VULCAN

Intel IXP425 XScale based
PC/104 Single Board Computer
Technical Manual

EuroTech Ltd

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Revision History

Manual	*PCB*	*Date*	*Comments*
Issue A		11th June 2004	First full release of Manual.
Issue B		28th June 2004	Minor modifications.
Issue C		16th May 2005	Updated to reflect product name change.
Issue D		1st October 2007	Eurotech rebranding.

For contact details, see page 52.

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Introduction

The VULCAN is a low power PC/104 compatible single board computer based on the Intel 533MHz IXP425 XScale network processor. The IXP425 is a 32 bit ARM Architecture v.5TE compliant CPU combined with a comprehensive set of integrated peripherals including two 10/100Mb/s Ethernet Interfaces, three Network Processor Engines (NPE) for Layer-2 packet/frame network processing, Encryption/Authentication Hardware Acceleration, PCI 2.2 Interface, Expansion bus Interface operating at 33MHz, 32 bit SDRAM Interface operating at 133MHz, two UART interfaces and a watchdog timer.

The VULCAN board offers a wide range of features that make it ideal for embedded communications and networking solutions.

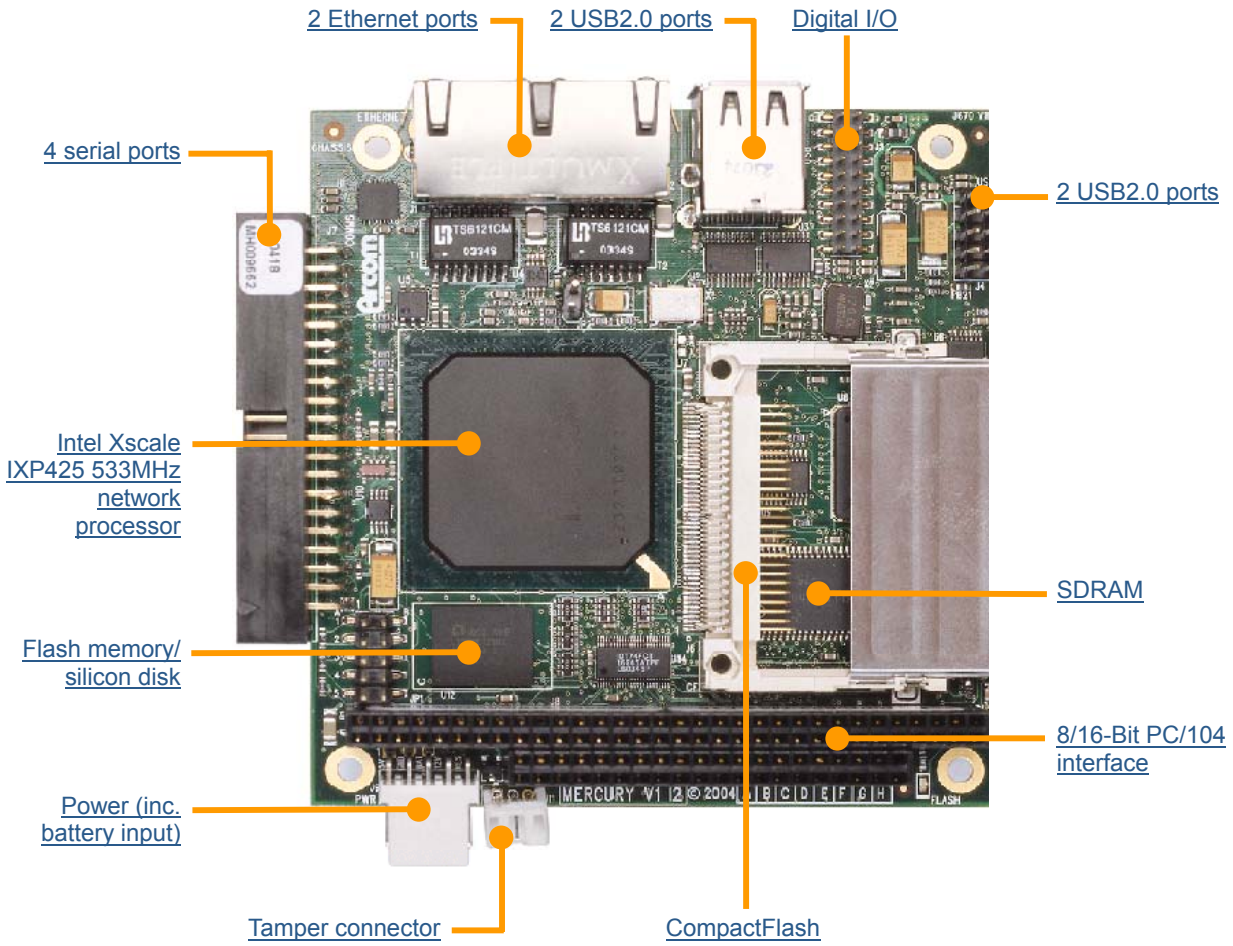
The board is available in the following standard variants:

- VULCAN-533-M64-F16 Intel IXP425 533MHz CPU, Mx=64M DRAM, Fx=16M FLASH
- VULCAN-533-M64-F32 Intel IXP425 533MHz CPU, Mx=64M DRAM, Fx=32M FLASH

An industrial temperature variant is available on request. For alternative memory configurations, please contact Eurotech. See Appendix A - Contacting Eurotech, page 52.

This product was known as the MERCURY until 30th June 2005. The internal (numeric) product codes used to identify this product and its variants have not changed. Please contact our sales team if you have any questions (see page 52).

VULCAN 'at a glance'



VULCAN features

Processor

Intel IXP425 XScale 533MHz network processor.

Cache

32KBytes instruction cache; 32KBytes data cache; 2KBytes mini data cache.

System memory

Fixed on-board memory:

- 32/64MB SDRAM (32 bit wide SDRAM data bus).

Silicon disk

Fixed on-board memory:

- 16/32MB AMD Mirrorbit™ Flash (with Flash access LED).

SRAM (battery backed disk)

256KBytes of SRAM battery backed off board.

Serial ports

4 x UART fast serial ports:

- 2 x IXP425 UARTs (921KBaud) - RS232.
- 2 x 16550 compatible UARTs (115.2 KBaud):
  - 1 x RS232. This port has a factory build option for TTL signal levels.
  - 1 x RS422/485 jumper selectable.
- 40 pin 0.1” Box header.

USB support

USB 2.0 host controller:

- 4 x USB 2.0 ports supporting 480Mb/s, 12Mb/s, 1.5Mb/s speeds.
- Power switch included on board - 500mA current limit and short circuit protection.
- 2 USB A-type connectors and 10 pin header.

Network support

2 x IEEE 802.3u 10/100-BaseT Ethernet controllers:

- Twisted pair interface.
- On-board dual-port RJ45 jack with LEDs.
- Transformer coupling on-board.

Extension buses

- CompactFlash socket supports Type I,II form factor CF+ cards.
- 16 bit PC/104 interface.

Date/time support

Real time clock - battery backed off board or on-board supercap.

Tamper detect

Tamper detect circuit implemented using DS1302 RTC.

Unique ID number

Implemented using DS2401 silicon serial number.

Watchdog timer

2 WD timers:

- Internal to IXP425.
- External with software selectable timeout (1ms - 60s).

General I/O

16 x general purpose I/O:

- Eight inputs – 5V tolerant.
- Eight 3.3V outputs – 5V tolerant.

Test support

JTAG interface:

- JTAG debugger and Flash download.

Power requirements

+5V only operation:

- 4.5W max. not including CF+ card and USB devices.
- On-board regulators for CPU core and I/O voltages.
- Power monitor generates reset on low-voltage condition.

Super capacitor

On-board GoldCap:

- Provides RTC backup for up to 5 days.

Mechanical

Standard PC/104 form factor, 95mm x 90mm.

Environmental

Operating temperature:

- Commercial: -20°C to +70°C (-4°F to +158°F).
- Industrial: -40°C to +85°C (-40°F to +185°F).

VULCAN support products

The VULCAN is supported by the VULCAN ICE (Industrial Compact Enclosure). This is a simple low cost aluminum enclosure that provides easy connection to all on board features.

Handling your board safely

Anti-static handling

This board contains CMOS devices that could be damaged if static electricity is discharged through them. At all times, please observe anti-static precautions when handling circuit boards. This includes storing boards in appropriate anti-static packaging and wearing a wrist strap when handling.

Packaging

Should a board need to be returned to Eurotech, please ensure that it is adequately packed, preferably in the original packing material.

Electromagnetic compatibility (EMC)

The VULCAN is classified as a component with regard to the European Community EMC regulations and it is the user's responsibility to ensure that systems using the board are compliant with the appropriate EMC standards.

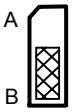
About this manual

This manual describes the operation and use of the VULCAN single board computer. It is designed to be a reference and user manual and includes information about all aspects of the board.

Conventions

Symbols

The following symbols are used in this guide:

Symbol	Explanation
	Note - information that requires your attention.
	Tip - a handy hint that may provide a useful alternative or save time.
	Caution – proceeding with a course of action may damage your equipment or result in loss of data.
	Jumper fitted on pin A.
	Jumper fitted on pin B.
	Jumper is fitted.
	Jumper is not fitted.

Related documents

The VULCAN Technical Manual is normally supplied as part of a VULCAN Development Kit, which also includes the technical documentation for specific operating system and the VULCAN Industrial Compact Enclosure (ICE) Technical Manual. Other manuals are referred to from time to time. These are provided on the CD-ROM that accompanies your Development Kit.

The Quickstart Manual for the selected operating system explains how to set up and start using the board. Please work through it before reading this manual. You will then have a working VULCAN system and development can begin.

Getting started

This section explains how to set up and use various features of the VULCAN. If you require more detailed information, see Detailed hardware description, page 15.

Using the VULCAN

Using the CompactFlash™ socket

The VULCAN is fitted with a Type I/II CompactFlash socket mounted on the topside of the board. The socket is connected to Slot A of the TI PCI1520 PCI-CardBus bridge interface and supports 3.3V/5V Type I and II CF+ cards for both memory and IO. The VULCAN supports hot swap changeover of the cards and notification of card insertion.

There is only one way the CF+ card can be inserted into the socket. The correct orientation is for the top of the card, i.e. the side that is normally printed, to be face up.

