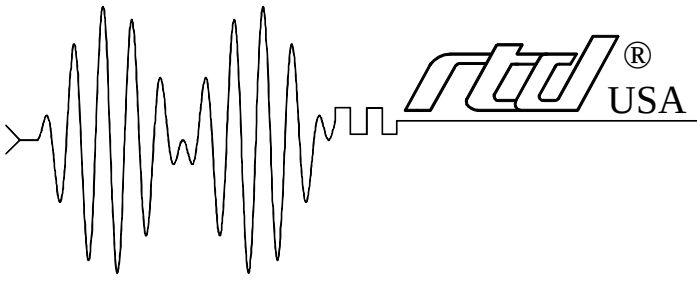
CMR686GX233-256
cpuModule™ User's Manual

RTD Enhanced Phoenix BIOS Versions 6.00.xx



Real Time Devices USA, Inc.
"Accessing the Analog World"®

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CMR686GX233 cpuModule™
User's Manual

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CHAPTER 1: INTRODUCTION

This manual is meant for users developing with the CMR686GX233 cpuModule. It contains information on hardware and software of the cpuModule.

The manual is organized as follows:

Chapter 1: Introduction

Introduces main features and specifications.

Chapter 2: Getting Started

Provides abbreviated instructions to get started.

Chapter 3: Connecting the cpuModule

Provides information on connecting the cpuModule to peripherals.

Chapter 4: Configuring the cpuModule

Provides information on configuring hardware and software.

Chapter 5: Using the cpuModule

Provides information needed to develop applications for the cpuModule. The chapter includes general information on the cpuModule, plus detailed information on storing applications and system functions, and using utility programs.

Chapter 6: Hardware Reference

Lists jumpers and their locations and mechanical dimensions.

Chapter 7: Troubleshooting

Offers advice on debugging problems with your system.

Chapter 8: Warranty

The CMR686GX233 cpuModule

The PC/104 cpuModules described in this manual are designed for industrial applications which require:

- software and hardware compatibility with the PC/AT world
- high-speed "number-crunching" operation
- low power consumption
- small physical dimensions
- high reliability
- good noise immunity

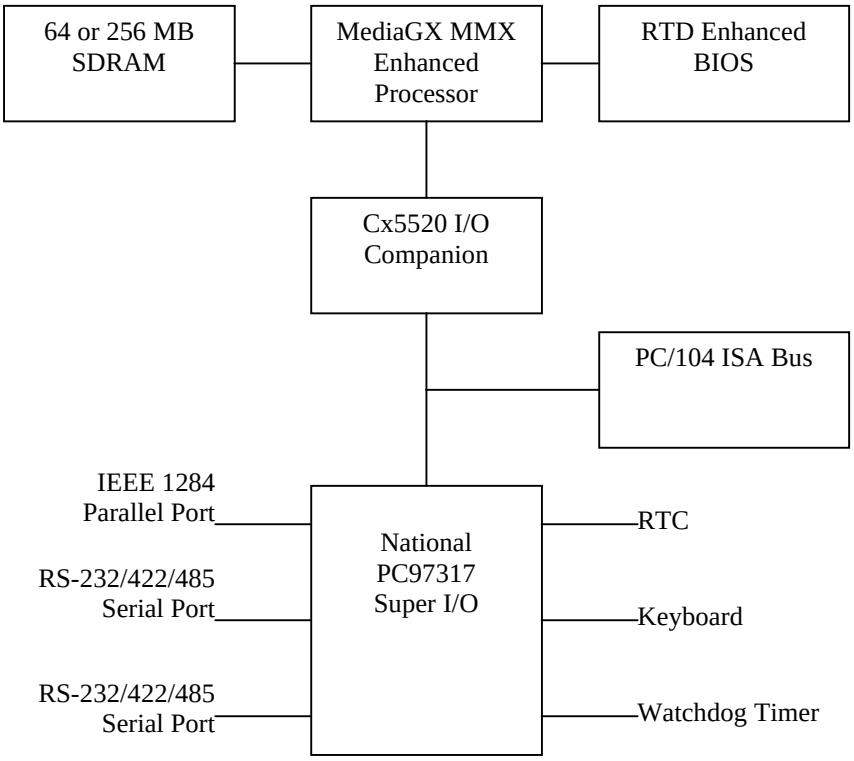
This cpuModule is highly integrated, combining all major functions of a PC/AT computer on one compact board. It integrates all primary I/O functions of a AT compatible computer:

- a keyboard interface
- an ECP/EPP parallel port
- two versatile RS232/422/485 serial ports
- a Real Time Clock
- a speaker port

It also enhances standard AT-compatible computer systems by adding:

- one Solid State Disk socket
- a non-volatile configuration without a battery
- a Watchdog Timer

The figure below shows a simplified block diagram of the cpuModule:



You can easily customize the cpuModule by stacking PC/104 modules such as video controllers, modems, LAN controllers, or analog and digital data acquisition modules. Stacking PC/104 modules on the cpuModule avoids expensive installations of backplanes and card cages and preserves the module's compactness.

RTD Enhanced Phoenix BIOS is also implemented in the cpuModule. This BIOS supports ROM-DOS, MS-DOS and Windows operating systems. Drivers in the BIOS allow booting from floppy disk, hard disk or DiskOnChip, thus enabling the system to be used with traditional disk drives or non-mechanical drives.

The cpuModule and BIOS are also compatible with most real-time operating systems for PC compatible computers, although these may require creation of custom drivers to use the SSD and watchdog timer.

