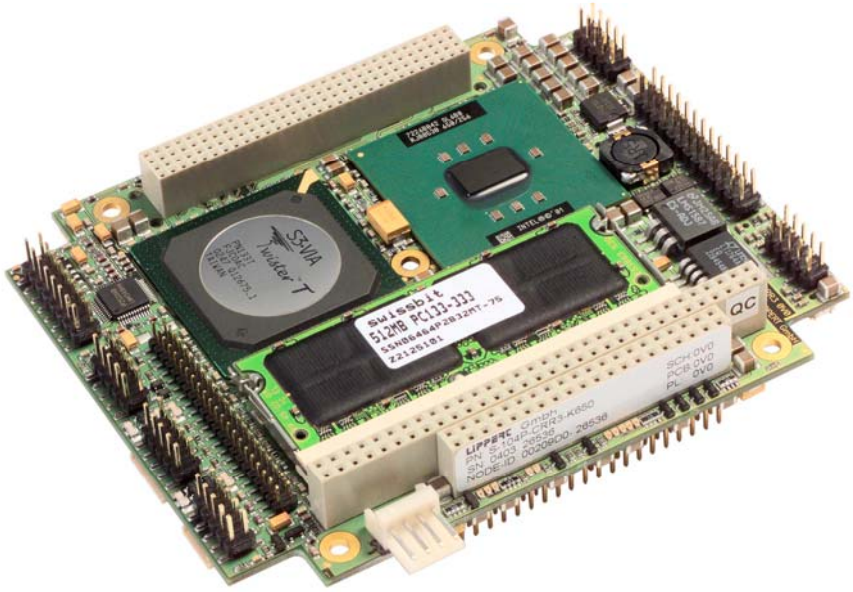
Cool RoadRunner III
PC/104-Plus CPU board

Technical Manual



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1 Functional Specification

The Cool RoadRunner III is an all-in-one CPU module conforming to the PC/104-Plus specification. It comes with AGP4x graphics, 10/100BaseT Ethernet and AC-97 sound on-board. It also comprises a Compact Flash socket and an ATA-6 (Ultra DMA-100) compliant EIDE interface. The system's main memory is expandable up to 512 MB SDRAM via the on-board SODIMM socket.

The core of the board can be either the Intel® ULV Celeron® microprocessor running at 650 MHz or the Intel® LV Pentium®-III processor running at 933 MHz. Both are fully compatible with previous x86 processors and provides plenty of features like support for MMX® technology and for streaming SIMD extensions.

The infrastructure of the board is provided by the VIA TwisterT chipset which integrates a Savage4 graphics accelerator from S3. With up to 32 MB of graphics memory it supports resolutions as high as 1600x1200 at 64K colors. In addition to ordinary SVGA-monitors almost all kinds of LCD and TFT Flat Panels can be connected through the 2-channel LVDS or the 18-bit parallel TFT interface.

The board also provides a TV-Out port supporting both, the NTSC and the PAL standard. Besides the usual serial and parallel ports, there are two USB 1.1 host ports and one IrDA compliant infrared interface located on the board.

1.1 The Cool RoadRunner III At a Glance

CPU:

- Intel® ULV Celeron® at 650MHz
- Intel® Pentium® -III at 933MHz

Cache Memory:

- Celeron
  - L1: 16 KB instruction cache and 16 KB write-back data cache
  - L2: 256 KB ECC protected cache

- Pentium-III
  - L1: 32 KB instruction cache and 32 KB write-back data cache
  - L2: 512 KB ECC protected cache

Main Memory:

- Supports a 64-bit memory bank using single- or double-sided 144-pin SODIMM modules up to 512 MB SDRAM

Chipset:

- Northbridge: VIA VT8606 with integrated Savage4 AGP4x graphics core
- Southbridge: VIA VT82C686B

Extension buses:

- 1 x 32-bit PC/104Plus
- 1 x 16-bit PC/104

Interfaces:

- Ethernet: 10/100BaseT
- Power supply
- ATA-6 EIDE (Ultra DMA-100)
- Compact Flash socket
- Floppy
- PS/2 Keyboard
- PS/2 Mouse
- 2 x USB 1.1 ports
- 2 x serial ports
- IrDA (SIR)
- 1x parallel port
- Audio: Line-In (left/right), Line-Out (left/right) and Microphone-In
- SVGA monitor
- 18-bit Flat Panel
- 2-channel LVDS
- S-Video and Composite TV-Out
- Supervisory port: External Power Button, Live-Signal and some general purpose signals

Other configurations are possible with high volume orders.

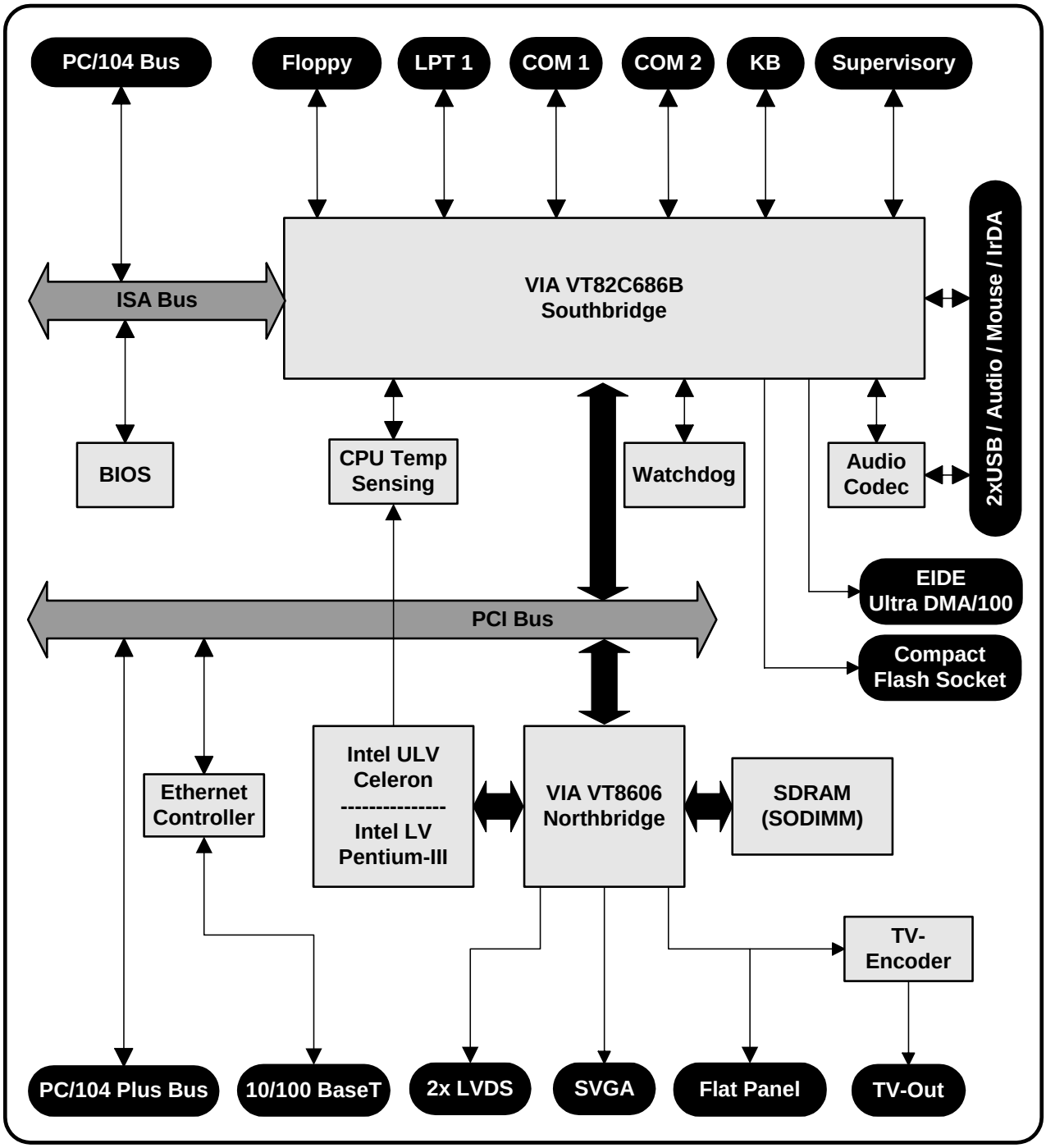
Dimensions:

