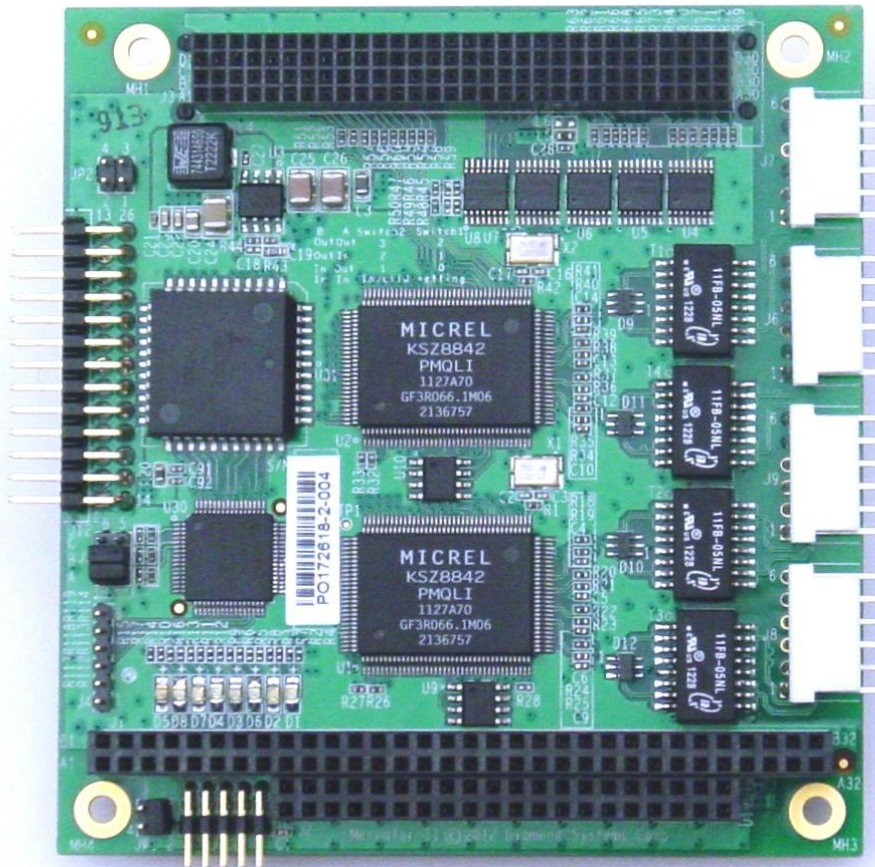




# Mercator II User Manual

PC/104-Plus I/O Module with 2 Dual 10/100 Ethernet Switches and DIO



Revision	Date	Comment
A	11/19/2012	Initial Release
A.1	5/2/13	Minor update with enhanced Ethernet description

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## 1. IMPORTANT SAFE HANDLING INFORMATION



### WARNING!

#### ESD-Sensitive Electronic Equipment

Observe ESD-safe handling procedures when working with this product.

Always use this product in a properly grounded work area and wear appropriate ESD-preventive clothing and/or accessories.

Always store this product in ESD-protective packaging when not in use.

#### Safe Handling Precautions

The Epsilon board contains a high density connector with many connections to sensitive electronic components. This creates many opportunities for accidental damage during handling, installation and connection to other equipment. The list here describes common causes of failure found on boards returned to Diamond Systems for repair. This information is provided as a source of advice to help you prevent damaging your Diamond (or any vendor's) boards.

**ESD damage** – This type of damage is usually almost impossible to detect, because there is no visual sign of failure or damage. The symptom is that the board eventually simply stops working, because some component becomes defective. Usually the failure can be identified and the chip can be replaced. To prevent ESD damage, always follow proper ESD-prevention practices when handling computer boards.

**Damage during handling or storage** – On some boards we have noticed physical damage from mishandling. A common observation is that a screwdriver slipped while installing the board, causing a gouge in the PCB surface and cutting signal traces or damaging components.

Another common observation is damaged board corners, indicating the board was dropped. This may or may not cause damage to the circuitry, depending on what is near the corner. Most of our boards are designed with at least 25 mils clearance between the board edge and any component pad, and ground / power planes are at least 20 mils from the edge to avoid possible shorting from this type of damage. However these design rules are not sufficient to prevent damage in all situations.