Using the serial interfaces (RS232/422/485)

The four serial port interfaces on the VULCAN are fully 16550 compatible. Connection to the serial ports is made via a 40-way boxed header. The pin assignment of these headers has been arranged to enable a 9-way IDC D-Sub plug to be connected directly to the cable. For pin assignments and connector details see J7 – COMS ports and JTAG connector, page 46.

A suitable cable for COM1 is provided as part of the Development Kit. The D-Sub connector on this cable is compatible with the standard 9-way connector on a desktop computer.

Using the USB ports

The standard USB connector is an A type 4-way socket, which provides power and data signals to the USB peripheral. Two of four USB ports are available on standard USB connectors. For the other two, the 10-way header J4 is designed to be compatible with PC expansion brackets. For further details, please refer to the sections USB 2.0 interface, page 31, and J4 – USB header, page 44.

Using the Ethernet interfaces

The 10/100-BaseTx Ethernet controllers of the IXP425 network processor are configured by the RedBoot bootloader. Connection is made via standard RJ45 connectors that include speed and link/activity status LEDs. For further details, see 10/100-BaseTX Ethernet, page 31, and J1 – 10/100-BaseTX Ethernet connector, page 43.

Using the PC/104 expansion bus

PC/104 modules can be used with the VULCAN to add extra functionality to the system. This interface supports 8/16 bit ISA bus style peripherals.

Eurotech has a wide range of PC/104 modules which are compatible with the VULCAN, including:

- Digital I/O.
- Analogue I/O.
- Motion control.
- CAN bus.
- Serial interfaces.

Please contact the Eurotech sales team if the interface you require does not appear to be available, as these modules are in continuous development.

If you want to use a PC/104 board with the VULCAN, the board should be plugged into J8 for 8 bit cards and J8/J10 for 8/16 bit cards. The peripheral PC/104 board should normally be plugged into the bottom side of the board. For further details, see PC/104 interface, page 36, and J8 & J10 – PC/104 connectors, page 47.

Before you power up the system, check that the jumper settings on the add-on cards for I/O address and IRQ settings do not conflict with each other. The ISA interface on the VULCAN does not support DMA. For PC/104 interrupt use, see Interrupt assignments, page 29.

The VULCAN provides +5V to a PC/104 add-on-board via the J8 and J10 connectors. If a PC/104 add-on board requires a +12V supply, then +12V must be supplied to the VULCAN power connector J9 pin 4. If -12V or -5V are required, these must be supplied directly to the PC/104 add-on board.

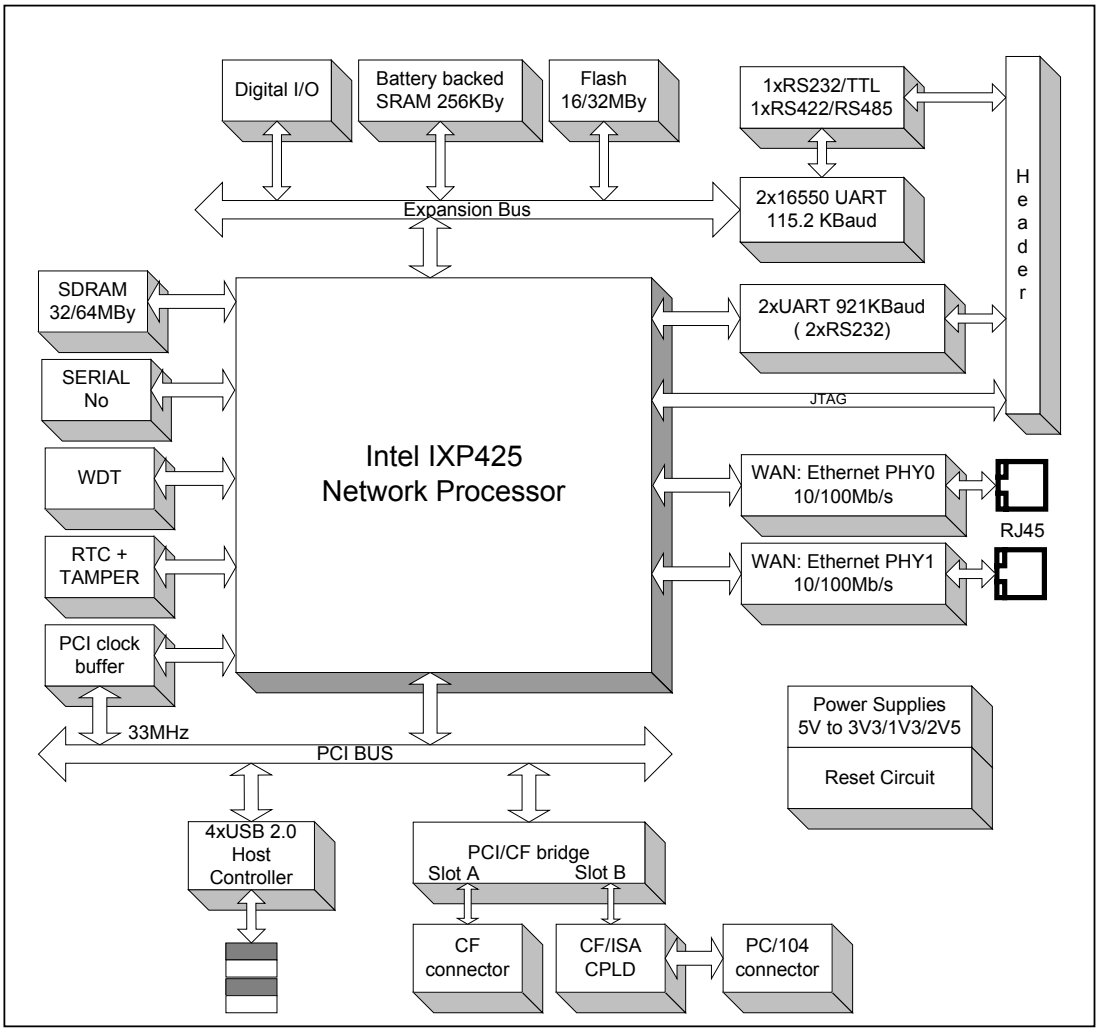
The VULCAN is available with non-stack through connectors by special order. Contact the Eurotech sales department for details. See Appendix A - Contacting Eurotech, on page 52.

Detailed hardware description

The following section explains the functions that are included in the VULCAN. You may need this information during development, when you start adding extra peripherals or when you begin to use some of the embedded features.

VULCAN block diagram

The following diagram illustrates the functional organisation of the VULCAN:



IXP425 network processor

The VULCAN is based on the Intel IXP425 Xscale network processor (see www.intel.com/design/network/products/npfamily/ixp425.htm). This is a 32 bit ARM Architecture v.5TE compliant CPU with integrated peripherals.

The IXP425 network processor has the following features:

- Intel® XScale™ core running the system clock rate of 133MHz.
- Three Network Processor Engines (NPEs) for layer-2 packet/frame network processing.
- PCI 2.2 interface.
- Expansion bus interface operating at 33MHz.
- 2-MII/RMII interfaces (10/100Mb/s Ethernet).
- 32 bit SDRAM interface operating at 133MHz.
- Encryption/authentication hardware acceleration.
- High-speed UART (921KBaud).
- Console UART (921KBaud).
- Internal bus performance monitoring unit.
- 16 GPIO.
- Four internal timers including watchdog timer.
- Available in 266MHz, 400MHz and 533MHz speed variants
- 492 pin PBGA packaging.

The VULCAN design supports all speed variants of the Intel IXP425 processor. The standard variant of VULCAN uses the 533MHz version of Intel IXP425.

A single 33.33MHz external oscillator is used to run the IXP425 processor. All other clocks are generated internally in the processor.

The GPIO15 processor pin is configured as 33MHz clock output. Zero-delay clock buffer is used to distribute 33MHz clock to devices connected to the PCI bus, and back to the processor's expansion bus clock input.

The IXP425 network processor also includes a WAN/HSS network processor engine (for UTOPIA 2). This is not connected on the VULCAN SBC.

The three NPEs in the Intel IXP425 network processor are designed to complement the Intel XScale core for many computationally-intensive communications applications. These tasks include:

- IP header inspection and modification.
- Packet filtering.
- Packet error checking.
- Checksum computation.
- Flag insertion and removal.

The NPE architecture includes an ALU, self-contained internal data memory and an extensive list of I/O interfaces, together with hardware acceleration elements. The hardware acceleration elements associated with an NPE target a set of networking applications. Each hardware acceleration element is designed to increase the speed of a specific networking task that would otherwise take many MIPS to complete using a stand-alone RISC processor. Each NPE can handle layer 2 and, in some cases, layer 3 packets.

The Intel IXP425 network processor provides integrated hardware acceleration for security applications. The network processor implements DES, 3DES and AES data encryption algorithms in addition to SHA-1 and MD5 authentication algorithms, which are typically used in applications such as VPNs (Virtual Private Networks). Using the NPE for dedicated hardware acceleration enables the processing of cryptography and authentication algorithms to be offloaded from the Intel XScale core. The Intel XScale core API calls allow the cryptography and authentication elements to be used by any interface within the Intel IXP425 network processor. This provides maximum flexibility for all interfaces, especially when dealing with security issues over wireless. The high-performance architecture of the Intel IXP425 network processor can support bulk encryption/decryption rates of up to 70 Mbps for DES, 3DES and AES algorithms.

The processor requires two power supply rails. The core uses a 1.3V supply, and the I/O interfaces run at 3.3V, both generated on-board from the main +5V power input, using switching DC/DC converters. For details about its operation, see Power and power management, page 37.

The IXP425 processor is a low power device and does not require a heat sink for ambient temperatures up to 70°C (85°C for the industrial variant).

IXP425 GPIO pin assignments

The following table summarises the use of the 16 IXP425 GPIO pins, their direction and active level:

GPIO	Signal name	Direction	Active	Function	See section...
0	RTC_RST#	Output		RTC reset	Real time clock, page 23.
1	RTC_CLK	Output		RTC clock	
2	USB_INTA#	Input	Low	USB interrupt	Interrupt assignments, page 29.
3	CF_INTB#	Input	Low	CF interrupt	
4	UART_IRQ#	Input	Low	UART interrupt	
5	ISA_IRQ3	Input	Rising edge	PC/104 interrupt	
6	ISA_IRQ4	Input	Rising edge	PC/104 interrupt	
7	ISA_IRQ5	Input	Rising edge	PC/104 interrupt	
8	ISA_IRQ6	Input	Rising edge	PC/104 interrupt	
9	ISA_IRQ7	Input	Rising edge	PC/104 interrupt	
10	ISA_IRQ10	Input	Rising edge	PC/104 interrupt	
11	ISA_IRQ11	Input	Rising edge	PC/104 interrupt	
12	ISA_IRQ12	Input	Rising edge	PC/104 interrupt	
13	RTC_D	Bidirectional		RTC data	Real time clock, page 23.
14	SER_NO	Bidirectional		Serial number data	Silicon serial number, page 27.
15	GPIO_PCI_CLK	Output		PCI clock 33MHz	PCI bus, page 22.