- 95.9mm x 115.6mm (including I/O extension)

Mounting:

- 5 mounting holes

1.2 Functional Block Diagram



1.3 Processor

Using Intel's advanced 0.13-micron process technology with copper interconnect, both the ULV Celeron and. the LV Pentium-III processor offers high-performance and low-power consumption. They are based on the same core as existing Mobile Intel® Pentium® III Processor-M. Key performance features include MMX® technology, Internet Streaming SIMD instructions, an Advanced Transfer Cache architecture, Dynamic Execution and a processor system bus speed of 100 MHz (Pentium-III: 133MHz). The integrated L2 cache based on the Advanced Transfer Cache architecture runs at full speed and is designed to help improve performance. It complements the system bus by providing critical data faster and reducing total system power consumption. The processor also features Data Prefetch Logic that speculatively fetches data to the L2 cache, resulting in improved performance. The processor's 64-bit wide Assisted Gunning Transceiver Logic (AGTL) system bus provides a glue-less, point-to-point interface to the Northbridge.

1.4 Northbridge – VIA TwisterT

TwisterT is a high performance and energy efficient SMA chipset which connects to the CPU through a 64-bit, 100MHz (Pentium-III: 133MHz) Front Side Bus (FSB). It comprises the system controller, S3's Savage4 2D/3D graphics accelerator and S3's flat panel interfaces.

The TwisterT SMA system controller provides superior communication performance between the CPU, DRAM and PCI bus with pipelined, burst, and concurrent operation. The Synchronous DRAM interface allows zero wait state bursting between the DRAM and the data buffers at FSB frequency.
TwisterT supports a 32-bit 3.3 / 5V system bus (PCI 2.2) that is synchronous / pseudo-synchronous to the CPU bus. The chip contains a built-in bus-to-bus bridge to allow simultaneous concurrent operations on each bus.

TwisterT also contains S3's Savage4 graphics accelerator. Featuring a new super-pipelined 128-bit engine, it utilizes a single cycle architecture that provides high performance along with superior image quality. Resolutions as high as 1600x1200 at 64K colors are supported. Several new features enhance the 3D architecture, including single-pass multitexturing, anisotropic filtering, and an 8-bit stencil buffer. For MPEG-2 (DVD) playback, TwisterT's video accelerator offloads the CPU by performing the planar to packed format conversion and motion compensation tasks, while its enhanced scaling algorithm delivers incredible full-screen video playback.

TwisterT supports a wide variety of DSTN or TFT panels through an 18-bit interface. Alternatively a TV that conforms to the NTSC or the PAL standards can be connected. In addition, the integrated 2-channel LVDS interface can support another panel.

1.5 Southbridge – VIA VT82C686

The VT82C686B "PCI Super-I/O Integrated Peripheral Controller" is a high integration, high performance, power-efficient, and high compatibility device. In addition to complete ISA extension bus functionality, the VT82C686B includes the following standard intelligent peripheral controllers:

- Master mode enhanced IDE controller with dual channel DMA engine and interlaced dual channel commands. The VT82C686B supports data transfer rates up to 100MB/s through the UltraDMA-100 (ATA-6) standard.
- Standard floppy disk drive interface
- Keyboard controller and PS/2 mouse support.
- Universal Serial Bus controller with two ports that are USB v1.1 and Universal HCI v1.1 compliant.
- Two 16550-compatible serial I/O ports and infrared communications port option

- ECP/EPP-capable parallel port

- Integrated PCI-mastering full-duplex direct-sound AC97 sound system. Hardware SoundBlaster Pro and hardware-assisted FM blocks are included for Windows DOS box and real-mode DOS compatibility.

- Power management functionality compliant with ACPI and legacy APM requirements. Multiple sleep states (Power-on Suspend, Suspend-to-RAM (STR) and Suspend-To-Disk) are supported with hardware automatic wake-up.

- Hardware monitoring subsystem for managing system voltage levels and CPU fan speed

1.6 PC/104-Plus Bus Interface

The PC/104-Plus bus is a modification of the standard PCI bus. It incorporates all of the PC/104 features, with the added advantage of the high speed PCI bus.

The main features are:

- PC/104 Plus Bus slot fully compatible with PCI version 2.2 specifications.
- Integrated PCI arbitration interface (32 bit wide, 3.3V and 5V).
- Translation of PCI cycles to ISA bus.
- Translation of ISA master initiated cycle to PCI.
- Support for burst read/write from PCI master.
- 33 MHz PCI clock.

> **Note**: The internal DC/DC converter does not supply the 3.3 Volts pins to the PC/104-Plus bus.

1.7 PC/104 Bus Interface

The PC/104 bus is a modification of the industry standard (ISA) PC bus specified in IEEE P996. The PC/104 bus has different mechanics than P966 to allow the stacking of modules. The main features are:

- Supports programmable extra wait state for ISA cycles.
- Supports I/O recovery time for back-to-back I/O cycles.

The specifications for the PC/104 bus and the PC/104-Plus bus are available from the PC/104 Consortium at http://www.pc104.org.

1.8 National MacPhyter Ethernet Controller

The National Semiconductor MacPhyter is a fully integrated 10/100 Base-TX LAN solution and consists of both the Media Access Controller and the physical layer interface combined into a single component solution.

The 32-bit PCI v2.2 controller provides enhanced scatter-gather bus mastering capabilities and enables the MacPhyter to perform high-speed data transfers over the PCI bus. Its bus master capabilities enable the

component to process high level commands and perform multiple operations, which lowers CPU utilization by off-loading communication tasks from the CPU: two large transmit and receive FIFOs of 2 KB each help to prevent data underrun and overrun while waiting for bus accesses. This enables the MacPhyter to transmit data with minimum interframe gap.

The CSMA/CD unit of the MacPhyter allows it to be connected to either a 10 or 100 Mbps Ethernet network. The CSMA/CD unit performs all of the functions of the 802.3 protocol such as frame formatting, frame stripping, collision handling, deferral to link traffic, etc. The CSMA/CD unit can also be placed in a full duplex mode, which allows simultaneous transmission and reception of frames. In full duplex mode it adheres to the IEEE 802.3x Flow Control specification.

The PHY unit of the MacPhyter supports Auto-Negotiation for 10BaseT-/100BaseTX Half Duplex and 10BaseT-/100BaseTX Full Duplex modes.

The signals of the Ethernet interface are located on the IDC10 header “Ethernet”. An adapter cable from IDC10 to RJ45 connector is available.

