance to all related safety requirements. However, the life of this product can be seriously shortened by improper handling and incorrect operation. That is why it is necessary to follow general safety and operational instructions below.

Warning!

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

Warning!

When handling this product, special care must be taken not to hit the heatsink (if installed) against another rigid object. Also, be careful not to drop the product, since this may cause damage to the heatsink, CPU or other sensitive components as well.

Please, keep in mind that any physical damage to this product is not covered under warranty.

Note:

This product is guaranteed to operate within the published temperature ranges and relevant conditions. However, prolonged operation near the maximum temperature is not recommended by Fastwel or by electronic chip manufacturers due to thermal stress related failure mechanisms. These mechanisms are common to all silicon devices; they can reduce the MTBF of the product by increasing the failure probability. Prolonged operation at the lower limits of the temperature ranges has no limitations.

Caution, Electric Shock!

Before installing this product into a system and before installing other devices on it, always ensure that your mains power is switched off.

Always disconnect external power supply cables during all handling and maintenance operations with this module to avoid serious danger of electrical shock.

Unpacking, Inspection and Handling

Please read the manual carefully before unpacking the module or mounting the device into your system. Keep in mind the following:

ESD Sensitive Device!

Electronic modules and their components are sensitive to static electricity. Even a non-perceptible by human being static discharge can be sufficient to destroy or degrade a component's operation! Therefore, all handling operations and inspections of this product must be performed with due care, in order to keep product integrity and operability:

- Preferably, unpack or pack this product only at EOS/ESD safe workplaces. Otherwise, it is important to be electrically discharged before touching the product. This can be done by touching a metal part of your system case with your hand or tool. It is particularly important to observe anti-static precautions when setting jumpers or replacing components.
- If the product contains batteries for RTC or memory back-up, ensure that the module is not placed on conductive surfaces, including anti-static mats or sponges. This can cause short-circuit and result in damage to the battery and other components.
- Store this product in its protective packaging while it is not used for operational purposes.

Unpacking

The product is carefully packed in an antistatic bag and in a carton box to protect it against possible damage and harmful influence during shipping. Unpack the product indoors only at a temperature not less than +15°C and relative humidity not more than 70%. Please note, that if the product was exposed to the temperatures below 0°C for a long time, it is necessary to keep it at normal conditions for at least 24 hours before unpacking. Do not keep the product close to a heat source.

Following ESD precautions, carefully take the product out of the shipping carton box. Proper handling of the product is critical to ensure correct operation and long-term reliability. When unpacking the product, and whenever handling it thereafter, be sure to hold the module preferably by the front panel, card edges or ejector handles. Avoid touching the components and connectors.

Retain all original packaging at least until the warranty period is over. You may need it for shipments or for storage of the product.

Initial Inspection

Although the product is carefully packaged, it is still possible that shipping damages may occur. Careful inspection of the shipping carton can reveal evidence of damage or rough handling. Should you notice that the package is damaged, please notify the shipping service and the manufacturer as soon as possible. Retain the damaged packing material for inspection.

After unpacking the product, you should inspect it for visible damage that could have occurred during shipping or unpacking. If damage is observed (usually in the form of bent component leads or loose socketed components), contact Fastwel's official distributor from which you have purchased the product for additional instructions. Depending on the severity of the damage, the product may even need to be returned to the factory for repair. DO NOT apply power to the product if it has visible damage. Doing so may cause further, possibly irreparable damage, as well as result in a fire or electric shock hazard.

If the product contains socketed components, they should be inspected to make sure they are seated fully in their sockets.

Handling

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

In order to keep Fastwel's warranty, you must not change or modify this product in any way, other than specifically approved by Fastwel or described in this manual.

Technical characteristics of the systems in which this product is installed, such as operating temperature ranges and power supply parameters, should conform to the requirements stated by this document.

Retain all the original packaging; you will need it to pack the product for shipping in warranty cases or for safe storage. Please, pack the product for transportation in the way it was packed by the supplier.

When handling the product, please, remember that the module, its components and connectors require delicate care. Always keep in mind the ESD sensitivity of the product.

Three Year Warranty

Fastwel Co. Ltd. (Fastwel), warrants that its standard hardware products will be free from defects in materials and workmanship under normal use and service for the currently established warranty period. Fastwel's only responsibility under this warranty is, at its option, to replace or repair any defective component part of such products free of charge.

Fastwel neither assumes nor authorizes any other liability in connection with the sale, installation or use of its products. Fastwel shall have no liability for direct or consequential damages of any kind arising out of sale, delay in delivery, installation, or use of its products.

If a product should fail through Fastwel's fault during the warranty period, it will be repaired free of charge. For out of warranty repairs, the customer will be invoiced for repair charges at current standard labor and materials rates.

Warranty period for Fastwel products is 36 months since the date of purchase.

The warranty set forth above does not extend to and shall not apply to:

1. Products, including software, which have been repaired or altered by other than Fastwel personnel, unless Buyer has properly altered or repaired the products in accordance with procedures previously approved in writing by Fastwel.
2. Products, which have been subject to power, supply reversal, misuse, neglect, accident, or improper installation.

Returning a product for repair

1. Apply to Fastwel company or to any of the Fastwel's official representatives for the Product Return Authorization.
2. Attach a failure inspection report with a product to be returned in the form, accepted by customer, with a description of the failure circumstances and symptoms.
3. Carefully package the product in the antistatic bag in which the product had been supplied. Failure to package in antistatic material will VOID all warranties. Then package the product in a safe container for shipping.
4. The customer pays for shipping the product to Fastwel or to an official Fastwel representative or dealer.

1 Introduction

1.1 Overview

The product described in this manual is CPC1600, a PC/104-Plus single board computer designed for mission critical embedded systems operating in harsh environments. All components including memory are soldered onboard, thus providing superior shock/vibration resistance.

The board is based on Intel® Pentium® M processor in the μFCBGA479M package operating at frequencies of up to 2.0 GHz, and a Processor Side Bus (PSB) running at 400 or 533 MHz. The Intel Pentium M processor core with integrated 64 KB L1 and up to 2048 KB L2 cache provides its unique performance to power consumption ratio.

The CPC1600 chipset comprising 82915GM GMCH and ICH6M provides a number of integrated modern communication and storage interfaces, thus eliminating the need for additional external controllers. The chipset also incorporates DDR2 memory interface. The board can bear up to 1 GB of PC4200 memory soldered onboard.

The board has wide range of interfaces for peripheral devices: six USB 2.0 and standard video interfaces, dual Gigabit Ethernet controller wired via PCI Express 4x bus. The chipset's built-in video controller incorporates a 2D/3D graphics accelerator with up to 64 MB memory shared with system for enhanced graphics performance with VGA CRT-display and LVDS TFT panel.

CPC1600 supports storage devices with IDE UltraATA33 and CompactFlash interfaces, up to two SerialATA channels. The board also has a 32 MB solid-state disk for embedded OS.

Compliant to PC/104-Plus standard, the board is equipped with 16-bit ISA and 32-bit PCI connectors.

The board is designed to support both conductive and convective (passive or active) heat sinking and is manufactured in two versions – for industrial temperature range (–40°C to +85°C) and for commercial temperature range (0°C to +70°C). Extra reliability of CPC1600 is provided by the hardware monitoring subsystem and built-in watchdog timer. This prevents accidental damage to the hardware under unfavourable thermal conditions.

CPC1600 is manufactured using high quality embedded industrial system components specially selected to ensure their long term availability.

The board is compatible with the Windows® 2000/XP/XP Embedded, QNX v.4.20, 6.0 and Linux® 2.4.20, 2.6.11 operating systems.

Some of the CPC1600's outstanding features are:

- Intel® Pentium® M processor family, up to 2.0 GHz
  Up to 2 MB L2 on-die cache running at CPU speed
- Celeron M LV 1.0 MHz (option)
- Chipset: 82915GM GMCH and ICH6M
- 400/533 MHz processor system bus
- Up to 1 GB of PC4200 DDR2 SDRAM soldered memory
- Integrated 3D high performance VGA controller
  - 64 MB memory shared with system
  - CRT-displays support with resolutions of up to 2048 x 1536 pixels at 16 bits and 75 Hz (*)
  - LVDS TFT panels support (*)
- Two Gigabit Ethernet interfaces via PCI-Express bus: 10Base-T, 100Base-TX, 1000Base-T (*)
- EIDE Ultra ATA33 interface
- Up to two SATA channels
- Onboard 32 MB solid-state disk for embedded OS
- Onboard CompactFlash Type I/II socket
- Eight programmable GPIO lines
- Up to six USB 2.0 ports (*)
- PCI bus: 32-bit / 33 MHz, 3.3 / 5 V
- ISA bus 16-bit
- Hardware Monitor (LM87)
- Watchdog timer
- Additional counters and timers integrated in the ICH
- Real-time clock with battery backup
- Phoenix® BIOS with backup copy
- +5 V power supply via two-pin onboard connector,
  possibility to supply +5 V via PCI and ISA buses
- Conductive or convective heat sinking; passive or active air cooling variants
- Commercial (0…+70°C) or industrial (-40…+85°C) versions

(*) – Available via additional cable adapters

1.2 CPC1600 Versions

The board is offered in flexible configuration. Options include different processors, the size of supplied system memory, and other options described in this section.

Customer can choose necessary configuration options using the following template:

1	–	2	–	3	–	4	–	5		6

1 Basic product name:

CPC1600

2 Intergral part of the product code (configuration version):

01	Basic configuration version

3 Processor:

C1.0	Celeron M 1.0 GHz, LV, 400 MHz FSB
P1.4	Pentium M 1.4 GHz, 400 MHz FSB

4 Soldered memory:

RAM512	512 MB soldered DDR2 SDRAM
RAM1024	1024 MB soldered DDR2 SDRAM

5 Operating temperature range:

I	Industrial range, -40…+85°C
C	Commercial range, 0…+70°C

6 Other options:

CompactFlash memory module:

\CF128	128 MB CompactFlash, industrial (CF128C - commercial)
\CF256	256 MB CompactFlash, industrial (CF256C - commercial)
\CF512	512 MB CompactFlash, industrial (CF512C - commercial)
\CF1024	1024 MB CompactFlash, industrial (CF1024C - commercial)
\CF2048	2048 MB CompactFlash, industrial (CF2048C - commercial)
\CF4096	4096 MB CompactFlash, industrial (CF4096C - commercial)

Coating:

\COATED	Protective coating

Operating System

\XPE	Windows XP Embedded
\QNX	QNX 4.20, 6.0
\LNX	Linux 2.4.20, 2.6.11

Example:

