Reference Manual

DOC. REV. 12/29/2006

EPM-CPU-6
EPM-CPU-7

Pentium/K6 and Intel Tillamook processor module with 10/100 Ethernet, Video, and PC/104-Plus interface.

VERSALOGIC CORPORATION

EPM-CPU-6
EPM-CPU-7

Pentium/K6 and Intel Tillamook processor module with 10/100 Ethernet, Video, and PC/104-*Plus* interface

MEPM-CPU-6

Product Release Notes

This page includes recent changes or improvements that have been made to this product. These changes may affect its operation or physical installation in your application. Please read the following information.

Rev 3 Release (EPM-CPU-7 only)

- BIOS. EPM-CPU-7 with BIOS version 4.3.105
- CPU. EPM-CPU-7 designed to support the Intel Tillamook chip.

Rev 2 Release

- Initial public release.

Support Page

The **EPM-CPU-6/7 Support Page**, at **http://www.VersaLogic.com/private/panthersupport.asp**, contains additional information and resources for this product including:

- Reference Manual (PDF format)
- Operating system information and software drivers
- Data sheets and manufacturers' links for chips used in this product
- BIOS information and upgrades
- Utility routines and benchmark software

Note: This is a private page for EPM-CPU-6/7 users only. It cannot be reached through our web site. You must enter this address directly to find the support page.

Model EPM-CPU-6/7

Pentium/K6 and Intel Tillamook processor module
with 10/100 Ethernet,
Video, and PC/104-*Plus* interface

REFERENCE MANUAL

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Notice:

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Table of Contents

Introduction 1

Description

The EPM-CPU-6/7 is a performance-oriented processor board in a compact PC/104-Plus format. It is specifically designed for OEM control projects requiring fast processing, compact size, flexible memory options, high reliability, and long product lifespan / availability. It's features include:

- Full Socket 7 CPU Support - to 400 MHz
  - Intel Pentium MMX
  - AMD K6-2 3D
  - AMD K6-2e low power
  - Intel Tillamook (EPM-CPU-7 only)
- 512 KB Level 2 cache
- 8 to 256 MB system RAM
- 10 / 100 dual-speed Ethernet
- PCI based video
  2 MB VRAM on EPM-CPU-6
  4 MB VRAM on EPM-CPU-7
- Flat panel display support
- 32-pin DOC Flash support
- PC/104-*Plus* high speed expansion interface
- PCI based IDE controller
- Dual USB 1.0 interfaces
- 2 COM + 1 LPT port
- Keyboard and PS/2 mouse port
- RS-232/422/485 COM port
- CPU temperature sensor
- Watchdog timer
- Vcc sensing reset circuit
- Flash BIOS with OEM enhancements
- Ethernet Remote boot option
- Single supply (+5V) operation
- Latching I/O connectors
- Customizing available
- Fanless option

The EPM-CPU-6/7 is a complete computer system in a compact two board set. It may be used alone or with expansion modules. It features a PC/104-*Plus* expansion interface for fast PCI-based interface to a wide variety of PC/104 and PC/104-*Plus* stacking modules.

It is fully compatible with popular operating systems including Windows operating systems, QNX, Linux, RT-Linux, OS-9, and other Real Time Operating Systems.

On-board I/O includes 10/100 Mbit Ethernet, CRT / Flat Panel interface, IDE, USB 1.0, two COM and one LPT port. In addition, one of the COM ports is convertible to RS-232/422/485.

Up to 256 MB of low power system RAM is supported in a high-reliability latching 144-pin SODIMM socket. Up to 72 MB of bootable DiskOnChip Flash space is support for non-volatile program and data file storage without the use of mechanical disk drives.

The high reliability design and construction of this board also features latching I/O connectors, watchdog timer, voltage sensing reset circuit, and self-resetting fuse on the 5V supply to the keyboard, mouse, and USB 1.0 ports. An onboard programmable CPU temperature sensor is included for use in difficult thermal situations. The sensor output can be used to turn on additional fans, create local or remote warnings, or take other action through software triggers.

The EPM-CPU-6/7 delivers both full performance and product longevity by utilizing only standardized components in its design. Features such as full socket 7 compatibility were made possible by its unique 2-board design with PC/104-Plus interconnect. The EPM-CPU-6/7 is designed to mount at the top of a PC/104 stack due to fan / heat sink height. Other configurations are possible depending on the environmental characteristics of the application.

This exceptional processor card was designed from the ground up for OEM applications with longevity and reliability as the focus. It is fully supported by the VersaLogic design team. Both hardware and software (BIOS) customization are available in quantities as low as 25 pieces. Each board is subjected to a 48-hour burn-in and 100% functional testing and backed by a limited two-year warranty.

Technical Specifications

Specifications are typical at 25°C with 5.0V supply unless otherwise noted.

Board Size:
3.55" x 3.775" (PC/104 standard). Two board set.

Storage Temperature:
–40° C to 85° C

Free Air Operating Temperature:
0° C to +60° C (free air, CPU fan with heatsink attached and operating)

Power Requirements: *(with 32 MB SDRAM, keyboard, mouse, running Win95 with Ethernet)*

EPM-CPU-6/7bj	266 MHz K6-2 CPU	5V ±5% @ 3.30 A (16.5 W) typ.
EPM-CPU-6c	233 MHz Pentium CPU	5V ±5% @ 3.50 A (17.5 W) typ
EPM-CPU-6/7g	400 MHz K6-2 CPU	5V ±5% @ 4.25 A (21.3 W) typ.
EPM-CPU-6/7h	266 MHz K6-2E CPU	5V ±5% @ 2.55 A (12.8 W) typ.
EPM-CPU-7s	266 MHz Tillamook	5V ±5% @ 1.95 A (9.7 W) typ.
EPM-CPU-7t	266 MHz Tillamook	5V ±5% @ 2.05 A (10.3 W) typ.

+3.3V or ±12V may be required by some expansion modules

System Reset:
V_{CC} sensing, resets below 4.37V typ. Watchdog timeout

DRAM Interface:
One 144-pin SODIMM socket, 8 to 256 MB, EDO (60 ns) or
SDRAM (66 MHz or PC-100 compatible, runs at 66 MHz).

Flash / BBSRAM Interface:
One 32-pin JEDEC DIP socket.
Accepts one 8 to 96 MB DiskOnChip device or 512 KB battery-backed static RAM chip. Height limit of 0.0330”

Video Interface:

EPM-CPU-6:	Based on Intel/C&T 69000 chip. 2 MB VRAM. Resolutions to 1600 x 1200.
EPM-CPU-7:	Based on Intel/C&T 69030 chip. 4 MB VRAM. Resolutions to 1600 x 1200

44-pin flat panel display interface compatible with common panels.

IDE Interface:
One PCI-based IDE channel, 40-pin interface, compatble with enhanced IDE mode 4 and Ultra DMA only.
Supports up to two IDE devices (hard drives, CD-ROM, etc.)

Floppy Disk Interface:
Supports two floppy drives

Ethernet Interface:
Autodetect 10BaseT/100BaseTX based on AMD 79C973. 12K transmit/receive buffer.

COM1 Interface:
RS-232, 16C550 compatible, 115K baud max.

COM2 Interface:
RS-232/422/485, 16C550 compatible, 460K baud max.

LPT Interface:
Bi-directional/EPP/ECP compatible

Connectors:

I/O:	Two high-density 80-pin (break out to standard .1" IDC and PC connectors).
Video:	10-pin 2mm SVGA connector,44-pin 2mm FPD connector
Power:	10-pin .1"

BIOS: General Software embedded BIOS with OEM enhancements
Field upgradable with Flash BIOS Upgrade Utility

Bus Speed:

CPU External:	66 MHz
PCI, PC/104-*Plus*:	33 MHz
PC/104:	8 MHz

Compatibility:
PC/104 – Full compliance
Embedded-PCI (PC/104-*Plus*) – Full compliance, 3.3V or 5V modules

Specifications are subject to change without notice.

Technical Support

If you have problems that this manual can't help you solve, first visit the EPM-CPU-6/7 Product Support web page at **http://www.VersaLogic.com/private/panthersupport.asp**. If you have further questions, contact VersaLogic for technical support at (541) 485-8575. You can also reach our technical support engineers via e-mail at Support@VersaLogic.com.

EPM-CPU-6/7 Support Website

http://www.VersaLogic.com/private/panthersupport.asp

REPAIR SERVICE

If your product requires service, you must obtain a Returned Material Authorization (RMA) number by calling (541) 485-8575.

Please provide the following information:

- Your name, the name of your company, and your phone number
- The name of a technician or engineer who we can contact if we have questions
- Quantity of items being returned
- The model and serial number (bar code) of each item.
- A description of the problem
- Steps you have taken to resolve or repeat the problem
- The return shipping address

Warranty Repair All parts and labor charges are covered, including return shipping charges for UPS 3rd Day Select delivery to United States addresses.

Non-warranty Repair All non-warranty repairs are subject to diagnosis and labor charges, parts charges, and return shipping fees. We will need to know what shipping method you prefer for return back to your facility, and we will need to secure a purchase order number for invoicing the repair.

Note: Please mark the RMA number clearly on the outside of the box before returning. Failure to do so can delay the processing of your return.

Configuration / Operation 2

Overview

ELECTROSTATIC DISCHARGE

Warning! Electrostatic discharge (ESD) can damage boards, disk drives, and other components. The circuit board must be only be handled at an ESD workstation. If an approved station is not available, some measure of protection can be provided by wearing a grounded antistatic wrist strap. Keep all plastic away from the board, and do not slide the board over any surface.

After removing the board from its protective wrapper, place the board on a grounded, static-free surface, component side up. Use an anti-static foam pad if available.

The board should also be protected during shipment or storage by keeping inside a closed metallic anti-static envelope.

Note: The exterior coating on some metallic anti-static bags is sufficiently conductive to cause excessive battery drain if the bag comes in contact with the bottom side of the EPM-CPU-6/7.

LITHIUM BATTERY

Warning! To prevent shorting, premature failure, or damage to the lithium battery, do not place the board on a conductive surface such as metal, black conductive foam, or the outside surface of a metalized ESD protective pouch. The lithium battery may explode if mistreated. Do not recharge, disassemble, or dispose of in fire. Dispose of used batteries promptly.

Initial Configuration and Setup

The following list describes the recommended components and gives an abbreviated outline for setting up a typical development system.

RECOMMENDED COMPONENTS

- EPM-CPU-6/7 Board Set
- 144-pin SODIMM SDRAM Memory Module (66 MHz or PC-100)
- ATX Power Supply
- SVGA Video Monitor
- Keyboard with PS2 connector
- 3.5" Floppy Disk Drive
- IDE Hard Drive
- IDE CD ROM Drive (optional)

DRAM MODULE

- Insert DRAM module into the SODIMM socket. Latch into place.

CABLES / PERIPHERAL DEVICES

- Plug video adapter cable (p/n VL-CBL-1007) into socket JN2 and attach video monitor.
- Plug keyboard into socket JS1[JC].
- Plug floppy data connector JS3[JK] into floppy drive.