1.9 Watchdog

A watchdog is implemented by a Maxim 691 Reset/Watchdog circuit. It is accessible through some general-purpose ports of the Southbridge controller: setting bit 0 of port 404Ch to 1 enables the watchdog function. Thereafter the watchdog must be triggered within 600ms; otherwise the watchdog generates a full hardware reset. Toggling bit 1 of port 404Dh triggers the watchdog.

The status of the watchdog can either be read through port 4048h (bit 7) or be determined from pin 3 of the supervisory connector (WD-ACTIVE). In each case a high level indicates, that a watchdog time-out has occurred. Additionally a red LED lights up, which is located on the topside of the board.

1.10 CPU Temperature Control

The Intel processors contain a temperature sensor to monitor the CPU temperature. The current temperature is shown in the **PC Health Status** screen of BIOS setup. It is measured directly under the SODIMM RAM socket. The measurement has an accuracy of ±3°C.
There is also a feature in the **PC Health Status** screen, which enables throttling of the CPU speed, if a selectable temperature limit is exceeded. It is called **Shutdown Temperature** and it can be set to 75°C, 85°C or 95°C or it can be completely disabled (default).

The Cool RoadRunner III variants up to 650 MHz do not need a cooling fan at the standard environment temperatures from –20°C…+60°C. It should be noted, however, that the provided passive heatsink can reach a temperature of +80°C. This is normal behavior and the CPU's maximum die temperature of 100°C is not exceeded if that happens.

The provided passive heatsink is a rather large device and may cause mechanical problems in certain system environments. In that case the customer must develop his own approach to cooling. This might be a specially built heatsink, a heatpipe, a Peltier element or something else.

The 933 MHz variant does always need a CPU fan (or some other active cooling device, such as a heat pipe) in order to keep the temperature below the maximum allowed value.

Caution!	The Cool RoadRunner III must always be operated with proper cooling provisions. Warranty will be void if operated without cooling.

1.11 On Board Power Supply

The on board power supply generates all necessary voltages from the single supply voltage of 5 volts. The voltages are observed by the Southbridge and are shown in the **PC Health Status** screen of BIOS setup.

The generated voltage of 3.3 Volts is available on the connectors “Flat Panel“ and “LVDS“.

> **Note**: This 3.3 V must not be used to supply external electronic devices with high power consumption like other PC/104 boards or displays.

1.12 EIDE Port

An EIDE (**E**nhanced **I**ntegrated **D**rive **E**lectronics) port is provided by the chipset to connect up to two drives that integrate the controller (hard disk, CD-ROM etc.). To enhance the performance, this port supports Ultra DMA-100 type of transfer. The EIDE port is available on a standard 44-pin header (2mm) for 2,5” hard disks. An adapter cable is available to connect standard EIDE devices with a 40 pin IDC header.

1.13 Compact Flash connector

On the bottom side of the board a compact flash connector is located that allows the use of compact flash cards instead of a hard disk. This socket is connected to the secondary EIDE port of the chipset. Compact flash cards are available as solid-state disks starting at 16 Mbytes up to several Gbytes and also as IBM MicroDrives.

1.14 Floppy Disk Interface

The floppy interface connector is built for slimline floppy disk drives. For connection of a conventional floppy disk drive an optional adapter connector is available.

1.15 PS/2 Keyboard Interface

The keyboard interface is located on the IDC10 Header “KEYBOARD”. An adapter cable is available to use a standard PS/2 keyboard with this connector.

1.16 PS/2 Mouse Interface

The PS/2 mouse signals MCLK and MDAT are located on the IDC16 header “AUDIO”. The PS/2 mouse function is programmable in BIOS setup by pressing DEL at boot time. **PS/2 mouse function control** can be enabled or disabled in the **Advanced BIOS features** menu.

1.17 USB 1.1 Ports

Two USB 1.1 ports are located on the IDC16 header “AUDIO”. When using USB it has to be enabled in BIOS setup by entering **Advanced Chipset Features** and then choosing **OnChip USB: Enabled**.

It is possible to use an USB keyboard under MSDOS without special driver software*. To do so, USB legacy support has to be enabled in the BIOS. Entering **Advanced Chipset Features** and then selecting **USB Keyboard support**: **Enabled** does this setting**.**

An adapter cable with two standard USB connectors is available.

*Note: not all keyboard manufacturers are supported.

1.18 Serial Port COM1 And COM2

The serial ports are located on two IDC headers “COM1” and “COM2”. Adapter cables with standard DB9 male connectors are available.

The serial ports are programmable in BIOS setup by pressing DEL at boot time. When entering **Integrated Peripherals** and then choosing **Onboard Serial Port 1** or **Onboard Serial Port 2**, configuration of the serial ports is accessible.

The following settings are possible for COM1 and COM2, respectively:

- Auto
- Disabled
- 3F8 / IRQ4 (base address / interrupt channel)
- 2F8 / IRQ3 (base address / interrupt channel)
- 3E8 / IRQ4 (base address / interrupt channel)
- 2E8 / IRQ3 (base address / interrupt channel)

1.19 IrDA Interface

The IrDA interface signals IRRX and IRTX are located on the IDC16 header “AUDIO”. The IrDA interface is available as serial port 2 by selecting it in the BIOS setup. The normal serial port 2 cannot be used at the same time as the IrDA interface. Entering **Integrated Peripherals** and then choosing **Auto** or one of the available base addresses in the menu point **Serial Port 2**, the submenu **UART2 Mode** will appear. There are three different possibilities to choose from:

- **Standard** (= normal function of COM2)
- **HPSIR**
- **ASK-IR**

When **HPSIR** or **ASK-IR** is selected, the duplex mode can be changed between half and full duplex via the submenu **Duplex Select**.

To use the IrDA interface an external transmitter must be connected to the IrDA signals.

1.20 Parallel Port LPT1

The parallel port is located on an IDC26 header. An adapter cable with a standard DB25 female connector is available.

The parallel port is programmable in the BIOS setup. The configuration of LPT1 is accessible by entering **Integrated Peripherals** and then choosing **Onboard Parallel Port**. The following settings are possible:

- Disabled
- 3BC/IRQ7 (base address / interrupt channel)
- 378/IRQ7 (base address / interrupt channel)

- 278/IRQ5 (base address / interrupt channel)

When **Onboard Parallel Port** is not disabled, the **Parallel Port Mode** can be selected:

- Normal
- ECP
- EPP
- EPP + ECP

If **Parallel Port Mode** is switched to ECP or EPP + ECP, **ECP Mode Use DMA** is accessible. DMA channels 1 or 3 can be selected. If EPP or EPP + ECP is chosen, **Parallel Port EPP Type** can be set to EPP1.7 or EPP1.9.

1.21 Audio Interface

The audio signals are located on the IDC16 header “AUDIO”. The signals are LINE-IN (left/right), LINE-OUT (left/right) and MICROPHONE-IN of the AC-97 Audio Codec. For using sound under MS-DOS, legacy audio support has to be enabled in the BIOS setup. To achieve this, **Onboard Legacy Audio** in the submenu **Integrated Peripherals** has to be set to “Enabled”. Then the following submenus are also accessible:

Sound Blaster:	**Enabled, Disabled**
SB I/O Base Address:	**220h, 240h, 260h** or **280h**
SB IRQ Select:	**IRQ5, IRQ7, IRQ9** or **IRQ10**
SB DMA Select:	**DMA0, DMA1, DMA2** or **DMA3**
MPU-401:	**Enabled, Disabled**
MPU-401 I/O Base Address:	**300h, 310h, 320h** or **330h**

Driver packages for MS-Windows are available.

There is an adapter cable available with standard audio connectors.