CPC1600 – 01 – P1.4–RAM512–C \CF512C \COATED \XPE

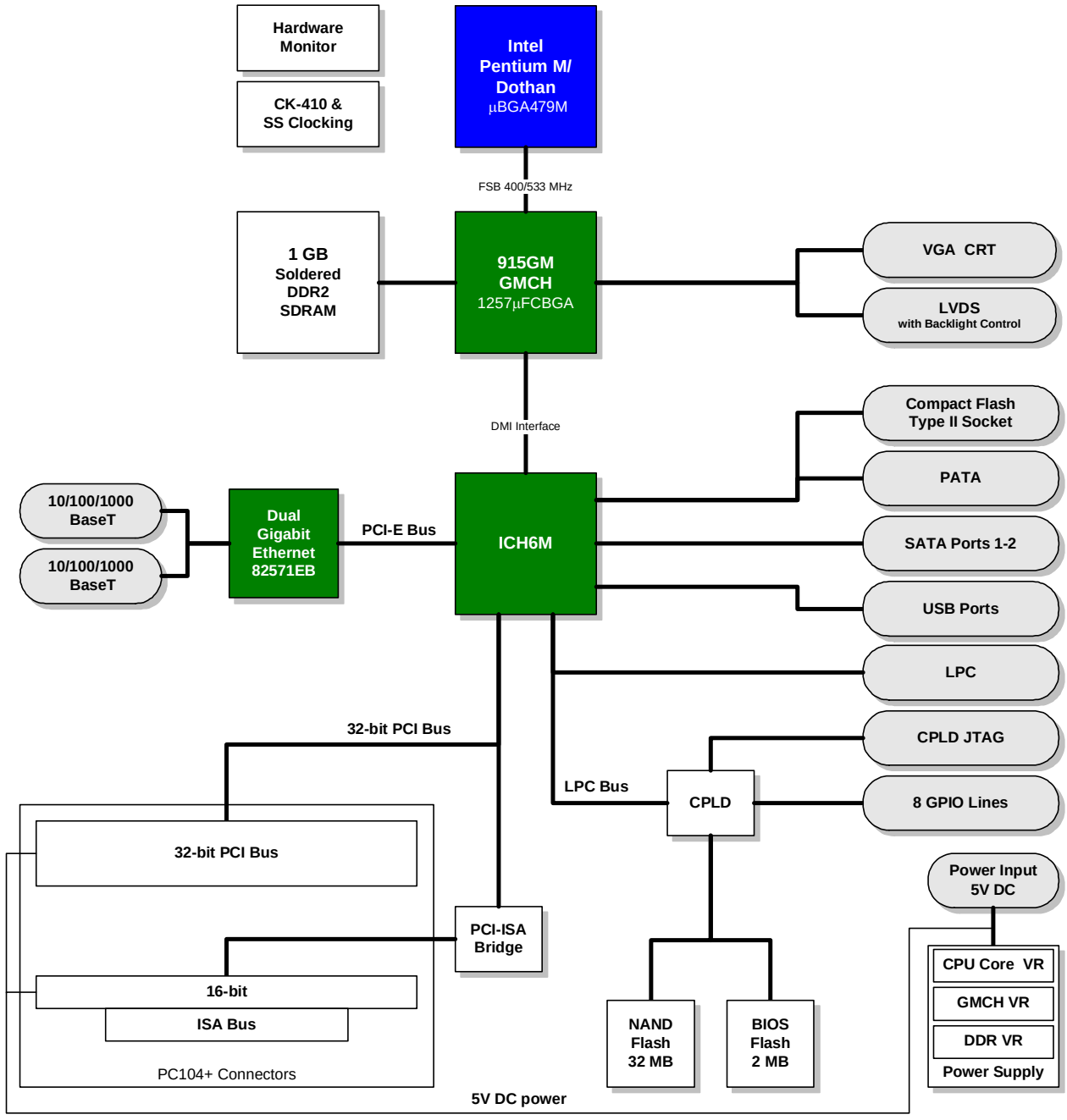
PC/104-Plus processor module, Intel® 82915GM, DDR2 SDRAM, SVGA, SATA, 2 Gigabit Ethernet
Pentium M 1.4 GHz, 400 MHz FSB
512 MB soldered DDR2 SDRAM
Commercial temperature range, 0…+70°C
512 MB CompactFlash card, commercial range
Protective coating
Windows XP Embedded preinstalled

1.3 CPC1600 Diagrams

The diagrams in this section give visual information about the CPC1600 board design, its appearance, connectors and components layout. The diagrams may not reflect insignificant differences between the CPC1600 versions and generations.

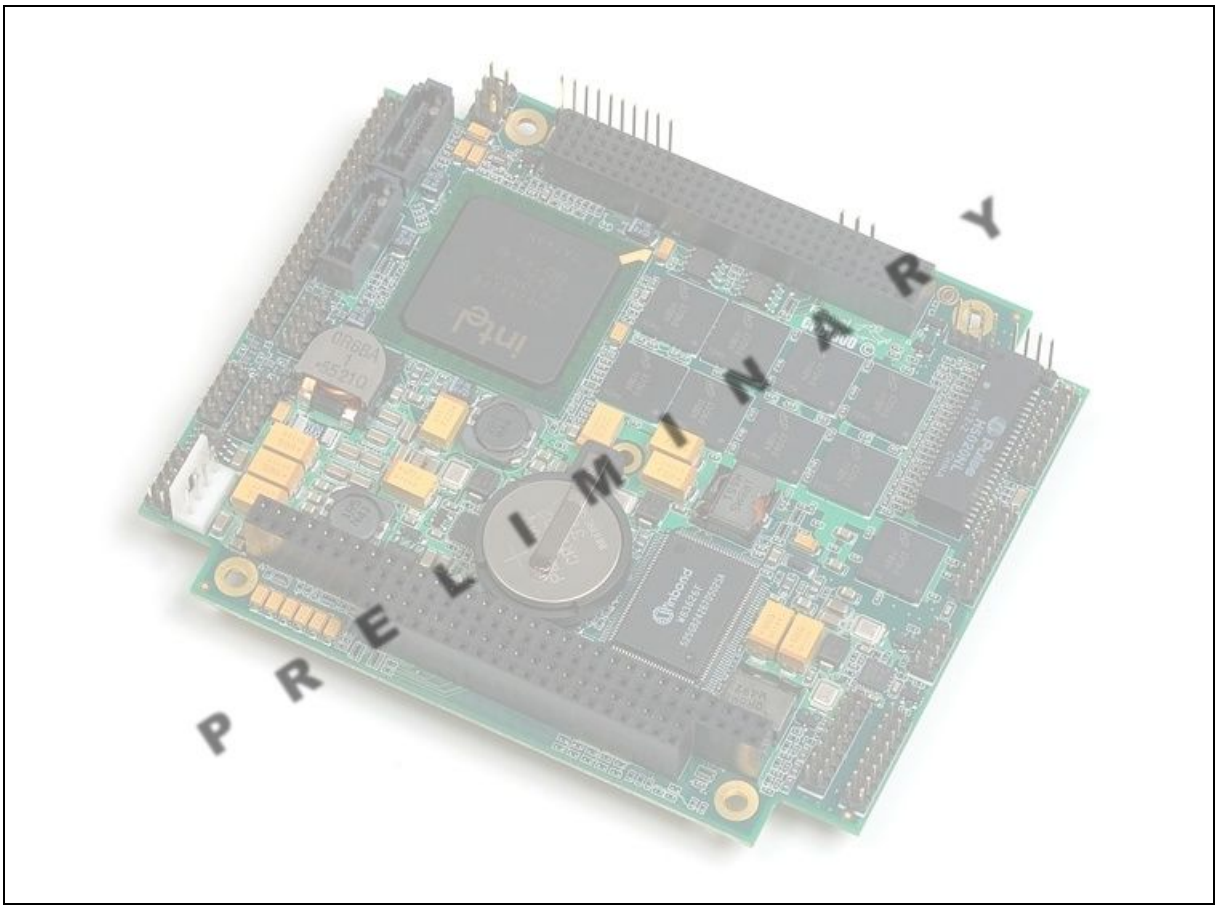
1.3.1 Block Diagram

Figure 1-1: CPC1600 Block Diagram



1.3.2 Board Appearance

Figure 1-2: CPC1600 Board Appearance

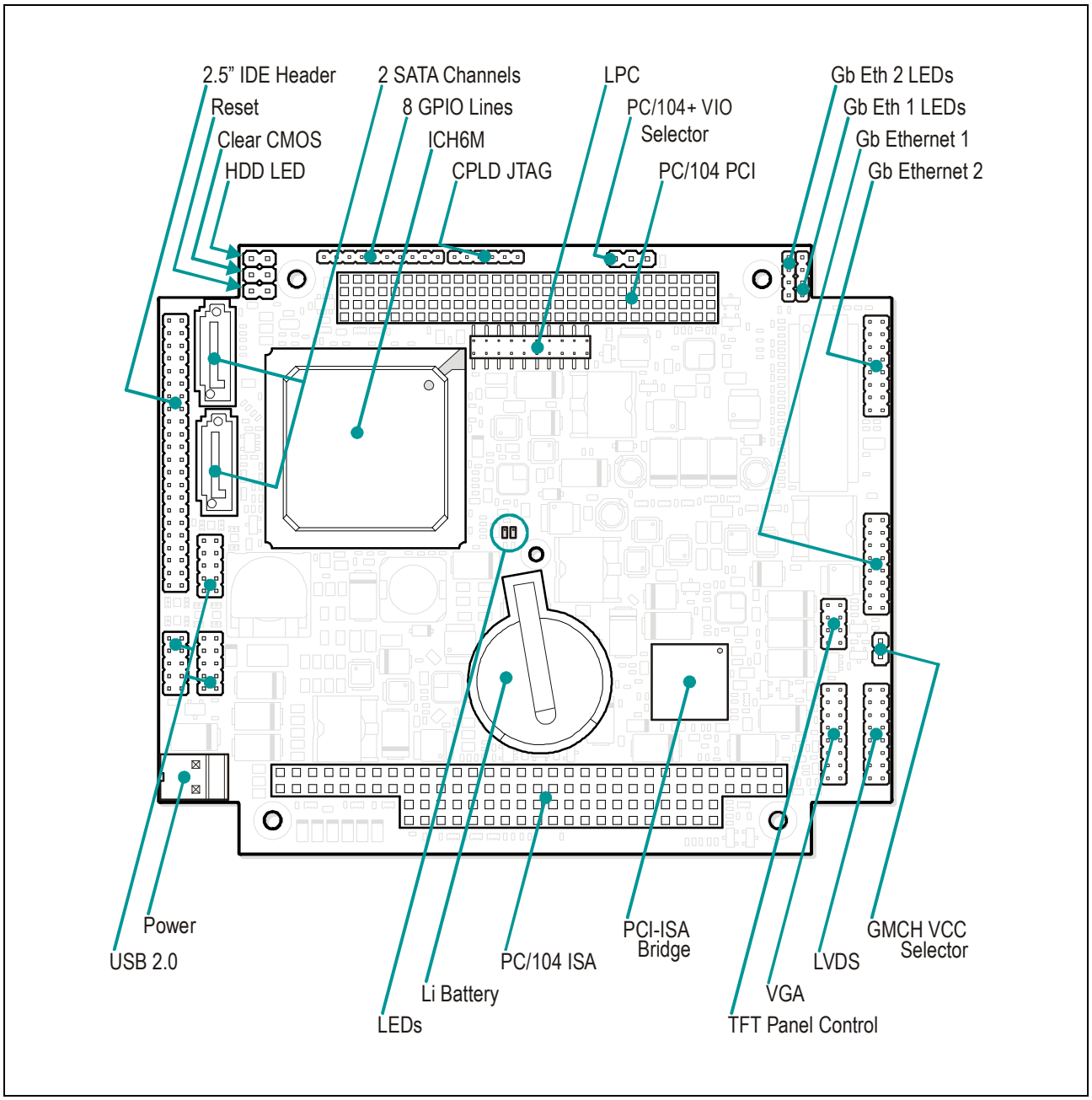


The appearance may vary for different versions of the board.
Heatsinks are not shown.