Note: The floppy drive used to boot the system (Drive A) should be connected after the twist in the cable (connector JS3[JK]).

- Plug hard drive data connector JS3[JH] into IDE hard drive.
- Optionally, a CD ROM can be connected to JS3[JJ].
- Plug power supply into JS4.
- Attach power supply cables to external drives.
- Jumper hard drive to operate as a master device.

CMOS Setup / Boot Procedure for EPM-CPU-6x

- Turn power on.
- Press the DEL key the instant that video is displayed (during the memory test).
- Verify correct CMOS Setup information as shown below.
- Insert bootable floppy disk into floppy drive.
- Reset computer using push button reset.

Basic CMOS Configuration

```
+-------------------------------------------------------------------------------+
|                 System Bios Setup - Basic CMOS Configuration                  |
|            (C) 1999 General Software, Inc. All rights reserved                |
+---------------------------+--------------------+--------------------------+
| DRIVE ASSIGNMENT ORDER:   | Date:>Jan 01, 1980 | Typematic Delay  : 250 ms |
| Drive A: Floppy 0         | Time: 00 : 00 : 00 | Typematic Rate   : 30 cps |
| Drive B: (None)           | NumLock:  Disabled | Seek at Boot     : Floppy |
| Drive C: (None)           +--------------------+ Show "Hit Del"   : Enabled |
| Drive D: (None)           | BOOT ORDER:        | Config Box       : Enabled |
| Drive E: (None)           | Boot 1st: Drive A: | F1 Error Wait    : Enabled |
| Drive F: (None)           | Boot 2nd: (None)   | Parity Checking  : (Unused)|
| Drive G: (None)           | Boot 3rd: (None)   | Memory Test Tick : Enabled |
| Drive H: (None)           | Boot 4th: (None)   | Test Above 1 MB  : Disabled|
| Drive I: (None)           | Boot 5th: (None)   | Long Memory Test : (Unused)|
| Drive J: (None)           | Boot 6th: (None)   | Hexadecimal Case : Upper  |
| Drive K: (None)           +--------------------+-----------+-----------+
| (Loader): (Unused)        | IDE DRIVE GEOMETRY:  Sect  Hds  Cyls | Memory    |
+---------------------------+ Ide 0: Not installed                 |  Base:    |
| FLOPPY DRIVE TYPES:       | Ide 1: Not installed                 |           |
| Floppy 0: 1.44 MB, 3.5"   | Ide 2: Not installed                 |  Ext:     |
| Floppy 1: Not installed   | Ide 3: Not installed                 |           |
+---------------------------+--------------------------------------+-----------+
```

Custom Configuration

```
+-------------------------------------------------------------------------------+
|               System BIOS Setup - Advanced Configuration                      |
|            (C) 1999 General Software, Inc. All rights reserved                |
+-------------------------------------+-----------------------------------------+
| Cache (L1 and L2)          : Enabled| COM1 (03F8) Enable/IRQ    : IRQ4        |
| Ethernet                   : Enabled| COM2 (02F8) Enable/IRQ    : IRQ3        |
| Parallel Port Mode         : SPP    | LPT1 (0378) Enable/IRQ    : IRQ7        |
| I/O Register Base Address  : 0E0h   | External Interrupt        : No IRQ      |
| 32Pin Socket (DOC/BBSRAM)  : Disabled| PC/104 (ISA)              : No IRQ      |
| USB Controller             : Disabled| PC/104 (ISA)              : No IRQ      |
| Interrupt Vector Restore   : 19h & 40h| PC/104 (ISA)              : No IRQ      |
| 32-Bit PCI BIOS Extension  : Enabled| PC/104 (ISA)              : No IRQ      |
| Display Type               : CRT    | IDE 0 PIO Mode            : Auto        |
| CPU Temperature Threshold  : 70C    | IDE 1 PIO Mode            : Auto        |
+-------------------------------------+-----------------------------------------+
```

Shadow Configuration

```
+-------------------------------------------------------------------------------+
|               System BIOS Setup - Shadow/Cache Configuration                  |
|            (C) 1999 General Software, Inc. All rights reserved                |
+-------------------------------------+-----------------------------------------+
| Shadowing                  : None   | Shadow 16KB ROM at C000   : Enabled     |
| Shadow 16KB ROM at C400    : Enabled| Shadow 16KB ROM at C800   : Enabled     |
| Shadow 16KB ROM at CC00    : Disabled| Shadow 16KB ROM at D000   : Disabled    |
| Shadow 16KB ROM at D400    : Disabled| Shadow 16KB ROM at D800   : Disabled    |
| Shadow 16KB ROM at DC00    : Disabled| Shadow 16KB ROM at E000   : Disabled    |
| Shadow 16KB ROM at E400    : Disabled| Shadow 16KB ROM at E800   : Disabled    |
| Shadow 16KB ROM at EC00    : Disabled| Shadow 64KB ROM at F000   : Enabled     |
+-------------------------------------+-----------------------------------------+
```

Note: Due to changes and improvements in the system BIOS, the information on your monitor may differ from that shown above. Above screen version is Version 4.3.104

CMOS Setup / Boot Procedure for EPM-CPU-7x

- Turn power on.
- Press the DEL key the instant that video is displayed (during the memory test).
- Verify correct CMOS Setup information as shown below.
- Insert bootable floppy disk into floppy drive.
- Reset computer using push button reset.

Basic CMOS Configuration

```
+--------------------------------------------------------------------------+
|                 System Bios Setup - Basic CMOS Configuration             |
|           (C) 2000 General Software, Inc. All rights reserved            |
+--------------------------+--------------------+--------------------------+
| DRIVE ASSIGNMENT ORDER:  | Date:>Jan 01, 1980 | Typematic Delay  : 250 ms  |
| Drive A: Floppy 0        | Time: 00 : 00 : 00 | Typematic Rate   : 30 cps  |
| Drive B: (None)          | NumLock:  Disabled | Seek at Boot     : None    |
| Drive C: (None)          +--------------------+ Show "Hit Del"   : Enabled |
| Drive D: (None)          | BOOT ORDER:        | Config Box       : Enabled |
| Drive E: (None)          | Boot 1st: Drive A: | F1 Error Wait    : Enabled |
| Drive F: (None)          | Boot 2nd: (None)   | Parity Checking  : (Unused)|
| Drive G: (None)          | Boot 3rd: (None)   | Memory Test Tick : Enabled |
| Drive H: (None)          | Boot 4th: (None)   | Test Above 1 MB  : Disabled|
| Drive I: (None)          | Boot 5th: (None)   | Debug Breakpoints: (Unused)|
| Drive J: (None)          | Boot 6th: (None)   | Splash Screen    : Disabled|
| Drive K: (None)          +--------------------+-----------------+-----------+
| (Loader): (Unused)       | IDE DRIVE GEOMETRY:  Sect  Hds  Cyls | Memory    |
+--------------------------+ Ide 0: Not installed                 |  Base:    |
| FLOPPY DRIVE TYPES:      | Ide 1: Not installed                 |   640KB   |
| Floppy 0: 1.44 MB, 3.5"  | Ide 2: Not installed                 |  Ext:     |
| Floppy 1: Not installed  | Ide 3: Not installed                 |   15MB    |
+--------------------------+--------------------------------------+-----------+
```

Custom Configuration

```
+--------------------------------------------------------------------------+
|                 System BIOS Setup - Custom Configuration                 |
|           (C) 2000 General Software, Inc. All rights reserved            |
+--------------------------------------+-----------------------------------+
| Cache (L1 and L2)         : Enabled  | COM1 (03F8) Enable/IRQ    : IRQ4  |
| Ethernet                  : Enabled  | COM2 (02F8) Enable/IRQ    : IRQ3  |
| Parallel Port Mode        : SPP      | LPT1 (0378) Enable/IRQ    : IRQ7  |
| I/O Register Base Address : 0E0h     | External Interrupt        : No IRQ|
| DiskOnChip                : Disabled | PCI INTA                  : IRQ11 |
| USB Controller            : Disabled | PCI INTB                  : IRQ11 |
| Interrupt Vector Restore  : Disabled | PCI INTC                  : IRQ11 |
| BIOS Extension            : Disabled | PCI INTD                  : IRQ11 |
| Display Type              : CRT      | IDE 0 PIO Mode            : Auto  |
| CPU Temperature Monitor   : 70 C     | IDE 1 PIO Mode            : Auto  |
+--------------------------------------+-----------------------------------+
```

Shadow Configuration

```
+--------------------------------------------------------------------------+
|                 System BIOS Setup - Shadow/Cache Configuration           |
|           (C) 2000 General Software, Inc. All rights reserved            |
+--------------------------------------+-----------------------------------+
| Shadowing                 : >Chipset | Shadow 16KB ROM at C000   : Disabled |
| Shadow 16KB ROM at C400   : Disabled | Shadow 16KB ROM at C800   : Disabled |
| Shadow 16KB ROM at CC00   : Disabled | Shadow 16KB ROM at D000   : Disabled |
| Shadow 16KB ROM at D400   : Disabled | Shadow 16KB ROM at D800   : Disabled |
| Shadow 16KB ROM at DC00   : Disabled | Shadow 16KB ROM at E000   : Disabled |
| Shadow 16KB ROM at E400   : Disabled | Shadow 16KB ROM at E800   : Disabled |
| Shadow 16KB ROM at EC00   : Disabled | Shadow 64KB ROM at F000   : Enabled  |
+--------------------------------------+-----------------------------------+
```

Note: Due to changes and improvements in the system BIOS, the information on your monitor may differ from that shown above. Above screen version is Version 4.3.105

Operating System Installation

The standard PC architecture used on the EPM-CPU-6/7 makes the installation and use of most of the standard x86 processor-based operating systems simple. The operating systems listed on the VersaLogic OS Compatibility Chart (http://www.versalogic.com/kb/KB.asp?KBID=1487) use the standard installation procedures provided by the maker of the OS. Special optimized hardware drivers for a particular operating system, or a link to the drivers, are available at the EPM-CPU-6/7 support web page: http://www.VersaLogic.com/private/panthersupport.asp.

