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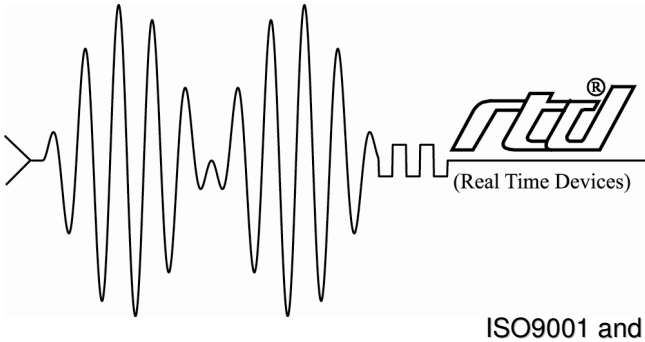
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CM17407HR User's Manual

Five Port USB 2.0 PC/104-Plus Module



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CM17407HR User's Manual



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Introduction

Product Overview

The CM17407HR brings high-speed USB 2.0 communications to a PC/104-*Plus* system. It can be used to connect USB peripherals (1.0, 1.1, or 2.0) to the embedded system. Up to five USB devices can be connected directly to the board. To connect more than five devices, USB hubs can be attached.

Product Features and Specifications

USB Interface

- Five Independent USB 2.0 Ports
- USB port 1 provides up to 2.0A @ +5.0V
- USB ports 2 – 5 provide up to 500mA @ +5.0V
- Each port supports all USB 2.0 speeds:
  - High-speed (400 Mbit/s)
  - Full-speed (12 Mbit/s)
  - Low-speed (1.5 Mbit/s)
- Backwards compatible with USB 1.1 and 1.0 devices
- NEC µPD720101 USB 2.0 Host Controller
  - EHCI core for high-speed devices
  - Two OHCI cores for full-speed and low-speed devices
  - USB ports are dynamically connected to the appropriate controller based on the speed of the attached device
  - Allows slower USB devices to be attached without affecting the performance of high-speed devices
- Uses standard ECHI and OHCI software drivers built into modern operating systems.

PCI Interface

- Supports 3.3V and 5.0V PCI Signaling
- User-selectable PCI Slot Number
- Uses three interrupt lines (1 for EHCI core, 2 for OCHI cores)
- PCI Bus Master
- Internal PCI arbiter allows one PCI Bus Mastering connection to be shared between all three USB controller cores

I/O Connections

- Five standard USB Type A connectors
  - Compatible with off-the-shelf USB cables
- Three 10-pin DIL USB connectors
  - 0.1” Pin Spacing
  - Compatible with commercially available PC motherboard USB headers
- PC/104-*Plus* (PCI) stack-through bus connector
- PC/104 (ISA) stack-through bus connector

Physical Attributes

- Size: 3.6”L x 3.8”W x 0.6”H (90mm L x 96mm W x 15mm H)
- Weight: 0.18 lbs (0.08 Kg)

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- Operating Temperature: -40° C to +85° C (90% humidity non-condensing)
- Storage Temperature: -55° C to +125° C
- Power Requirements: 0.5W @ +5V typical (Board Only)
  Note: Power consumption can increase depending on the type and number of USB devices attached.

Getting Technical Support

For help with this product, or any other product made by RTD, you can contact RTD Embedded Technologies via the following methods:

Phone: +1-814-234-8087

E-Mail: techsupport@rtd.com

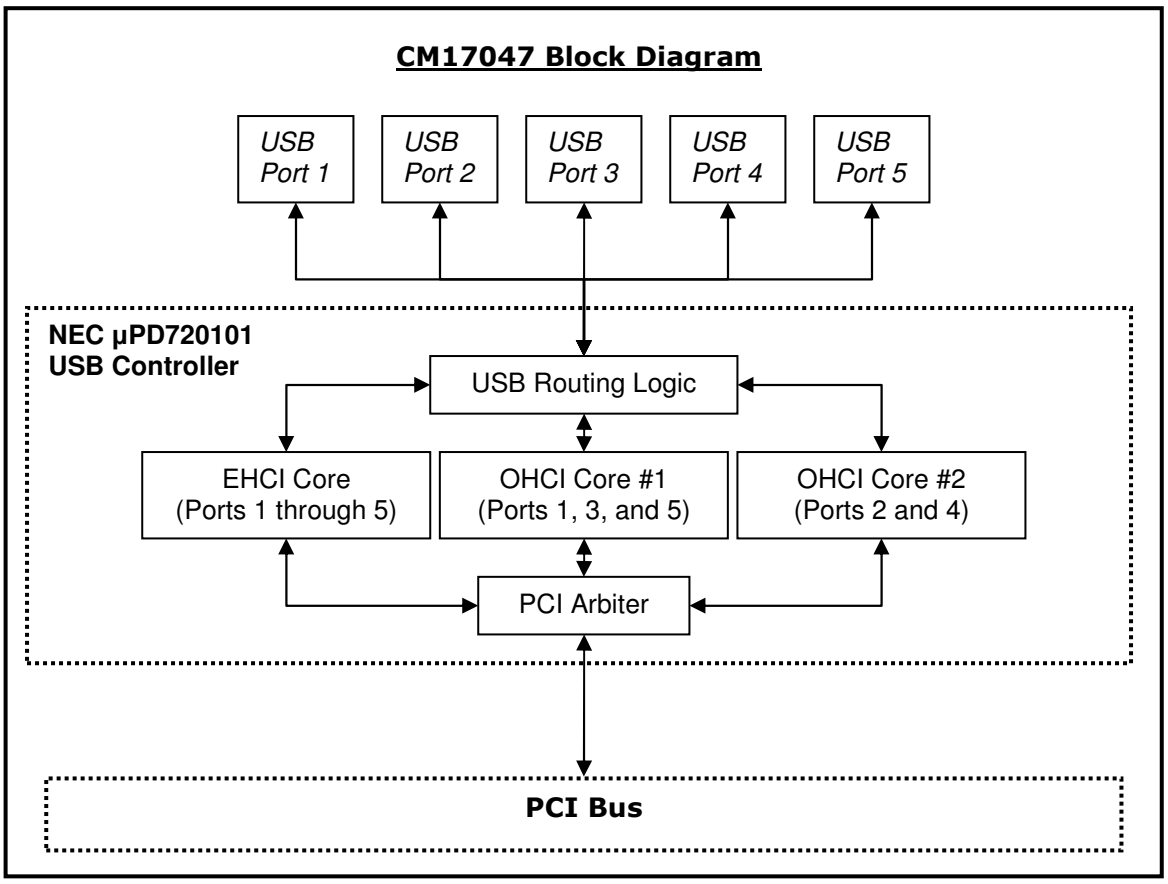
Be sure to check the RTD web site (http://www.rtd.com) frequently for product updates, including newer versions of the board manual and application software.

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Board Functionality

Block Diagram

Below is a block diagram of the CM17047. Primary board components are in bold, while external I/O connections are italicized.



USB Controller Cores

The CM17407 uses the NEC µPD720101 USB 2.0 Host Controller. It is a standard PCI USB 2.0 controller, and is compatible with all USB 2.0-compliant devices. As per the USB 2.0 specification, it is fully backwards compatible with USB 1.1 and 1.0 devices.

The NEC µPD720101 includes three USB controller cores. The primary core is an *Enhanced Host Controller Interface* (EHCI), which provides high-speed USB 2.0 connections to all 5 ports. The other two cores are *Open Host Controller Interface* (OHCI) cores, which provide full-speed and low-speed connections to the ports. Which core is used will be determined dynamically by the USB routing logic.

When a USB device is attached, the NEC µPD720101 detects the speed of the device. If it is a high-speed USB 2.0 device, the EHCI core will be used for that port. If a full-speed or low-speed device is connected, one of the OHCI cores will be used for that port. This approach allows slower USB devices to be attached without affecting the performance of faster ones.

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PCI Interface

The CM17407 is a multifunction PCI device. It exposes three PCI device functions to the host system. Each function corresponds to one of the USB controller cores. They each appear as separate PCI devices, with their own address space and interrupt lines.

The CM17407 is a PCI Bus Master. Despite having multiple functions, it will only use one PCI Bus Master Request/Grant connection. This is made possible by arbitration logic inside the NEC µPD720101.