A third cause of failure is when a metal screwdriver tip slips, or a screw drops onto the board while it is powered on, causing a short between a power pin and a signal pin on a component. This can cause overvoltage / power supply problems described below. To avoid this type of failure, only perform assembly operations when the system is powered off.

Sometimes boards are stored in racks with slots that grip the edge of the board. This is a common practice for board manufacturers. However our boards are generally very dense, and if the board has components very close to the board edge, they can be damaged or even knocked off the board when the board tilts back in the rack. Diamond recommends that all our boards be stored only in individual ESD-safe packaging. If multiple boards are stored together, they should be contained in bins with dividers between boards. Do not pile boards on top of each other or cram too many boards into a small location. This can cause damage to connector pins or fragile components.

**Power supply wired backwards** – Our power supplies and boards are not designed to withstand a reverse power supply connection. This will destroy each IC that is connected to the power supply (i.e. almost all ICs). In this case the board will most likely will be unrepairable and must be replaced. A chip destroyed by reverse power or by excessive power will often have a visible hole on the top or show some deformation on the top surface due to vaporization inside the package. **Check twice before applying power!**

**Overvoltage on analog input** – If a voltage applied to an analog input exceeds the design specification of the board, the input multiplexor and/or parts behind it can be damaged. Most of our boards will withstand an erroneous connection of up to  $\pm 35V$  on the analog inputs, even when the board is powered off, but not all boards, and not in all conditions.

**Overvoltage on analog output** – If an analog output is accidentally connected to another output signal or a power supply voltage, the output can be damaged. On most of our boards, a short circuit to ground on an analog output will not cause trouble.

**Overvoltage on digital I/O line** – If a digital I/O signal is connected to a voltage above the maximum specified voltage, the digital circuitry can be damaged. On most of our boards the acceptable range of voltages connected to digital I/O signals is 0-5V, and they can withstand about 0.5V beyond that (-0.5 to 5.5V) before being damaged. However logic signals at 12V and even 24V are common, and if one of these is connected to a 5V logic chip, the chip will be damaged, and the damage could even extend past that chip to others in the circuit.

## 2. INTRODUCTION

Mercator II is a PC/104-*Plus* I/O module with two dual 10/100 Ethernet switches. Each switch occupies a single PCI slot. All four Ethernet ports are brought out to a 6-pin header. 24 digital I/O lines are available on a 26-pin header. The board contains both PC/104 (ISA) and PC/104-*Plus* (PCI) stackthrough connectors. All circuitry is driven by and accessed by the PCI bus, the ISA connector is only used for pass-through. Mercator II requires +5VDC input power and operates over the industrial temperature range of -40°C to +85°C.

### 2.1 Main Feature List

- ◆ Two dual 10/100 Ethernet switches
- ◆ Four Ethernet ports accessible with pin headers
- ◆ On-board magnetics for a complete circuit for each port
- ◆ On-board status LEDs plus connector for off-board LED access
- ◆ Selectable PCI slots: 0-1, 1-2, and 2-3
- ◆ 24 digital I/O lines

### 2.2 Operating Systems Support

- ◆ Windows Embedded Standard 7
- ◆ Linux 2.6.xx

### 2.3 Mechanical and Environmental

- ◆ PC/104 form factor: 3.55" x 3.775"
- ◆ PCI interface is compatible with both 5V and 3.3V bus signaling
- ◆ Power input: +5VDC +/- 5%
- ◆ -40°C to +85°C ambient operating temperature with convection cooling

### 2.4 Model Numbers

<b><i>Model Number</i></b>	<b><i>Description</i></b>
MRC-424-XT	PC/104- <i>Plus</i> dual PCI 2-port Ethernet switch and 24 digital I/O

### 2.5 Cable List

<b><i>Part Number</i></b>	<b><i>Cable Description</i></b>
C-PRZ-02	Ethernet pin header cable, 6-pin header to RJ-45
C-26-18	Digital I/O cable