1.22 Speaker

The speaker signal is located on the IDC10 Header “KEYBOARD”. A standard PC Speaker can be connected between the signal SPEAKER and VCC.

1.23 SVGA Port

The SVGA connector is located on a 10-pin IDC header. An adapter cable to Sub-D HD15 female for CRT Monitors is available. The following display modes are supported:

Resolution	Color (bpp)	Max. Refresh rate (Hz)
640x480	8/16/32	160
800x600	8/16/32	85
1024x768	8/16/32	130
1280x1024	8/16/32	100
1600x1200	8/16	60

1.24 Flat Panel Port

The Flat panel port supports 8-bit and 16-bit DSTN displays and 9-bit, 12-bit, 15-bit and 18-bit TFT displays. The signals are provided through an IDC 30 header, which is located on the bottom side of the board. Next to it the backlight connector (Hirose DF13-8P) is mounted. The supply voltages of the backlight converter and of the display can be switched over the board. This is necessary for the correct power-on sequence of some displays. Furthermore these voltages can be adjusted in value by the display voltage selector (see chapter 3).

The **Panel type** can be selected using the BIOS setup utility, in **Advanced Chipset Features**. Additionally the **Display Device** in the same submenu has to be set to **LCD** or **CRT+LCD** to activate the flat panel port.

The following TFT display types are supported:

Resolution	Panel Type
640x480	0
800x600	9
1024x768	A
1280x1024	3 or B

The following DSTN display types are supported:

Resolution	Panel Type
640x480	4
800x600	5 or D
1024x768	E
1280x1024	F

Note: The TV-Out port cannot be used at the same time as the Flat Panel port.

1.25 LVDS Port

A 20 pin Hirose DF14 connector provides a 1- or 2-channel LVDS interface. The supply voltages of the back-light converter and of the display can be switched over the board. This is necessary for the correct power-on sequence of some displays. Furthermore these voltages can be adjusted in value by the display voltage selector (see chapter 3).

The **Panel type** can be selected in the **Advanced Chipset Features** of BIOS setup. Additionally the **Display Device** in the same submenu has to be set to **LCD** or **CRT+LCD** to activate the flat panel port.

The following LVDS display types are supported:

Resolution	Number of channels	Panel Type
640x480	1	8
800x600	1	1
1024x768	2	6
1024x768	1	7
1400x1050	2	C

Note that a single channel interface uses only the Y (see pin definitions in chapter 3) outputs; a dual channel uses both, the Y and the Z outputs.

1.26 TV-out Port

The TV-out port offers the possibility to directly connect a TV to the Cool Road Runner 3. The TV standards supported are PAL, NTSC and NTSC-J (Japan). A 6-pin Hirose DF-13 header on the bottom side of the board provides composite and S-Video signals.

The **TV type** can be selected in the **Advanced Chipset Features** of BIOS setup. Additionally the **Display Device** in the same submenu has to be set to **TV** or **CRT+TV** to activate the TV-out port.

Note: The TV-Out port cannot be used at the same time as the Flat Panel port.

1.27 Supervisory Connector

The Cool RoadRunner III provides a 15-pin Supervisory Connector on its bottom side. Besides several general purpose signals (see table below) it delivers misc. control and status signals:

- Watchdog active: high when the watchdog was triggered
- Live signal: user-programmable “application running” signal
- External Power Button: an impulse to GND (> 4 s) on this signal switches the system to the “Soft-off” state. Another impulse (> 100 ms) turns it on again.
- The following table shows the general purpose signals and explains how to control them:

Pin	Direction	Enable	5V tolerant	Value (Note 1)
4	Output	-	-	I/O 404E[6]
6	Input	-	**no**	I/O 4048[2]
7	Input	-	yes	I/O 4048[1]
8	Input	-	yes	I/O 4048[6]
9	Input	-	yes	I/O 404A[6]
10	Input	-	yes	I/O 404A[7]
11	Input	Note 2	yes	I/O 4049[3]
11	Output	Note 2	-	I/O 404D[3]
12	Output	-	-	I/O 404C[5]
13	Output	Note 3	-	I/O 404D[4]
14	Output	-	-	Note 4

Notes:

1) I/O xxxx[n] means Bit n of I/O Port xxxx
2) Pin 11 can be used as an input or as an output port. To switch between these modes, first write address 80003874h to Port CF8h. Then writing a 0 to bit 5 of Port CFCh results in pin 11 being an input, while writing a 1 to this bit configures it as an output.
3) Pin 13 must be enabled before it can be used. To do so write address 80003874h to Port CF8h. Then write a 1 to Bit 17 of port CFCh.
4) To set the value of pin 14, first write 0Dh to Port 3C4h. Then the value can be controlled by bit 0 of Port 3C5h.

1.28 Reset-In Signal

The RESET-IN signal is located on the IDC10 Header “KEYBOARD”. To reset the board the signal RESET-IN must be connected to GND.

2 Hardware Installation

The Cool RoadRunner III is delivered with jumper settings for proper operation. The customer must not change the default jumper settings. Improper jumper settings will cause system instability or system hang-ups.

Caution!

The board must not be connected or disconnected to PC/104 bus or PC/104Plus bus with power supply switched ON!

2.1 Adapter Cable Set

With the optional available cable set standard PC devices can be easily connected to the board. The adapter cable set comprises the following items:

- Adapter cable 3.5'' power supply connector female to 5.25'' power supply connector male for supplying the board with a standard PC power supply
- Two adapter cables IDC10 female to DB9 male for serial port 1 and 2
- Adapter cable IDC26 female to DB25 female for parallel port
- Adapter cable IDC10 female to DB9 female plus adapter to SUB-D 15p. female for standard VGA monitors
- Adapter cable IDC44 / 2mm female to IDC44 / 2mm female to connect 2.5'' EIDE hard disks
- Flat foil cable 26p. plus PCB adapter to 34p. female 2 row 2.54mm grid

The flat foil cable must be inserted in the FFC connector with the blank side on the top. Be careful not to damage the little safety lever at the floppy connector.

3 Software

3.1 BIOS

The Cool RoadRunner III is delivered with a standard PC BIOS. The default setting guarantee a “ready to run” system, even without a BIOS setup backup battery.

If the user wants to change settings, pressing the <DEL> key on power up accesses the setup utility.

The BIOS is located in a flash prom and can be easily updated on board with software under DOS.

All changes in the setup of the BIOS are stored in the CMOS RAM of the real time clock. A copy of the CMOS RAM excluding date and time data is stored in the flash ROM. This means that even if the backup battery runs out of power, the CMOS settings are not lost. Only date and time will be set to their default value.

The default values of the BIOS can be automatically loaded at boot time. To achieve this, the key “0 / INSERT” on the numerical keypad should be pressed before the system is turned on. Holding this key and turning the system on loads the default values.

3.2 Drivers

Software drivers for Sound, Ethernet, graphics adapter as well as for the VIA chipset are available for the Cool RoadRunner III.

These drivers can be downloaded from LiPPERT's website http://www.lippert-at.com.

For installation follow the instructions on the driver disks.

4 Connector Definitions

Refer to chapter 5.2 Mechanical specifications for an overview of the connector positions.