It is the responsibility of software to set up these GPIO port pins correctly.

VULCAN address map

Start address	End address	Size	Use
0000_0000	0FFF_FFFF	256MB	Expansion bus data[1]
0000_0000	3FFF_FFFF	1GB	SDRAM data[1] (64Mbyte available)
4000_0000	47FF_FFFF	128MB	Reserved
4800_0000	4FFF_FFFF	128MB	PCI data
5000_0000	5FFF_FFFF	256MB	Expansion bus data
6000_0000	63FF_FFFF	64MB	Queue manager
6400_0000	BFFF_FFFF	1472MB	Reserved
C000_0000	C3FF_FFFF	64MB	PCI controller configuration and status registers
C400_0000	C7FF_FFFF	64MB	Expansion bus configuration registers
C800_0000	C800_0FFF	1KB	COM1 UART
C800_1000	C800_1FFF	1KB	COM2 UART
C800_2000	C800_2FFF	1KB	Internal bus performance monitoring unit
C800_3000	C800_3FFF	1KB	Interrupt controller
C800_4000	C800_4FFF	1KB	GPIO controller
C800_5000	C800_5FFF	1KB	Timers
C800_6000	C800_6FFF	1KB	WAN/HSS NPE (NOT connected on VULCAN SBC)
C800_7000	C800_7FFF	1KB	Ethernet NPE A – not user programmable
C800_8000	C800_8FFF	1KB	Ethernet NPE B – not user programmable
C800_9000	C800_9FFF	1KB	Ethernet MAC A
C800_A000	C800_AFFF	1KB	Ethernet MAC B
C800_B000	C800_BFFF	1KB	USB controller (NOT connected on VULCAN SBC)
C800_C000	C800_FFFF	4KB	Reserved
C801_0000	CBFF_FFFF	64MB	Reserved
CC00_0000	CC00_00FF	256B	SDRAM configuration registers
CC00_0100	CEFF_FFFF	48MB	Reserved
D000_0000	FFFF_FFFF	768MB	Reserved

[1] The first 256MB of address space is configurable based on the value of a configuration register located in the expansion bus controller.

When the configuration register is set to logic 1, the expansion bus occupies the lowest 256MB of address space. When it is set to logic 0, the SDRAM occupies the lowest 256MB of address space. In both cases, the SDRAM occupies the 768MB immediately following the lowest 256MB and the expansion bus can be accessed starting at the address 5000_0000.

Upon reset Expansion bus on VULCAN starts at address 0000_0000 and SDRAM can be accessed starting from address 1000_0000. RedBoot reconfigures the memory map so that Expansion bus starts at address 5000_0000 and SDRAM starts at address 0000_0000.

The largest SDRAM memory size supported by the Intel® IXP4XX product line processors is 256MB.

The actual memory implemented in any given configuration is aliased (repeated) to fill the 1GB SDRAM address space. Due to aliasing, all of the SDRAM is accessible even when the expansion bus occupies the lowest 256MB of address space. On reset, the configuration register in the expansion bus is set to logic 1. This setting is required because the dedicated boot memory is Flash memory located on the expansion bus.

Details of the internal registers are in the IXP425 Intel Developer Manual on the Development Kit CD.

Expansion bus

The expansion bus in the IXP425 network processor has 16 bit data and 24 bit addresses for each of its eight independent chip selects. This allows an addressing range of 512 bytes to 16MByte and connection of up to eight independent external devices.

The chip selects of VULCAN devices connected to the expansion bus and corresponding address spaces are listed in the following table. Chip select address spaces relate to the expansion bus base address given in the main memory map.

Chip select	Assignment	Size	Address space (relative to base address)	Data bus width	Access
CS0	Flash	16MB	0x00000000-0x00FFFFFF	16b - D[15:0]	R/W
CS1	Flash (F32 variant)	16MB	0x01000000-0x01FFFFFF	16b - D[15:0]	R/W
CS2	SRAM	256KB	0x02000000-0x0203FFFF	8b - D[7:0]	R/W
CS3	UART (COM3)	8B	0x03000000-0x03000007	8b - D[7:0]	R/W
	UART (COM4)	8B	0x03000008-0x0300000F		
CS4	GPIO registers	1B	0x04000000-0x040001FF	8b - D[7:0]	R/W
CS5	WDT set register	1B	0x05000000-0x050001FF	8b - D[7:0]	R/W
CS6	Not used	-	-	-	
CS7	Not used	-	-	-	

PCI bus

The IXP425 network processor PCI interface is a 32 bit 66MHz / 33MHz PCI controller and PCI bus compatible with PCI v2.2 specification. The PCI controller on VULCAN is configured to operate at 33MHz as a host, with internal built-in PCI arbiter and PCI initiator capabilities. 33MHz clock distribution for PCI based devices and the processor's expansion bus interface are implemented using the GPIO15 clock output of the IXP425 processor and the zero-delay clock buffer.

The Initialization Device SELect (IDSEL) signals of each of the PCI devices are mapped to the PCI address and data bus (PCI_AD) signals as shown in the table below. The corresponding PCI device is selected if the PCI address and data bus signal mapped to the particular PCI device IDSEL signal is asserted.

Device	IDSEL signal	PCI interrupt mapping	
USB 2.0 host controller	PCI_AD31	USB_INTA#	GPIO2
CardBus controller	PCI_AD30	CF_INTB#	GPIO3

PCI bus devices can be reset using bit 4 of WD setup register. The register is memory mapped and located on the expansion bus (CS5#). The following table shows the WD setup register bit definitions:

Bits	Description
7:5	Not used.
4	PCI_RST#: When zero, resets PCI bus. Set to one if not used.
3	WDI: Watchdog Input. If WDI remains either high or low for the duration of the watchdog timeout period (t_{WD}), WDT triggers a reset pulse. The internal watchdog timer clears whenever a reset pulse is asserted or whenever WDI sees a rising or falling edge.
2:0	WDSET[2:0] - watchdog timeout period setup bits.

Hex Offset Address: 0x05000000

Reset Hex Value: 0x1B

Access: Read/write

Bits 0-3 of WD setup register are used to configure external Watch Dog Timer. When writing to this register make sure that you mask bits [0-3].

Real time clock

The RTC used on the VULCAN is the Dallas DS1302 RTC. The accuracy of the DS1302 RTC is based on the operation of the 32.768KHz watch crystal. Its calibration tolerance is 20ppm, which provides an accuracy of +/-1 minute per month if the ambient temperature is +25°C. When the board is used at other temperatures, its accuracy may be reduced, typically by -0.035ppm/ °C² ±10%. The watch crystal's accuracy changes by a maximum of ±3ppm in the first year, ±1ppm in the year after, and decreases logarithmically in subsequent years. The following IXP425 GPIO pins are used to emulate the serial I/O interface to the DS1302 RTC:

IXP425 GPIO pin	Function
GPIO 0	RTC_RST#
GPIO 1	RTC_CLK
GPIO 13	RTC_D

The DS1302 RTC also contains 31 bytes of RAM, which can be used for any data that must be recoverable on power-up. RTC is backed by an external battery or the onboard supercap. For details, see Battery backup, page 37 and GoldCap backup, page 37.

DS1302 RTC is also used in the tamper detect circuit. This means that if a tamper switch is not used, a jumper is required on the J11 connector for the RTC to operate. Without a jumper link RTC clock will stop. See J11 – Tamper jumper, page 51.

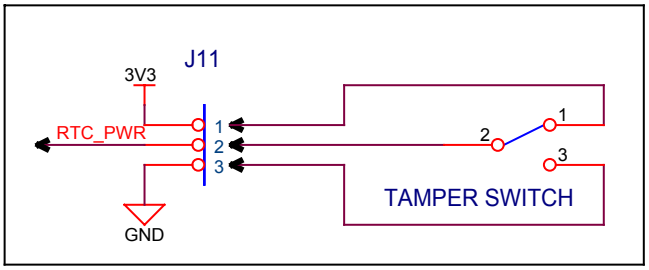
Tamper detect circuit

When the VULCAN is fitted in the ICE enclosure, the tamper detect switch is mounted onto the side of the enclosure in such a position that it is activated when the lid is opened. The switch is connected to the tamper connector J11. Once the tamper detect software has been invoked, any attempt to remove this assembly activates the tamper detect system. The VULCAN tamper detect circuit is implemented using the DS1302 RTC incorporating a 31 byte battery-backed non-volatile RAM. The RTC is backed up by a super capacitor giving maximum memory retention of 5 days.

The tamper detect software stores a unique pattern in the RTC RAM, which is cleared when the tamper detect system is activated. Any tamper detect activity (in either a powered or non-powered situation) cuts the power supply to the RTC and clears the contents of the DS1302 RAM and a CLOCK HALT bit within the device. This single bit is not battery-backed and is guaranteed to activate once the RTC power supply voltage drops below 2.0V. A concatenation of the CLOCK HALT bit and the contents of the RAM fully ensure tamper activity detection.

If the tamper detect circuit is not used, pins 1 and 2 of connector J11 must be connected together using a jumper, to provide a power supply to DS1302 RTC. For more information, see J11 – Tamper jumper, page 51.

Diagram of tamper switch and J11 connections is shown below.



Watchdog timers

The IXP425 contains an internal WatchDog Timer (WDT), which may be used by software applications to monitor inactivity. Timeout periods can be adjusted in steps of 15ns using a 32 bit counter register up to a maximum of 64 seconds. WDT can be programmed to reset the processor or to generate interrupt when a timeout occurs. Upon reset, the watchdog timer is disabled, and remains so until enabled by the software.

For more information, please refer to either the Eurotech Operating System Technical Manual or the IXP425 Developer's Manual.

In addition, an external WD timer (MAX6369) is available. This is a programmable watchdog timer that can be adjusted for timeout periods of 1ms, 10ms, 30ms, 100ms, 1s, 10s and 60s. The board is reset when timeout occurs. The MAX6369 WDT can be programmed using the WD setup register provided within the CPLD. The register is memory mapped and located on the expansion bus (CS5#). The WDT is disabled upon reset, and remains so until enabled by the software.