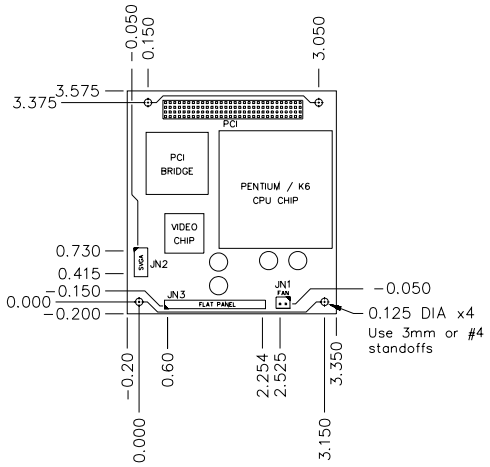
Creating a Bootable DOS DiskOnChip

The DiskOnChip is shipped pre-formatted, non-bootable, without any files on it. The DiskOnChip will appear as Drive D in systems with an installed hard drive. If a hard drive is not installed, the DOC will appear as Drive C:

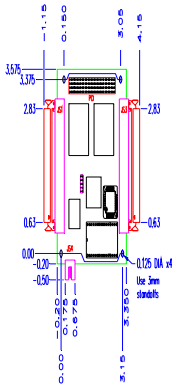
1. Boot your system under DOS or Windows (if using Windows, start a DOS session)
2. Type SYS C: (or SYS D: if appropriate)

Physical Dimensions

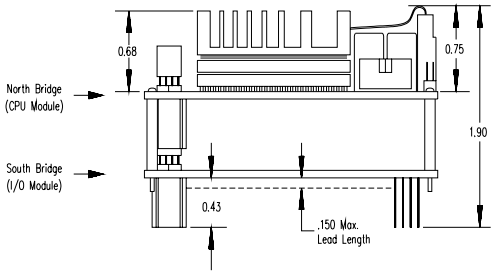
The EPM-CPU-6/7 is a two board set consisting of a CPU Module (North Bridge) and an I/O Module (South Bridge). Dimensions are given below to help with pre-production planning and layout.



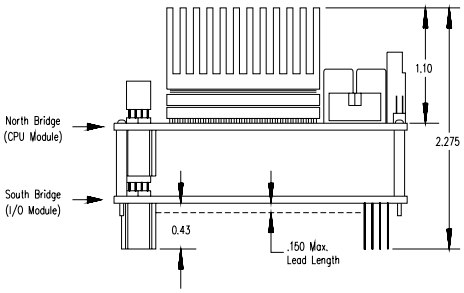
CPU Module (North Bridge)



I/O Module (South Bridge)



Overall Height (Both Cards)



Overall Height (Fanless Model)

Figure 1. Dimensions

(Not to scale. All dimensions in inches.)

HARDWARE ASSEMBLY

The EPM-CPU-6/7 consists of two boards which are mounted together with eight 5mm x 15mm M3 threaded hex male/female standoffs (p/n VL-HDW-101) using the corner mounting holes. These standoffs are secured to the top circuit board using four pan head screws.

Caution Extreme care must be taken not to damage components near the corner mounting holes when tightening standoffs with nut driver tools.

Additional PC/104-*Plus* or PC/104 cards can be attached to the bottom of the EPM-CPU-6/7 board set and secured with standoffs or 5mm nuts.

PC/104-*Plus* expansion modules can be secured directly to the underside of the EPM-CPU-6/7.

PC/104 expansion modules can be secured to the underside of the EPM-CPU-6/7, however, the 40-pin and 64-pin ISA feedthrough connectors may need to be extended, and longer standoffs might need to be used to provide adequate clearance between the PCI connector and the components on the top side of the PC/104 module.

The entire assembly can sit on a table top or it can be secured to a base plate. When bolting the unit down, make sure to secure all four standoffs to the mounting surface to prevent circuit board flexing. Refer to the drawing on page 11 for dimensional details.

An extractor tool is available (part number VL-HDW-201) to separate the modules from the stack.

STACK ARRANGEMENT

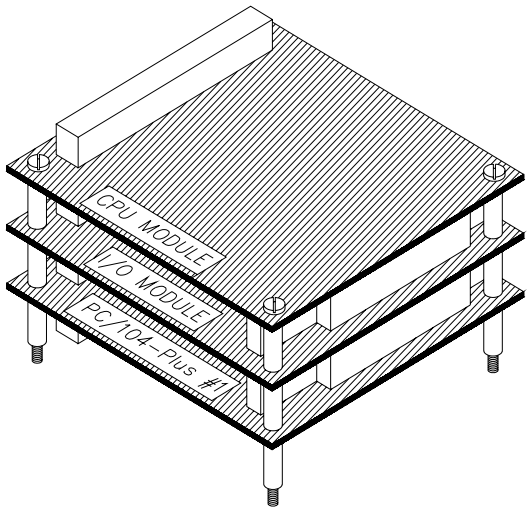


Figure 2. PC/104-*Plus* Card Added to Bottom of Stack

External Connectors

CONNECTOR LOCATION DIAGRAMS

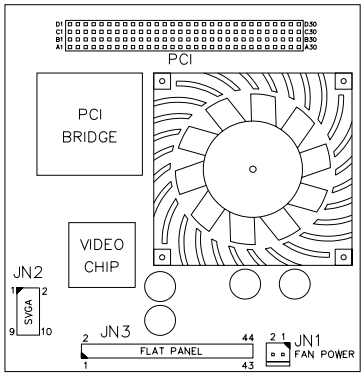


Figure 3. Connector Location Diagram (CPU Module)

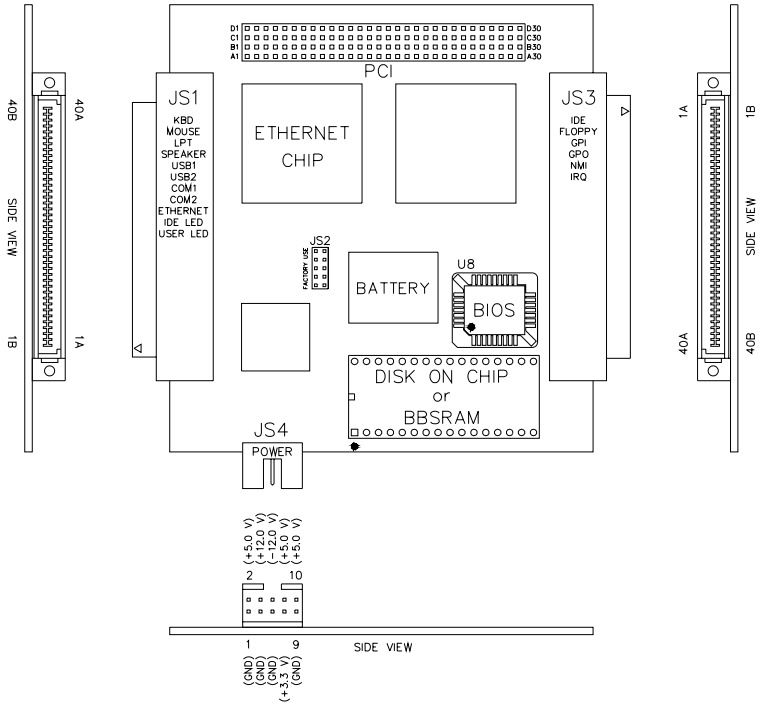


Figure 4. Connector Location Diagram (I/O Module)

CONNECTOR FUNCTIONS AND INTERFACE CABLES

The table below notes the function of each connector, as well as mating connectors and cables, and the page where a detailed pinout or further information is available.

Table 1: Connector Functions and Interface Cables

Connector	Function	Mating Connector	Transition Cable	Cable Description	Page
JN1	Fan Power Output (+5V)	Molex 22-01-3027 or Molex 22-01-2025	Provided with fan assembly	—	22
JN2	SVGA Video Output	Samtec TCSD-05-12.00-01 ‡	VersaLogic VL-CBL-1007		32
JN3	Flat Panel Interface	Adam Tech 2CH-A2-44 Adam Tech 2CTA*	—	Contact Factory	33
JS1	Keyboard, Mouse, LPT1, Speaker, USB1, USB2, COM1, COM2, Ethernet, IDE Data LED, Programmable LED	Robinson-Nugent P50E-080S-TG	VersaLogic VL-CBL-8001	Breakout to standard PC device connectors	20
JS2	PLD Reprogramming Port *(Factory use Only)*	—	—	—	—
JS3	IDE0, Floppy, General Purpose Input, General Purpose Output, NMI, IRQ	Robinson-Nugent P50E-080S-TG	VersaLogic VL-CBL-8002	Breakout to standard PC device connectors	35
JS4	Main Power Input	Berg 69176-010 (Housing) + Berg 47715-000 (Pins)	VersaLogic VL-CBR-1008	Interface from industry standard ATX power supply	20

* **Note:** This connector is a 2.00mm housing and crimp terminal, discrete wire style. Number of crimp terminals depends upon flat panel display model being used. Insulation displacement connector (IDC) for ribbon cable not recommended due to lack of clearance between connector JN3 and jumper header VN3.

‡ **Note:** The 12.00 in this part number specifies cable length. This part number has a 12" cable attached to the 10-pin 2mm connector.

HIGH DENSITY 80-PIN CABLE (JS1)

Cable assembly VL-CBL-8001 is used to break-out this high density connector into standard PC I/O connectors. This chart shows the pinout for the cable assembly.

Table 2: JS1 High Density 80-Pin Connector Pinout

JS1 Pin	External Connector	Pin	Signal
1A	**LPT1**	1	Strobe
2A	JA	14	Auto feed
3A		2	Data bit 1
4A		15	Printer error
5A		3	Data bit 2
6A		16	Reset
7A		4	Data bit 3
8A		17	Select input
9A		5	Data bit 4
10A		18	Ground
11A		6	Data bit 5
12A		19	Ground
13A		7	Data bit 6
14A		20	Ground
15A		8	Data bit 7
16A		21	Ground
17A		9	Data bit 8
18A		22	Ground
19A		10	Acknowledge
20A		23	Ground
21A		11	Port Busy
22A		24	Ground
23A		12	Paper End
24A		25	Ground
25A		13	Select
26A	**MISC**	—	No Connect
27A		—	Programmable LED+
28A		—	Programmable LED–
29A		—	Speaker +
30A		—	Speaker –
31A		—	IDE Data LED–
32A		—	IDE Data LED+
33A	**MOUSE**	4	+5V (Protected)
34A	JB	1	Mouse Data
35A		3	Ground
36A		5	Mouse Clock
37A	**KBD**	4	+5V (Protected)
38A	JC	1	Keyboard Data
39A		3	Ground
40A		5	Keyboard Clock

JS1 Pin	External Connector	Pin	Signal
1B	**USB CH0**	1	+5V (Protected)
2B	JD	6	Ground
3B		2	Channel 0 Data –
4B		7	Cable Shield
5B		3	Channel 0 Data +
6B		8	Channel 1 Data +
7B		4	Cable Shield
8B		9	Channel 1 Data –
9B		5	Ground
10B		10	+5V (Protected)
11B	**ETHERNET**	4	Isolated Ground
12B	JE	5	Isolated Ground
13B		6	Receive Data –
14B		3	Receive Data +
15B		7	Isolated Ground
16B		8	Isolated Ground
17B		2	Transmit Data –
18B		1	Transmit Data +
19B	**PBRESET**	—	Pushbutton Reset
20B		—	Ground
21B	**COM1**	1	Data Carrier Detect
22B	JF	6	Data Set Ready
23B		2	Receive Data
24B		7	Request to Send
25B		3	Transmit Data
26B		8	Clear to Send
27B		4	Data Terminal Ready
28B		9	Ring Indicator
29B		5	Ground
30B		—	No Connect
31B	**COM2**	1	Data Carrier Detect
32B	JG	6	Data Set Ready
33B		2	Receive Data
34B		7	Request to Send
35B		3	Transmit Data
36B		8	Clear to Send
37B		4	Data Terminal Ready
38B		9	Ring Indicator
39B		5	Ground
40B		—	No Connect

HIGH DENSITY 80-PIN CABLE (JS3)

Cable assembly VL-CBL-8002 is used to break-out this high density connector into standard PC I/O connectors. This chart shows the pinout for the cable assembly.