Since there are three device functions, the CM17407 will use three interrupt lines on the system. As a PCI device, the board can share IRQ lines with other PCI devices. One IRQ can even be shared between all three device functions. The actual IRQ numbers assigned to the CM17407 will be determined by the CPU's BIOS at boot time.

Note: Certain operating systems remap PCI resources after bootup. The IRQ assigned by the BIOS may be overridden once the OS has loaded. Some operating systems will remap all PCI devices to the same IRQ. This is perfectly normal operation, and not a cause for concern.

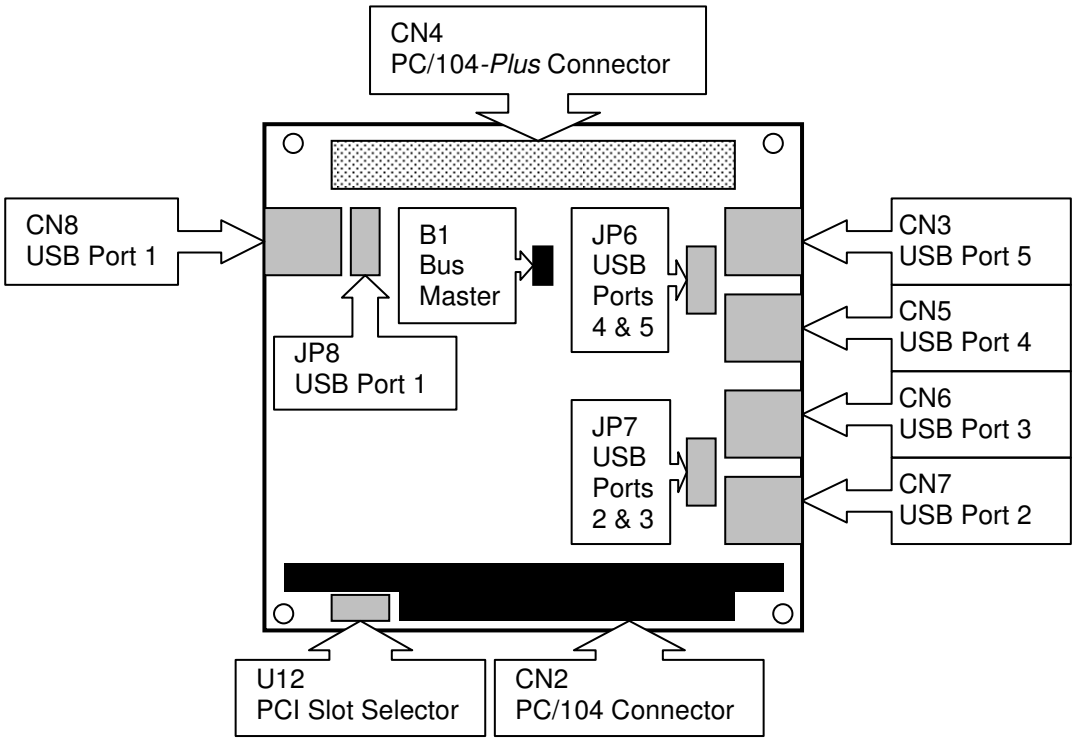
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Board Connections and Configuration

Connector and Component Locations

The following diagram shows the location of all connectors, switches, and solder blobs on the CM17407. For a description of each item, refer to the following sections.

CM17407 Connector and Switch Locations



External I/O Connections

The following sections describe the external I/O connections of the CM17407.

Connector CN8 – USB Port 1

Connector CN8 is an industry-standard Type A USB connector. It uses the standard pinout as defined by the USB specification. Connector CN8 has the ability to supply up to 2A of current to a USB device at +5.0V.

Note: When connecting a USB device to CN8, make sure that JP8 is unused.

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Connectors CN3, CN5, CN6, and CN7 – USB Ports 2 through 5

Connectors CN3, CN5, CN6, and CN7 are industry-standard Type A USB connectors. They use the standard pinout as defined by the USB specification. Each connector has the ability to supply up to 500mA of current to a USB device at +5.0V.

The relationship between connectors and USB ports is described in the connector and switch location diagram in the previous section.

Note: When connecting a USB device to CN3, CN5, CN6, or CN7, be certain that the corresponding pins on JP6 and JP7 are unused.