### 3. FUNCTIONAL OVERVIEW

#### 3.1 Functional Block Diagram

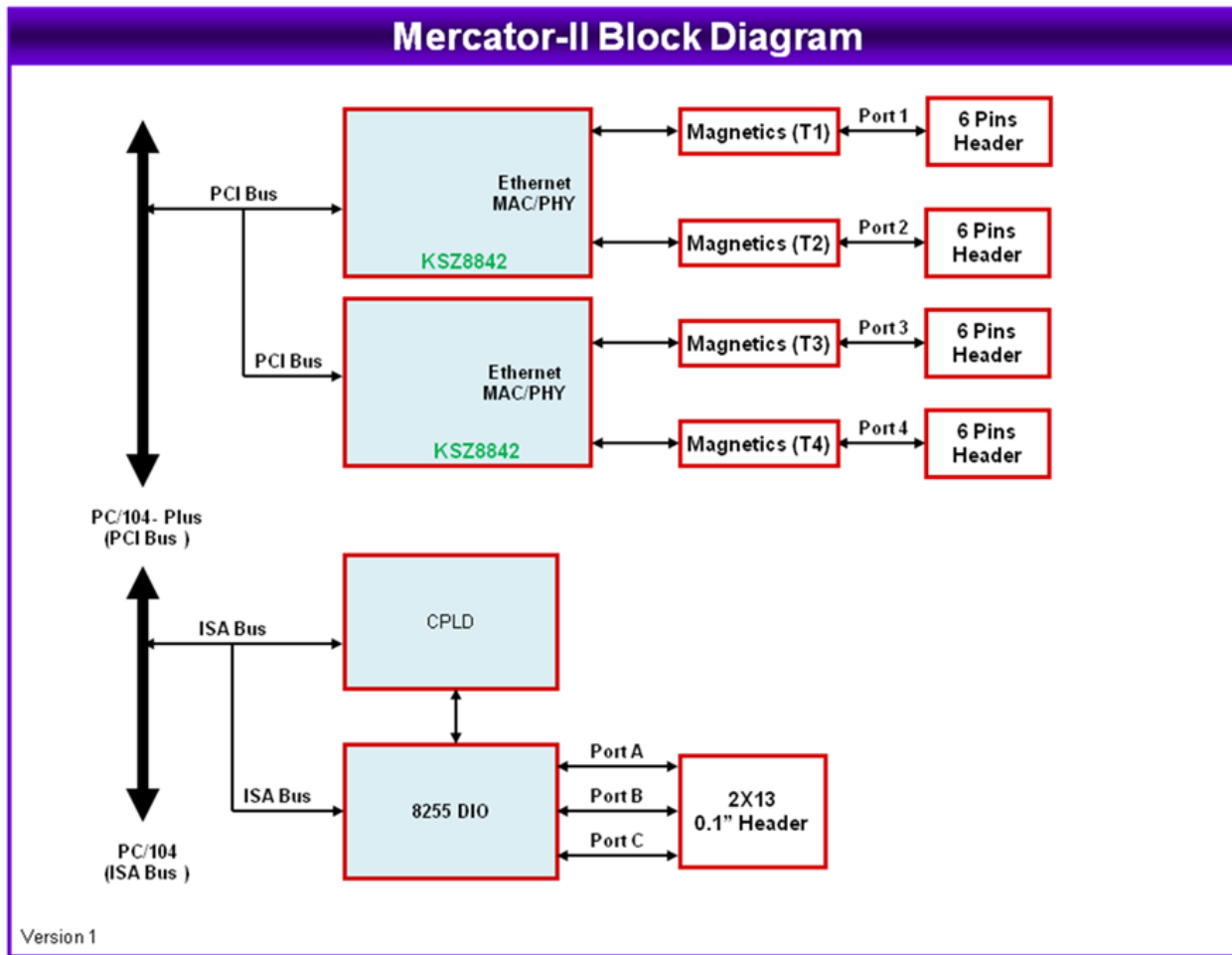


Figure 1. Functional Block Diagram

Mercator II is a PC/104-Plus I/O module with two dual 10/100 Ethernet switches. Each switch occupies a single PCI slot. Each Ethernet port is brought out to a 6-pin header. The board contains both PC/104 (ISA) and PC/104-Plus (PCI) stackthrough connectors. All circuitry is driven by and accessed by the PCI bus, the ISA connector is only used for pass-through. Mercator II requires +5VDC input power and operates over the industrial temperature range of -40°C to +85°C.

## 3.2 Ethernet

The Ethernet circuits consist of two Micrel dual 10/100 Ethernet switches. Each chip has a unique MAC address; therefore, only two Ethernet ports are visible to the end user for active communication. The other two ports work in switch fashion to enable daisy chaining of networks with one port on the chip as an uplink to a network while the other port provides active communication on the network.