The following table shows the WD setup register bit definitions:

Bits	Description
7:5	Not used.
4	PCI_RST#: When zero, resets PCI bus. Set to one if not used.
3	WDI: Watchdog Input. If WDI remains either high or low for the duration of the watchdog timeout period (t_{WD}), WDT triggers a reset pulse. The internal watchdog timer clears whenever a reset pulse is asserted or whenever WDI sees a rising or falling edge.
2:0	WDSET[2:0] - watchdog timeout period setup bits.

Hex Offset Address:	0x05000000
Reset Hex Value:	0x1B
Access:	Read/write

Bit 4 of WD setup register is not related to Watch Dog Timer. It is PCI bus reset bit. When writing to this register make sure that you mask PCI_RST# bit.

The following table shows the definitions for various watchdog timeout periods:

WDSET2	WDSET1	WDSET0	t_{DELAY}, t_{WD}
0	0	0	1ms
0	0	1	10ms
0	1	0	30ms
0	1	1	Disabled
1	0	0	100ms
1	0	1	1s
1	1	0	10s
1	1	1	60s

Silicon serial number

Unique ID is provided on the VULCAN using DS2401 enhanced silicon serial number. The DS2401 consists of a factory-lasered 64 bit ROM that includes a unique 48 bit serial number, an 8 bit CRC and an 8 bit family code (01h). Data is transferred serially via the 1-Wire protocol that requires only a single data lead and a ground return. The IXP425 processor's pin GPIO14 is used to emulate the serial 1-Wire interface to the DS2401.

Memory

The VULCAN has three types of memory fitted:

- 16 or 32 Mbytes of resident Flash disk containing Redboot (to boot the OS), the OS and application images.
- 64 Mbytes of SDRAM for system memory.
- 256 Kbytes of SRAM.

Further details about each of these memory types are provided below:

Flash memory/silicon disk

The VULCAN supports 16 or 32 Mbytes of AMD MirrorBit Flash memory for the RedBoot bootloader, OS and application images. The memory is arranged as 8M x 16 bits (128 megabit device) or as 16M x 16 bits (256 megabit device), respectively. Since each Chip Select of the IXP425 expansion bus interface supports the Flash chips up to 8M x 16 bits (128 megabit), CS0# and CS1# lines with simple glue logic are used to support the 256 megabit Flash device (F32 VULCAN variant).

The Flash memory array is divided into equally sized symmetrical sectors that are 32-Kword in size. A 128 megabit device contains 256 sectors, and a 256 megabit device contains 512 sectors.

Whenever you access the Flash memory, the Flash access LED illuminates.

SDRAM interface

VULCAN supports 64 Mbytes of SDRAM. The SDRAM is configured as 16M x 32 bits by 2 devices with 4 internal banks of 4M x 16 bits.

These are surface mount devices soldered to the board and cannot be upgraded. RedBoot automatically detects the amount of memory fitted to the board and configures the SDRAM controller accordingly. The SDRAM controller operates at a frequency of 133MHz.

Static RAM

The VULCAN has a 256KB SRAM device fitted, arranged as 256K x 8 bits.

The data in the SRAM can be made non-volatile by fitting an external battery to power the device in the event of power loss on the main VULCAN 5V supply. For more information, see Battery backup, page 37.

Interrupt assignments

Internal interrupts

For details about the IXP425 interrupt controller and internal peripheral interrupts, refer to the Intel IXP425 developer's manual, which is on the Development Kit CD.

External interrupts

The following table lists the IXP425 signal pins used for external interrupt inputs:

IXP425 pin	Signal	Active	Peripheral
GPIO 2	USB_INTA#	Low	USB controller
GPIO 3	CF_INTB#	Low	CF controller
GPIO 4	UART_IRQ#	Low	UART
GPIO 5	ISA_IRQ3	Rising edge	PC/104
GPIO 6	ISA_IRQ4	Rising edge	PC/104
GPIO 7	ISA_IRQ5	Rising edge	PC/104
GPIO 8	ISA_IRQ6	Rising edge	PC/104
GPIO 9	ISA_IRQ7	Rising edge	PC/104
GPIO 10	ISA_IRQ10	Rising edge	PC/104
GPIO 11	ISA_IRQ11	Rising edge	PC/104
GPIO 12	ISA_IRQ12	Rising edge	PC/104

General purpose I/O

Eight general-purpose inputs and eight general-purpose output lines are provided on connector J3, using memory mapped register located on the expansion bus (CS4#) at address offset 0x04000000 (0x54000000). The general purpose inputs are 5V tolerant, and the outputs can sink and source up to 24mA @ 3.3V.

The following table shows the bit definitions:

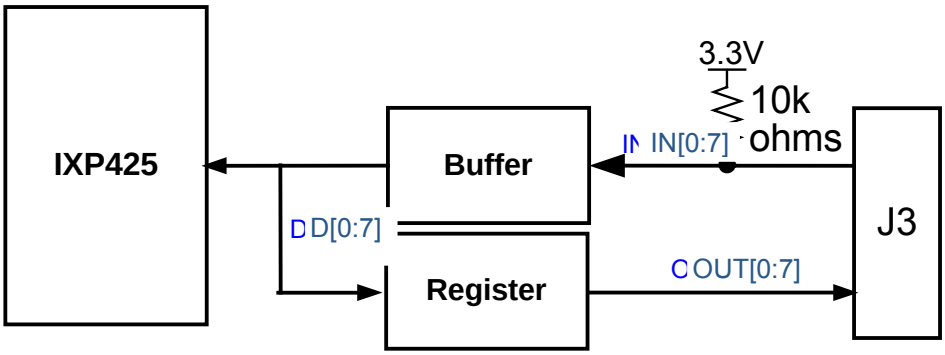
Bits	Description
7:0	IN[7:0]: GP inputs on read access. OUT[7:0]: GP outputs on write access.

Hex Offset Address: 0x04000000

Reset Hex Value: 0x00

Access: Read/write

This is illustrated by the following diagram:



Data communications

USB 2.0 interface

There are four USB 2.0 interfaces on the VULCAN, provided by the Philips ISP1561 Hi-Speed USB PCI host controller. These interfaces are designed to support the Enhanced Host Controller Interface (EHCI).

There are four signal lines associated with each USB channel, VBUS, DATA+, DATA- and GND. For details of connector pin outs, see J2 – USB connector, page 43 and J4 – USB header, page 44. A USB power control switch controls the power and protects against short-circuit conditions. See USB power management, page 40 for details.

More information about the USB bus and the availability of particular USB peripherals can be found at www.usb.org. Please refer to the ISP1561 datasheet, on the Development Kit CD, for details about the Hi-Speed USB PCI host controller.

10/100-BaseTX Ethernet

The IXP425 network processor provides two 10/100-BaseT interfaces with MAC and complies with both the IEEE802.3u 10/100-BaseTX and the IEEE 802.3x full-duplex flow control specifications.

A dual-port Fast Ethernet PHY Intel LXT973 is used on VULCAN, along with 10/100-BaseT magnetics. Connection to the VULCAN Ethernet port is via dual RJ45 connector with speed and link/activity status LEDs. For pin assignment and connector details, see J1 – 10/100-BaseTX Ethernet connector, page 43.

The link/activity LED is illuminated when a 10/100-BaseT link is made, and when there is Tx/Rx activity. The speed LED is illuminated when 100Mb/s speed is selected.

Serial COMs ports

There are four high speed fully functionally compatible 16550 serial UARTs on the VULCAN. Three of these channels can be used as standard RS232 serial interfaces, and the remaining one can be configured as either RS422 or RS485.

Port	Controller	IRQ	FIFO depth RX / TX	Signals
COM1	IXP425 'High-speed' UART	Internal	64 / 64	RS232 Rx,Tx,RTS, CTS
COM2	IXP425 'Console' UART	Internal	64 / 64	RS232 Rx,Tx,RTS, CTS
COM3	XR162551L DUART	GPIO4	16 / 16	RS232 Rx, Tx, CTS, RTS, RI, DSR, DCD, DTR
COM4	XR162551L DUART	GPIO4	16 / 16	RS422/RS485 Tx, Rx

The terms 'High-speed' and 'Console' UART are used in Intel IXP425 technical documentation only to make a distinction between the two UART interfaces. Both UART Interfaces exhibit exactly the same features. The term 'Console' doesn't presume the use of this UART by user's software.

Further details about each of these COMs ports is provided below:

COM1 – RS232 interface

Uses the 'High-speed' UART in the IXP425, with 64 bytes-deep transmit and receive buffers. The port is buffered to RS232 levels by a 3V transceiver with ±15kV ESD protection, and supports RTS, CTS handshaking signals only. The maximum baud rate on this channel is 921.6KBaud.

COM2 – RS232 interface

Uses the 'Console' UART in the IXP425, with 64 bytes-deep transmit and receive buffers. The port is buffered to RS232 levels by a 3V transceiver with ±15kV ESD protection, and supports RTS, CTS handshaking signals only. The maximum baud rate on this channel is 921.6KBaud/s.

COM3 – RS232 interface

Supported on channel A of an external XR162551L UART. The port is buffered to RS232 levels by a 3V transceiver with ±15kV ESD protection, and supports full handshaking and modem control signals. The maximum baud rate on this channel is 115.2KBaud. A factory fit option configures COM2 as a TTL, so that it can be interfaced directly to an embedded modem. Please contact Eurotech for details. See Appendix A - Contacting Eurotech, page 52.

COM4 – RS422/485 interface

Supported on channel B of an external XR162551L UART, and buffered to RS422/485 levels by a 5V transceiver with ±15kV ESD protection, to provide support for RS422 (default) and RS485 (jumper selectable) interfaces. The maximum baud rate on this channel is 115.2KBaud.

This channel can be configured as either RS422 or RS485. Further details about these interfaces are provided below:

- RS422
  The RS422 interface provides full-duplex communication. The signals available are TX+, TX-, RX+, RX- and ground. The maximum cable length for an RS422 system is 4000ft (1200m). It supports one transmitter and up to ten receivers.