Connector JP6 – USB Ports 4 & 5 (Alternate Connection)

Connector JP6 provides an alternate method for connecting to USB ports 4 and 5. Instead of plugging a USB device directly into CN6 or CN7, one can attach a standard PC motherboard USB header to JP6. This gives one the ability to mount the USB connectors at a different location, away from the PC/104 stack. Since JP6 shares the same physical link as CN6 and CN7, be sure to not connect anything to those ports when JP6 is in use.

The pins of JP6 are arranged in the following pattern:

Pin 9	Pin 7	Pin 5	Pin 3	Pin 1
Pin 10	Pin 8	Pin 6	Pin 4	Pin 2

Note: Pin 1 can be identified by a square solder pad. Pins 2 – 10 have round solder pads.

The pins of JP6 have the following functions:

Pin 1	USB Port 5 Vcc
Pin 2	USB Port 4 Vcc
Pin 3	USB Port 5 Data -
Pin 4	USB Port 4 Data -
Pin 5	USB Port 5 Data +
Pin 6	USB Port 4 Data +
Pin 7	Ground
Pin 8	Ground
Pin 9	Ground
Pin 10	Ground

Connector JP7 – USB Ports 2 & 3 (Alternate Connection)

Connector JP7 provides an alternate method for connecting to USB ports 2 and 3, similar to JP6. Since JP7 shares the same physical link as CN6 and CN7, be sure to not connect anything to those ports when JP7 is in use.

The pins of JP7 are arranged in the following pattern:

Pin 9	Pin 7	Pin 5	Pin 3	Pin 1
Pin 10	Pin 8	Pin 6	Pin 4	Pin 2

Note: Pin 1 can be identified by a square solder pad. Pins 2 – 10 have round solder pads.

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The pins of JP7 have the following functions:

Pin 1	USB Port 3 Vcc
Pin 2	USB Port 2 Vcc
Pin 3	USB Port 3 Data -
Pin 4	USB Port 2 Data -
Pin 5	USB Port 3 Data +
Pin 6	USB Port 2 Data +
Pin 7	Ground
Pin 8	Ground
Pin 9	Ground
Pin 10	Ground

Connector JP8 – USB Port 1 (Alternate Connection)

Connector JP8 provides an alternate method for connecting to USB Port 1, similar to JP6 and JP7. Unlike JP6 and JP7, however, JP8 only provides one USB port. A standard PC motherboard USB header can still be used. Since JP8 shares the same physical link as CN8, be sure to not connect anything to those ports when JP8 is in use.

The pins of JP8 are arranged in the following pattern:

Pin 9	Pin 7	Pin 5	Pin 3	Pin 1
Pin 10	Pin 8	Pin 6	Pin 4	Pin 2

Note: Pin 1 can be identified by a square solder pad. Pins 2 – 10 have round solder pads.

The pins of JP8 have the following functions:

Pin 1	USB Port 1 Vcc
Pin 2	USB Port 1 Vcc
Pin 3	USB Port 1 Data -
Pin 4	Reserved
Pin 5	USB Port 1 Data +
Pin 6	Reserved
Pin 7	Ground
Pin 8	Ground
Pin 9	Ground
Pin 10	Ground

PCI Configuration Options

To install the CM17407 into the stack, the PCI Slot Number must be configured correctly. This is done by the PCI Slot Selector located at U12. Depending on the hardware revision of the board, the slot selector may be either a set of DIP switches or a rotary switch.

There are four possible PCI Slot Numbers (0 – 3). Each PCI device (PC/104-*Plus* or PCI-104) must a use a different slot number. The slot number is related to the position of the board in the stack. Slot 0 represents the PCI device closest to the CPU. Slot 3 represents the PCI devices farthest away from the CPU.

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Note: In a PC/104-*Plus* or PCI-104 system, all PCI devices should be located on one side of the CPU board (above or below the add-on cards). The CPU should not be located between two PCI devices.