The Micrel switch chip has a feature of accepting additional MAC addresses. This feature is enabled only in the Linux driver and is not supported in Windows. The feature can be enabled in the Linux driver by supplying a "multi\_dev=1" parameter to the driver. This can be done using the insmod command for dynamic driver uploading or putting "ksz884x.multi\_dev=1" in the Linux command line. This command turns off the switch capability and operates each port on the chip independently.

Each chip has an independent PCI interface for communication with the host CPU and each port contains its own magnetics to provide a complete circuit. All of the four ports are brought out to one of two 6-pin connectors.

## 3.3 PCI Slot Configuration

The PCI slot for each switch chip is selected with bus switches on jumper block JP1. The available slot options are 0-1, 1-2, and 2-3. The bus switches select which set of PCI signals are used by each of the switches: Request, Grant, Clock, ID select, and Interrupt. The slot selection is configured with a jumper block, JP1. All jumper positions are labeled with their function on-board.

As an optional assembly option, 0-ohm resistors may be installed in place of the jumpers for a more rugged assembly.

## 3.4 Ethernet LEDs

Each Ethernet port has 2 LED signals (Link and Speed) that drive LEDs on the board and may also be used to drive indicator LEDs on a panel via the LED pin header connection.

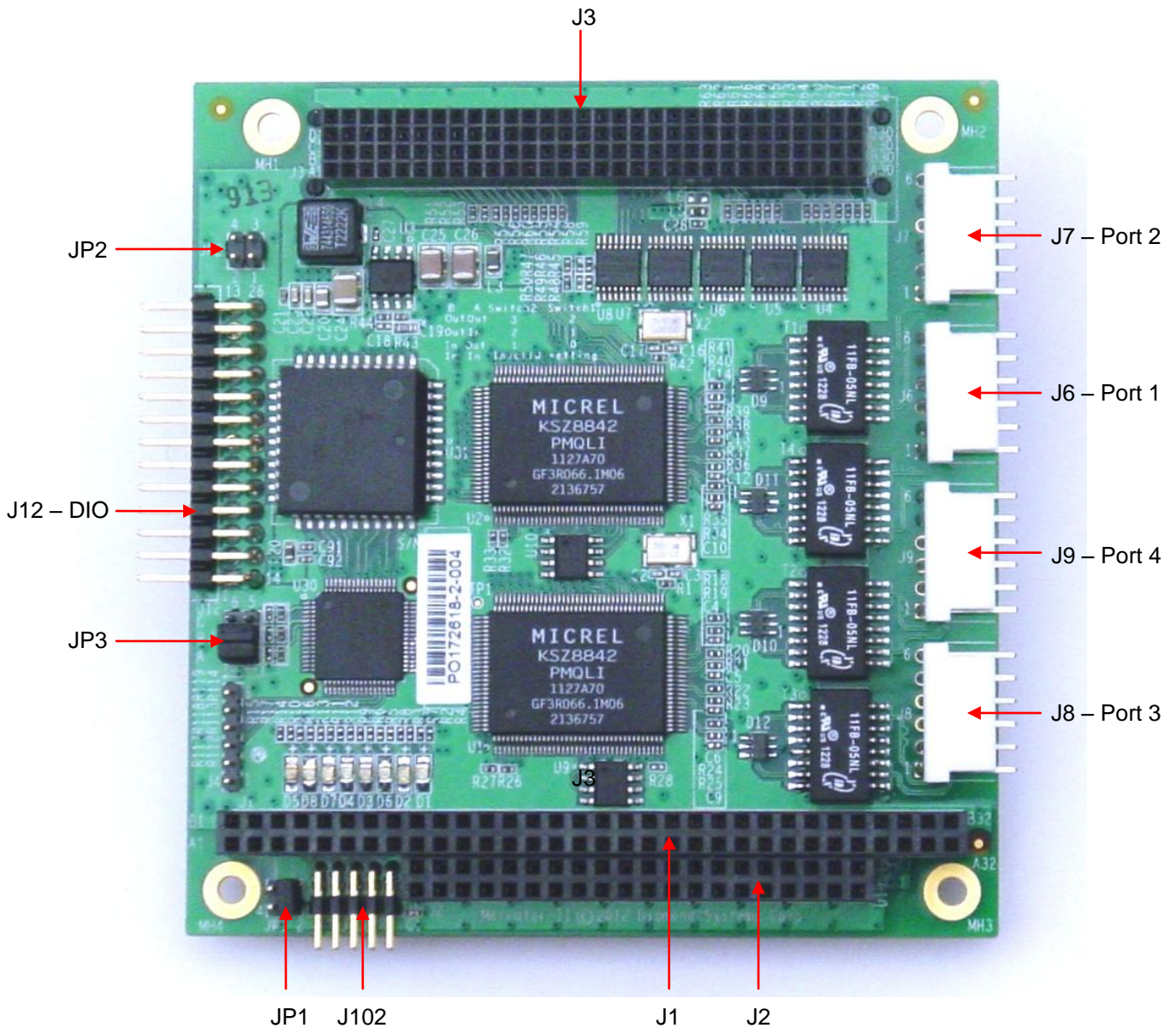
## 3.5 Digital I/O Ports

The DIO circuits consist of an 82c55 and a CPLD that provides the base address decoding logic for the 8255. The DIO circuit occupies 4 bytes in the ISA space in the form of 4 8 bit wide registers to access the DIO lines and configure them in input/output modes. The DIO ports are available as 2 byte wide ports namely Port A and Port B and 2 4 bit wide ports named Ports CH and CL.

The DIO ports are accessible via the PC/104 address space and the address decoding logic is provided by a CPLD. The DIO ports can be configured at various addresses using 3 jumpers. The board will default at base address of 0x300.

## 4. MERCATOR II BOARD OUTLINE AND LAYOUT

The following diagram shows the locations for all connectors and jumpers which are described in the next sections.