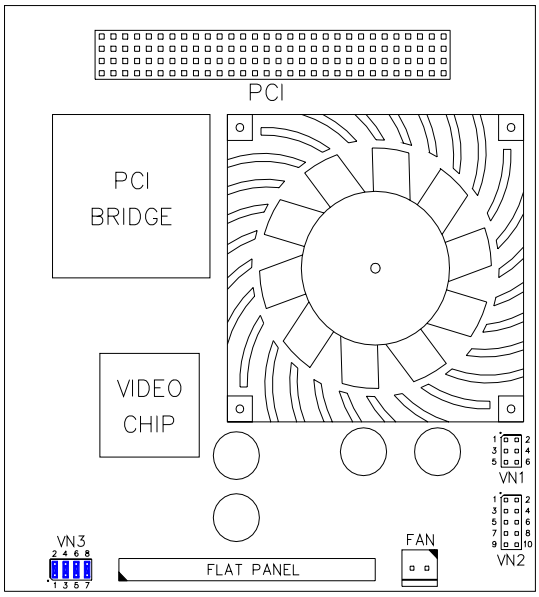
Table 3: JS3 High Density 80-Pin Connector Pinout

JS3 Pin	External Connector	Pin	Signal
1A	**IDE CH0**	1	Reset
2A	JH/JJ	2	Ground
3A		3	Data bit 7
4A		4	Data bit 8
5A		5	Data bit 6
6A		6	Data bit 9
7A		7	Data bit 5
8A		8	Data bit 10
9A		9	Data bit 4
10A		10	Data bit 11
11A		11	Data bit 3
12A		12	Data bit 12
13A		13	Data bit 2
14A		14	Data bit 13
15A		15	Data bit 1
16A		16	Data bit 14
17A		17	Data bit 0
18A		18	Data bit 15
19A		19	Ground
20A		20	No connection
21A		21	No connection
22A		22	Ground
23A		23	I/O write
24A		24	Ground
25A		25	I/O read
26A		26	Ground
27A		27	I/O Channel Ready
28A		28	No connection
29A		29	No connection
30A		30	Ground
31A		31	IRQ14
32A		32	Drive 16-bit I/O
33A		33	Address bit 1
34A		34	No connection
35A		35	Address bit 0
36A		36	Address bit 2
37A		37	Chip select 0
38A		38	Chip select 1
39A		39	Light Emitting Diode –
40A		40	Ground

JS3 Pin	External Connector	Pin	Signal
1B	**FLOPPY**	1	Ground
2B	JK/JL	2	Load Head
3B		3	Ground
4B		4	No Connection
5B		5	Ground
6B		6	No Connection
7B		7	Ground
8B		8	Beginning Of Track
9B		9	Ground
10B		10	Motor Enable 1
11B		11	Ground
12B		12	Drive Select 0
13B		13	Ground
14B		14	Drive Select 1
15B		15	Ground
16B		16	Motor Enable 0
17B		17	Ground
18B		18	Direction Select
19B		19	Ground
20B		20	Motor Step
21B		21	Ground
22B		22	Write Data Strobe
23B		23	Ground
24B		24	Write Enable
25B		25	Ground
26B		26	Track 0 Indicator
27B		27	Ground
28B		28	Write Protect
29B		29	Ground
30B		30	Read Data
31B		31	Ground
32B		32	Head Select
33B		33	Ground
34B		34	Drive Door Open
35B	**MISC**	1	Ground
36B	JM	2	+5V (Protected)
37B		3	General Purpose Output
38B		4	General Purpose Input
39B		5	Non Maskable Interrupt
40B		6	Interrupt Request Input

Jumper Block Locations

Note: Jumpers shown in as-shipped configuration.



EPM-CPU-6b	EPM-CPU-6c	EPM-CPU-6g EPM-CPU-7g	EPM-CPU-6h EPM-CPU-6j EPM-CPU-7h EPM-CPU-7j	EPM-CPU-7s EPM-CPU-7t	
266 MHz	233 MHz	400 MHz	266 MHz	266 MHz	
1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4 5 6	VN1
1 2 3 4 5 6 7 8 9 10	1 2 3 4 5 6 7 8 9 10	1 2 3 4 5 6 7 8 9 10	1 2 3 4 5 6 7 8 9 10	1 2 3 4 5 6 7 8 9 10	VN2

Figure 5. Jumper Block Locations (CPU Module)

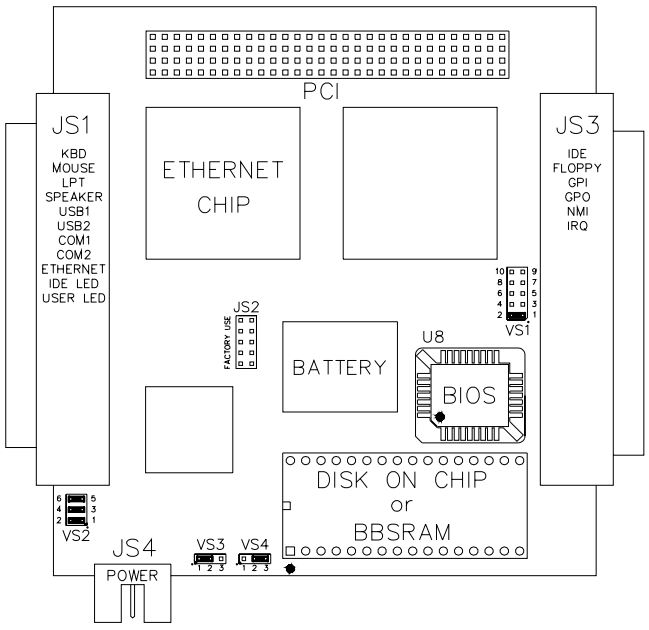
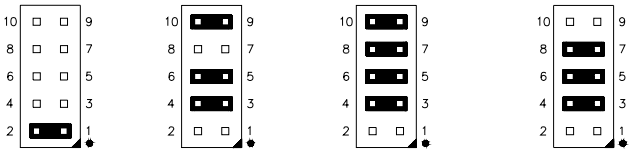
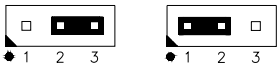


Figure 6. Jumper Block Locations (I/O Module)

JUMPER SUMMARY

Table 4: Jumper Summary

Jumper Block	Description	As Shipped	Page
VN1	**CPU Clock Speed Multiplier** **VN1[5-6] / VN1[3-4] / VN1[1-2] / Multiplier / Speed** Out / Out / In / 6.0 / 400 MHz Out / In / In / 2.5 / 166 MHz Out / In / Out / 3.0 / 200 MHz Out / Out / Out / 3.5 / 233 MHz In / Out / In / 4.0 / 266 MHz Out / In / In / 4.0 / 266 MHz* In / In / In / 4.5 / 300 MHz In / In / Out / 5.0 / 333 MHz In / Out / Out / 5.5 / 366 MHz **Note: For the Intel Tillamook 266 MHz CPU chips only.*	Varies	22
VN2	**CPU Core Voltage Selection** **VN2[9-10] / VN2[7-8] / VN2[5-6] / VN2[3-4] / VN2[1-2] / Voltage** In / In / Out / In / Out / 1.80 V **In / In / Out / In / In / 1.85 V** In / In / In / Out / Out / 1.90 V In / In / In / Out / In / 1.95 V In / In / In / In / Out / 2.00 V In / In / In / In / In / 2.05 V Out / Out / Out / Out / Out / 2.00 V Out / Out / Out / Out / In / 2.10 V **Out / Out / Out / In / Out / 2.20 V** Out / Out / Out / In / In / 2.30 V **Out / Out / In / Out / Out / 2.40 V** Out / Out / In / Out / In / 2.50 V Out / Out / In / In / Out / 2.60 V Out / Out / In / In / In / 2.70 V **Out / In / Out / Out / Out / 2.80 V** Out / In / Out / Out / In / 2.90 V Out / In / Out / In / Out / 3.00 V Out / In / Out / In / In / 3.10 V Out / In / In / Out / Out / 3.20 V Out / In / In / Out / In / 3.30 V Out / In / In / In / Out / 3.40 V Out / In / In / In / In / 3.50 V ***Note:*** *Do not confuse CPU Core Voltage with CPU I/O voltage. The EPM-CPU-6/7 will only work with CPU chips with an I/O voltage of 3.3V.*	Varies	22
VN3	**Flat Panel Selection** **VN3[7-8] / VN3[5-6] / VN3[3-4] / VN3[1-2] / Number / Type** In / In / In / In / — / — In / In / In / Out / 1 / 1024x768 Dual Scan STN Color In / In / Out / In / 2 / 128x1024 TFT Color In / In / Out / Out / 3 / 640x480 Dual Scan STN Color In / Out / In / In / 4 / 800x600 Dual Scan STN Color In / Out / In / Out / 5 / 640x480 Sharp TFT Color In / Out / Out / In / 6 / 640x480 18-bit TFT Color In / Out / Out / Out / 7 / 1024x768 TFT Color Out / In / In / In / 8 / 800x600 TFT Color Out / In / In / Out / 9 / 800x600 TFT Color Out / In / Out / In / 10 / 800x600 TFT Color Out / In / Out / Out / 11 / 800x600 Dual Scan STN Color Out / Out / In / In / 12 / 800x600 Dual Scan STN Color Out / Out / In / Out / 13 / 1024x768 TFT Color Out / Out / Out / In / 14 / 1280x1024 Dual Scan STN Color Out / Out / Out / Out / 15 / 1024x600 Dual Scan STN Color	—	—

Jumper Block	Description	As Shipped	Page
VS1	**COM2 Configuration** RS-232 RS-422 RS-485 Endpoint Station RS-485 Intermediate Station 	RS-232	26
VS2[1-2]	**System BIOS Selector** In — Primary System BIOS occupies F0000h to FFFFFh Out — Secondary System BIOS occupies F0000h to FFFFFh ***Note:*** *The secondary System BIOS is field upgradable using the BIOS upgrade utility. See www.VersaLogic.com/private/panthersupport.asp for further information.*	In	—
VS2[3-4]	**Video BIOS Selector** In — Primary Video BIOS occupies C0000h to C9FFFh Out — Secondary Video BIOS occupies C0000h to C9FFFh ***Note:*** *The secondary System BIOS is field upgradable using the BIOS upgrade utility. See www.VersaLogic.com/private/panthersupport.asp for further information.*	In	—
VS2[5-6]	**General Purpose Input Bit** In — Bit D1 in SCR register reads as 1 Out — Bit D1 in SCR register reads as 0	In	35,39
VS3	**32-Pin DIP Memory Socket Device Type Selector** BBSRAM DOC  ***Note:*** *The 32-pin socket must be enabled in CMOS Setup.*	DOC	25
VS4	**CMOS RAM and Real Time Clock Erase** Normal Operation Erase  ***Note:*** *Do not operate the board with the jumper in the erase position. Leave the jumper in position VS4[1-2] for at least one full minute to fully erase CMOS RAM.*	Normal	23

Power Supply

POWER CONNECTORS

Main power is applied to the *EPM-CPU-6/7* through a 10-pin polarized connector. Mating connector Berg 69176-010 (Housing) + Berg 47715-000 (Pins).