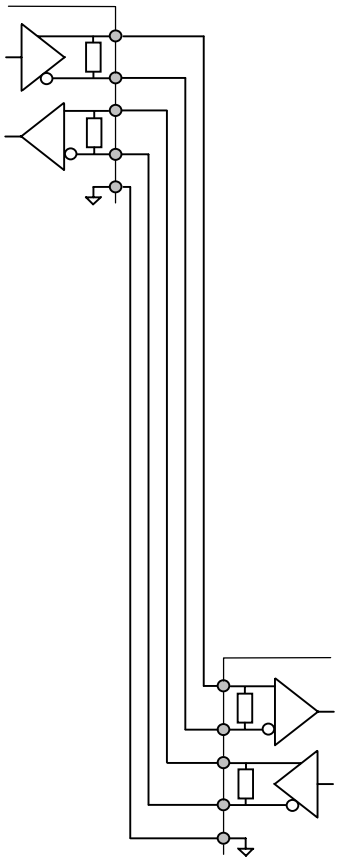
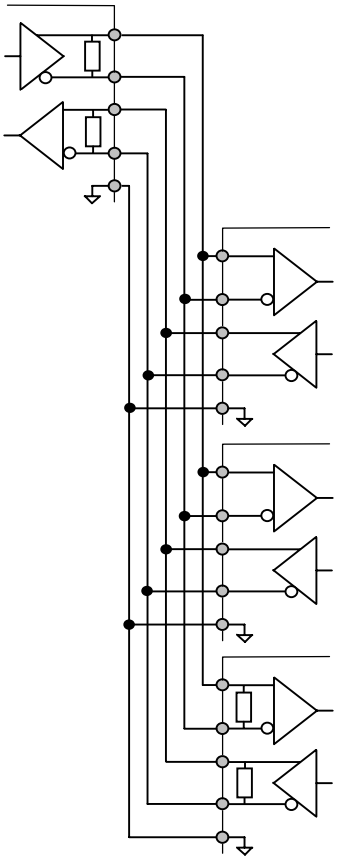
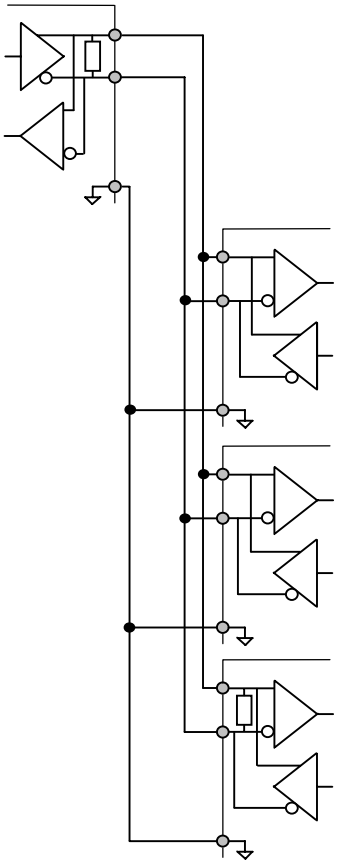
  To enable RS422 operation, jumpers must be fitted in positions A2-A1 & B2-B1 on the JP1 jumper header. Jumpers in positions A4-B4 & A5-B5 must be fitted if the board is at the end of the network. See JP1 – Jumper header, page 49, for details.

- RS485
  This is a half-duplex interface that provides combined TX and RX signals. Connector J7 pin 5 provides TX+/RX+ and pin 6 provides TX-/RX-. A ground connection is also required for this interface. The maximum cable length for this interface is the same as RS422 (4000ft), but RS485 supports up to 32 transmitters and receivers on a single network. Only one transmitter should be switched on at a time. The VULCAN uses the RTS signal to control transmission. When this signal is at logic 1 the driver is switched off and data can be received from other devices. When the RTS line is at logic 0 the driver is on. Any data transmitted from the VULCAN is automatically echoed back to the receiver. This enables the serial communications software to recognise that all data has been sent and disable the transmitter when required.

  Jumpers must be fitted in positions A2-A3 & B2-B3 to enable the RS485 interface. Jumpers in positions A4-B4 & A5-B5 provide parallel line termination 120 Ohm resistors and must be fitted if the VULCAN is at the end of the network.

  The UART used on the VULCAN for COM4 has extended features including auto-RTS control for RS485. This forces the RTS signal to change state (and therefore the direction of the RS485 transceivers) when the last bit of a character has been sent onto the wire. Please refer to the XR162551L datasheet, which is on the accompanying Development Kit CD.

Typical RS422 and RS485 connection:

RS422 POINT-TO-POINT	RS422 MULTI-DROP	RS485 MULTI-DROP
		
Number of Wires 5 **Transmitters Enabled** always **Receivers Enabled** always **Duplex Mode** full **LINKS** **A2-A1 & B2-B1**	**Number of Wires** 5 **Transmitters Enabled** active RTS **Receivers Enabled** always **Duplex Mode** full **LINKS** **A2-A1 & B2-B1**	**Number of Wires** 3 **Transmitters Enabled** active RTS **Receivers Enabled** always **Duplex Mode** half **LINKS** **A2-A3 & B2-B3**

Expansion interfaces

CompactFlash

A CompactFlash extension socket for full I/O mode operation is provided using the PCI bus interface of the IXP425 processor and a PCI/CardBus bridge to support Type I,II CF+ cards. For this purpose, PCI to CardBus Bridge Texas Instruments PCI1520 device, with support for 2 CardBus slots, is used. The other slot is used to interface with PC/104 ISA bus.

The standard 50 pin CompactFlash connector J6 is interfaced to slot A of the PCI1520 controller. This is a hot-swappable 3.3V/5V interface, controlled by the detection of CompactFlash card insertion. A PC card power-interface switch controls the power and protects against short-circuit conditions. For details, see CompactFlash power management, page 39.

CF+ is a small form factor card standard. It encompasses CompactFlash (CF) Flash data storage cards, magnetic disk cards and I/O cards including serial cards, Ethernet cards, fax/modem cards, digital phone cards, USB, barcode scanners, Bluetooth, 802.11b wireless LAN, wireless digital cell phone cards, etc. For more details about CF+ standards and availability of particular CF+ peripherals, see www.compactflash.org.

The CF+ card provides high capacity data storage and I/O functions that electrically comply with the Personal Computer Memory Card International Association (PCMCIA) standard.

PCI1520 MFUNC pin assignments

The following table summarises the use of the 6 MFUNC pins of PCI/CardBus Bridge PCI1520, their direction and their active level:

MFUNC	Signal name	Direction	Active	Function	See section...
0	CF_INTB#	Output	Low	CF PCI interrupt	Interrupt assignments, page 29.
1	CLK_SHDOWN#	Output	Low	Clock shutdown	Clock generator power management, page 40.
2	ISACTL_EN#	Output	Low	PC/104 enable	PC/104 interface, page 36.
3	NC			Not connected	
4	USB_SEL2PORTS	Output	High	USB select 2 ports	USB power management, page 40.
5	PWRSAVE	Output	High	Ethernet PHY & UART power save	Ethernet power management, page 39.

It is the responsibility of software to setup these MFUNC port pins correctly.

PC/104 interface

The PC/104 interface supports 8/16 bit ISA bus style signals. Add-on boards can be used to enhance the functionality of the main board. Eurotech has an extensive range of PC/104 compliant modules and these can be used to quickly add digital I/O, analogue I/O, serial ports, video capture devices, PC card interfaces etc. The ISA bus is based on the x86 architecture and is not normally associated with RISC processors. It is necessary to modify the standard drivers if you want them to support any third party PC/104 modules.

The PC/104 interface is implemented using a PCI bus interface of the IXP425 processor and slot B of Texas Instruments PCI1520 PCI/CardBus Bridge. Any PC/104 board that is plugged in appears in the EXCA memory or I/O window of the PCI1520 device. The PCI1520 - PCI/CardBus Bridge itself appears in the PCI memory space of the IXP425 processor.

The PC/104 bus signals are compatible with the ISA bus electrical timing definitions. DMA and bus mastering are not supported on VULCAN's PC/104 interface. For details about PC/104 interrupts, see Interrupt assignments, page 29.

The VULCAN provides +5V to a PC/104 add-on board via the J8 and J10 connectors. If a PC/104 add-on board requires a +12V supply, then +12V must be supplied to the VULCAN power connector J9 pin 4. If -12V or -5V are required, these must be supplied directly to the PC/104 add-on board.

All signals between the PCI1520 CardBus Controller and the PC/104 are buffered. After powering up slot B of the PCI1520 device, it is necessary to configure the MFUNC2 pin on PCI1520 as GP output (ISACTL_EN#) and set it low, to enable the PC/104 buffers.

Once MFUNC2 is set low, the PC/104 bus is enabled for access. At times when the PC/104 bus is idle, the PCI1520 slot B and the PC/104 connector are automatically isolated by the buffers transceiver output enables being driven high.

This is illustrated in the following table:

MFUNC2 (ISACTL_EN#)	PC/104 Operation Status
0	PC/104 Buffers Enabled (default)
1	PC/104 Buffers Disabled

Power and power management

Power supplies

The VULCAN is designed to operate from a single +5V±5% supply (4.75V to +5.25V). The power connector J9 has a +12V connection defined, but is not required for the VULCAN under normal operation. It can be used to supply +12V to the PC/104 stack if required. For information about the power connector, see J9 – Power connector, page 48.

There are three on-board supply voltages derived from the +5V supply. These are +1.3V (µP core), +2.5V (Ethernet PHY core) and +3.3V.

The reset circuitry monitors +5V, +1.3V, +3.3V, +2.5V supply rails. If any of them falls below the threshold, the board is placed in reset. When the power supply rises above the threshold voltage the board comes out of reset and reboots itself.

Power rail:	+5V	+3.3V	+2.5V	+1.3V
Reset threshold:	4.63V	3.09V	2.34V	1.18V

Battery backup

An external battery (CR2032 or similar) providing +2.8V to +3.3V can be used to backup the DS1302 RTC and the SRAM. The external battery supplies power to the battery backup circuit only when there is no +5V supply to the board. A battery backup supervisor circuit is used to enable battery switchover.

To use an external battery, connect its + and - terminals across J9 pins 3 (VBAT) and 2 (GND), respectively. For connector and mating connector details, see J9 – Power connector, page 48.

The SRAM minimum supply voltage in data retention mode is 1.5V, and the DS1302 minimum voltage is 2V. Please check the datasheet for external battery details concerning mAh at 3V and operating temperature.

The user jumper JP2 must not be fitted if an external battery is connected.