4.1 PC104-Plus Bus

Pin	A	B	C	D
1	GND	Reserved	+5 Volts	AD00
2	VI/O	AD02	AD01	+5 Volts
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	NC	C/BE1	AD15	NC
9	SERR	GND	SB0	PAR
10	GND	PERR	NC	SDONE
11	STOP	NC	LOCK	GND
12	NC	TRDY	GND	DEVSEL
13	FRAME	GND	IRDY	NC
14	GND	AD16	NC	C/BE2
15	AD18	NC	AD17	GND
16	AD21	AD20	GND	AD19
17	NC	AD23	AD22	NC
18	IDSEL0	GND	IDSEL	IDSEL2
19	AD24	C/BE3	VI/O	IDSEL3
20	GND	AD26	AD25	GND
21	AD29	+5 Volts	AD28	AD27
22	+5 Volts	AD30	GND	AD31
23	REQ0	GND	REQ1	VI/O
24	GND	REQ2	+5 Volts	GNT0
25	GNT1	VI/O	GNT2	GND
26	+5 Volts	CLK0	GND	CKL1
27	CLK2	+5 Volts	CLK3	GND
28	GND	INTD	+5 Volts	RST
29	+12 Volts	INTA	INTB	INTC
30	-12 Volts	Reserved	Reserved	GND

Note: All VIO pins are connected to +5 Volts by default.
This board does not support -12 Volts.

4.2 PC/104 Bus

Pin	D	C
0	GND	GND
1	MEMCS16	SBHE
2	IOCS16	LA23
3	IRQ10	LA22
4	IRQ11	LA21
5	IRQ12	LA20
6	IRQ15	LA19
7	IRQ14	LA18
8	DACK0	LA17
9	DRQ0	MEMR
10	DACK5	MEMW
11	DRQ5	SD8
12	DACK6	SD9
13	DRQ6	SD10
14	DACK7	SD11
15	DRQ7	SD12
16	+5 Volts	SD13
17	MASTER	SD14
18	GND	SD15
19	GND	GND

Pin	A	B
1	IOCHCK	GND
2	D7	RSTDRV
3	D6	+5 Volts
4	D5	IRQ9
5	D4	-5 Volts
6	D3	DRQ2
7	D2	-12 Volts
8	D1	ENDXFR
9	D0	+12 Volts
10	IOCHRDY	KEY
11	AEN	SMEMW
12	A19	SMEMR
13	A18	IOW
14	A17	IOR
15	A16	DACK3
16	A15	DRQ3
17	A14	DACK1
18	A13	DRQ1
19	A12	REFRESH
20	A11	SYSCLK
21	A10	IRQ7
22	A9	IRQ6
23	A8	IRQ5
24	A7	IRQ4
25	A6	IRQ3
26	A5	DACK2
27	A4	TC
28	A3	BALE
29	A2	+5 Volts
30	A1	OSC
31	A0	GND
32	GND	GND

-5 Volts and –12 Volts are not supported on this board.

4.3 10/100BaseT Connector

Connector type: IDC10 pin header 2.54 mm

Signal name	Pin	Signal name	Pin
TX+	1	TX-	2
RX+	3	PE	4
PE	5	RX-	6

4.4 EIDE Connector

Connector type: IDC14 pin header 2.00 mm

Signal name	Pin	Signal name	Pin
/Reset	1	GND	2
Data7	3	Data8	4
Data6	5	Data9	6
Data5	7	Data10	8
Data4	9	Data11	10
Data3	11	Data12	12
Data2	13	Data13	14
Data1	15	Data14	16
Data0	17	Data15	18
GND	19	NC	20
DRQ0	21	GND	22
Write	23	GND	24
Read	25	GND	26
Ready	27	CSEL	28
DACK0	29	GND	30
IRQ	31	IOCS16-	32
Address1	33	PD66	34
Address0	35	Address2	36
CS1	37	CS3	38
NC	39	GND	40
+5 Volts	41	+5 Volts	42
GND	43	GND	44

4.5 Power Connector

Connector type: 3.5” FDD Power connector

Signal name	Pin	Signal name	Pin
+5 Volts	1	GND	2
GND	3	+ 12 Volts	4

4.6 Floppy Connector

Connector type: FFC 26 pin 1.00 mm

Signal name	Pin	Signal name	Pin
+5 Volts	1	Index	2
+5 Volts	3	Drive Select 0	4
+5 Volts	5	Disk change	6
NC	7	NC	8
NC	9	Motor On 0	10
NC	11	Direction	12
NC	13	Step	14
GND	15	Write Data	16
GND	17	Write Gate	18
GND	19	Track 0	20
GND	21	Write Protect	22
GND	23	Read Data	24
GND	25	Head Select	26

4.7 Keyboard Connector n

Connector type: IDC10 pin header 2.54 mm

Signal name	Pin	Signal name	Pin
Speaker	1	GND	2
Reset-In	3	NC	4
KB Data	5	KB Clock	6
GND	7	+5 Volts	8
Ext. battery	9	Reset-In	10

4.8 PS/2 Mouse / USB 1.1 / IrDA / Audio Connector

Connector type: IDC16 pin header 2.54 mm

Signal name	Pin	Signal name	Pin
IRRX	1	IRTX	2
MS Data	3	MS Clock	4
USBDT0+	5	USBDT0-	6
USBDT1+	7	USBDT1-	8
USBVCC	9	USBGND	10
Line In L	11	Line In R	12
Line Out L	13	Line Out R	14
Microphone	15	GND Audio	16

4.9 COM1 Connector

Connector type: IDC10 pin header 2.54 mm

Signal name	Pin	Signal name	Pin
DCD	1	DSR	2
RXD	3	RTS	4
TXD	5	CTS	6
DTR	7	RI	8
GND	9	+5 Volts	10

4.10 COM2 Connector

Connector type: IDC10 pin header 2.54 mm

Signal name	Pin	Signal name	Pin
DCD	1	DSR	2
RXD	3	RTS	4
TXD	5	CTS	6
DTR	7	RI	8
GND	9	+5 Volts	10

4.11 LPT1 Connector

Connector type: IDC26 pin header 2.54 mm

Signal name	Pin	Signal name	Pin
Strobe	1	Auto LF	2
Data0	3	Error	4
Data1	5	Init	6
Data2	7	Select In	8
Data3	9	GND	10
Data4	11	GND	12
Data5	13	GND	14
Data6	15	GND	16
Data7	17	GND	18
ACK	19	GND	20
Busy	21	GND	22
Paper End	23	GND	24
Select	25	NC	26

4.12 VGA Connector

Connector type: IDC10 pin header 2.54 mm

Signal name	Pin	Signal name	Pin
Red	1	RGB-GND	2
Green	3	RGB-GND	4
Blue	5	RGB-GND	6
HSYNC	7	GND	8
VSYNC	9	GND	10

4.13 Flat Panel Connector

Connector type: IDC30 pin header 2.00 mm

Signal name	Pin	Signal name	Pin
GND	1	FPCLK	2
HSYNC	3	VSYNC	4
GND	5	R0	6
R1	7	R2	8
R3	9	R4	10
R5	11	GND	12
G0	13	G1	14
G2	15	G3	16
G4	17	G5	18
GND	19	B0	20
B1	21	B2	22
B3	23	B4	24
B5	25	GND	26
EN	27	VLCD-SW	28
VLCD-SW	29	GND	30

4.14 Flat Panel Backlight

Connector type: Hirose DF13 8 pin

Signal name	Pin	Signal name	Pin
+12 Volts	1	+12 Volts	2
+5 Volts	3	+5 Volts	4
EN	5	NC	6
GND	7	GND	8

4.15 LVDS Connector

Connector type: Hirose DF14 20-pin header

Signal name	Pin	Signal name	Pin
Y0P	1	Y0M	2
Y1P	3	Y1M	4
Y2P	5	Y2M	6
YCP	7	YCM	8
Z0P	9	Z0M	10
Z1P	11	Z1M	12
Z2P	13	Z2M	14
ZCP	15	ZCM	16
GND	17	GND	18
VLCD-SW	19	VLCD-SW	20

4.16 Display Voltage Selector

Connector type: IDC6 pin header 2.00 mm. Use a 2mm jumper between 1-3 or 3-5 to select the display voltage. Use a 2mm jumper between 2-4 or 4-6 to select the backlight voltage.