See page 13 for connector location information.

Warning! To prevent severe and possibly irreparable damage to the system, it is critical that the power connectors be wired correctly. Make sure to use all three +5VDC pins and all four ground pins to prevent excess voltage drop.

Table 5: Main Power Connector Pinout

JS4 Pin	Signal Name	Description
1	Ground	Ground
2	+5VDC	Power Input
3	Ground	Ground
4	+12VDC	Power Input
5	Ground	Ground
6	–12VDC	Power Input
7	+3.3VDC	Power Input
8	+5VDC	Power Input
9	Ground	Ground
10	+5VDC	Power Input

Note: The +3.3VDC, +12VDC, and –12VDC inputs are only required for expansion modules that require these voltages.

POWER REQUIREMENTS

The *EPM-CPU-6/7* only requires +5 volts (±5%) for proper operation. The voltage required for the RS-232 ports and analog input sections are generated with an on-board DC/DC converter. A variable low-voltage supply circuit provides power to the CPU and other on-board devices.

The exact power requirement of the *EPM-CPU-6/7* depends on several factors, including memory configuration, CPU speed, peripheral connections, type and number of expansion modules, and attached devices. For example, PS/2 keyboards typically draw their power directly from the *EPM-CPU-6/7*, and driving long RS-232 lines at high speed can increase power demand.

LITHIUM BATTERY

Warning! To prevent shorting, premature failure, or damage to the lithium battery, do not place the unit on a conductive surface such as metal, black conductive foam, or the outside surface of a metalized ESD protective pouch. The lithium battery may explode if mistreated. Do not recharge, disassemble, or dispose of in fire. Dispose of used batteries promptly.

Normal battery voltage should be at least 3.0V. If the voltage drops below 3.0V, contact the factory for a replacement (part number T-HB3/5-2). Life expectancy under normal use is approximately 10 years.

CPU

CPU Clock Speed Multiplier

Jumper block VN1 is used to multiply the on-board 66 MHz bus clock to match the internal clock speed of the CPU chip. For example, the 200 MHz CPU shown shown below uses a multiplier of 3.0

See page 17 for jumper configuration details.

CPU Core Voltage Selection

Jumper block VN2 is used to program a variable output voltage regulator to match the V_{CORE} power supply requirements of the CPU chip.

Heat Sink

A heat sink and cooling fan must be in place whenever power is applied to the CPU. The fan connects to header JN1 for power.

Table 6: Fan Power Connector

JN1 Pin	Signal Name	Function
1	GND	Ground
2	+5V	Fan Power

Note: A fan is not required for the low-power K6-2E model (h version) or Intel Tillamook (s version) models.

L2 Cache Memory

No configuration is required for the L2 Cache memory. The *EPM-CPU-6/7* is shipped with 512 MB of cache memory.

System RAM

Compatible Memory Modules

The *EPM-CPU-6/7* will accept one 144-pin SODIMM memory module with the following characteristics:

- Storage Capacity 8 to 256 MB
- Voltage 3.3 Volt
- Error Detection Not supported
- Error Correction Not supported
- Type EDO, 60 ns or SDRAM, 66 MHz or PC-100

CMOS RAM

CLEARING CMOS RAM

Jumper VS4 can be moved to position [1-2] for 30 seconds to erase the contents of the CMOS RAM. Be sure to move the jumper back to position [2-3] for normal operation.

Note: Operation with the jumper in the erase position [1-2] will cut-off all battery power to the CMOS RAM and Real Time Clock chip. The board will operate in this condition, however, this will force the board to use the factory default parameters as shown on page 7. For custom programming of the Factory Default Parameters, please contact the Customization Department at VersaLogic.

DEFAULT CMOS RAM SETUP VALUES

After the CMOS RAM is cleared, the system will load default CMOS RAM parameters the next time the board is powered on. The default CMOS RAM setup values will be used in order to boot the system whenever the main CMOS RAM values are blank, or when the system battery is dead or has been removed from the board.

USER DEFAULT CMOS RAM SETUP VALUES

Jumper V9 determines whether the factory defined default values, or a set of user default values are loaded when CMOS RAM values are corrupted or blank. In order for a custom (user defined) set of values to be used as the backup (default) CMOS RAM values, it is necessary to:

1. Use CMOS Setup to configure the CMOS RAM values exactly the way you want them to be permanently stored
2. Select "Save CMOS Settings to FLASH" on the main CMOS Setup screen.
3. Remove jumper V9[1-2]

Real Time Clock

The *EPM-CPU-6/7* features a year 2000 compliant, battery-backed 146818 compatible real time clock/calendar chip. Under normal battery conditions, the clock will maintain accurate timekeeping functions during periods when the board is powered off.

SETTING THE CLOCK

The CMOS Setup utility (accessed by pressing the [DEL] key during a system boot) can be used to set the time/date of the real time clock.

Battery Backed Static RAM

A 32-pin socket (U9 on the I/O module) will accept a battery-backed static RAM chip for non-volatile storage. We recommend using the Dallas 128Kx8 DS1645 series or the 512Kx8 DS1650/DS1250 series memory devices. They need to be a 32-pin, 0.6" DIP, 200nS or faster part. Make sure that jumper VS3 is in the [2-3] position, and the socket is enabled in CMOS Setup.

Disk on Chip

A 32-pin socket (U9 on the I/O module) will accept an M-Systems DiskOnChip (DOC) Flash Disk for non-volatile, read/write data storage. The DOC can be configured as a boot device

ENABLE / DISABLE

The DOC can be enabled or disabled through CMOS Setup by going into the Advanced Configuration screen and setting "32 Pin Socket" to "DOC" or "Disabled". When enabled, the DOC appears in the upper memory region as an 8K page frame from CE000h to CFFFFh.

When disabled, this memory range is freed up for other devices to use.

COMPATIBLE DEVICES

Any 5 Volt, M-Systems series rev 1.10 or later DOC device will work.

Note: DOC chips used must be low profile.

INSTALLING THE DOC CHIP

1. Align pin 1 on the DOC with pin 1 of socket U9 on the I/O module.
2. Push the DOC into the socket carefully until it is fully seated.
3. Make sure jumper VS3[1-2] is installed.

Warning! ***The DOC will be permanently damaged if installed incorrectly!*** When installing or removing the DOC, be sure to align pin-1 on the the chip with pin-1 on the socket. To prevent electrostatic damage, first touch a grounded surface to discharge any static electricity from your body.

CMOS SETUP

To enable the DOC as drive C on a system without a hard disk, set the CMOS setup of drive C to “not installed”, and reboot the computer.

Note: The DOC needs to be formatted with the System files in order for it to be a bootable drive. Refer to the M-Systems web site (www.m-sys.com) for documentation on the DOC 2000 and details on making it a bootable device.

Serial Ports

The *EPM-CPU-6/7* features two on-board 16550 based serial channels located at standard PC I/O addresses. COM1 is an RS-232 (115.2K baud) serial port.

COM2 can be operated in RS-232, RS-422, or RS-485 modes. Two additional non-standard baud rates are also available (programmable in the normal baud rate registers) of 230K and 460K baud.

Interrupt assignment for each COM port is handled in CMOS Setup, and each port can be independently enabled or disabled.

COM Port Configuration

There are no configuration jumpers for COM1 because it only operates in RS-232 mode.

Jumper VS1 is used to configure COM2 for RS-232/422/485 operation. See page 17 for jumper configuration details.

COM2 RS-485 Mode Line Driver Control

The TxD+/TxD– differential line driver can be turned on and off by manipulating the DTR handshaking line.

The following code example shows how to turn the line driver for COM2 on and off:

```
mov   dx,02FCh   ; Point to COM2 Modem Control register
in    al,dx      ; Fetch existing value
or    al,01h     ; Set bit D0
out   dx,al      ; Turn DTR on (enables line driver)

in    al,dx      ; Fetch existing value
and   al,0FEh    ; Clear bit D0
out   dx,al      ; Turn DTR off (disables line driver)
```

SERIAL PORT CONNECTORS

See the *Connector Location Diagram* on pages 13 and 14 for connector and cable information. The pinout of the DB9 connector applies to use of the VersaLogic transition cable #VL-CBL-8001.

Table 7: Connectors JF / JG — Serial Port Pinout

COM1 JS1 Pin	COM2 JS1 Pin	RS-232	RS-422	RS-485	JF/JG DB9 Pin
21B	31B	DCD	—	—	1
22B	32B	DSR	—	—	6
23B	33B	RXD*	TxD+	TxD+	2
24B	34B	RTS	TxD–	TxD–	7
25B	35B	TXD*	—	—	3
26B	36B	CTS	Ground	Ground	8
27B	37B	DTR	RxD–	TxD/RxD–	4
28B	38B	RI	RxD+	TxD/RxD+	9
29B	39B	Ground	Ground	Ground	5
30B	40B	N/C	—	—	—

Parallel Port

The *EPM-CPU-6/7* includes a standard bi-directional/EPP/ECP compatible LPT port which resides at the PC standard address of 378h. The port can be enabled/disabled and interrupt assignments can be made via the CMOS Setup screen. The pinout of the JA connector applies to use of the VersaLogic transition cable #VL-CBL-8001.

Table 8: LPT1 Parallel Port Pinout

JS1 Pin	Centronics Signal	Signal Direction	JA Pin
1A	Strobe	Out	1
2A	Auto feed	Out	14
3A	Data bit 1	In/Out	2
4A	Printer error	In	15
5A	Data bit 2	In/Out	3
6A	Reset	Out	16
7A	Data bit 3	In/Out	4
8A	Select input	Out	17
9A	Data bit 4	In/Out	5
10A	Ground	—	18
11A	Data bit 5	In/Out	6
12A	Ground	—	19
13A	Data bit 6	In/Out	7
14A	Ground	—	20
15A	Data bit 7	In/Out	8
16A	Ground	—	21
17A	Data bit 8	In/Out	9
18A	Ground	—	22
19A	Acknowledge	In	10
20A	Ground	—	23
21A	Port Busy	In	11
22A	Ground	—	24
23A	Paper End	In	12
24A	Ground	—	25
25A	Select	In	13

EIDE Hard Drive / CD-ROM Interfaces

One EIDE interface is available to connect up to two hard disk or CD-ROM drives. Use CMOS Setup to specify the drive parameters of the attached drives.