GoldCap backup

An on-board super capacitor (GoldCap 0.2F) can be used to backup the DS1302 RTC. The super capacitor supplies power to the DS1302 RTC only when there is no +5V supply to the board.

To use the super capacitor, fit the jumper JP2. See JP2 – Jumper header, page 50. The GoldCap maximum voltage is +3.2V when fully charged and the DS1302 minimum voltage is 2V. The GoldCap provides timekeeping for a maximum of 5 days at room temperature.

Power management

The IXP425 processor does not include any internal power management features, however the VULCAN board does allow power control to some on board peripherals. These include:

- UART.
- CompactFlash.
- Ethernet.
- USB.
- Clock generator.

These are explained in the following sections.

UART power management

COM3 and COM4 are implemented using external XR16L2551 DUART. This device supports a sleep mode with an automatic wake up. When this feature is enabled and there are no interrupts pending, the DUART enters sleep mode. The XR16L2551 stops its crystal oscillator to conserve power in the sleep mode. The part resumes normal operation when any of the following occur:

- Receive data start bit.
- Change of state on: CTS, DSR, CD, RI.
- Data is being loaded into transmit FIFO.

If the part was awakened by one of the above conditions, it returns to sleep mode automatically after the condition has cleared.

Using the PowerSave feature of XR16L2551 it is possible to reduce power consumption even further. The L2551 enters PowerSave mode when the PWRSAVE pin is logic high and the XR16L2551 is in sleep mode. This internally isolates the address, data and control signals from other bus activities. The device wakes up as a result of a receive data start bit transition or a change of logic state on any of the modem or general-purpose serial inputs: CTS#, DSR#, CD#, RI#.

Placing the XR16L2551 into low power mode can reduce the power consumption of the VULCAN by 10mW. Please refer to the XR16L2551 datasheet, on the Development Kit CD, for details about enabling the sleep and PowerSave modes.

MFUNC5 pin on PCI1520 device must be configured as GP output and can be used to put the XR16L2551 in PowerSave mode. RedBoot configures MFUNC5 pin as GP output. The same pin is used to power down the Ethernet PHY device.

MFUNC5 (PWRSAVE)	UART Operation Status	Ethernet PHY Operation Status
0	Normal operation	Normal operation
1	PowerSave	Power-down

CompactFlash power management

The TPS2210A PC CardBus power interface switch provides an integrated power-management solution for the PC card socket. This device allows the controlled distribution of 3.3V and 5V to the CompactFlash card slot. The current-limiting and thermal-protection features eliminate the need for fuses. The switch $r_{DS(on)}$ and current-limit values are set for the peak and average current requirements stated in the PC card specification.

Ethernet power management

The Ethernet PHY device (Intel LXT973) incorporates numerous features to maintain the lowest power possible. The device can be put into a low-power state via Register 0 of LXT973 as well as a near-zero power state with the power-down pin. When in power-down mode, the device is not capable of receiving or transmitting packets. The lowest power operation is achieved using the global power-down pin. This active high pin powers down every circuit in the device, including all clocks.

Individual ports can be powered down using the control register bit 0.11 of LXT973 (software power-down). This bit powers down a significant portion of the port, but clocks to the register section remain active. This allows the management interface to remain active during register power-down.

MFUNC5 pin on the PCI1520 device should be configured as GP output and can be used to control the power-down pin of Ethernet PHY. The same pin is used to place XR16L2551 DUART in PowerSave mode. Placing the LXT973 into near-zero power state can reduce the power consumption of the VULCAN by 500mW. Please refer to the LXT973 datasheet, on the Development Kit CD, for information about power management.

MFUNC5	UART Operation Status	PHY Operation Status
0	Normal operation	Normal operation
1	PowerSave	Global power-down

USB power management

A USB power control switch controls the power and protects against short-circuit and overcurrent conditions.

If the USB voltage VBUSx is short-circuited, or more than 500mA is drawn from any VBUSx supply, the switch turns off the power supply and protects the device and board automatically. The VBUSx power supplies are derived from the VULCAN +5V supply.

The ISP1561 USB host controller provides an advanced power management capabilities interface that is compliant with PCI bus Power Management Interface Specification, Rev. 1.1. Power is controlled and managed by the interaction between drivers and PCI registers. Please refer to the ISP1561 datasheet on the Development Kit CD for more information about power management.

The ISP1561 USB Host Controller supports four USB ports. Two of the ports can be disabled if not used by setting the SEL2PORTS pin high. MFUNC4 pin on the PCI1520 device should be configured as GP output and can be used to control the SEL2PORTS pin of the ISP1561 controller. Disabling two of the ports can reduce the power consumption of the VULCAN by up to 165mW.

MFUNC4 (SEL2PORTS)	ISP1561 Operation Status
0	All ports enabled
1	Ports 3,4 disabled

Clock generator power management

Two clock generator ICs can be placed in low power mode by shutting down the clock outputs in case the corresponding interfaces are not used. The following clocks are affected:

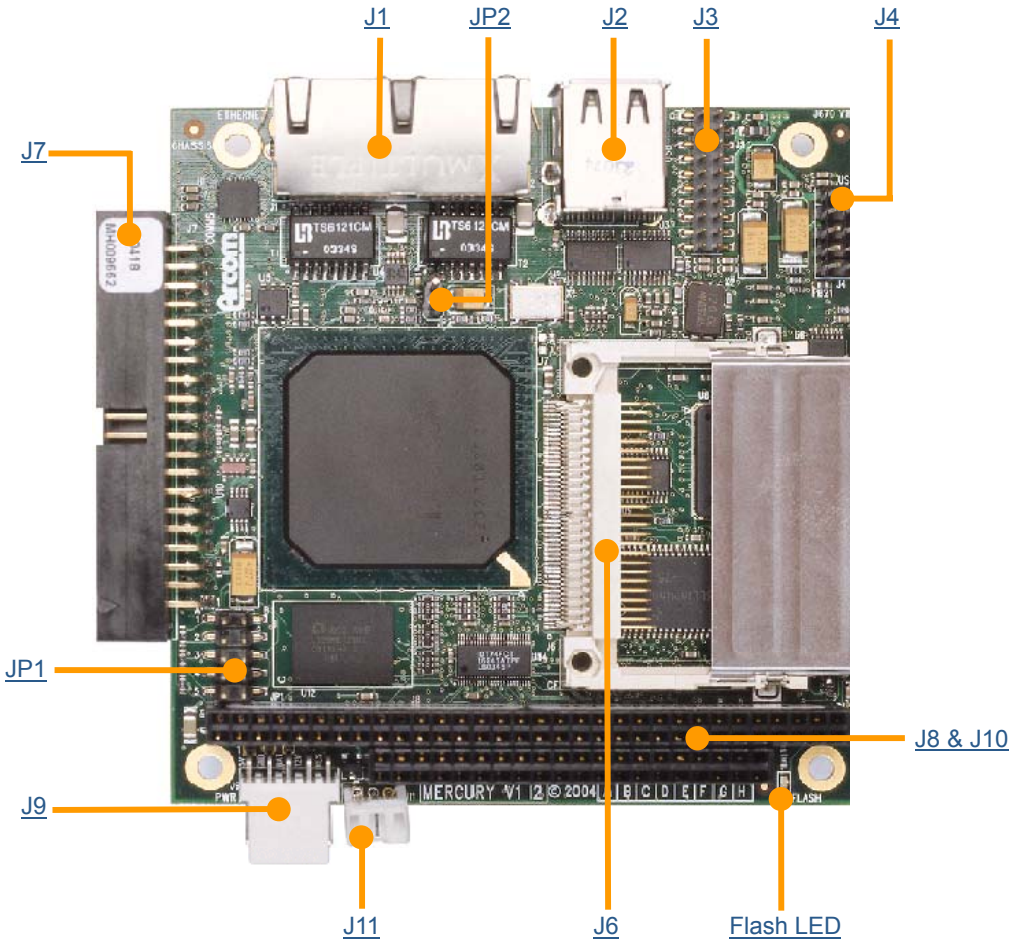
- XR16L2551 DUART 1.8432MHZ clock.
- Ethernet PHY 25MHz clock.
- PC/104 8MHz and 14MHz clocks.

MFUNC1 pin on the PCI1520 device should be configured as GP output and can be used to control the SHUTDOWN# pin of clock generator IC's. This can reduce the power consumption of the VULCAN by up to 130mW.

MFUNC1 (CLK_SHDOWN#)	Clock Operation Status
0	Shutdown mode
1	Normal operation

Connectors, LEDs and jumpers

The following photo shows the location of the connectors, LEDs and jumpers on the VULCAN:



Connectors and headers

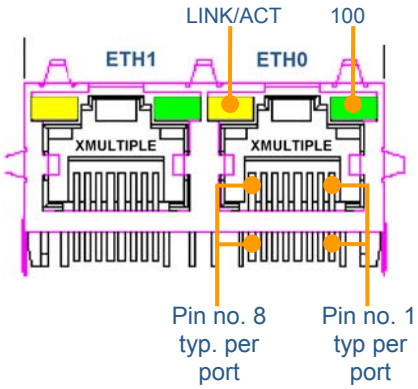
There are 10 connectors on the VULCAN for accessing external devices:

Connector	Function	See section...
J1	10/100-BaseTX Ethernet interface	J1 – 10/100-BaseTX Ethernet connector, page 43.
J2	USB	J2 – USB connector, page 43.
J3	GPIO	J3 – GPIO connector, page 44.
J4	USB	J4 – USB header, page 44.
J6	CompactFlash Type I/II	J6 – CompactFlash connector, page 45.
J7	Serial and JTAG	J7 – COMS ports and JTAG connector, page 46.
J8	64-way PC/104 expansion	J8 & J10 – PC/104 connectors, page 47.
J9	Power / battery / external reset	J9 – Power connector, page 48.
J10	40-way PC/104 expansion	J8 & J10 – PC/104 connectors, page 47.
J11	Tamper detect connector	J11 – Tamper jumper, page 51.

J1 – 10/100-BaseTX Ethernet connector

Dual RJ45, shielded, with LEDs, Xmultiple XRJM-S-02-8-8-1.