(TBA)

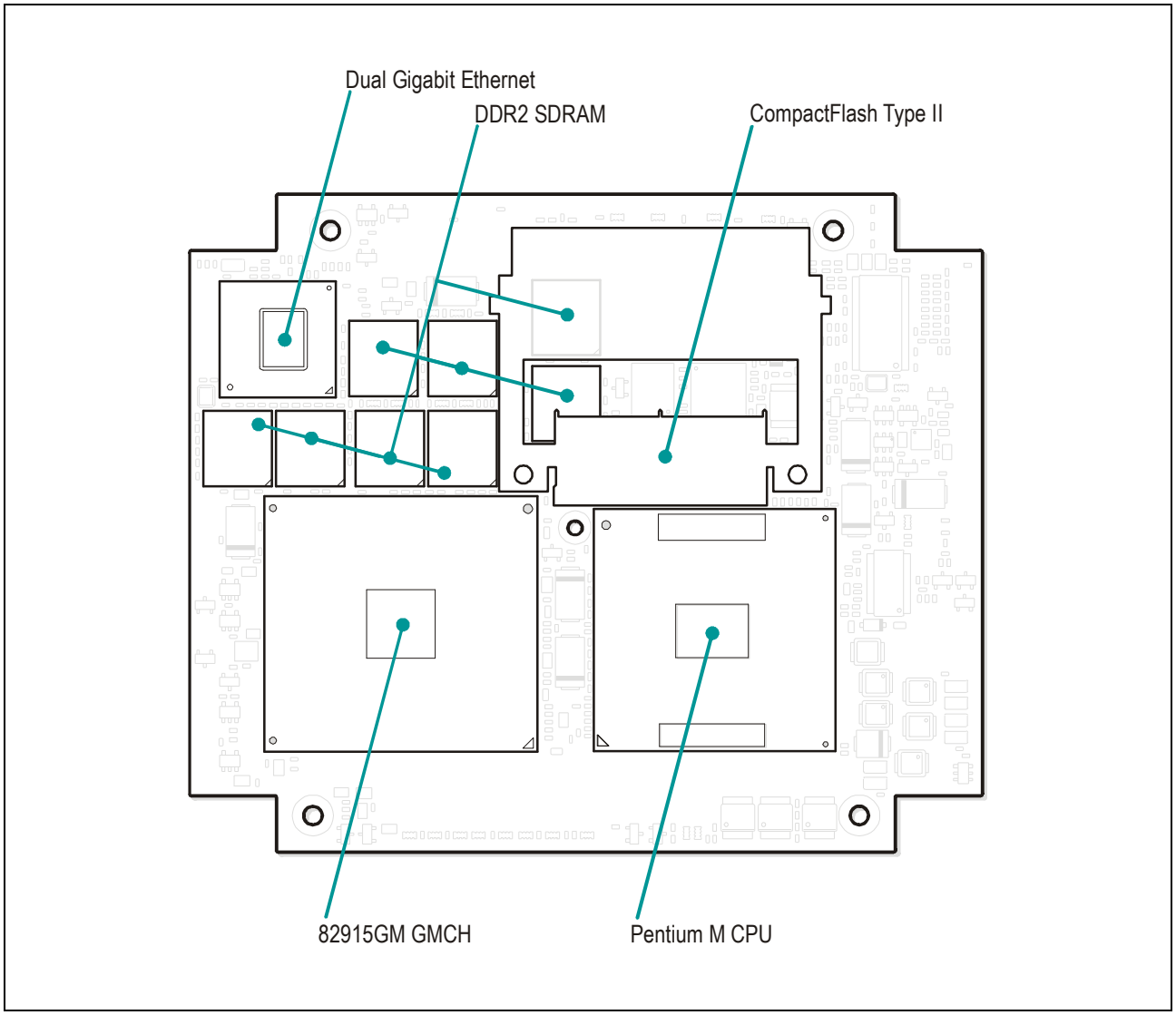
1.3.3 Board Layout

Figure 1-3: CPC1600 Top Side Layout



The layout may slightly differ for various versions of the board.

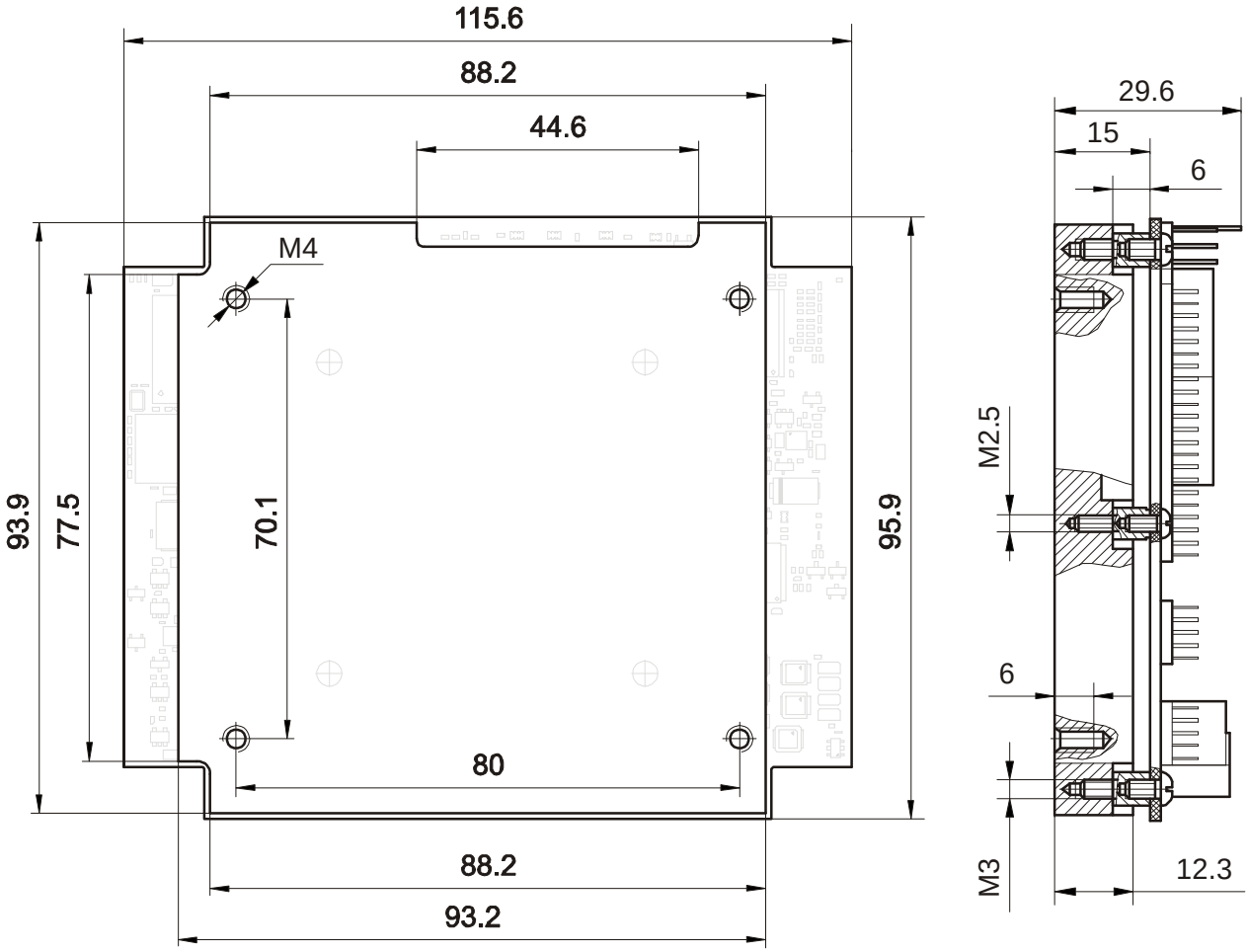
Figure 1-4: CPC1600 Bottom Side Layout



The layout may slightly differ for various versions of the board.

1.3.4 Dimensions Diagram

Figure 1-5: CPC1600 Mounting Dimensions Diagram



1.4 Technical Characteristics

1.4.1 Processor, Memory and Chipset

CPU

The CPC1600 supports the following Intel processors:

Pentium® M Processor 90 nm (Dothan)

- Up to 2.0 GHz
- Up to 2 MB L2 on-die cache
- 400/533 MHz PSB
- Supports SpeedStep® III for low power mode

Celeron® M 373 ULV Processor 90 nm

- 1.0 GHz
- 512 KB L2 on-die cache
- 400 MHz PSB

Memory

Main memory:

- Up to 1 GB of DDR2 SDRAM memory soldered onboard
- Memory frequency: 533 MHz (PC4200)

Flash memory:

- 2 MB flash memory for BIOS storage
- 32 MB NAND flash memory solid-state disk
- CompactFlash card in CF Type I/II socket

Chipset

Intel® 82915GM Graphics and Memory Controller Hub (GMCH)

- Intel® Pentium® M processor with 2 MB L2 cache support (533 MHz PSB)
- Intel® Pentium® M processor LV and ULV support (400 MHz PSB)
  - 32-bit host bus addressing
  - 12-deep in-order queue
  - Enhanced Intel SpeedStep® technology
- Intel® Celeron® M and Celeron® M ULV 90 nm processor support (400 MHz PSB)
  - 32-bit host bus addressing support
  - 12-deep in-order queue support
- 64-bit AGTL/AGTL+ based PSB interface at 400/533 MHz
- 64-bit System Memory interface, optimized for DDR or DDR2 SDRAM memory operating at 400 or 533 MHz
- DDR2 dual channel memory symmetric and asymmetric modes
- Integrated 2D/3D Graphics and H/W Motion Compensation Engines
- Integrated DAC, 400 MHz
- Intel® Graphics Media Accelerator 900
- Intel® Stable Image Technology

Intel® I/O Controller Hub 6M (ICH6M, 82801FBM)

- PCI-Express bus rev. 1.0
- PCI Bus rev. 2.3 interface at 33 MHz
- Integrated Serial ATA host controller
- Integrated IDE controller Ultra ATA33/66/100, BMIDE and PIO modes
- USB 2.0 host interface
- ACPI 2.0 compliant power management logic
- Enhanced DMA controller
- High precision event timers
- Interrupt controller
- System Management Bus
- Low Pin Count (LPC) interface
- Firmware Hub (FWH) interface support via LPC bus

1.4.2 Interfaces

PCI Bus Interface

Compliant with 2.3 Specification at 33 MHz

- System master operation
- Support for 32-bit addressing on PCI using DAC protocol
- Four available PCI REQ/GNT pairs
- 3.3/5.0 V compatible
- 120-pin PC/104-Plus connector

ISA Bus Interface

- 16-bit interface
- Available via PCI-ISA bridge
- 104-pin PC/104 connector
- Up to four devices without additional buffering

USB Interface

Up to six USB 2.0 ports supporting UHCI and EHCI:

- Up to six USB 2.0 channels via three 10-pin on-board connectors
- Require adapter cables

GPIO Lines

- 8 general purpose I/O lines
- 3.3V LVCMOS signaling
- Access via CPLD I/O port
- 10-pin connector on board

LAN Interface

Two 10/100/1000 Mb/s Gigabit Ethernet interfaces
based on Intel 82571EB Dual Ethernet PCI-E bus controller.

- Two 16-pin onboard connectors
- Automatic mode recognition
- Automatic cabling configuration recognition
- Cabling requirement: Category 5, UTP, four (two)-pair cabling
- Gigabit Ethernet LEDs via two separate 4-pin onboard connectors

Video Interfaces

- Built-in Intel 2D/3D high performance graphics accelerator Intel® Graphics Media Accelerator 900
- Hardware Motion Compensation Engine for software MPEG2 and MPEG4 decoding
- Integrated DAC, 400 MHz
- Intel® Stable Image Technology
- Video memory up to 64 MB shared with system

VGA CRT

- Resolutions of up to 2048 x 1536, 16 bit at 75 Hz refresh rate
- 16-pin connector onboard

LVDS TFT

- Dual/Single channel interface
- Resolutions of up to 1600 x 1200, 18 bpp
- Spread spectrum clocking 25-112 MHz single/dual channel
- 16-pin connector onboard

Keyboard and Mouse

- USB keyboard and mouse supported

Mass Storage

EIDE Ultra ATA33

- One channel is shared by CompactFlash interface and EIDE devices
- 44-pin onboard connector for 2.5” IDE drive

Serial ATA interface

- Up to two standard SATA onboard connectors
- Data transfer rates up to 150 MB/s

CompactFlash:

- CompactFlash on-board socket (true IDE mode) on bottom side, supports type I or type II CompactFlash cards
- DMA modes supported as per CompactFlash Specification v.4.1

1.4.3 Control and Monitoring

Thermal Management

The processor is protected from overheating by:

- Internal processor temperature control unit, which initiates CPU shut down
- Processor die temperature monitor
- Heat spreader or heatsink

Temperature Monitor

LM87 hardware monitor is used for supervision of the on-die CPU temperature and the board surface temperature

LEDs

System status:

- Onboard Power LED (green)
- Onboard Standby LED (red)
- IDE/SATA activity (onboard 2-pin header)
- Gigabit Ethernet LEDs – two 4-pin onboard connectors

Reset Input

- Onboard reset header

Power Supply

- 2-pin power connector
- Power can be supplied via ISA and PCI bus

1.4.4 General

Mechanical

PC/104-Plus form factor

Dimensions: 115.5 × 96 mm (see Figure 1-5 for details)

Board weight: 120 g (to be amended)

Shock/Vibration: 50G / 3G

Power Supply

8 A @ 5 V (to be amended)

See Chapter 6 for details on power supply requirements

Temperature Ranges

Operational: 0°C ... +70°C – commercial range
-40°C ... +85°C – industrial range

Storage: -55°C ... +95°C

Humidity

5% to 95% RH, non-condensing

Battery

3.0 V lithium battery for RTC in a battery holder. Use PANASONIC BR2032 or compatible

1.4.5 Software

Software BIOS

Flash memory based enhanced Phoenix® BIOS has the following features:

- BIOS boot support for USB keyboards
- Software enable/disable function for Ethernet ports configuration
- Plug&Play capability

Operating Systems

Supported operating systems:

- Microsoft® Windows® 2000, XP, XP Embedded
- Linux® 2.4.20, 2.6.11
- QNX® v.4.20, 6.0

1.5 Delivery Checklist

The CPC1600 supplied set includes:

1. CPC1600 SBC with installed heat conducting plate
2. Ribbed heatsink (*)
3. Cooling fan (*)
4. Set of adapter and power cables (*to be specified*)
5. CD-ROM with documentation and service software
6. Antistatic bag
7. Consumer carton box

(*) Ordered separately

Note:

Keep the antistatic bag and the original package at least until the warranty period is over. It can be used for future storage or warranty shipments.