Switch U12 – PCI Slot Selector

If the CM17407 has a set of DIP switches, the PCI Slot Number can be configured as follows:

Switch 1	Switch 2	PCI Slot Number
Off	Off	Slot 0 (closest to CPU)
Off	On	Slot 1
On	Off	Slot 2
On	On	Slot 3

If the CM17407 has a rotary switch, the PCI Slot Number can be configured as follows:

Switch Position	PCI Slot Number
0	Slot 0 (closest to CPU)
1	Slot 1
2	Slot 2
3	Slot 3
4	*Undefined*
5	*Undefined*
6	*Undefined*
7	*Undefined*

Solder Blob B1 – Bus Master Control

When the PC/104-*Plus* Specification was first introduced, it only allowed for three PCI add-on cards to be bus masters. Version 2.0 of the PC/104-*Plus* specification was released in November 2003. This version of the specification (which the CM17407 is designed for) adds support for all 4 PCI slots to be bus masters.

For compatibility with CPUs designed for the older PC/104-*Plus* Specification, the CM17407 offers a configuration solder blob at location B1. If this solder blob is open (the default), the board supports bus mastering in all 4 PCI slots. If it is closed, the board will work in a 3 bus master configuration.

Note: The CM17407 comes with solder blob B1 open by default. This should be compatible with most PC/104-*Plus* CPUs. There is no need to change this blob unless you are having compatibility problems with your specific CPU.

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Board Installation

Installing the Hardware

The CM17407 can be installed into a PC/104-*Plus* or PCI-104 stack. It can be located above or below the CPU, as long as all PCI add-on cards are on the same side of the CPU.

Static Precautions

Keep your board in its antistatic bag until you are ready to install it into your system! When removing it from the bag, hold the board at the edges and do not touch the components or connectors. Handle the board in an antistatic environment and use a grounded workbench for testing and handling of your hardware.

Steps for Installing

1. Shut down the PC/104-*Plus* system and unplug the power cord.
2. Ground yourself with an anti-static strap.
3. Set the PCI Slot Selector as described in the previous chapter.
4. If any other PCI add-on cards are to be included in the stack, be sure that their PCI slot numbers are configured correctly (Slot 0 for the board closest to the CPU, Slot 1 for the next board, etc).
5. Line up the pins of the CM17407's PC/104 and PC/104-*Plus* connectors with the corresponding bus connectors of the stack. Make sure that both connectors are lined up.
6. Apply pressure to both bus connectors and gently press the board onto the stack. The board should slide into the matching bus connectors. Do not attempt to force the board, as this can lead to bent/broken pins.
7. If any USB headers are to be attached to JP6, JP7, or JP8, attach them.
8. If any boards are to be stacked above the CM17407, install them.
9. Attach any necessary cables to the PC/104-*Plus* stack.
10. Re-connect the power cord and apply power to the stack.
11. Boot the system and verify that all of the hardware is working properly.

Note: If multiple PCI devices are configured to use the same PCI slot number, the system will not boot.

Installing Software

The CM17407 uses the standard USB EHCI and OHCI drivers built into modern operating systems. These drivers need to be loaded before the board will function. The exact method of installing and configuring these drivers will depend on the operating system.

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At the time this manual was published, the following operating systems have native support for ECHI and OHCI USB controllers:

- Microsoft Windows 2000 Service Pack 4
- Microsoft Windows XP Service Pack 1
- Microsoft Windows Server 2003
- Microsoft Windows CE .NET 5.0
- Linux kernel 2.4.22
- Linux kernel 2.6
- QNX Neutrino 6.3
- Wind River VxWorks 6.0

Microsoft Windows 2000/XP/2003 should detect and install the necessary drivers automatically. Other operating systems may require extra configuration.

Note: For the most up-to-date information on USB 2.0 software support, contact the operating system vendor.

When installing and configuring USB support, be aware of the following:

- Since the CM17407 is a multifunction device, it will appear as three PCI devices (1 EHCI controller, 2 OHCI controllers) to the host operating system.
- To use the board properly, all three USB controllers need to be installed and configured.
- If the operating system only supports USB 1.0/1.1, it will recognize the OHCI controllers, but will be unable to use the EHCI one.

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Additional Information

NEC µPD720101 Specifications

More information on the NEC µPD720101, including product datasheets and register maps can be found at the NEC web site.

http://www.nec.com

USB 2.0 Specifications

The specifications for USB 2.0 are available from the USB Implementers Forum, and may be downloaded free from their web site.

http://www.usb.org

The USB 2.0 Specification also includes the specifications for the *Enhanced Host Controller Interface* (EHCI) and *Open Host Controller Interface* (OHCI), which the CM17407 implements.

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