Some older IDE drives, such as those that are PIO Mode 0-1, do not operate reliably with this product. VersaLogic recommends the use of only PIO Mode 2-3 and Ultra DMA type drives with this product.

Warning! Cable length must be 18" or less to maintain proper signal integrity. The grounds in this connector should not be used to carry motor current.

Table 9: EIDE Hard Drive Connector Pinout

JS3 Pin	Signal Name	EIDE Signal Name	Function	JH/JJ Pin
1A	HRST*	Host Reset	Reset signal from CPU	1
2A	Ground	Ground	Ground	2
3A	IDE7	DATA 7	Data bit 7	3
4A	HD8	DATA 8	Data bit 8	4
5A	HD6	DATA 6	Data bit 6	5
6A	HD9	DATA 9	Data bit 9	6
7A	HD5	DATA 5	Data bit 5	7
8A	HD10	DATA 10	Data bit 10	8
9A	HD4	DATA 4	Data bit 4	9
10A	HD11	DATA 11	Data bit 11	10
11A	HD3	DATA 3	Data bit 3	11
12A	HD12	DATA 12	Data bit 12	12
13A	HD2	DATA 2	Data bit 2	13
14A	HD13	DATA 13	Data bit 13	14
15A	HD1	DATA 1	Data bit 1	15
16A	HD14	DATA 14	Data bit 14	16
17A	HD0	DATA 0	Data bit 0	17
18A	HD15	DATA 15	Data bit 15	18
19A	Ground	Ground	Ground	19
20A	NC	NC	No connection	20
21A	NC	NC	No connection	21
22A	Ground	Ground	Ground	22
23A	HWR*	HOST IOW*	I/O write	23
24A	Ground	Ground	Ground	24
25A	HRD*	HOST IOR*	I/O read	25
26A	Ground	Ground	Ground	26
27A	NC	NC	No connection	27
28A	HAEN	ALE	Address latch enable	28
29A	NC	NC	No connection	29
30A	Ground	Ground	Ground	30
31A	HINT	HOST IRQ14	IRQ14	31
32A	XI16*	HOST IOCS16*	Drive register enabled	32
33A	HA1	HOST ADDR1	Address bit 1	33
34A	NC	NC	No connection	34
35A	HA0	HOST ADDR0	Address bit 0	35
36A	HA2	HOST ADDR2	Address bit 2	36
37A	HCS0*	HOST CS0*	Reg. access chip select 0	37
38A	HCS1*	HOST CS1*	Reg. access chip select 1	38
39A	NC	NC	No connection	39
40A	Ground	Ground	Ground	40

Utility Connector

KEYBOARD/MOUSE INTERFACE

A standard PS/2 keyboard and mouse interface is accessible through connector JS1. In addition, you will find a programmable LED output, hard drive activity LED, and a speaker output as shown in the table below. The pinout of the PS/2 connectors applies to use of the VersaLogic transition cable #VL-CBL-8001.

Table 10: Utility Connector

JS1 Pin	Description	PS/2 Pin	
27A	Programmable LED +		
28A	Programmable LED –		
29A	Speaker +		
30A	Speaker –		
31A	IDE Drive Indicator LED –		
32A	IDE Drive Indicator LED +		
33A	Protected +5V	4	
34A	Mouse Data	1	
35A	Ground	3	← (JB) Mouse Connector
36A	Mouse Clock	5	
37A	Protected +5V	4	
38A	Keyboard Data	1	
39A	Ground	3	← (JC) Keyboard Connector
40A	Keyboard Clock	5	

PROGRAMMABLE LED

The high-density I/O connector JS1 includes an output signal for attaching a software controlled LED. Connect the cathode of the LED to JS1[28A]; anode to JS1[27A]. An on-board resistor limits the current to 15 mA when the circuit is turned on.

To turn the LED on and off, set or clear bit D7 in I/O port 0E0h (or 1E0h if selected in CMOS Setup). When changing the register, make sure not to alter the value of the other bits.

The following code examples show how to turn on and off the LED. Refer to page 42 for further information:

LED On

```
in    al,E0h
or    al,80h
out   E0h,al
```

LED Off

```
in    al,E0h
and   al,7Fh
out   E0,al
```

Note: The LED is turned on by the BIOS during system startup. This causes the light to function as a "power on" indicator if it is not otherwise controlled by user code.

EXTERNAL SPEAKER

A miniature 8 ohm speaker can be connected between JS1[29A] and JS1[30A].

PUSH-BUTTON RESET

A normally open, momentary action push-button reset switch can be connected between JS1[19B] and JS1[20B]. Shorting JS1[19B] to ground will cause the *EPM-CPU-6/7* to reboot.

Floppy Drive Interface

The *EPM-CPU-6/7* supports a standard 34-pin PC/AT style floppy disk interface via connector JS3[JK] and JS3[JL]. Up to two floppy drives can be attached. CMOS Setup can be used to enable or disable the floppy disk interface.

Note: The floppy drive used to boot the system (Drive A) should be connected after the twist in the cable, JS3[JK].

Warning! Cable length must be 18" or less to maintain proper signal integrity. The grounds in this connector should not be used to carry motor current.

Table 11: Floppy Disk Interface Connector Pinout

JS3 Pin	Signal Name	Function	JK/JL Pin
1B	Ground	Ground	1
2B	R/LC	Load Head	2
3B	Ground	Ground	3
4B	NC	No Connection	4
5B	Ground	Ground	5
6B	NC	No Connection	6
7B	Ground	Ground	7
8B	INDX*	Beginning Of Track	8
9B	Ground	Ground	9
10B	MTR1*	Motor Enable 1	10
11B	Ground	Ground	11
12B	DRV0*	Drive Select 0	12
13B	Ground	Ground	13
14B	DRE1*	Drive Select 1	14
15B	Ground	Ground	15
16B	MTR0*	Motor Enable 0	16
17B	Ground	Ground	17
18B	DIR	Direction Select	18
19B	Ground	Ground	19
20B	STEP*	Motor Step	20
21B	Ground	Ground	21
22B	WDAT*	Write Data Strobe	22
23B	Ground	Ground	23
24B	WGAT*	Write Enable	24
25B	Ground	Ground	25
26B	TRK0*	Track 0 Indicator	26
27B	Ground	Ground	27
28B	WPRT*	Write Protect	28
29B	Ground	Ground	29
30B	RDAT*	Read Data	30
31B	Ground	Ground	31
32B	HDSL	Head Select	32
33B	Ground	Ground	33
34B	DCHG	Drive Door Open	34

Video Interface

An on-board Asiliant Technologies 690X0 controller with 2MB video RAM on the EPM-CPU-6 and 4MB video RAM on the EPM-CPU-7 provides full SVGA video output capabilities for the *EPM-CPU-6/7*.

Windows 95/98/NT automatically detects the 65550 and installs native driver support for all resolutions and color depths. The 65550 is also supported by QNX and VXWorks operating systems.

VIDEO RESOLUTIONS

This table displays the *EPM-CPU-6/7* standard VESA SVGA modes and color depths.

Table 12: Video Resolutions

2 MB Video RAM *(EPM-CPU-6)*	**4 MB Video RAM** *(EPM-CPU-7)*
640 x 480, 16M colors	640 x 480, 16M colors
800 x 600, 16M colors	800 x 600, 16M colors
1024 x 768, 64K colors	1024 x 768, 16M colors
1280 x 1024, 256 colors	1280 x 1024, 64K colors
1600 X 1200, 16 colors	1600 X 1200, 64K colors

VIDEO OUTPUT CONNECTOR

See the *Connector Location Diagram* on page 13 for pin and connector location information. An adapter cable, part number VL-CBL-1007 is available to translate JN2 into a standard 15-pin D-Sub SVGA connector.

Table 13: Video Output Pinout

JN2 Pin	Signal Name	Function	Mini DB15 Pin
1	GND	Ground	6
2	CRED	Red Video	1
3	GND	Ground	7
4	CGRN	Green Video	2
5	GND	Ground	8
6	CBLU	Blue Video	3
7	GND	Ground	5
8	CHSYNC	Horizontal Sync	13
9	GND	Ground	10
10	CVSYNC	Vertical Sync	14

FLAT PANEL DISPLAY CONNECTOR

See the *Connector Location Diagram* on page 13 for pin and connector location information.

Table 14: Flat Panel Display Pinout

JN3 Pin	Signal Name	Function	Mono SS 8-bit	Mono DD 8-bit	Mono DD 16-bit	Color TFT 9/12/ 16-bit	Color TFT 18/24 bit	Color TFT HR 18/24 bit	Color STN STN SS 8-bit (X4bP)	Color STN SS 16-bit (4bP)	Color STN DD 8-bit (4bP)	Color STN DD 16-bit (4bP)	Color STN DD 24-bit
1	+12V	Power Supply											
2	+12V	Power Supply											
3	GND	Ground											
4	GND	Ground											
5	+5V	Power Supply											
6	+5V	Power Supply											
7	ENAVEE	Power sequencing control for LCD bias voltage											
8	GND	Ground											
9	P0	Data Output		UD3	UD7	B0	B0	B00	R1	R1	UR1	UR0	UR0
10	P1	" "		UD2	UD6	B1	B1	B01	B1	G1	UG1	UG0	UG0
11	P2	" "		UD1	UD5	B2	B2	B02	G2	B1	UB1	UB0	UB0
12	P3	" "		UD0	UD4	B3	B3	B03	R3	R2	UR2	UR1	LR0
13	P4	" "		LD3	UD3	B4	B4	B10	B3	G2	LR1	LR0	LG0
14	P5	" "		LD2	UD2	G0	B5	B11	G4	B2	LG1	LG0	LB0
15	P6	" "		LD1	UD1	G1	B6	B12	R5	R3	LB1	LB0	UR1
16	P7	" "		LD0	UD0	G2	B7	B13	B5	G3	LR2	LR1	UG1
17	P8	" "	P0		LD7	G3	G0	G00	SHF CLKU	B3		UG1	UB1
18	P9	" "	P1		LD6	G4	G1	G01		R4		UB1	LR1
19	P10	" "	P2		LD5	G5	G2	G02		G4		UR2	LG1
20	P11	" "	P3		LD4	R0	G3	G03		B4		UG2	LB1
21	P12	" "	P4		LD3	R1	G4	G10		R5		LG1	UR2
22	P13	" "	P5		LD2	R2	G5	G11		G5		LB1	UG2
23	P14	" "	P6		LD1	R3	G6	G12		B5		LR2	UB2
24	P15	" "	P7		LD0	R4	G7	G13		R6		LG2	LR2
25	P16	" "					R0	R00					LG2
26	P17	" "					R1	R01					LB2
27	P18	" "					R2	R02					UR3
28	P19	" "					R3	R03					UG3
29	P20	" "					R4	R10					UB3
30	P21	" "					R5	R11					LR3
31	P22	" "					R6	R12					LG3
32	P23	" "					R7	R13					LB3
33	GND	Ground											
34	GND	Ground											
35	SHFCLK	Shift Clock. Pixel clock for flat panel data.	SHF CLK	SHF CLK	SHF CLK	SHF CLK	SHF CLK	SHF CLK	SHF CLK	SHF CLK	SHF CLK	SHF CLK	SHF CLK
36	FLM	First Line Marker. Flat panel equivalent of VSYNC.											
37	DE	Display Enable or M signal (ADCCLK) or BLANK#											
38	LP	Latch Pulse. Flat panel equivalent of HSYNC.											
39	GND	Ground											
40	ENABKL	Enable Backlight. Can be programmed for other functions.											
41	DDCDATA	Serial Data											
42	DDCCLK	Serial Data											
43	+3V	Power Supply											
44	+3V	Power Supply											