2 Detailed Description

2.1 Processor, Memory and Chipset

2.1.1 Processor

The CPC1600 board is based on the Intel® Pentium® M processor (90 nm, Dothan) in μFCBGA479M package operating at frequencies of up to 2 GHz.

Intel® Pentium® M processor combines high performance and low power consumption. Its enhanced performance characteristics are provided by a newly designed processor core with an integrated 64 KB L1 (32 KB instruction cache and 32 KB write-back data cache) and 2048 KB L2 cache.

Intel® Pentium® M processor supports Intel SpeedStep® enhanced technology to control power consumption and processor die temperature by switching the processor core voltage and frequency between several modes without resetting the system.

Important performance features of the Intel Pentium M processor also include

- Intel® Architecture with Dynamic Execution
- Data Prefetch Logic
- L2 cache memory with Advanced Transfer Cache Architecture
- Streaming SIMD extensions 2 (SSE2)
- 400/533 MHz, source-synchronous FSB
- Support for MMX™ technology and Internet Streaming SIMD instructions

The Ultra Low Voltage (ULV) Pentium M and 90 nm Celeron M/ Celeron M ULV processors are optional.

2.1.2 System Memory

All system memory chips are soldered onboard. Total capacity of the installed DDR2 SDRAM memory is up to 1 GB. The installed memory is PC4200 compliant and supports PC SPD (Serial Presence Detect) Specification.

2.1.3 Chipset

The CPC1600 chipset consists of the following devices:

- 82915GM Graphics and Memory Controller Hub (GMCH) with Accelerated Hub Architecture (AHA) bus
- ICH6M I/O Controller Hub with AHA bus

The GMCH provides interface for the microprocessor, the memory bus and includes a high performance graphics accelerator. The ICH is a centralized controller for I/O peripherals of the board, such as the PCI, PCI-Express, USB 2.0, EIDE, SATA and AC97 interface.

North Bridge

The 915GM Graphics and Memory Controller Hub (GMCH) in the 1257µFCBGA package provides interfaces with the central processor and with the DDR2 SDRAM system memory. It also provides a DMI interface to the ICH.

The 915GM is optimized for the Intel® Pentium® M family of microprocessors. The chipset supports a PSB frequency of 400/533 MHz with AGTL+ signaling. For single processor systems the single ended AGTL termination is supported. It also supports 32-bit addressing for using up to 4 GB memory address space. The 915GM includes a system memory controller with a 64-bit interface. The chipset supports up to PC4200 dual or single channel DDR2 SDRAMs for use as system memory.

When running in internal graphics mode, high performance video capabilities of the 915GM are supported by a 2D/3D graphics accelerator and H/W Motion Compensation engines for software MPEG2 decoding. The internal graphics controller allows connection of a standard CRT display and a LVDS TFT panel.

Integrated graphic adapter supports internal core frequencies 133-200 MHz with 1.05V of core voltage and 133-333 MHz with 1.5V of core voltage. So, more frequency provides more power consumption (about 4 Watts additionally). Core voltage may choose by Core Voltage Selector.

South Bridge

The ICH6M is a multifunctional I/O Controller Hub that provides interfaces to the PCI-Express and PCI buses and to a number of PC interfaces, such as UltraDMA 100/66/33, USB 2.0 host interface, LPC interface, FWH interface, SATA, and an AC'97 digital audio. The ICH communicates with the host controller directly via a dedicated DMI interface.

I/O Controller Hub features are:

- PCI 2.3 interface with eight IRQ inputs
- PCI-Express Bus four 1x or one 4x
- Bus Master EIDE controller UltraDMA 100/66/33
- SATA interface, two channels
- USB controller supporting eight USB 2.0 ports
- DMI interface with 915GM
- LPC interface
- AC'97 2.1 interface or High Definition audio interface
- RTC controller
- Additional timer
- Power Management functions

2.2 Internal Peripherals

The following internal peripherals are available on the CPC1600 module:

2.2.1 Flash Memory

There are three flash devices available - one is used for the BIOS storage, one is a 32 MB NAND flash solid-state disk, and one is a CompactFlash card in the socket.

2.2.1.1 CompactFlash

CPC1600 has a standard Compact Flash type I/II socket, which can accept CompactFlash memory card for use as a disk drive connected to IDE channel. The CompactFlash socket is located on the bottom side of the board. Please, refer to a subsection "CompactFlash Socket" below in this Chapter for details on this connector and its pinout.

2.2.1.2 Solid-State Disk

A 32 MB onboard solid state disk may be used for operating system storage.

2.2.1.3 BIOS Flash

CPC1600 has 2 MB flash memory for BIOS storage.

2.2.2 Timers

CPC1600 is equipped with the following timers:

- **RTC – Real-Time Clock**

The ICH contains a MC146818A-compatible real-time clock. The RTC includes 256 bytes of battery-backed CMOS RAM. RTC features include timekeeping with alarm function and 100-year calendar, as well as programmable periodic interrupt. A coin-cell battery powers the real-time clock and CMOS memory.

- **Counter/Timer**

Three 8254-type counters/timers are available on the CPC1600.

- **Additional Timer**

The ICH includes an additional programmable timer, which prevents system hang-ups during start-ups. After the first time-out period is over, it generates the SMI# signal, which starts the software hang-up recovery subroutine. If the second timeout ends, the "Reset" signal is issued to recover the system from the hardware hang-up state.

2.2.3 Local SMBus Devices

The CPC1600 incorporates a System Management Bus to access several system monitoring and control devices via a two-wire I^2C™ bus interface. The following table presents functions and addresses of onboard SMBus devices.

Table 2-1: SMBus Devices

№	SMB Address	Device
1	0D2H	CY28411 System clock generator
2	0A0H	SPD EEPROM Module
4	9CH	LM87 Temperature Sensor

2.2.3.1 Temperatures Monitoring

The integrated LM87 temperature sensor monitors the processor die and board surface temperatures to make sure that the system is operating at a safe temperature. On request, LM87 can report the current processor and board temperatures to the software responsible for the module operation mode.

2.2.3.2 Serial EEPROM

SPD serial EEPROM includes all necessary parameters of memory chips. This nonvolatile memory is used by the system and is not available for user.

2.2.4 Battery

The CPC1600 utilizes a 3.0 V lithium battery for the RTC and CMOS memory backup. Use PANASONIC BR2032 or compatible.

2.3 Interfaces and Connectors

2.3.1 PC/104-Plus Connectors

CPC1600 is equipped with standard PC/104-Plus connectors. The PC/104 and PC/104-Plus connectors allow CPC1600 to interface with expansion modules such as A/D converters, digital I/O modules, etc. A maximum of four PC/104 or PC/104-Plus expansion modules may be stacked on the CPC1600 module to form a fully-integrated system.

PC/104 Interface

The PC/104 interface accepts an 8- or 16-bit PC/104 expansion modules. The PC/104 Bus uses a 104-pin 0.10” (2.54 mm) header located on the top of the board. This interface header will carry all of the appropriate 8 MHz ISA bus signals.

The processor module can accommodate maximum four PC/104 expansion modules without additional buffering.

The contact configuration of PC/104 header is shown in Figure 2-1. Tables 2-1 and 2-2 give the designation of this header contacts.

Figure 2-1: PC/104 Connector Contacts Layout

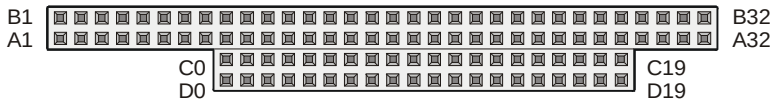


Table 2-2: PC/104 Connector (Rows A and B) Contacts Designation

Pin #	Signal	In/Out	Pin #	Signal	In/Out
A1	IOCHK#	–	B1	GND	Ground
A2	SD7	In/Out	B2	RESETDRV	Out
A3	SD6	In/Out	B3	+5V	Power
A4	SD5	In/Out	B4	IRQ9	In
A5	SD4	In/Out	B5	-5V	–
A6	SD3	In/Out	B6	DRQ2	In
A7	SD2	In/Out	B7	-12V	Power
A8	SD1	In/Out	B8	ENDXFR#	In
A9	SD0	In/Out	B9	+12V	Power
A10	IOCHRDY	In	B10	KEY	–
A11	AEN	Out	B11	SMEMW#	Out
A12	SA19	Out	B12	SMEMR#	Out
A13	SA18	Out	B13	IOW#	Out
A14	SA17	Out	B14	IOR#	Out
A15	SA16	Out	B15	DACK3#	Out
A16	SA15	Out	B16	DRQ3	In
A17	SA14	Out	B17	DACK1#	Out
A18	SA13	Out	B18	DRQ1	In
A19	SA12	Out	B19	REFRESH#	Out
A20	SA11	Out	B20	SYSCLK	Out
A21	SA10	Out	B21	IRQ7	In
A22	SA9	Out	B22	IRQ6	In
A23	SA8	Out	B23	IRQ5	In
A24	SA7	Out	B24	IRQ4	In
A25	SA6	Out	B25	IRQ3	In
A26	SA5	Out	B26	DACK2#	Out
A27	SA4	Out	B27	TC	Out
A28	SA3	Out	B28	BALE	Out
A29	SA2	Out	B29	+5V	Power
A30	SA1	Out	B30	OSC	Out
A31	SA0	Out	B31	GND	Ground
A32	GND	Ground	B32	GND	Ground

Table 2-3: PC/104 Connector (Rows C and D) Contacts Designation

Pin #	Signal	In/Out	Pin #	Signal	In/Out
C0	GND	Ground	D0	GND	Ground
C1	SBHE#	Out	D1	MEMCS16#	In
C2	LA23	Out	D2	IOCS16#	In
C3	LA22	Out	D3	IRQ10	In
C4	LA21	Out	D4	IRQ11	In
C5	LA20	Out	D5	IRQ12	In
C6	LA19	Out	D6	IRQ13	In
C7	LA18	Out	D7	IRQ14	In
C8	LA17	Out	D8	DACK0#	Out
C9	MEMR#	Out	D9	DRQ0	In
C10	MEMW#	Out	D10	DACK5#	Out
C11	SD8	In/Out	D11	DRQ5	In
C12	SD9	In/Out	D12	DACK6#	Out
C13	SD10	In/Out	D13	DRQ6	In
C14	SD11	In/Out	D14	DACK7#	Out
C15	SD12	In/Out	D15	DRQ7	In
C16	SD13	In/Out	D16	+5V	Power
C17	SD14	In/Out	D17	MASTER#	In
C18	SD15	In/Out	D18	GND	Ground
C19	KEY	–	D19	GND	Ground

Note:

In tables 2-1 and 2-2:

"–" - Not used;
"Power" - Power is supplied to the installed module

In/Out column shows the data transfer direction for a processor module being the bus master.