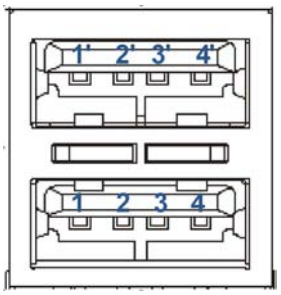
Pin	Signal name	Pin	Signal name
1B	TX0+	1A	TX1+
2B	TX0-	2A	TX1-
3B	RX0+	3A	RX1+
4B	N.C.	4A	N.C.
5B	N.C.	5A	N.C.
6B	RX0-	6A	RX1-
7B	N.C.	7A	N.C.
8B	N.C.	8A	N.C.
9B	LED0_SPEED#	9A	LED1_SPEED#
10B	+3V3	10A	+3V3
11B	LED0_LINK#	11A	LED1_LINK#
12B	+3V3	12A	+3V3



J2 – USB connector

USB type A dual stacked connector Suyin 020122MR008S236ZA.

Pin	Signal name	Pin	Signal name
1	VBUS1	1'	VBUS2
2	D1-	2'	D2-
3	D1+	3'	D2+
4	GND	4'	GND



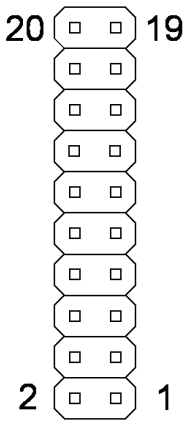
J3 – GPIO connector

Oupiin 2115-2 X 10 G D N, 20-way, 2mm (0.079") x 2mm (0.079") dual row header.

Mating connector: FCI 69307-020.

Mating connector crimps (x20): FCI 77138-001.

Pin	Signal name	Pin	Signal name
1	+5V	2	+5V
3	IN0	4	IN1
5	IN2	6	IN3
7	IN4	8	IN5
9	IN6	10	IN7
11	GND	12	GND
13	OUT0	14	OUT1
15	OUT2	16	OUT3
17	OUT4	18	OUT5
19	OUT6	20	OUT7



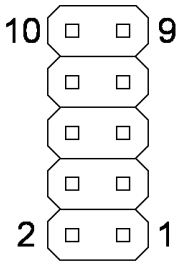
J4 – USB header

Neltron 2213S-10G, 10-way, 2.54mm (0.1") x 2.54mm (0.1") dual row header.

Mating connector: Molex 51110-1050.

Mating connector crimps: Molex 50394-8051.

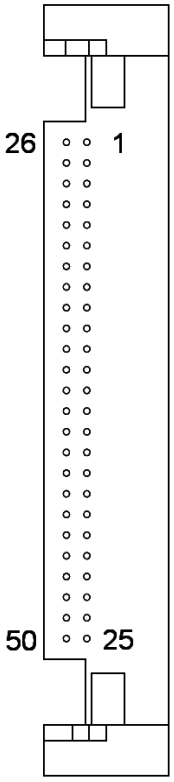
Pin	Signal name	Pin	Signal name
1	VBUS3	2	VBUS4
3	D3-	4	D4-
5	D3+	6	D4+
7	GND	8	GND
9	GND	10	GND



J6 – CompactFlash connector

50-way CompactFlash type II connector STECH N016-0140-004.

Pin	Signal name	Pin	Signal name
1	GND	2	D03
3	D04	4	D05
5	D06	6	D07
7	CE1#	8	A10
9	OE#	10	A09
11	A08	12	A07
13	+3.3V	14	A06
15	A05	16	A04
17	A03	18	A02
19	A01	20	A00
21	D00	22	D01
23	D02	24	IOCS16#
25	CD2#	26	/CD1
27	D11	28	D12
29	D13	30	D14
31	D15	32	CE2#
33	VS1# (GND)	34	IORD#
35	IOWR#	36	WE#
37	RDY/BSY	38	+3.3V
39	CSEL (GND)	40	N/C
41	RESET#	42	WAIT
43	INPACK#	44	REG#
45	N/C	46	N/C
47	D08	48	D09
49	D10	50	GND

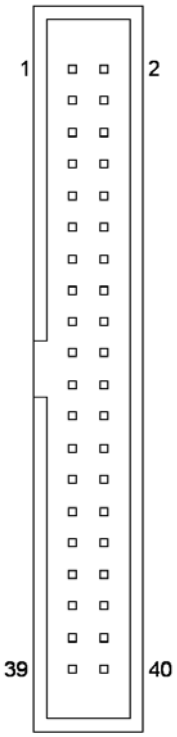


J7 – COMS ports and JTAG connector

Oupiin 3014-40GRB, 40-way, 2.54mm (0.1") x 2.54mm (0.1") dual row IDC boxed header.

Mating connector: FCC 71600-040.

Pin	Signal name	Pin	Signal name
1	+3V3	2	JTG_TRST#
3	JTG_TDO	4	JTG_TDI
5	RX3/TX3+	6	RX3/TX3-
7	RX3+	8	RX3-
9	GND	10	GND
11	N/C	12	N/C
13	RXD1	14	RTS1
15	TXD1	16	CTS1
17	GND	18	GND
19	GND	20	JTG_SRST#
21	DCD2	22	DSR2
23	RXD2	24	RTS2
25	TXD2	26	CTS2
27	DTR2	28	RI2
29	GND	30	JTG_TMS
31	N/C	32	N/C
33	RXD0	34	RTS0
35	TXD0	36	CTS0
37	N/C	38	N/C
39	GND	40	JTG_TCK

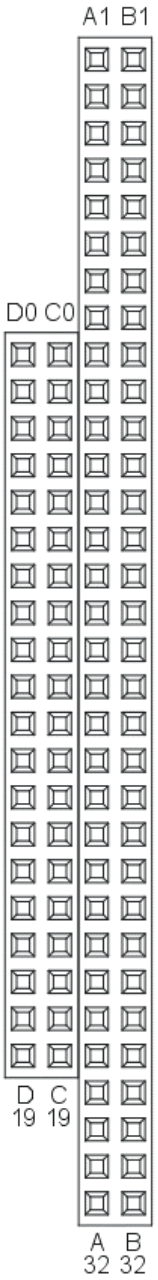


As viewed from the connector pins.

J8 & J10 – PC/104 connectors

Astron 25-1201-232-2G, 64-way, 2.54mm (0.1") x 2.54mm (0.1") non-stackthrough PC/104 compatible connector (Row A & B).
Astron 25-1201-220-2G, 40-way, 2.54mm (0.1") x 2.54mm (0.1") non-stackthrough PC/104 compatible connector (Row C & D).

Pin	J10		Pin	J8	
	Row D	Row C		Row A	Row B
			1	IOCHCK#	GND
			2	D7	RSTDRV
			3	D6	+5V
			4	D5	IRQ9
			5	D4	NC
			6	D3	DRQ2
			7	D2	NC
			8	D1	NC
0	GND	GND	9	D0	+12V
1	/MEMCS16#	/SBHE	10	IOCHRDY	KEY
2	/IOCS16#	LA23	11	AEN	SMEMW#
3	IRQ10	LA22	12	A19	SMEMR#
4	IRQ11	LA21	13	A18	IOW#
5	IRQ12	LA20	14	A17	IOR#
6	IRQ15	LA19	15	A16	DACK3#[1]
7	IRQ14	LA18	16	A15	DRQ3
8	DACK0#[1]	LA17	17	A14	DACK1#[1]
9	DRQ0	MEMR#	18	A13	DRQ1
10	DACK5[1]	MEMW#	19	A12	REFSH[1]
11	DRQ5	D8	20	A11	8MHz Clk
12	DACK6#[1]	D9	21	A10	IRQ7
13	DRQ6	D10	22	A9	IRQ6
14	DACK7#[1]	D11	23	A8	IRQ5
15	DRQ7	D12	24	A7	IRQ4
16	+5V	D13	25	A6	IRQ3
17	NC	D14	26	A5	DACK2#[1]
18	GND	D15	27	A4	TC[1]
19	GND	KEY	28	A3	BALE
			29	A2	+5V
			30	A1	14MHz Clk
			31	A0	GND
			32	GND	GND

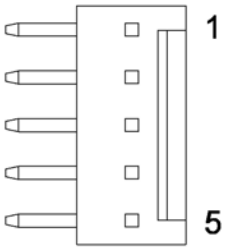


1 Signal not used, tied to +5V by 10KΩ resistor.

J9 – Power connector

J9 is a Molex 2.54mm (0.1") Pitch KK® Header - Right Angle Friction Lock 7395 series connector 22-05-7058. Mating connector is a Molex 2.54mm (0.1") Pitch KK® Crimp Terminal Housing 2695 series connector 22-01-2055.

Pin	Signal name
1	+5V
2	GND
3	VBAT [1]
4	+12V [2]
5	RST#



[1] Provides connection for a battery backup supply for the 256Kbyte static RAM and the Dallas DS1302 real time clock

[2] +12V connection defined, but is not required for the VULCAN under normal operation. It can be used to supply +12V to the PC/104 stack if required.

J11 – Tamper detect connector

PH200 series 3 pin 2mm boxed header, right angle, Toby PH200-03-R.

Mating connector: PH200 Series 2mm housings & crimps, Toby PH200-03H.

J11 provides the connections for the tamper detect switch. If the switch is not used, pins 1 and 2 must be shorted to enable the operation of the real time clock.

Pin	Signal name
1	+3V3
2	TAMPER
3	GND

Jumpers

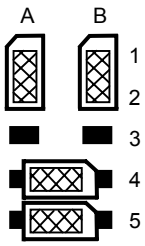
There are two user jumper headers on the VULCAN. They are summarised in the following table and their use is described below:

Connector	Function	Jumper details in section...
JP1	RS422/485 selection	JP1 – Jumper header, page 49.
JP2	Supercap/battery selection	JP2 – Jumper header, page 50.

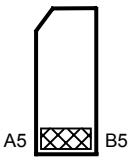
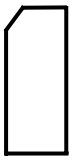
JP1 – Jumper header

The user selectable jumper header JP1 is used to choose between RS422 and RS485 options, and termination resistor options. For more details, see COM4 – RS422/485 interface, page 33. The default position of the jumpers are shown in the following diagram:

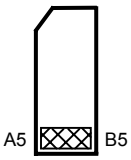
JP1 default jumper locations

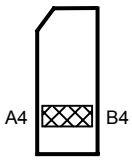
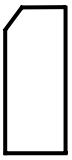


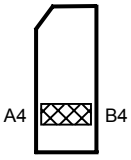
The following tables describe the jumper locations in more detail:

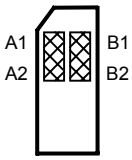
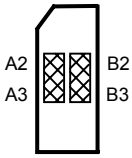
A5-B5	Description
	(RS485 TX/RX) RS422 TX line termination resistor (120Ω) connected. Only fit if the VULCAN is at the end of the network.
	(RS485 TX/RX) RS422 TX line termination resistor (120Ω) disconnected.