**Figure 2. Mercator II Top (Connectors and Jumpers)**

## 5. CONNECTOR AND JUMPER LIST

### 5.1 Connector List

The following table summarizes the functions of Mercator II's interface connectors. Refer to Figure 2 for the locations of these connectors on Mercator II. Signal functions relating to all of Mercator II's interface connectors are discussed in greater detail in Section 5 of this document.

<b>Connector</b>	<b>Function</b>
J1 & J2	PC/104 Expansion bus connectors
J3	PC/104-Plus (PCI) connector
J6, J7, J8, J9	Ethernet pin headers (x4)
J102	LED pin header

### 5.2 PCI Slot Configuration Jumper Block (JP1)

The PCI slot for each switch chip is selected with bus switches on jumper block JP1. The available slot options are 0-1, 1-2, and 2-3. The bus switches select which set of PCI signals are used by each of the switches: Request, Grant, Clock, ID select, and Interrupt. The slot selection is configured with jumper block JP1 using the following settings:

<b>Jumper 1-2</b>	<b>Jumper 3-4</b>	<b>Switch 1</b>	<b>Switch 2</b>
Out	Out	2	3
In (default)	Out (default)	1	2
Out	In	0	1
In	In	Invalid	Invalid

All jumper positions are labeled with their function on-board.

### 5.3 Digital I/O Pull-up / Pull-down Jumper (JP2)

The digital I/O lines can be set with a pull-up or pull-down configuration using jumper JP2.

<b>Configuration</b>	<b>Jumper JP2</b>
Pull-up	Between pins 1 & 2 (default)
Pull-down	Between pins 1 & 3



## 5.4 Digital I/O Base Address (JP3)

The DIO ports are accessible via the PC/104 address space and the address decoding logic is provided by a CPLD. The DIO ports can be configured at various addresses using 3 jumpers (A, B, C) as shown in the table below. The board will default at base address of 0x300.

ISA Base Address		Jumper Position		
Hex	Decimal	A	B	C
200	512	In	In	In
240	576	Out	In	In
280	640	In	Out	In
2C0	706	Out	Out	In
300	768 (Default)	In	In	Out
340	832	Out	In	Out
380	896	In	Out	Out
3C0	960	Out	Out	Out

## 6. CONNECTOR PINOUT AND PIN DESCRIPTION

### 6.1 PC/104 Connectors (J1 and J2)

Connectors J1 and J2 are provided as a passthrough ISA bus which allows Mercator II to be incorporated into a PC/104 stack. The PC/104 stackable bus is supported by a standard PC/104 ISA stackable expansion bus connector. The four row, 104-pin female header connector is actually broken into two pieces (J1 - A/B, J2 - C/D) with the pin assignment shown below.

Note: For more information on the PC/104 specification, visit the PC/104 Embedded Consortium website, at <http://www.pc104.org>.