Signal name	Pin	Signal name	Pin
+3.3 volts	1	+12 volts	2
display voltage	3	backlight voltage	4
+5 volts	5	+ 5 volts	6

4.17 TV-OUT Connector

Connector type: Hirose DF13 6-pin header

Signal name	Pin	Signal name	Pin
COMPOSITE	1	GND	2
CROMA	3	GND	4
LUMA	5	GND	6

4.18 Supervisory Connector

Connector type: Hirose DF13 15-pin

Signal name	Pin	Signal name	Pin
+5 Volts	1	+3.3 Volts	2
WD-ACTIVE	3	LIVE	4
PWR_BTN	5	GPI2	6
GPI1	7	GPI6	8
GPI22	9	GPI23	10
GPIOD	11	GPO5	12
GPO12	13	NB_GPOUT	14
GND	15		

Note: The 3,3 Volts are generated by an on-board DC-DC converter. It must be not used to supply power to any peripherals with high power consumption.

5 System Address Map

This section describes the layout of the CPU memory and I/O address spaces.

Note: Depending on enabled or disabled functions in the BIOS, other or more resources may be used

5.1 Memory Address Map

Address Range (Dec)	Address Range (Hex)	Size	Description
1024K - 16384K	100000 - FFFFFF	15360K	Extended Memory
896K - 1024K	E0000 - FFFFF	128K	System BIOS
812K - 895K	CB000 - DFFFF	88K	Unused
768K - 811K	C0000 - CAFFF	44K	Graphics BIOS
736K - 768K	B8000 - BFFFF	32K	Monochrome Text Memory
704K - 736K	B0000 - B7FFF	32K	Color Text Memory
640K - 704K	A0000 - AFFFF	64K	Graphic Memory
0K - 640K	0 - 9FFFF	640K	Conventional Memory

5.2 I/O Address Map

The system chip set implements a number of registers in I/O address space. These registers occupy the following map in the I/O space.

Address Range (Hex)	Size	Description
0000 – 000F	16 bytes	DMA Controller 1 (8237)
0020 – 0021	2 bytes	Interrupt Controller 1 (8259)
0040 – 0043	4 bytes	Timer Controller (8254)
0060	1 byte	Keyboard Controller Data Byte
0061	1 byte	Misc. Functions & Speaker Control
0064	1 byte	Keyboard Controller Command, Status
0070, bit 7	1 bit	NMI Enable
0070, bit6:0	7 bits	Real Time Clock Address
0071	1 byte	Real Time Clock Data
0072 – 0075	2 byte	reserved
0080	1 byte	reserved
0081 – 008F	15 bytes	DMA Page Registers
0092	1 byte	System Control
00A0 – 00A1	2 bytes	Interrupt Controller 2 (8259)
00C0 – 00DE	31 bytes	DMA Controller 1 (8237)
02F8 – 02FF	8 bytes	Serial Port 2
0378 – 037F	8 bytes	Parallel Port 1 (Standard & EPP)
03F0 – 03F1	2 bytes	Super-I/O Configuration Registers
03F0 – 03F7	6 bytes	Floppy Controller Registers
03F8 – 03FF	8 bytes	Serial Port 1
0778 – 077A	3 bytes	Parallel Port 1 (ECP Extensions)
0CF8 – 0CFB	4 bytes	PCI Configuration Address Register
0CFC – 0CFF	4 bytes	PCI Configuration Data Registers

5.3 Interrupts

IRQ	System Resource
NMI	Parity Error
0	Timer
1	Keyboard
2	Interrupt Controller 2
3	Serial Port 2
4	Serial Port 1
5	available (PC/104 or -Plus)
6	Floppy
7	Parallel Port 1
8	Real Time Clock
9	available (PC/104 or -Plus)
10	available (PC/104 or -Plus)
11	available (PC/104 or -Plus)
12	PS/2 Mouse
13	Math coprocessor
14	EIDE
15	Compact Flash

5.4 DMA Channels

DMA	Data width	System Resource
0	8 bits	Available
1	8 bits	Available
2	8 bits	Floppy
3	8 bits	Parallel Port
4		Reserved, Cascade Channel
5	16 bits	IDE Controller
6	16 bits	Available
7	16 bits	Available

6 Technical Characteristics

6.1 Electrical

Supply voltage:	+5 Volts
Supply voltage ripple:	±3 %
Supply current:	depending on CPU frequency: max. 2.8 A @ 400 MHz max. 3.3 A @ 650 MHz max. 3.9 A @ 933 MHz

6.2 Environmental

Operating Temperature:	-20…+60°C
Storage temperature:	-40...+70°C
Temperature change:	max. 10K / 30 minutes
Humidity (relative):	10…90 %
Pressure:	450...1100 hPa

Note: The passive heat sink can reach a temperature of +80°C. The maximum CPU temperature is not exceeded if this happens.
To lower the system temperature the “Shutdown Temperature” feature can be enabled in BIOS setup. Notice that this throttles the CPU speed.

Caution! The Cool RoadRunner III must always be operated with proper cooling provisions.
Warranty will be void if operated without cooling.

6.3 MTBF

MTBF at 30°C: 154.500 hours

In order to perform a failure rate assessment, several assumptions have to be made to minimize the complexity of the analysis.

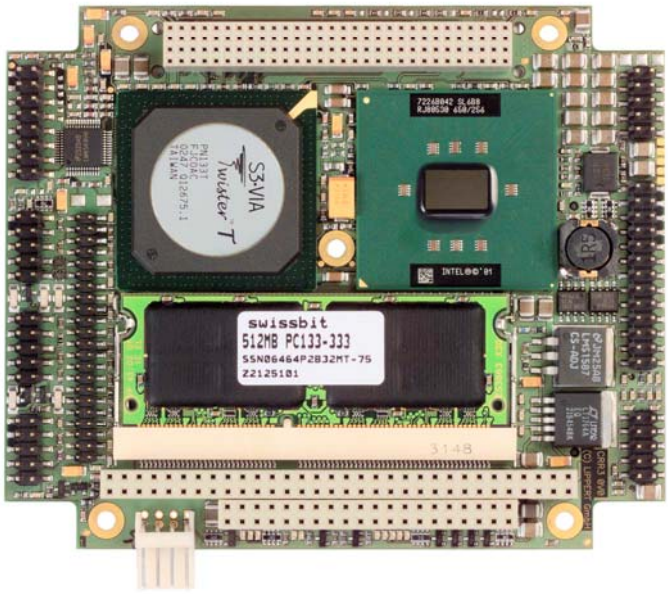
1. Basis for the calculation was „Parts-Stress“ method according to MIL-HDBK-217 F Notice 2. Although this method requires stress values for all components, mean stress values have been used.
2. Environmental factor „Ground Benign“ according to MIL-HDBK-217 has been used as well as an environmental temperature of 30 °C.
3. Failure rate of mechanical components (screws, chassis, etc) is negligible.

The detailed analysis report is available on request.