PC/104-Plus Interface

The PC/104-Plus uses a 120-pin (30x4) 2 mm header located on the top side of the board. This interface header accepts four stackable modules and carries all of the appropriate 32-bit 33 MHz PCI signals. Three PCI bus mastering devices are supported on the PC/104-Plus header.

Figure 2-2: PC/104-Plus Connector Contacts Layout

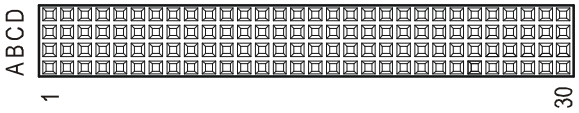
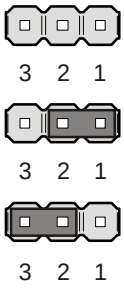


Table 2-4: PC/104-Plus Connector Contacts Designation

Pin	A	B	C	D
1	GND/5.0V_KEY2	Reserved	+5	AD00
2	VI/O	AD02	AD01	+5V
3	AD05	GND	AD04	AD03
4	C/BE0#	AD07	GND	AD06
5	GND	AD09	AD08	GND
6	AD11	VI/O	AD10	M66EN
7	AD14	AD13	GND	AD12
8	+3.3V	C/BE1#	AD15	+3.3V
9	SERR#	GND	Reserved	PAR
10	GND	PERR#	+3.3V	Reserved
11	STOP#	+3.3V	LOCK#	GND
12	+3.3V	TRDY#	GND	DEVSEL#
13	FRAME#	GND	IRDY#	+3.3V
14	GND	AD16	+3.3V	C/BE2#
15	AD18	+3.3V	AD17	GND
16	AD21	AD20	GND	AD19
17	+3.3V	AD23	AD22	+3.3V
18	IDSEL0	GND	IDSEL1	IDSEL2
19	AD24	C/BE3#	VI/O	IDSEL3
20	GND	AD26	AD25	GND
21	AD29	+5V	AD28	AD27
22	+5V	AD30	GND	AD31
23	REQ0#	GND	REQ1#	VI/O
24	GND	REQ2#	+5V	GNT0#
25	GNT1#	VI/O	GNT2#	GND
26	+5V	CLK0	GND	CLK1
27	CLK2	+5V	CLK3	GND
28	GND	INTD#	+5V	RST#
29	+12V	INTA#	INTB#	INTC#
30	-12V	Reserved	Reserved	GND/3.3V_KEY

The PC/104-Plus VIO selector is located on the top side of the module next to the PC/104-Plus header and allows to set the voltage supplied to PCI interface I/O buffers.

Figure 2-3: PC/104-Plus VIO Selector Positions



There is a standard 3-pin header for PC/104-Plus voltage selection. The explanation of its jumper positions is presented below.

Contacts 1-2 closed, +5 V power is supplied to PCI interface I/O buffers

Contacts 2-3 closed, +3.3 V

Note:

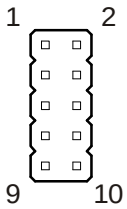
If you use PC/104 or PC/104-Plus power supply, I/O voltage could be set on the power supply module. In this case the jumper must be removed from VIO Selector (all contacts OPEN)

2.3.2 USB Interfaces

The CPC1600 supports up to six USB 2.0 ports. They are available via three 10-pin onboard connectors. All USB ports support high-speed, full-speed, and low-speed operation. Hi-speed USB 2.0 supports data transfer rate of up to 480 Mb/s.

One USB device may be connected to each port. To connect more than six USB devices use an external hub. The USB power supply is protected by a self-resettable 500 mA fuse.

Figure 2-4: Onboard USB Header



Six USB ports are available via three onboard IDC2-10 connectors with the following pinouts:

Table 2-5: Onboard USB Connectors Pinouts

Pin Number	Signal	Function	In/Out
1	VCC	VCC signal	–
3	UV0-	Differential USB-	–
5	UV0+	Differential USB+	–
7	GND	GND signal	–
9	NC		
2	VCC	VCC signal	–
4	UV0-	Differential USB-	–
6	UV0+	Differential USB+	–
8	GND	GND signal	–
10	GND	GND signal	

Note:

The maximum current for each USB port is limited to the amount of 0.5 A by the board's circuitry. All signal lines are EMI-filtered.

2.3.3 Graphics Controller

A highly integrated 2D/3D graphics accelerator is included in the 915GM GMCH. The internal graphics controller provides interfaces to a standard analog monitor and/or to a digital TFT panel with LVDS interface. VGA and LVDS headers are located on the top side of the module and require adapter cables for connection of the monitors.

Integrated 2D/3D Graphics features:

- Resolutions up to 1600×1200 at 100 Hz, 1920×1440 at 85 Hz and 2048×1536 at 75 Hz.
- 3D Setup and Render Engine
- 3D Graphics Rasterization Enhancements
- High Quality Texture Engine
- Full 2D hardware acceleration
- Intel® 915GM DVMT graphics core
- Intelligent Memory Management
- Integrated 400 MHz DAC

2.3.3.1 DVM Technology

The Intel® 915GM chipset supports the Dynamic Video Memory Technology (DVMT) v.3.0. This technology provides use of all available memory in the most efficient way for maximum graphics performance. DVMT dynamically responds to requests from applications allocating the required amount of video memory. The Intel® 915GM graphics driver is allowed to request up to 64 MB of system memory. When not needed by the graphics subsystem, the memory is freed up for other applications. Thus, memory usage is balanced for optimal graphics and system memory performance.

To support legacy VGA devices the internal video-controller needs at least 1 MB of system memory. Thus, the reported system memory size is always 1 MB less than available amount of physical memory.

2.3.3.2 Supported Resolutions

The integrated 400 MHz RAMDAC of the 915GM chipset allows direct connection of a progressive scan analog monitor with a resolution of up to 2048 × 1536 at 75 Hz. The supported resolution depends on the color depth and on the vertical scanning frequency, as illustrated in the table below.

Table 2-6: Supported Display Modes

Display Mode	Color Resolution vs. Vertical Frequency											
	8-bit Indexed				16- bit				32- bit			
	60	75	85	100	60	75	85	100	60	75	85	100
640 × 480	×	×	×	×	×	×	×	×	×	×	×	×
800 × 600	×	×	×	×	×	×	×	×	×	×	×	×
1024 × 768	×	×	×	×	×	×	×	×	×	×	×	×
1280 × 1024	×	×	×	×	×	×	×	×	×	×	×	×
1600 × 1200	×	×	×	×	×	×	×	×	×	×	×	×
1920 × 1440	×	×	×		×	×	×		×	×	×	
2048 × 1536	×	×			×	×			×	×		

2.3.3.3 GMCH Core Voltage Selector

The range of integrated graphic adapter core frequencies is 133-200 MHz at core voltage of 1.05 V and 133-333 MHz at core voltage of 1.5 V.

Figure 2-1: GMCH Core Voltage Selector

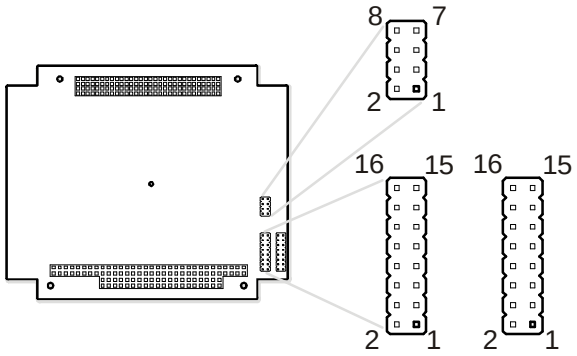
GMCH Core Voltage Selector allows to switch between core voltage values of 1.05 or 1.5 V. In open position the core voltage is set to 1.5 V; in closed position the core voltage is set to 1.05 V.

Note:

Increasing internal core frequency leads to CPC1600's power consumption growth by up to 4 Watts.

2.3.3.4 Video Interfaces and Connectors

Figure 2-2: SVGA, LVDS, and TFT Panel Control Connectors



One 2-row 16-pin connector on the top side is used to connect a CRT monitor to the CPC1600 module. The 75 ohm termination resistors for the red, green and blue video signals are installed on the CPC1600.

Another 16-pin connector is used to connect devices with LVDS interface to the CPC1600 module.

8-pin connector is used for TFT panel control.

For connection of external devices all three connectors require adapter cables, supplied with CPC1600. Pinouts of these connectors can be found in the following tables.

Table 2-7: SVGA Connector Pinout

Pin Number	Signal	Function	In/Out
1	Red	Red video signal output	Out
2	VGA_VCC	Power +5V 200 mA	Out
3	Green	Green video signal output	Out
5	Blue	Blue video signal output	Out
8	DDCdata	I^2C™ data	In/Out
10	Hsync	Horizontal sync.	TTL out
12	Vsync	Vertical sync.	TTL out
14	DDCclk	I^2C™ clock	Out
4, 9, 11, 13, 15	GND	Signal ground	–
6, 7, 16	NC	–	–

Table 2-8: LVDS Connector Pinout

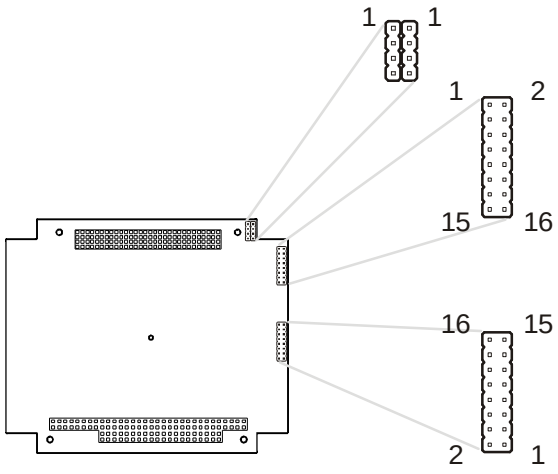
Pin Number	Signal	Pin Number	Signal
1	LVDS_A_DATA0+	9	LVDS_B_DATA0+
2	LVDS_A_DATA0-	10	LVDS_B_DATA0-
3	LVDS_A_DATA1+	11	LVDS_B_DATA1+
4	LVDS_A_DATA1-	12	LVDS_B_DATA1-
5	LVDS_A_DATA2+	13	LVDS_B_DATA2+
6	LVDS_A_DATA2-	14	LVDS_B_DATA2-
7	LVDS_A_CLK+	15	LVDS_B_CLK+
8	LVDS_A_CLK-	16	LVDS_B_CLK-

Table 2-9: TFT Panel Control Connector Pinout

Pin Number	Signal	Pin Number	Signal
1	LVDS_DDC_CLK	9	+5V
2	BACKLIGHT_CONTROL	10	VDD_ENABLE
3	LVDS_DDC_DATA	11	+3.3V
4	BACKLIGHT_ENABLE	12	GND

2.3.4 Ethernet Ports

Figure 2-2: Ethernet Connectors



Two 2-row 16-pin Ethernet headers are located on the top side of CPC1600. They are used by two Gigabit Ethernet interfaces.

Two 4-pin headers allow connection of Ethernet LEDs.

All these headers require cable adapters to connect network cables to standard RJ45 connectors.

CPC1600 is equipped with two 10Base-T/100Base-TX/1000Base-T Ethernet ports based on Intel® 82571EB Dual Gigabit Ethernet PCI-Express bus controller. Host interface is one 4x PCI Express lanes.

The Intel® 82571EB Gigabit Ethernet controller architecture combines high performance and low power consumption. The controller's features include independent transmit and receive queues to limit PCI-Express bus traffic, and PCI-Express interface providing efficient bus utilization by increased use of bursts.

The interfaces provide auto-detection and switching between 10Base-T, 100Base-TX, and 1000Base-T operation modes. Each of the two Ethernet channels may be disabled via the BIOS Setup or user software utility to free up system resources.