**J1: PC/104 8-bit bus connector**

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

**J2: PC/104 16-bit bus connector**

GND	D0	C0	GND
MEMCS1	D1	C1	SBHE
IOCS16	D2	C2	LA23
IRQ10	D3	C3	LA22
IRQ11	D4	C4	LA21
IRQ12	D5	C5	LA20
IRQ15	D6	C6	LA19
IRQ14	D7	C7	LA18
DACK0	D8	C8	LA17
DRQ0	D9	C9	MEMR
DACK5	D10	C10	MEMW
DRQ5	D11	C11	SD8
DACK6	D12	C12	SD9
DRQ6	D13	C13	SD10
DACK7	D14	C14	SD11
DRQ7	D15	C15	SD12
+5V	D16	C16	SD13
MASTER	D17	C17	SD14
GND	D18	C18	SD15
GND	D19	C19	KEY

## 6.2 PC/104-Plus PCI Connector (J3)

The PC/104-Plus bus is essentially identical to the PCI Bus except for the physical design. A single pin and socket connector is specified for the bus signals. A 120-pin header, J3, arranged as four 30-pin rows incorporates a full 32-bit, 33MHz PCI Bus. The additional pins on the PC/104-Plus connectors are used as ground or key pins. The female sockets on the top of the board enable stacking another PC/104-Plus board on top of the Mercator II board.

In the connector J3 pinout table, below, the top corresponds to the left edge of the connector when the board is viewed from the primary side (the side with the female end of the PC/104-Plus connector), and the board is oriented so that the PC/104 connectors are along the bottom edge of the board and the PC/104-Plus connector is in the top of the board.

Pin #	Row A	Row B	Row C	Row D
1	GND/5.0V KEY	Reserved	+5V	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	DESEL*
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	-REQ3	-GNT3	GND/3.3V KEY

### 6.3 Ethernet Connectors (J6, J7, J8, J9)

Each Ethernet port has a six-pin 1x6 right-angle friction lock pin header. The four Ethernet pin headers and their corresponding port numbers can be found in Figure 2.

1	Isolated Common
2	RX-
3	Isolated Common
4	RX+
5	TX-
6	TX+

**Connector Type:** 2mm single row right-angle, locking pin header with tin plating  
TE Electronics / Tyco / Amp part number 640457-6 or equivalent

### 6.4 Digital I/O Connector (J12)

The digital I/O is provided on a 26-pin right angle header. The digital I/O connector pin-out is as follows:

C7	13	26	C6
C5	12	25	C4
C3	11	24	C2
C1	10	23	C0
B7	9	22	B6
B5	8	21	B4
B3	7	20	B2
B1	6	19	B0
A7	5	18	A6
A5	4	17	A4
A3	3	16	A2
A1	2	15	A0
+5V	1	14	GND

**Connector Type:** Right-angle 26-pin (2x13) header  
Samtec IPL1-113-01-L-D-RA-K connector

### 6.5 Ethernet LED Connector (J102)

Connector J12 provides access to the LEDs for the four Ethernet ports for use in a custom panel display.

Ground	2	1	+3.3VDC
P1 LED1	4	3	P2 LED1
P1 LED2	6	5	P2 LED2
P3 LED1	8	7	P4 LED1
P3 LED2	10	9	P4 LED2

**Connector Type:** 2x5 2mm pitch right angle pin header with tin plating

## 7. SPECIFICATIONS

### 7.1 General Functions

- 4 10/100 Ethernet Ports
- IEEE 802.3 10Base-T and 100Base-TX compatible
- Maximum data rate 100Mbps
- Ethernet Connectors: 4 6-pin right angle male headers
- 24 programmable digital I/O lines
- Input voltage: Low -0.5V min, 0.8Vmax  
High 2.0V min, 5.5V max
- Output voltage: Low 0.0V min, 0.4V max  
High 3.0V min,  $V_{cc} - 0.4V$  max
- Output current +/-2.5mA max on each line
- Jumper configurable pull-up / pull-down configuration

### 7.2 Mechanical, Electrical, Environmental

- PC/104-*Plus* form factor: 3.55" x 3.755"
- Both PC/104 and PC/104-*Plus* stack through headers installed
- Operating temperature of -40°C to +85°C ambient without a fan
- Operating humidity of 5% to 95% non condensing
- MIL-STD-202G compatible
- Power input requirements: +5VDC +/- 5%
- MTBF: xxxxxx hours
- Weight: 3.2oz (90.7g)
- RoHS compliant