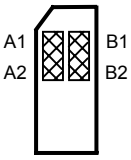
Default setting:



A4-B4	Description
	RS422 RX line termination resistor (120Ω) connected. Only fit if the VULCAN is at the end of the network.
	RS422 RX line termination resistor (120Ω) disconnected.

Default setting: 

A2 & B2	Description
	RS422 full-duplex
	RS485 half-duplex

Default setting: 

JP2 – Jumper header

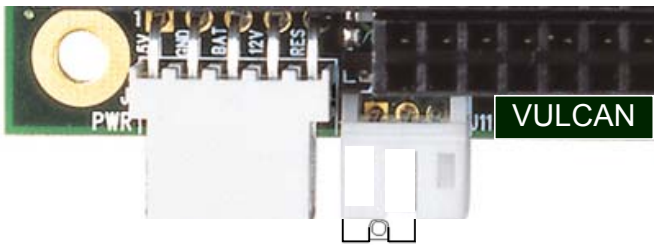
This user selectable jumper header is used to choose between the external battery and on-board Supercap for RTC and SRAM power backup.

JP2	Description
	Supercap connected (power backup for RTC only).
	External battery connected (power backup for RTC and SRAM).

Default setting: 

J11 – Tamper jumper

If the tamper detect circuit is not used, pins 1 and 2 of connector J11 should be shorted by jumper to enable normal operation of the DS1302 RTC, as shown in the following photo:



Pins 1 and 2 are on the side closest to the power connector.

Status LEDs

There is a single status LED on the VULCAN. This indicates when on board Flash memory (silicon disk) is being accessed.

Appendix A - Contacting Eurotech

Eurotech sales

Eurotech's sales team is always available to assist you in choosing the board that best meets your requirements.

Eurotech Ltd
3 Clifton Court
Cambridge
CB1 7BN
UK

Tel: +44 (0)1223 403410
Fax: +44 (0)1223 410457
Email: sales@eurotech-ltd.co.uk

Comprehensive information about our products is also available at our web site: www.eurotech-ltd.co.uk.

While Eurotech's sales team can assist you in making your decision, the final choice of boards or systems is solely and wholly the responsibility of the buyer. Eurotech's entire liability in respect of the boards or systems is as set out in Eurotech's standard terms and conditions of sale. If you intend to write your own low level software, you can start with the source code on the disk supplied. This is example code only to illustrate use on Eurotech's products. It has not been commercially tested. No warranty is made in respect of this code and Eurotech shall incur no liability whatsoever or howsoever arising from any use made of the code.

Eurotech technical support

Eurotech has a team of dedicated technical support engineers available to provide a quick response to your technical queries.

Tel: +44 (0)1223 412428
Fax: +44 (0)1223 410457
Email: support@eurotech-ltd.co.uk

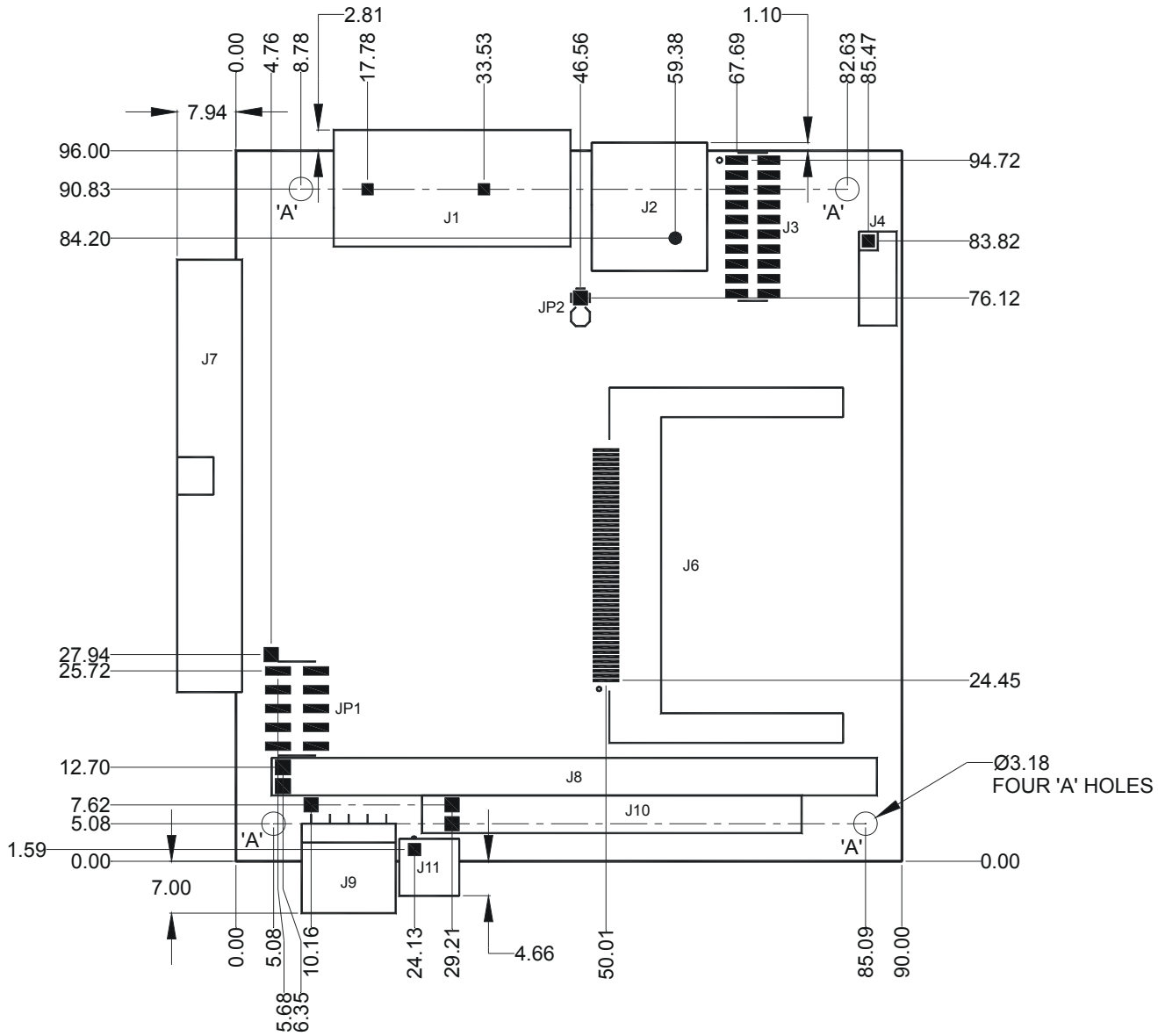
Eurotech Group

Eurotech Ltd is a subsidiary of Eurotech Group. For further details see www.eurotech.com

Appendix B - Specification

Microprocessor	Intel XScale™ IXP425 network processor.	
Memory	64MByte 133MHz SDRAM. 16/32MByte, AMD MirrorBit Flash. 256KByte SRAM (battery backed off board).	
Peripherals	Serial:	RS232 on COM1, COM2 and COM3. RS422/485 on COM4.
	CF+:	One 50 pin type I/II CompactFlash Socket.
	USB:	Quad channel v2.0 support.
	Ethernet	Dual IEEE802.3u support.
Temperature	Operating:	-20°C to +70°C, -4°F to +158°F (commercial). -40°C to +85°C, -40°F to +185°F (industrial).
Humidity	10% to 90% RH (non-condensing).	
Real time clock	Accuracy +/- 1minute/month.	
Software	RedBoot bootloader.	
Power requirement	5V +/- 5%. 4.5W maximum consumption (without CF+ or USB devices fitted). 3.5W typical.	
Battery input	2.7V to 3.3V (external). Typical discharge 2μA.	
Dimensions	PC/104 compatible format. 3.775” x 3.550”. 96mm x 91mm.	

Appendix C - Mechanical diagram



Units of measurement = mm

All connector dimensions taken from pin 1

Appendix D - Reference information

Product information

Product notices, updated drivers and support material:

www.eurotech-ltd.co.uk

PC/104 consortium

PC/104 Specifications. Vendor information and available add on products:

www.PC/104.org

USB information

Universal Serial Bus (USB) specification and product information:

www.usb.org

CompactFlash Association

CompactFlash (CF+) specification and product information:

www.compactflash.org

Intel

Intel XScale™ IXP425 processor documentation:

www.intel.com

Philips

ISP1561 USB 2.0 Host Controller documentation:

www.philips.com

Texas Instruments

PCI1520 PCI/CardBus Bridge documentation:

www.ti.com

Exar

Exar XR16C2551 DUART documentation:

www.exar.com

Maxim

Maxim DS1302 RTC and DS2401 Serial Number documentation:

www.maxim-ic.com

Appendix E - Acronyms and abbreviations

3DES	Triple Data Encryption Standard
AES	Advanced Encryption Standard
ALU	Arithmetical Logical Unit
API	Application Programming Interface
CAN	Controller Area Network
CF	CompactFlash
COM	Communication port
CPLD	Complex Programmable Logic Device
CMOS	Complementary Metal Oxide Semiconductor
DC	Direct Current
DES	Data Encryption Standard
DMA	Direct Memory Access
EHCI	Enhanced Host Controller Interface
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
FIFO	First-In First-Out
GPIO	General Purpose Input/Output
ICE	Industrial Compact Enclosure
IO	Input/Output
ISA	Industry Standard Architecture
JTAG	Joint Test Access Group
LAN	Local Area Network
LED	Light Emitting Diode
MAC	Media Access Control
MD5	Message Digest 5
MIPS	Million Instructions Per Second
µP	Microprocessor
NA	Not Applicable
NC	No Connect
NPE	Network Processor Engine
OS	Operating System
PC	Personal Computer
PCI	Peripheral Component Interconnect
PCMCIA	Personal Computer Memory Card International Association
RISC	Reduced Instruction Set Computer
RTC	Real Time Clock
SBC	Single Board Computer
SHA1	Secure Hash Algorithm

SRAM	Static Random Access Memory
SDRAM	Synchronous Dynamic Random Access Memory
TTL	Transistor Transistor Logic
UART	Universal Asynchronous Receiver / Transmitter
USB	Universal Serial Bus
VAC	Voltage Alternating Current
VDC	Voltage Direct Current
VPN	Virtual Private Network
WAN	Wide Area Network
WDT	Watchdog Timer

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