The following table presents pinouts of these connectors.

Table 2-10: Ethernet Connectors Pinouts

Pin Number	Signal	Pin Number	Signal
1	MDI0+	9	MDI2+
2	MDI0-	10	MDI2-
3	SHLD	11	SHLD
4	SHLD	12	SHLD
5	MDI1+	13	MDI3+
6	MDI1-	14	MDI3-
7	SHLD	15	SHLD
8	SHLD	16	SHLD

Table 2-11: Ethernet LEDs Connectors Pinouts

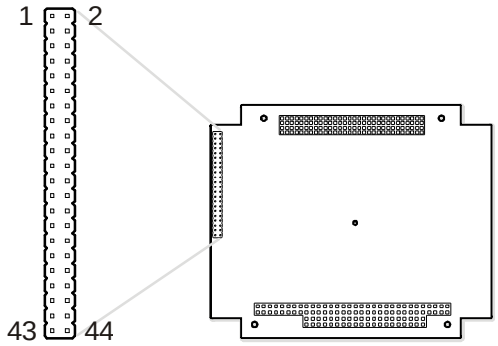
Pin Number	Signal	Pin Number	Signal
1	LINK_UP	3	LINK100
2	ACTIVITY	4	LINK1000

2.3.5 EIDE Interface

The EIDE interface supports several operation modes: PIO mode, 8237-type DMA mode, Ultra DMA, ATA-33. In PIO mode the central processor controls the data transfers. In all the DMA modes, the CPU is not engaged in data transfer. DMA modes are similar to each other, but differ in data transfer protocols details and DMA clock frequency, thus providing different transfer rates.

The current version of CPC1600 supports one EIDE channel to accommodate a maximum of two devices (with no CompactFlash card in slot).

Figure 2-3: HDD Connector



The EIDE channel is routed to standard 44-pin on-board connector and to the CompactFlash socket. It is possible to connect both master and slave devices to this EIDE channel. Maximum IDE cable length is 50 cm.

The pinout of the standard HDD connector is shown in the table below.

Table 2-12: Standard EIDE HDD Connector Pinout

Pin Number	Signal	Pin Number	Signal
1	RESET#	23	IOWR#
2	GND	24	GND
3	D7	25	IORD#
4	D8	26	GND
5	D6	27	IORDY
6	D9	28	CSEL#
7	D5	29	DACK#
8	D10	30	GND
9	D4	31	INTRQ
10	D11	32	IOCS16#
11	D3	33	A1
12	D12	34	PDIAG#
13	D2	35	A0
14	D13	36	A2
15	D1	37	CS0#
16	D14	38	CS1#
17	D0	39	DASP#
18	D15	40	GND
19	GND	41	+5V
20	NC	42	+5V
21	REQ	43	GND
22	GND	44	NC

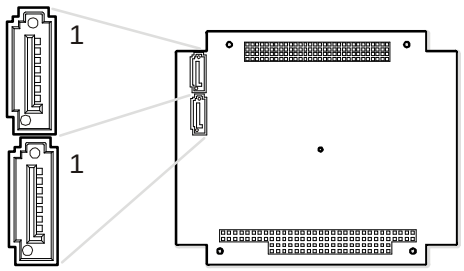
2.3.5.1 HDD LED Connector

Figure 2-4: HDD LED Connector

The onboard HDD LED connector is used to control an external HDD activity LED indicator. It is lit when any of IDE or SATA channel is active, the data are read or written from/to an external disk drive. Contact “1” should be connected to “+”.

2.3.6 Serial ATA Ports

Figure 2-5: Serial ATA Connectors



CPC1600 has two standard SerialATA connectors installed on board.

The connector's pinout is presented in the table below.

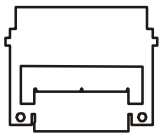
Table 2-13: SATA Connector Pinout

Contact Number	Function
1	GND
2	TXP
3	TXN
4	GND
5	RXN
6	RXP
7	GND

It is recommended to use a 45 cm cable for connection of SATA drives.

2.3.7 CompactFlash Socket

Figure 2-6: CompactFlash Socket



To enable usage of CF memory cards CPC1600 has a CompactFlash Type I/II socket located on the bottom side of the board. CF removable mass storage devices are fully compatible with 16-bit ATA/ATAPI-4 IDE interface with DMA support (CF Specification v.4.1).

CompactFlash socket is connected to the EIDE port as master at the current version of CPC1600.

Table 2-14: CompactFlash Socket Pinout

Pin Number	Signal	Function	In/Out
1	GND	Ground signal	–
2	D03	Data 3	In/Out
3	D04	Data 4	In/Out
4	D05	Data 5	In/Out
5	D06	Data 6	In/Out
6	D07	Data 7	In/Out
7	IDE_CS0	Chip select 0	Out
8	GND (A10)	–	–
9	GND (ATASEL)	–	–
10	GND (A09)	–	–
11	GND (A08)	–	–
12	GND (A07)	–	–
13	3.3 V	3.3 V power	–
14	GND (A06)	–	–
15	GND (A05)	–	–
16	GND (A04)	–	–
17	GND (A03)	–	–
18	A02	Address 2	Out
19	A01	Address 1	Out
20	A00	Address 0	Out
21	D00	Data 0	In/Out
22	D01	Data 1	In/Out
23	D02	Data 2	In/Out
24	NC (IOCS16)	–	–
25	NC (CD2)	–	–
26	NC (CD1)	–	–
27	D11	Data 11	In/Out
28	D12	Data 12	In/Out
29	D13	Data 13	In/Out
30	D14	Data 14	In/Out
31	D15	Data 15	In/Out
32	IDE_CS1	Chip select 1	Out
33	NC (VS1)	–	–
34	DIOR	I/O read	Out
35	DIOW	I/O write	Out
36	3.3 V (WE)	3.3 V power	–
37	INTRQ	Interrupt	In
38	3.3 V	3.3 V power	–
39	CSEL (GND pull-up)	Master/Slave	Out
40	NC (VS2)	–	–
41	Reset	Reset	Out
42	IORDY	I/O ready	In
43	REQ#	DMA request	Out
44	ACK#	DMA acknowledge	In
45	NC (ACTIVE)	–	–
46	NC (PDIAG)	–	–
47	D08	Data 08	In/Out
48	D09	Data 09	In/Out
49	D10	Data 10	In/Out
50	GND	–	–

2.3.8 GPIO Connector

Figure 2-7: GPIO Connector

10-pin GPIO connector is located on the top side of the board near the PC/104-Plus connector. It provides eight general purpose I/O lines that can be used for data exchange with such external devices as data acquisition modules.

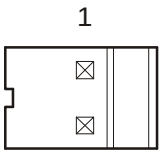
The pinout of this connector is shown in the table below.

Table 2-15: GPIO Connector Pinout

Pin Number	Signal	Pin Number	Signal
1	GND	6	+3.3V
2	GPIO 0	7	GPIO 4
3	GPIO 1	8	GPIO 5
4	GPIO 2	9	GPIO 6
5	GPIO 3	10	GPIO 7

2.3.9 Power Connector

Figure 2-8: External Power Supply Connector



The standard 2-pin connector for power supply is located on the top side of the board. As an option, power can also be supplied via PCI and ISA buses. The pinout of this connector is shown in the table below.

Table 2-16: Power Supply Connector Pinout

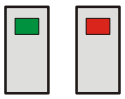
Pin Number	Function
1	+5V
2	GND

2.3.10 Other Connectors and System Status LEDs

A group of three 2-pin connectors next to PC/104-Plus connector consists of Remote reset switch connector, Clear CMOS jumper switch, and HDD LED connector (described above).

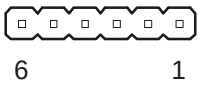
3-pin PC/104-Plus VIO selection switch is described above in a section devoted to PC/104-Plus connectors. The details on jumper switches use can be found in Chapter 4 of this Manual.

Figure 2-9: System Status LEDs



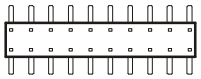
Two on-board system status LEDs are located on the top side of the module next to the central opening. Green power LED is lit when the module is in power up state. Red Standby LED indicates the module in standby mode.

Figure 2-10: CPLD JTAG Header



6-pin CPLD JTAG header located next to PC/104-Plus connector is used for initial CPLD programming at the factory.

Figure 2-11: LPC Header



20-pin LPC header is used for manufacturing purposes.

3 Installation

The CPC1600 is easy to install. However, it is necessary to follow the procedures and safety regulations below to install the module correctly without damage to the hardware, or harm to personnel.

The installation of the peripheral drivers is described in the accompanying information files. For details on installation of an operating system, please refer to the relevant software documentation.

3.1 Safety Regulations

The following safety regulations must be observed when installing or operating the CPC1600. Fastwel assumes no responsibility for any damage resulting from infringement of these rules.

Warning!

When handling or operating the module, special attention should be paid to the heatsink, because it can get very hot during operation. Do not touch the heatsink when installing or removing the module.

Moreover, the module should not be placed on any surface or in any kind of package until the module and its heatsink have cooled down to ambient temperature.

Caution!

If your module does not allow hotswapping, switch off the system power before installing the module in a free slot. Disregarding this requirement could be harmful for your life or health and can damage the module or entire system.

ESD Sensitive Equipment!

This product comprises electrostatically sensitive components. Please follow the ESD safety instructions to ensure module's operability and reliability:

- Use grounding equipment, if working at an anti-static workbench. Otherwise, discharge yourself and the tools in use before touching the sensitive equipment.
- Try to avoid touching contacts, leads and components.

Extra caution should be taken in cold and dry weather.

3.2 System Design Variants

In case of placing most heat emitting components, namely the processor and the north bridge chips, on the top side, the heat sinking system hight is limited by PC/104 expansion cards to be installed on the processor module. CPC1600 has these components placed on the bottom side of the module in order to make heat sinking easier. Moreover, this provides additional system design possibilities.

CPC1600 is supplied with a heat-conducting plate that is installed on the bottom (processor) side of the board. In this configuration it is possible to provide conduction heat sinking by mounting the unit directly on system cabinet or chassis, therefore turning the cabinet into large heatsink. Heat is drawn from the CPU and GMCH chips via the heat conducting plate and transferred to the PC/104 cabinet. This solution provides lower overall heat transmission resistance compared to systems where heat pipes are used for heat transfer.

Optionally, a ribbed heatsink and a cooling fan are supplied with CPC1600. The heatsink is installed on the heat-conducting plate using four M4 screws and thermal compound.

This configuration is used in a system case, where centralized forced air cooling is available.

An optional cooling fan can be installed on the ribbed heatsink to further intensify heat dissipation.

Power is supplied to the fan from the system power supply unit.

3.3 Installation of the Board and Expansion Modules

To install CPC1600, follow the instructions below.

1. Keep to the safety regulations of the Section 3.1 when performing the following operations.

Warning!

Failure to accomplish the following instruction may damage the module or result in incorrect system operation.

2. Ensure that the module configuration corresponds to the application requirements before installing. For information regarding the configuration of the CPC1600, refer to Chapter 4. For the installation of CPC1600 specific peripheral devices, expansion modules, and I/O devices refer to the appropriate sections in Chapter 3.
3. To install the CPC1600:
    1. Make sure that no power is connected to the system.
    2. Depending on the application, system configuration, and thermal requirements CPC1600 can be installed in different ways:
        a. For CPC1600 with only heatspreader mounted on board:
        Mount the module on a plane surface of the system case or chassis using four M4 srews. To reduce heat transfer resistance use thermal compound. Please, refer to Figure 1-5 for mounting openings coordinates.
        b. For CPC1600 with an optional ribbed heatsink (with or without cooling fan):
        Mount the heatsink on the heat spreader using four M4 srews and thermal compound. Mount the module on a surface using stud spacers replacing four corner heat spreader fixing screws. Provide conditions for sufficient cooling air flow. Mount the cooling fan on the ribbed heatsink using four screws, if required. The fan air flow should be directed to the heatsink. Connect the fan power cable to the system power supply unit.
    3. Connect the required external interfacing cables to the module's connectors and make sure that the module and all connected cables are properly fixed.