COMPATIBLE FLAT PANEL DISPLAYS

The following list of flat panel displays are reported to work properly with the Asiliant Technologies 690X0 video controller chip used on the *EPM-CPU-6/7*:

- Fujitsu FLC31SVC6S
- Hitachi D01VC1CAA
- Hitachi LMG9970ZWCC
- Hitachi LMG9972ZWCC
- Hitachi TX34D61VC1CAD
- NEC NL8060BC31-01
- Optrex DMF-50714NCU-FW (1024x768 DSTN)
- Samsung LT121-103
- Samsung LT133X1-104
- Samsung LT133X1-124
- Sanyo LM-GK53-22NTX (DSTN)
- Sanyo LM-GD53-22NAZ
- Sharp LM15X80 (XGA DSTN)
- Sharp LQ14X01
- Sharp LQ9D03B (640x480 TFT)
- Toshiba LTM12C016
- Toshiba LTM10C209

FLAT PANEL DISPLAY SELECTION

The video BIOS shipped with the *EPM-CPU-6/7* supports up to 15 different flat panel configurations. Use jumper block VN3 to select which type of panel is used, and make sure to configure CMOS Setup to enable flat panel support.

See page 18 for jumper configuration details.

Ethernet Interface

The *EPM-CPU-6/7* features an industry-standard 10baseT / 100baseTX Ethernet interface based on the AMD AM97C973 interface chip. While this interface is not NE2000 compatible, the AM97C9xx series is widely supported. Drivers are readily available to support a variety of operating systems such as QNX, VxWorks and other RTOS vendors. Win95/98/NT ship with built-in support for this Ethernet interface. The drivers load automatically when the operating system is installed.

SOFTWARE CONFIGURATION

The CMOS Setup screen is used to enable or disable the Ethernet interface.

ETHERNET CONNECTOR

Table 15: RJ45 Ethernet Connector

JS1 Pin	Signal Name	Function	JE Pin
11B	IGND	Isolated Ground	4
12B	IGND	Isolated Ground	5
13B	R–	Receive Data –	6
14B	R+	Receive Data +	3
15B	IGND	Isolated Ground	7
16B	IGND	Isolated Ground	8
17B	T–	Transmit Data –	2
18B	T+	Transmit Data +	1

Ethernet Status

LED D1 provides an onboard indication of the current condition of the board's Ethernet functionality.

Yellow = 10/100
On = 10 Base T
Off = 100 Base T
Green = Link/Activity
On = (solid) Link
Off = (Flickers) Blinks Activity

Watchdog Timer

A watchdog timer circuit is included on the *EPM-CPU-6/7* to reset the CPU if proper software execution fails or a hardware malfunction occurs.

ENABLING THE WATCHDOG

To enable or disable the watchdog, set or clear bit D0 in I/O port 0E0h (or 1E0h if selected in CMOS Setup). When changing the contents of the register, make sure not to alter the value of the other bits.

The following code example enables the watchdog:

```
in    al,E0h
or    al,01h
out   E0h,al
```

The Watchdog will be enabled after the first Watchdog refresh is performed.

Note: The watchdog timer powers up in a disabled state.

REFRESHING THE WATCHDOG

If the watchdog timer is enabled, software must periodically refresh the watchdog timer at a rate faster than the timer is set to expire (250 ms minimum). Outputting a 5Ah to the *Watchdog Timer Hold-Off Register* at 0E1h (or 1E1h if selected in CMOS Setup) resets the watchdog time-out period, preventing the CPU from being reset for the next 250 ms. See page 43 for additional information.

The following code example refreshes the watchdog:

```
mov   al,5Ah
out   E1h,al
```

CPU Temperature Monitor

A thermometer circuit is located directly under the CPU chip which constantly monitors the case temperature of the CPU. This circuit can be used to detect over-temperature conditions which can result from fan or heat sink failure or excessive ambient temperatures.

CMOS Setup is used to set the temperature detection threshold. A status bit in the *Special Control Register* can be read to determine if the case temperature is above or below the threshold.

The system can be configured to generate a Non-Maskable Interrupt (NMI) when the temperature exceeds the threshold.

See page 42 for additional information.

USB1.0 Interface

A USB 1.0 (Universal Serial Bus) connector provides a common interface to connect a wide variety of keyboards, modems, mice, and telephony devices to the *EPM-CPU-6/7*. With USB 1.0, there is no need to have separate connectors for many common PC peripherals.

The USB 1.0 interface on the *EPM-CPU-6/7* is OHCI (Open Host Controller Interface) compatible, which provides a common industry software/hardware interface.

Note: The USB 1.0 interface must be enabled in CMOS Setup.

Table 16: USB 1.0 Interface Connector

JS1 Pin	Signal Name	Function	JD Pin
1B	USBPWR1	+5V (Protected)	1
2B	GND	Cable Shield	6
3B	USBP00	Channel 0 Data –	2
4B	GND1	Digital Ground	7
5B	USBP01	Channel 0 Data +	3
6B	USBP11	Channel 1 Data +	8
7B	GND1	Digital Ground	4
8B	USBP10	Channel 1 Data –	9
9B	GND	Cable Shield	5
10B	USBPWR1	+5V (Protected)	10

Warning! Connector JD is not numbered in the conventional manner as most dual-row headers. Care must be taken to attach the USB 1.0 adapter cables as shown below to prevent voltage reversal.

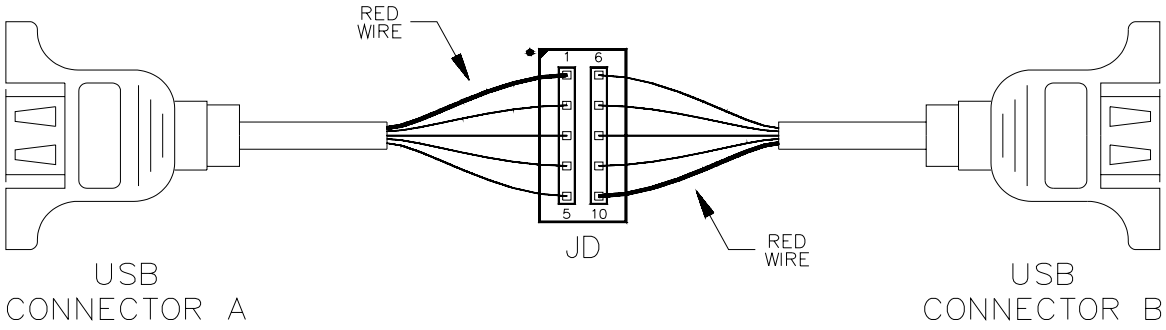


Figure 7. USB 1.0 Connector Orientation Diagram

Expansion Bus

The *EPM-CPU-6/7* will accept up to four PC/104 and/or two PC/104-*Plus* expansion modules. Both 3.3V and 5.0V modules are supported.

PC/104-*PLUS*

PC/104-*Plus* modules can be secured directly to the underside of the *EPM-CPU-6/7*. Since circuitry on the *EPM-CPU-6/7* takes up PCI slot positions 2 and 3, the first added module is called "Slot 0", the next module is "Slot 1". Make sure to correctly configure the "slot position" jumpers on each PC/104-*Plus* module appropriately.

The BIOS automatically configures the I/O ports and Memory map allocation, including allocation of interrupts.

PC/104

PC/104 modules are stacked under the *EPM-CPU-6/7* (under any PC/104-*Plus* modules); 16-bit modules first followed by 8-bit PC/104 modules. If necessary, a 40-pin and 64-pin ISA feedthrough connector "extender", and long standoffs may need to be used to provide adequate clearance between the PCI connector and the components on the top side of the PC/104 module.

I/O CONFIGURATION

PC/104–*Plus* Modules

No configuration is necessary except to jumper the expansion module for the correct slot number.

PC/104 Modules

PC/104 I/O modules should be addressed in the 100h – 3FFh address range. Care must be taken to avoid the I/O addresses shown in the *On-Board I/O Devices* table on page 40. These ports are used by on-board peripherals and video devices.

Memory and I/O Map

MEMORY MAP

The lower 1 MB memory map of the *EPM-CPU-6/7* is arranged as shown in the following table.

Various blocks of memory space between A0000h and FFFFFh can be shadowed. CMOS setup is used to enable or disable this feature.

Table 17: Memory Map

Start Address	End Address	Comment
F0000h	FFFFFh	System BIOS
E0000h	EFFFFh	BBSRAM, or Flash Page Frame
D0000h	DFFFFh	PC/104
CE000h	CFFFFh	DOC
CC000h	CDFFFh	Nothing
C0000h	CBFFFh	Video BIOS
A0000h	BFFFFh	Video RAM
00000h	9FFFFh	System DRAM

Note: The memory region from E0000h-EFFFFh is controlled by the Map and Paging Control Register.

I/O MAP

The following table lists the common I/O devices in the *EPM-CPU-6/7* I/O map. User I/O devices should be added in the 100h – 3FFh range, using care to avoid the devices already in the map as shown below.

Table 18: On-Board I/O Devices

I/O Device	Standard I/O Addresses	Alternate * I/O Addresses
Special Control Register	0E0h	1E0h
Watchdog Hold-Off Register	0E1h	1E1h
Digital Control / Analog Status Register	0E2h	1E2h
Map and Paging Control Register	0E3h	1E3h
Primary Hard Drive Controller	1F0h – 1F7h	
COM2 Serial Port	2F8h – 2FFh	
LPT1 Parallel Port	378h – 37Fh	
SVGA Video	3B0h – 3DFh	
Floppy Disk Controller	3F0h – 3F7h	
COM1 Serial Port	3F8h – 3FFh	

* User selectable via CMOS Setup.

Note: I/O ports occupied by on-board devices are freed up when the device is disabled in CMOS Setup.

Interrupt Configuration

The *EPM-CPU-6/7* has the standard complement of PC type interrupts. Ten non-shared interrupts are routed to the PC/104 bus, and up to four IRQ lines are automatically allocated as needed to PCI devices.

There are no interrupt configuration jumpers. All configuration is handled through CMOS setup. The switches in the diagram below indicate the various CMOS Setup options. Closed switches show factory default settings.

The temperature monitor interrupt is enabled/disabled with bit D3 (NMIEN) in the *Special Control Register*.

Note: If your design needs to use interrupt lines on the PC/104 bus, we recommend using IRQ5, IRQ9, and/or IRQ10. Make sure to configure CMOS Setup with the chosen PC/104 interrupts. This prevents their allocation to PCI devices.