6.4 Mechanical

Dimensions (LxW):	95.9mm x 115.6mm (including I/O extension)
Height:	15mm
Weight:	145g (including SDRAM Module)

Mechanical dimensions:



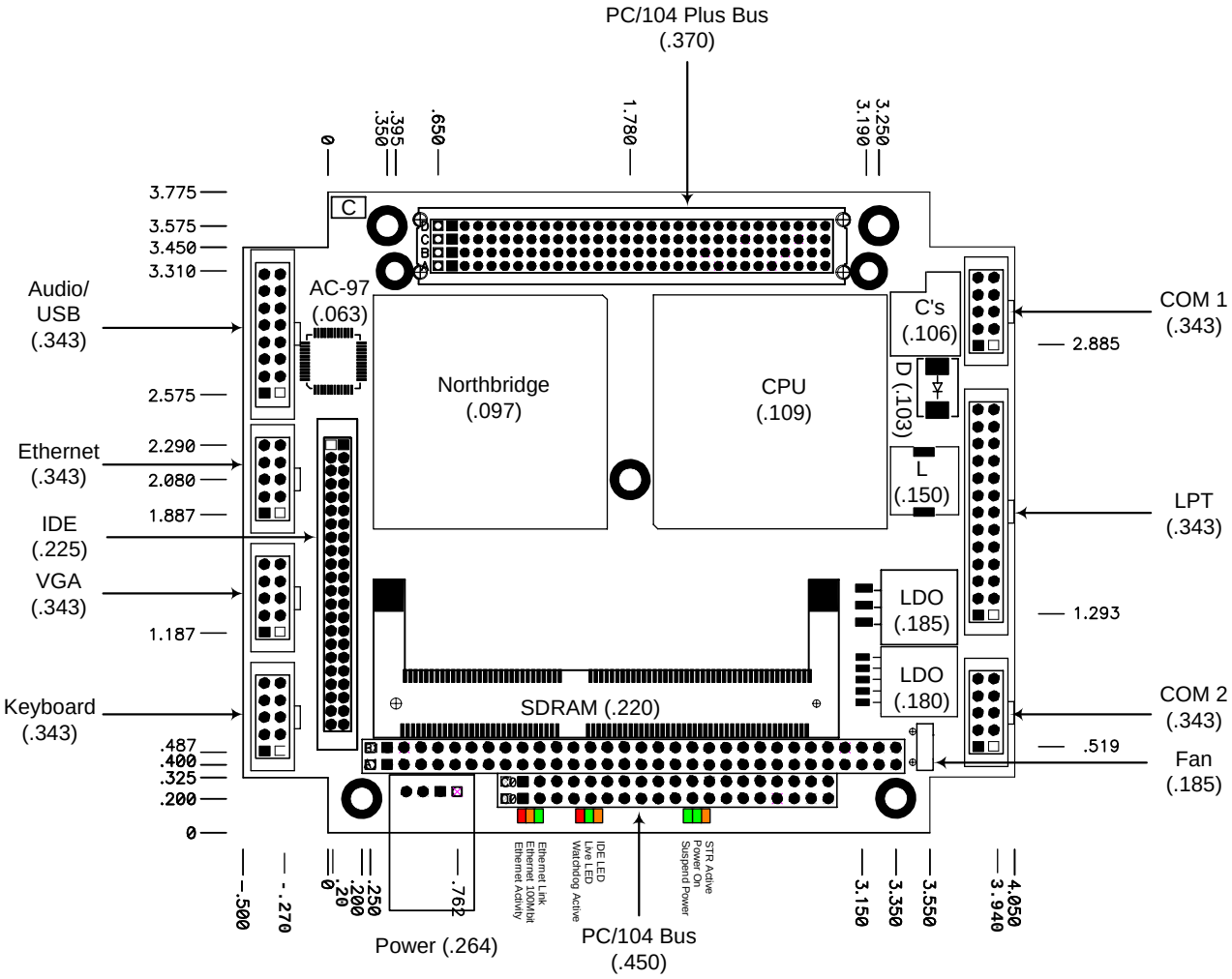
Top side:

Notes:

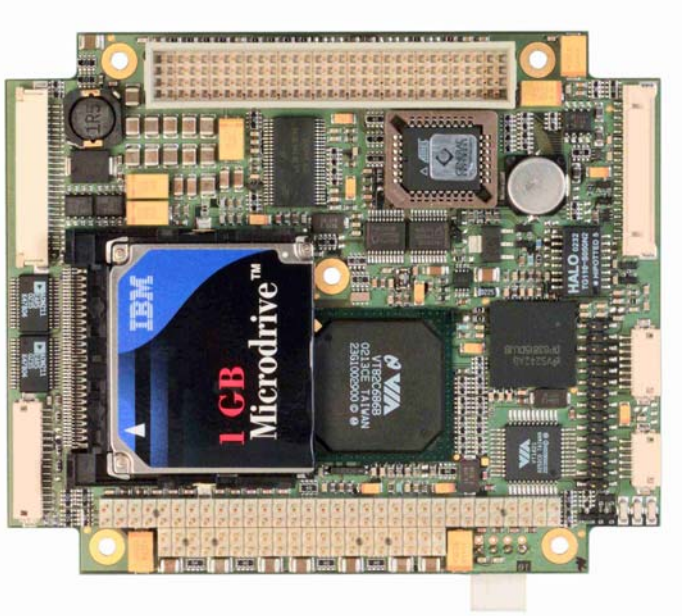
- All dimensions are in inch
- Values in brackets indicate the height of the component

□ marks Pin 1

■ marks Pin 2



Bottom side:



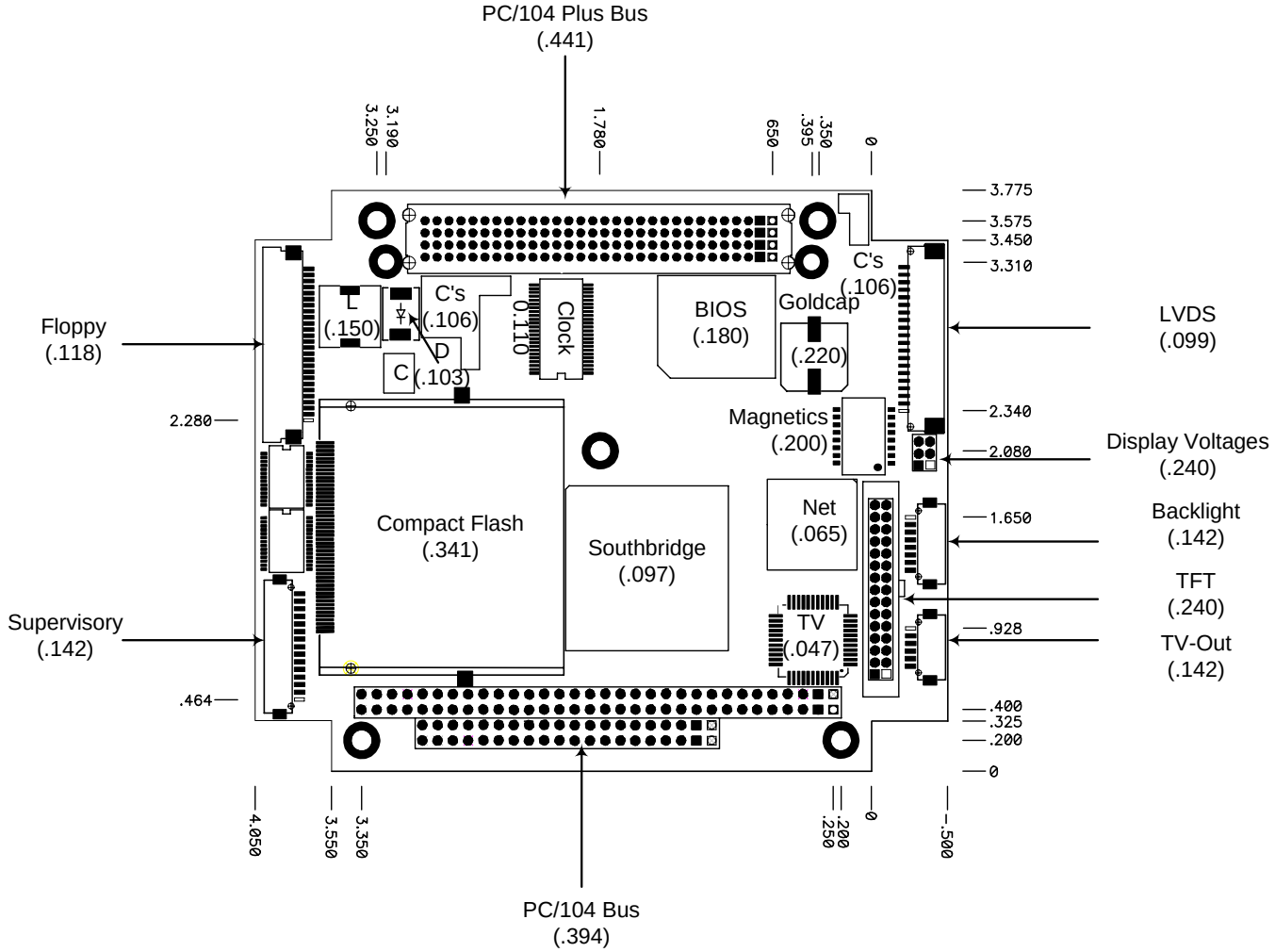
Notes:

- All dimensions are in inch

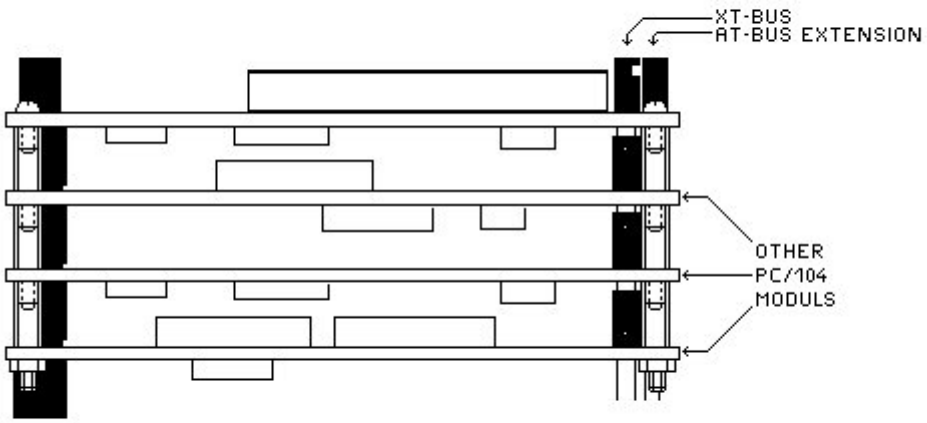
- Values in brackets indicate the height of the component

☐ marks Pin 1

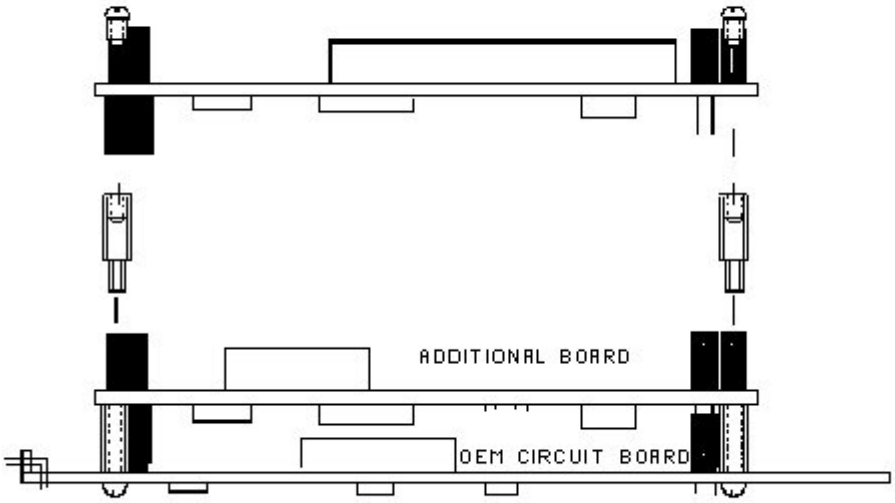
■ marks Pin 2



Self-stacking system (standard):



Customized system:



7 Options

The following accessories are available on request:

- Graphic driver software
- Ethernet driver software
- Sound driver software
- Compact flash cards
- Adapter cable set (including standard PC connectors for COM 1 and 2, LPT, Keyboard, flat foil cable adapter for 3,5” Floppy, VGA adapter cable, cable for 2,5’’ hard disk drives and Power supply)
- Adapter cable for Ethernet, Sound, USB, PS/2 Mouse

The drivers can be downloaded from LiPPERT's website http://www.lippert-at.com

8 Revision History

File name	Date	Edited by	Changes
TME-104P-CRR3-R0V0.doc	2002-11-15	KF	Created
TME-104P-CRR3-R0V0-PRE.doc	2003-02-04	KF	preliminary version generated
TME-104P-CRR3-R1V0.doc	2003-02-13	PK	Edited
TME-104P-CRR3-R1V1.doc	2003-07-30	KF/PK	- 933 MHz CPU added - several updates & corrections - general editing
TME-104P-CRR3-R1V2.doc	2003-08-19	PK	- minor textual corrections - heat sink temperature added
TME-104P-CRR3-R1V3.doc	2003-08-25	PK	Cooling is required
TME-104P-CRR3-R1V4.doc	2003-10-06	PK	Correct PC/104 bus definition, pin 6 is IRQ15
TME-104P-CRR3-R1V5.doc	2003-12-03	PK	Correct USB connector description: use USBVCC and USBGND
TME-104P-CRR3-R1V6.doc	2004-01-12	KF	Add description of GPIOs to chapter 1.27
TME-104P-CRR3-R1V7.doc	2004-03-16	KF	- Change 3.3Volt pins in chapter 3.1 (PC/104+ connector) to NC - Delete note regarding 3.3Volts are on PC104+ bus in chapter 1.1 - Correct size of PCI-Bus arrow between NB and SB in chapter 1.2 - Remove 2 Pixel/Clock modes from table in chapter 1.24
TME-104P-CRR3-R1V8.doc	2004-04-20	KF, PK	- Add “1.1” to references to the USB port - Include MTBF data - New chapter 3, "Software"
TME-104P-CRR3-R1V9.doc	2004-06-21	KF	- Add note regarding Shutdown temperature feature to chapter 6.2 - Chapter 1.27: completed table with pin 4 (Live signal) of Supervisory Connector
TME-104P-CRR3-R1V10.doc	2004-10-11	KF	- adapted mechanical drawings to PCB version 3V0
TME-104P-CRR3-R1V11.doc	2005-01-10	KF	- chapter 4.2: changed pin B10 of PC/104 bus to KEY (was GND/KEY) - chapter 4.12: corrected pin assignments of VGA connector - chapter 6.4: added some additional measurements to the top drawing