The CPC1600 is now ready for operation. Please, refer to appropriate software, application, and system manuals to get further instructions.

3.4 Removal Procedure

To remove the module from the system case do the following:

1. When performing the next actions, keep to safety regulations of the Section 3.1. Pay special attention to the temperature of the heatsink!
2. Ensure that the system power is switched off before proceeding.
3. Disconnect all cables that may be connected to the module.
4. Unscrew the retaining screws. Do not touch the heatsink, since it can get very hot during operation.
6. Dispose of the module at your discretion. The module should not be placed on any surface or in any form of package until the board and the heatsink have cooled down to room temperature.

3.5 Peripheral Devices Installation

Many peripheral devices can be connected to the CPC1600. Their installation procedures differ significantly. Therefore, the following sections provide mainly general guidelines regarding installation of peripheral devices.

The details on external devices connection can be found in documentation supplied with these devices.

3.5.1 USB Devices Installation

The CPC1600 can accept Plug&Play connection of USB 2.0 computer peripheral devices (printers, keyboards, mice, etc.) All USB devices may be connected or disconnected while the host power is on.

3.5.2 CompactFlash Cards Installation

CompactFlash socket of CPC1600 supports only 3.3 V CompactFlash ATA type I/II cards.

Note:

Connection of the CompactFlash cards while the power is on may damage your system.

Carefully slide in the correctly oriented card and gently press to engage the contacts completely.

Note:

It is recommended to use CompactFlash-cards, which has been initialized and formatted in this module.
By default, CPC1600 utilizes LBA mode. Utilization of CompactFlash cards, which has been initialized and formatted in another mode, may lead to errors in operation of the module.

3.5.3 Battery Replacement

The lithium battery must be replaced with Panasonic BR2032 or a battery with similar characteristics.

The expected life of a 190 mAh battery (Panasonic BR2032) is about 5 years. However, this typical value may vary because battery life depends on the operating temperature and the shutdown time of the system in which the battery is installed.

Note...

It is recommended to replace the battery after approximately 4 years to be sure it is operational.

Important:

Replacing the battery, make sure the polarity is correct ("+" up).

Dispose of used batteries according to the local regulations.

3.5.4 PC/104 and PC/104-Plus Expansion Modules Installation

The PC/104 and PC/104-Plus connectors allow you to install interface expansion modules. They can be stacked to form a highly integrated control system. CPC1600 is capable to communicate with up to four PC/104 or PC/104-Plus expansion modules.

Warning!

When installing any PC/104 or PC/104-Plus module, avoid excessively flexing the CPC1600 board. Mate pins correctly and use the required mounting hardware.

Note...

Before installing and operating the PC/104-Plus expansion modules it is necessary to set the voltage supplied to PCI interface I/O buffers using the PC/104-Plus VIO selector. See details in Section 4.2.

PC/104 and PC/104-Plus Mounting Fasteners(*)

1. Brass hex standoff spacer, PCHSN-15 – 8 items
2. Plain washer 3, DIN 125Z – 4 items
3. Toothed washer M3, DIN 6798A – 4 items
4. Nut M3, DIN 934Z – 4 items
5. Screw M3x8, DIN7985 – 4 items

(*) Proposed set. The items are not included in delivery checklist.

4 Configuration

4.1 Clear CMOS Jumper Description

If the system does not boot (due to, for example, the wrong BIOS configuration or incorrect password) the settings stored in CMOS may be cleared using jumper “Clear CMOS”.

Procedure for clearing CMOS settings:

1. Switch off the system power
2. Set the “Clear CMOS” jumper into the closed position
3. Wait for at least 10 seconds. CMOS setting are reset to factory defaults
4. Set the “Clear CMOS” jumper back to the open position
5. Switch the power on
6. Configure the system using the BIOS Setup program

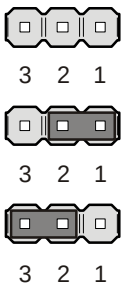
4.2 PC/104-Plus VIO Selection

The PC/104-Plus VIO selector is located on the top side of the module next to the PC/104-Plus header and allows to set the voltage supplied to PCI interface I/O buffers.

Warning!

All actions should be performed when the power is disconnected.

Figure 4-1: PC/104-Plus VIO Selector Positions



There is a standard 3-pin header for PC/104-Plus voltage selection. The explanation of its jumper positions is presented below.

Contacts 1-2 closed, +5 V power is supplied to PCI interface I/O buffers

Contacts 2-3 closed, +3.3 V

Note:

If you use PC/104 or PC/104-Plus power supply, I/O voltage could be set on the power supply module. In this case the jumper must be removed from VIO Selector (all contacts OPEN)

4.3 GMCH Core Voltage Selection

GMCH VCC selector is a 2-pin jumper switch, which allows to set the North Bridge core voltage. Default position is “closed”, in this case the voltage is set to 1.05 V. “Open” position provides 1.5 V power to GMCH.

Figure 4-2: GMCH Core Voltage Selector

1

GMCH Core Voltage Selector allows to switch between core voltage values of 1.05 or 1.5 V. In open position the core voltage is set to 1.5 V; in closed position the core voltage is set to 1.05 V.

Warning!

All actions should be performed when the power is disconnected.

4.4 Interrupts Handling

Interrupt handling of the CPC1600 module corresponds to the standard AT IRQ mapping (8259 IRQ controller integrated in the chipset). The functions of the interrupts described below are the default ones, but can be modified via the BIOS Setup.

Table 4-1: Interrupt Settings

IRQ	Priority	Standard Function
IRQ0	1	System Timer
IRQ1	2	Keyboard Controller
IRQ2	–	Second IRQ controller input (IRQ8-IRQ15)
IRQ3	11	COM2
IRQ4	12	COM1
IRQ5	13	Reserved
IRQ6	14	Floppy Disk Controller
IRQ7	15	LPT
IRQ8	3	System RTC
IRQ9	4	PCI or ACPI
IRQ10	5	PCI or Ethernet ports
IRQ11	6	PCI
IRQ12	7	PCI or PS/2 mouse
IRQ13	8	Coprocessor error
IRQ14	9	Primary IDE channel
IRQ15	10	Secondary IDE channel
NMI	–	Reserved

4.4.1 On-board PCI Interrupts

The ICH handles up to 8 PCI interrupt inputs. The table below describes the connected to these PIRQs PCI devices and their functions.

Table 4-2: PCI Interrupt Routing

ICH IRQ Input	PCI Device	Internal ICH Function
PIRQA	PCI IRQA or MINI PCI Socket	USB 1.0 controller #1
PIRQB	PCI IRQB or MINI PCI Socket	AC97 + MODEM + SMBUS
PIRQC	PCI IRQC	Storage (IDE/SATA) native mode
PIRQD	PCI IRQD	USB 1.0 controller #2
PIRQE	Free	Free
PIRQF	Free	Free
PIRQG	Free	Free
PIRQH	Security	USB 2.0 controller

The details can be found in the ICH technical documentation.

4.5 Memory Maps

The CPC1600 module employs the standard AT ISA memory mapping. The details of memory mapping are presented in the following subsections.

4.5.1 First Megabyte Memory Map

The following table shows the memory map for the first megabyte:

Table 4-3: First Megabyte Memory Map

Memory Address Range	Size	Function
0xE0000 – 0xFFFFF	128 k	BIOS implemented in FWH Reset vector 0xFFFF0
0xD0000 – 0xDFFFF	64 k	Free
0xCC000 – 0xCFFFF	16 k	Free
0xC0000 – 0xCC800	48 k	VGA card BIOS
0xA0000 – 0xBFFFF	128 k	Normally used as video RAM according to: CGA: 0xB8000-0xBFFFF Monochrome: 0xB0000-0xB7FFF EGA/VGA: 0xA0000-0xAFFFF
0x00000 – 0x9FFFF	640 k	DOS memory space

4.5.2 I/O Addresses

The following table presents the I/O memory mapping:

Table 4-4: I/O Address Map

I/O Address	Read Target	Write Target	Internal Unit
00h–08h	DMA Controller	DMA Controller	DMA
09h–0Eh	RESERVED	DMA Controller	DMA
0Fh	DMA Controller	DMA Controller	DMA
10h–18h	DMA Controller	DMA Controller	DMA
19h–1Eh	RESERVED	DMA Controller	DMA
1Fh	DMA Controller	DMA Controller	DMA
20h–21h	Interrupt Controller	Interrupt Controller	Interrupt
24h–25h	Interrupt Controller	Interrupt Controller	Interrupt
28h–29h	Interrupt Controller	Interrupt Controller	Interrupt
2Ch–2Dh	Interrupt Controller	Interrupt Controller	Interrupt
2E–2F	LPC SIO	LPC SIO	Forwarded to LPC
30h–31h	Interrupt Controller	Interrupt Controller	Interrupt
34h–35h	Interrupt Controller	Interrupt Controller	Interrupt
38h–39h	Interrupt Controller	Interrupt Controller	Interrupt
3Ch–3Dh	Interrupt Controller	Interrupt Controller	Interrupt
40h–42h	Timer/Counter	Timer/Counter	PIT (8254)
43h	RESERVED	Timer/Counter	PIT
4E–4F	LPC SIO	LPC SIO	Forwarded to LPC
50h–52h	Timer/Counter	Timer/Counter	PIT
53h	RESERVED	Timer/Counter	PIT
60h	Microcontroller	Microcontroller	Forwarded to LPC
61h	NMI Controller	NMI Controller	Processor I/F
62h	Microcontroller	Microcontroller	Forwarded to LPC
64h	Microcontroller	Microcontroller	Forwarded to LPC
66h	Microcontroller	Microcontroller	Forwarded to LPC
70h	RESERVED	NMI and RTC Controller	RTC
71h	RTC Controller	RTC Controller	RTC
72h	RTC Controller	NMI and RTC Controller	RTC
73h	RTC Controller	RTC Controller	RTC
74h	RTC Controller	NMI and RTC Controller	RTC
75h	RTC Controller	RTC Controller	RTC
76h	RTC Controller	NMI and RTC Controller	RTC
77h	RTC Controller	RTC Controller	RTC
80h	DMA Controller, or LPC, or PCI	DMA Controller and LPC or PCI	DMA
81h–83h	DMA Controller	DMA Controller	DMA
84h–86h	DMA Controller	DMA Controller and LPC or PCI	DMA
87h	DMA Controller	DMA Controller	DMA
88h	DMA Controller	DMA Controller and LPC or PCI	DMA
89h–8Bh	DMA Controller	DMA Controller	DMA
8Ch–8Eh	DMA Controller	DMA Controller and LPC or PCI	DMA
08Fh	DMA Controller	DMA Controller	DMA
90h–91h	DMA Controller	DMA Controller	DMA
92h	Reset Generator	Reset Generator	Processor I/F
93h–9Fh	DMA Controller	DMA Controller	DMA
A0h–A1h	Interrupt Controller	Interrupt Controller	Interrupt
A4h–A5h	Interrupt Controller	Interrupt Controller	Interrupt
A8h–A9h	Interrupt Controller	Interrupt Controller	Interrupt
ACh–ADh	Interrupt Controller	Interrupt Controller	Interrupt
B0h–B1h	Interrupt Controller	Interrupt Controller	Interrupt

I/O Address	Read Target	Write Target	Internal Unit
B2h–B3h	Power Management	Power Management	Power Management
B4h–B5h	Interrupt Controller	Interrupt Controller	Interrupt
B8h–B9h	Interrupt Controller	Interrupt Controller	Interrupt
BCh–BDh	Interrupt Controller	Interrupt Controller	Interrupt
C0h–D1h	DMA Controller	DMA Controller	DMA
D2h–DDh	RESERVED	DMA Controller	DMA
DEh–DFh	DMA Controller	DMA Controller	DMA
F0h	PCI and Master Abort1	FERR#/IGNNE# / Interrupt Controller	Processor I/F
170h–177h	IDE Controller, SATA Controller, or PCI	IDE Controller, SATA Controller, or PCI	Forwarded to IDE or SATA
1F0h–1F7h	IDE Controller, SATA Controller, or PCI 2	IDE Controller, SATA Controller, or PCI	Forwarded to IDE or SATA
376h	IDE Controller, SATA Controller, or PCI	IDE Controller, SATA Controller, or PCI	Forwarded to IDE or SATA
3F6h	IDE Controller, SATA Controller, or PCI 2	IDE Controller, SATA Controller, or PCI	Forwarded IDE or SATA
4D0h–4D1h	Interrupt Controller	Interrupt Controller	Interrupt
CF9h	Reset Generator	Reset Generator	Processor I/F

Notes:
1. A read to this address will subtractively go to PCI, where it will master abort.
2. Only if IDE I/O space is enabled (D31:F1:40 bit 15) and the IDE controller is in legacy mode. Otherwise, the target is PCI.