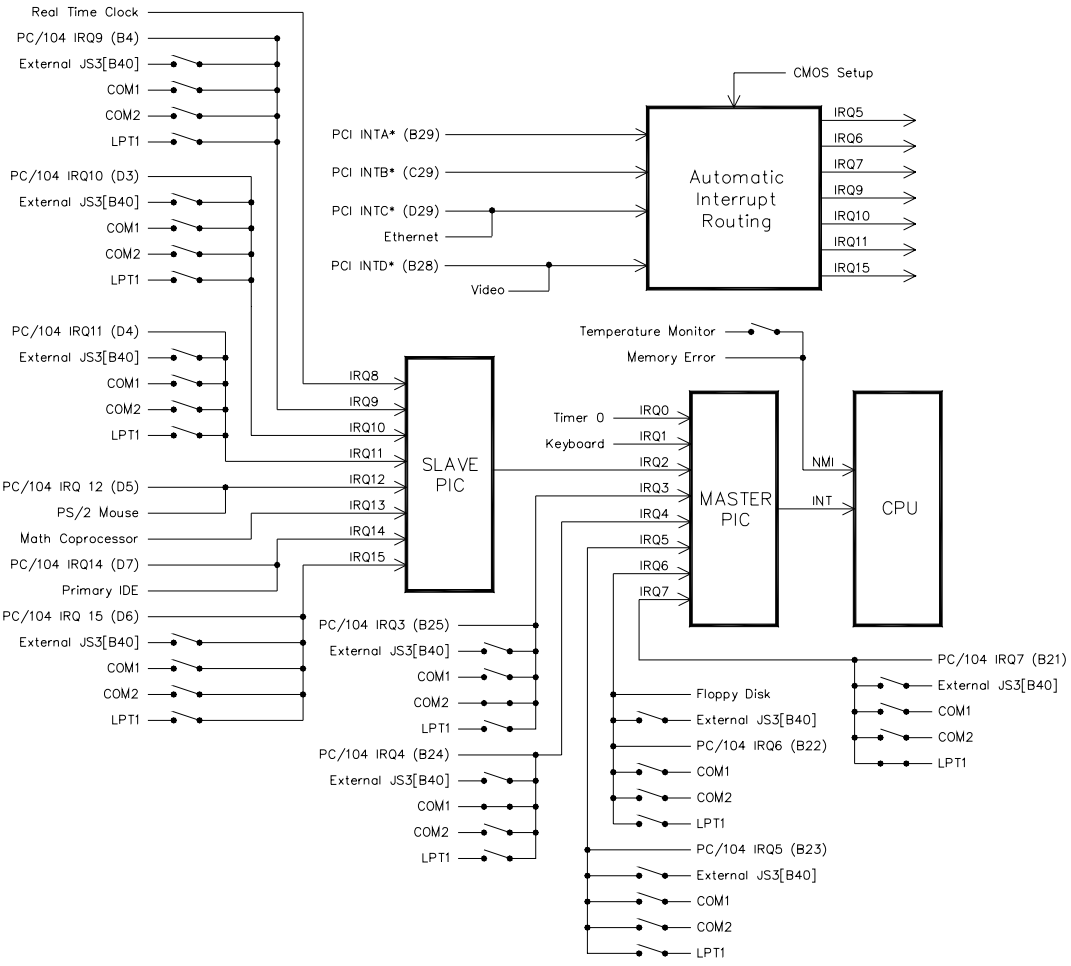


Figure 8. Interrupt Circuit Diagram

Special Control Register

SCR (READ/WRITE) 00E0h (or 01E0h via CMOS Setup)

D7	D6	D5	D4	D3	D2	D1	D0
LED	TEMP	GPI	GPO	NMIEN	ETHDIS	JPI	WDOGEN

Table 19: Special Control Register Bit Assignments

Bit	Mnemonic	Description
D7	LED	**Light Emitting Diode** — Controls the programmable LED connected to JS1[27A/28A] LED = 0 Turns LED off. LED = 1 Turns LED on.
D6	TEMP	**Temperature Status** — Indicates CPU case temperature. TEMP = 0 CPU case temperature is below value set in CMOS Setup TEMP = 1 CPU case temperature is above value set in CMOS Setup ***Note:*** *This bit is a read-only bit.*
D5	GPI	**General Purpose Input** — Indicates the status of TTL input at JS3[B38]. GPI = 0 Logic High GPI = 1 Logic Low ***Note:*** *This bit is a read-only bit.*
D4	GPO	**General Purpose Output** — Controls TTL output at JS3[37B]. GPO = 0 Logic High GPO = 1 Logic Low
D3	NMIEN	**Non-Maskable Interrupt Enable** — Controls the generation of Non-Maskable Interrupts whenever the CPU temperature sensor detects an over-temperature condition. NMIEN = 0 Disable NMIEN = 1 Enable
D2	ETHDIS	**Ethernet Disable** — Enables and disables the Ethernet port. ETHDIS = 0 Enables Ethernet port. ETHDIS = 1 Disables Ethernet port.
D1	JPI	**Jumper Input** — Indicates the status of jumper VS2[5-6] JPI = 0 Jumper VS2[5-6] = Out JPI = 1 Jumper VS2[5-6] = In ***Note:*** *This general purpose bit is read-only.*
D0	WDOGEN	**Watchdog Enable** — Enables and disables the watchdog timer reset circuit. WDOGEN = 0 Disables the watchdog timer. WDOGEN = 1 Enables the watchdog timer.

Revision Indicator Register

REVIND (READ ONLY) 00E1h (or 01E1h via CMOS Setup)

D7	D6	D5	D4	D3	D2	D1	D0
PC4	PC3	PC2	PC1	PC0	REV2	REV1	REV0

This register is used to indicate the revision level of the *EPM-CPU-6/7* product.

Bit	Mnemonic	Description
D7-D3	PC4-PC0	**Product Code** — These bits are hard coded to represent the product type. The EPM-CPU-6/7 will always read as 11100. Other codes are reserved for future products. **PC4 PC3 PC2 PC1 PC0 Product Code** 1 1 1 0 0 EPM-CPU-6/7 ***Note:*** *This bits are read-only.*
D2-D0	REV2-REV0	**Revision Level** — These bits are represent the EPM-CPU-6/7 circuit revision level. **REV2 REV1 REV0 Revision Level** 0 0 0 Rev 2 (Initial product release) 0 0 1 Rev 3 (EPM-CPU-7 only) 0 1 0 Reserved 0 1 1 Reserved 1 0 0 Reserved 1 0 1 Reserved 1 1 0 Reserved 1 1 1 Reserved ***Note:*** *This bits are read-only.*

Watchdog Timer Hold-Off Register

WDHOLD (WRITE ONLY) 00E1h (or 01E1h via CMOS Setup)

D7	D6	D5	D4	D3	D2	D1	D0
0	1	0	1	1	0	1	0

A watchdog timer circuit is included on the EPM-CPU-6/7 board to reset the CPU if proper software execution fails or a hardware malfunction occurs. The watchdog timer is enabled/disabled by writing to bit D0 of SCR

If the watchdog timer is enabled, software must periodically refresh the watchdog timer at a rate faster than the timer is set to expire (250 ms minimum). Writing a 5Ah to WDHOLD resets the watchdog timeout period, preventing the CPU from being reset for the next 250 ms.

Map and Paging Control Register

{xe "Memory:Control Registers:Map and Paging Control (MPCR)"}
{xe "Memory:FLASH Page Frame"}

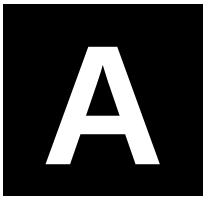
MPCR (READ/WRITE) 00E3H (or 01E3h via CMOS Setup)

D7	D6	D5	D4	D3	D2	D1	D0
FPGEN	Reserved	SPGEN	DPGEN	Reserved	PG2	PG1	PG0

Table 20: Map and Paging Control Register Bit Assignments

Bit	Mnemonic	Description
D7	FPGEN	**FLASH Paging Enable** — Enables a 64K page frame from E0000h to EFFFFh. Used to gain access to the on-board FLASH memory. FPGEN = 0 FLASH page frame disabled. FPGEN = 1 FLASH page frame enabled. ***Note:*** *This bit is for factory use only. It is used to write user default CMOS setup values to FLASH and to upgrade the system BIOS. When FPGEN = 1, the Page Select bits are used to access various blocks within the FLASH.*
D6	—	**Reserved** — This bit has no function.
D5	SPGEN	**Battery Backed Static RAM Paging Enable** — Enables a 64K page frame from E0000h to EFFFFh. Used to gain access to an optional Dallas Semiconductor Battery-Backed Static RAM chip plugged into socket U9 (512KB max.) SPGEN = 0 BBSRAM page frame disabled. SPGEN = 1 BBSRAM page frame enabled. ***Note:*** *When SPGEN = 1, the Page Select bits are used to access various 64K blocks within the BBSRAM chip.*
D4	DPGEN	**DiskOnChip Enable** — Enables a 8K page frame from CE000h to CFFFFh. Used to gain access to the Disk on Chip DPGEN = 0 DOC page frame disabled. DPGEN = 1 DOC page frame enabled. ***Note:*** *The Page Select bits are not used when accessing the DOC.*
D3	—	**Reserved** — This bit has no function.
D2-D0	PG2-PG0	**Page Select** — Selects which 64K block of FLASH or BBSRAM will be mapped into the page frame at E0000h to EFFFFh **PG2 PG1 PG0 — Memory Range within FLASH or BBSRAM** 0 0 0 — 000000h to 00FFFFh 0 0 1 — 010000h to 01FFFFh 0 1 0 — 020000h to 02FFFFh 0 1 1 — 030000h to 03FFFFh 1 0 0 — 040000h to 04FFFFh 1 0 1 — 050000h to 05FFFFh 1 1 0 — 060000h to 06FFFFh 1 1 1 — 070000h to 07FFFFh

Appendix A — Other References



PC Chipset *ALi Aladdin IV+ Chipset*	Acer Laboratories Inc., (www.acerlabs.com)
Ethernet Controller *AMD 79C973 (from the PC Net Family of devices)*	Advanced Micro Devices, (www.amd.com)
Video Controller *690X0*	Asiliant Technologies., (www.asiliant.com)
Disk On Chip *DOC2000*	M-Systems Inc., (www.m-sys.com)
PC/104 Specification *PC/104 Resource Guide*	PC/104 Consortium, (www.controlled.com/pc104)
PC/104-*Plus* Specification *PC/104 Resource Guide*	VersaLogic Corp., (www.VersaLogic.com)
CPU Chips *K6 & K6-2* *Pentium*	 Advanced Micro Devices, (www.amd.com) Intel Corporation, (www.intel.com)
General PC Documentation *The Programmer's PC Sourcebook*	Microsoft Press, mspress.microsoft.com
General PC Documentation *The Undocumented PC*	www.amazon.com