5 Phoenix® BIOS Setup

The Phoenix® BIOS in your SBC is an adapted version of a standard BIOS for IBM PC AT-compatible personal computers equipped with Intel®x86 and compatible processors. The BIOS provides low-level support for the central processing, memory, and I/O system units.

With the help of BIOS Setup program, you can modify the BIOS configuration parameters and control the special features of your module. The Setup program is started by pressing the F2 key and offers a convenient menu interface to modify basic system configuration settings and switching between the subsystems operation modes. These settings are stored in a dedicated battery-backed memory, CMOS RAM, which keeps the information when the power is switched off.

5.1 Boot Details

5.1.1 Booting without a Monitor, Keyboard or Mouse

To boot without a monitor, keyboard or mouse set the item "POST Errors" to "Disabled" at the page "Main" in PhoenixBIOS Setup program. This setting is a default one.

5.1.2 Booting from USB

To boot from a device connected to USB:

- Connect the device to boot from to a USB port. The appropriate USB controller should be enabled;
- Enter the PhoenixBIOS Setup program;
- Find this USB device in Boot Priority list at the "Boot" page and use «+» or «–» buttons to move it up or down in order to change its boot priority.
  In case the device is not in the Boot Priority list, find it in Excluded from Boot Order list, press “x” to move it to the Boot Priority list and set the boot order with «+» or «–» buttons;
- Save changes and reboot the module.

To get the on-line help about the details of BIOS Setup program operation, please apply to the screen tips and the integrated help system.

6 Thermal and Power Issues

6.1 Temperature Control

Intensive operation of Intel Pentium M processor in harsh environment requires a special technology to keep the processor's die temperature within allowed limits. The following sections provide system integrators with the information, which will help to meet thermal requirements when developing systems based on CPC1600.

6.1.1 Passive Regulation

The thermal management concept of CPC1600 module includes four separate but correlated functions. Their main purpose is to protect the processor from overheating and reduce its power consumption. Dedicated thermal control subsystem allows the processor to operate within safe temperature range without the need for special software or interrupt handling.

The four thermal protection functions provided by the processor are:

1. **Thermal Throttling**: The Pentium M internal thermal monitor controls the temperature of the processor. The internal temperature sensor is located near the hottest area of the processor die. Each processor is individually adjusted at the factory to compensate the potential manufacturing variations of its characteristics. To reduce the processor power dissipation the internal thermal monitor switches the processor core clock on and off with a duty cycle factor of 50%.
2. The Intel® Pentium® M processor supports the Intel **SpeedStep**® enhanced technology. It allows to switch the processor core voltage and frequency between several modes from High Frequency Mode to Low Frequency Mode without resetting the system. For example, the processor operating at 1.6 GHz and 1.484 V (HFM) can be switched down to 600 MHz and 0.956 V (LFM), thus reducing the processor power consumption in approx. 4 times.
3. **Thermtrip** function is always on to protect the processor in any event. In case of a serious cooling subsystem failure, the processor will automatically shut down when the die temperature has reached approximately 125°C. Once Thermtrip is activated, the system does not return to the normal operation mode automatically, it is necessary to reset the BIOS settings and to cold restart the system. The BIOS settings can be reset by lifting the contact plate of the battery holder for a period of more than 5 seconds.
4. **External thermal monitor** (LM87) gathers information about the processor and board surface temperatures from two sensors. This information may then be requested by a program to undertake the appropriate actions.

Recommendations

Generally, there is no need to enable the Thermal Management functions if the module is operated in an optimally designed environment with sufficient air flow. However, to guarantee a stable system in unsteady environment, both the internal and the external thermal monitors should be enabled. These two monitors protect the processor and the whole system against overheating.

Note:

Thermal Management functions should be disabled when performing Benchmarks and performance tests, otherwise the results will be incorrect due to the power reduction processes influence.

6.1.2 Active Regulation

To provide controlled active heat dissipation CPC1600 is equipped with standard heatsinks. Together with a system chassis with adjustable forced airflow capability, this provides a basis for reliable and steady operation. Forced airflow of sufficient volume is vital for high performance processors operating in high temperature environments.

When developing applications using the CPC1600, the system integrator must take into account the overall system thermal requirements. System chassis must satisfy these requirements. When performing thermal calculations for certain application, the developer must consider the contribution of peripherals to be used with the CPC1600 to the total heat emission. These devices must also be capable to operate at the temperatures within the system operating range, especially those, which are attached directly to the CPC1600 processor module.

Warning!!!

Since Fastwel does not assume responsibility for any damage to the CPC1600 module or other system parts resulting from overheating of the central processor, it is important to ensure that the CPC1600 operational environment parameters conform to the thermal requirements described in this Manual.

6.2 System Power

The Intel Pentium M processor family requires special characteristics of the power supply unit and the baseboard.

The CPC1600 module itself has been designed to provide best possible power supply for each system unit. However, in order to guarantee reliable and faultless operation the following requirements must be taken into account. Absolute maximum input voltage presented in the table below must not be exceeded to guarantee that the CPC1600 is not damaged. The range for the input power voltage, within which the module is functional, is also presented.

Table 6-1: DC Input Voltage Ranges and Limits

Power Voltage, V	Maximum Permitted Value, V	Absolute Limits, V	Recommended Range, V
+5	+5.5	4.9 to 5.25	5.0 to 5.25

Power supplies to be used with the CPC1600 should comply with these requirements.

Input power connections to the baseboard itself should provide minimum power loss. Avoid using long input lines, low carrying capacity cables, and high resistance connections.

To select the appropriate system power supply, it is necessary to consider the CPC1600 own power consumption (about 35 watts), the consumption of the remaining system components, possible variations of power consumption during operation (e.g. due to temperature changes) and some reserve. Taking all this into account, it is recommended to use a 150 watt power supply. If possible, power supplies with voltage sensing should be used. This may require an appropriate baseboard.

Table 6-2: Some CPC1600 Components Power Consumption

System Modules		Power Consumption
Pentium M 1.6 CPU		24.5 W
915GM+ICH6M Chipset		6 + 2.3 W
DDR SDRAM SODIMM PC2700 1 GB	(2.5 V)	5 W
Gigabit Ethernet chips 2pcs		1548x2 mW
CompactFlash card	(3.3 V)	100 to 300 mW
Keyboard	(5 V)	100 mW

7 Appendices

7.1 Supplementary Information

7.1.1 Related Standards and Specifications

The Fastwel's CPC1600 module comply with the requirements of the following standards:

Table 7-1: Related Standards

Type	Standard	Test Parameters
CE: Emission	EN50081-1	–
CE: Immission	EN61000-6-2	–
CE: Electrical safety	EN60950	–
Mechanical dimensions	IEEE 1101.10	–
Vibration (sinusoidal)	IEC60068-2-6-82; Fc	5 g / 10-500 Hz / 10 (acceleration / frequency range / test cycles per axis)
Permanent shock	IEC60068-2-29-87; Eb	50 g / 11 ms / 1000±10 / 1 s (peak acceleration / shock duration half sine / number of shocks / recovery time)
Single shock	IEC60068-2-27-87; Ea	100 g / 9 ms / 18 / 3 s (peak acceleration / shock duration / number of shocks / recovery time in seconds)
Reduced atmospheric pressure	IEC 60068-2-13-83, M	9 kPa (1.305 psi); approx. corresponds to 17000 m (over 55700 ft) above sea level

Important...

Some versions of the module may have the test results differing from the ones presented in the above table. For more information, please contact Fastwel's official representatives.

Information related to this product and its components can be found in the following specifications:

Table 7-2: Related Specifications

Product	Specification
PICMG	PICMG 1.0, Rev. 2.0
PCI Bus	PCI 2.3 Compliant Specifications For latest revision of the PCI specifications, contact the PCI Special Interest Group Office at: http://www.pcisig.com
PCI Express	PCI Express 1.0a Specification
MiniPCI	MiniPCI Specification, Rev. 1.0
CompactFlash Cards	CF+ and CompactFlash Specification, Revision 4.1

The Internet site of the PCI Industrial Computer Manufacturers Group (PICMG) provides information related to these standards (http://www.picmg.org/).

7.2 Useful Abbreviations, Acronyms and Short-cuts

Abbreviation	Meaning
BMC	Baseboard Management Controller
PM	Peripheral Management Controller
IPMI	Intelligent Platform Management Interface
IPMB	Intelligent Platform Management Bus
I^2C™	Inter Integrated Circuit Two-thread serial protocol, used in SMB and IPMI
KCS interface	Keyboard Controller Style interface Interface for communication between control software and BMC, similar to a keyboard controller interface
BT interface	Block Transfer interface Block transfer interface for communication between control software and BMC
DDR SDRAM	Double Data Rate Synchronous Dynamic Random Access Memory
SODIMM	Small Outline Dual In-Line Memory Module
ECC	Error Correction Code Data error correction technology used in memory modules
FWH	Firmware Hub Nonvolatile memory chip, part of Intel chipset, used for main and reserve BIOS copies in CPC1600
GMCH	Graphics and Memory Controller Hub
USB	Universal Serial Bus
LPC	Low Pin Count External devices communication interface
SMB	System Management Bus
UART	Universal Asynchronous Receiver-Transmitter
UHCI	Universal Host Controller Interface USB Host Controller Interface
EHCI	Enhanced Host Controller Interface (Universal Serial Bus specification)
UTP	Unshielded Twisted Pair
CRT-display	Cathode Ray Tube Display

Abbreviation	Meaning
PMC	PCI (Peripheral Component Interconnect) Mezzanine Card
CMC	Common Mezzanine Card
LVDS	Low Voltage Differential Signal Digital monitors communication specification
RTC	Real Time Clock
BIOS	Basic Input-Output System
PC	Personal Computer
PICMG	PCI Industrial Computer Manufacturers Group
AHA	Accelerated Hub Architecture GMCH and ICH communication bus specification
AGP	Accelerated Graphics Port
AGTL	Advanced Gunning Transceiver Logic PSB (Processor Side Bus) signal exchange specification
SMBus	System Management Bus
EEPROM	Electrically Erasable Programmable Read-Only Memory
NAND Flash	Not And (electronic logic gate) Flash memory specification
SSD	Solid State Disk
PLCC	Plastic Leaded Chip Carrier
RAMDAC	Random Access Memory Digital-to-Analog Converter
DAC	Digital-to-Analog Converter
DVMT	Dynamic Video Memory Technology
TTL	Transistor-Transistor Logic
ECP/EPP	Extended Capabilities Port / Enhanced Parallel Port Parallel port specifications
FDD	Floppy Disk Drive
EIDE	Enhanced Integrated Drive Electronics Mass storage devices interface
DMA	Direct Memory Access
PIO	Programmed Input/Output EIDE: Directly processor controlled data exchange
Rear I/O Board	Rear Input-Output Board Auxiliary interface board, which is connected to the cPCI backplane rear connectors
PWM output	Pulse-Width Modulation Cooling fan control technique
ESD	Electrostatically Sensitive Device Electrostatic Discharge
ACPI	Advanced Configuration and Power Interface
POST	Power On Self Test
cPCI	CompactPCI Industrial automation systems standard
EOS	Electrical Overstress
MDI	Media Dependent Interface Interface with connection type automatical detection