Specifications

CMR686GX233

- Cyrix MediaGXm MMX enhanced microprocessor
- 233 MHz clock speed
- 2.9 V processor supply (provided on-board)
- 16 KB L1 cache
- Math coprocessor

DMA, Interrupts, Timers

- Six (7) DMA channels (8237 compatible)
- Fifteen (15) interrupt channels (8259 compatible)
- Three (3) counter/timers (8254 compatible)

Memory Configurations

- 64 or 256 M bytes surface mount SDRAM, installed

Solid State Disk

- one 32-pin socket provided with 2 MB DiskOnChip standard
- SSD socket can hold one of the following BIOS extension devices

Device	Full Read/Write Access	Maximum Number per cpuModule	Sizes
DiskOnChip 2000	yes	1	2 - 144 MB *
DiskOnChip 1000	yes	1	1MB, 2MB
MCSI PromDisk	yes	1	4MB, 8MB *

(*) Larger devices may be available in the future.

Peripherals

- Two serial ports software configurable for RS232/422/485; baud rates from 50 to 115200 baud in 16450 and 16550A compatible mode and 1.5 Mbaud in Extended UART mode
- Parallel port with SPP, ECP, EPP capability and selectable interrupts and DMA channel
- PC/AT standard keyboard port
- PC speaker port
- Real Time Clock (requires user-supplied external battery for date and time backup)
- Watchdog Timer with time-out of 1.2 seconds

BIOS

- RTD Enhanced Phoenix PICO BIOS
- Directly supports DiskOnChip
- User-configurable using built-in Setup program
- Nonvolatile configuration without a battery
- Can boot from floppy disk, hard disk or Solid State Disk

Connections

- AT bus, per PC/104 specifications (64-pin P4, 40-pin P7)
- Serial port 1 connector (10-pin P1)
- Serial port 2 connector (10-pin P5)
- Parallel port connector (26-pin P3)
- Multifunction connector (10-pin P8)
- Auxiliary power connector (8-pin P9)

Physical Characteristics

- Dimensions: 4.05 x 3.775 x 0.6 inches (102.9 x 95.9 x 16mm)
- Weight (mass): 3.5 ounces (100 grams)
- PCB: 12-layer, mixed surface-mount and thru-hole

Operating environment

- Power supply: 5V +/- 5%, 10 Watts
- 686 GXm processor operating temperature: -40 to +85 degrees C case (with proper cooling)
  See ***686GX233 Processor Thermal Management*** on page 82
- Operating relative humidity: 0 to 95%, non-condensing
- Storage temperature : -55 to +125 degrees C.

Power Consumption

Exact power consumption depends on the peripherals connected to the board, the selected SSD configuration and the memory configuration.

The table below lists power consumption for typical configurations and clock speeds:

Typical Power Consumption

Module	Consumption, typ	RAM	SSD	Coprocessor
CMR686GX233 233 MHz	1.9 A (9.5 W)	64 MB	None	Internal

For information on changing clock speeds, see ***Processor Clock Control*** on page 70.

CHAPTER 2: GETTING STARTED

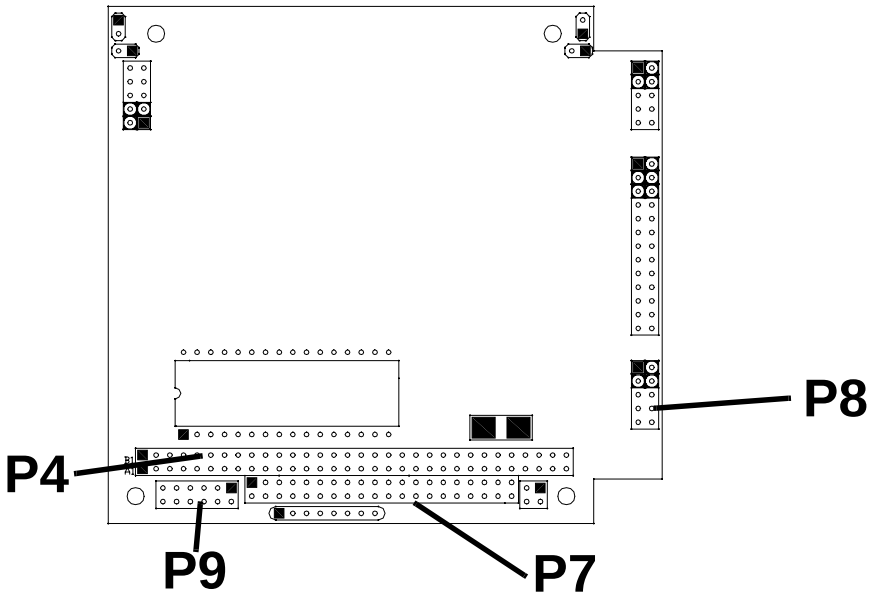
For many users, the factory configuration of the cpuModule can be used to get a PC/104 system operational. If you are one of these users, you can get your system up and running quickly by following a few simple steps described in this chapter. Briefly, these steps are:

- Connect power.
- Connect the utility cable.
- Connect a keyboard.

Refer to the remainder of this chapter for details on each of these steps.

Basic Connector Locations

The figure and table below show the connectors used in this chapter



CMR686GX233 Basic Connector Locations

Basic Connectors

Connector	Function	Size
P8	Multifunction	10 pin
P7	PC/104 bus (AT)	40 pin
P4	PC/104 Bus (XT)	64 pin
P9	Auxiliary power	10 pin

For a complete listing of connectors, please refer to ***I/O Connections*** on page 24.

NOTE! Pin 1 of each connector is indicated by a square solder pad on the bottom of the PC board and a white box silkscreened on the top of the board.

Cable Kits

For maximum flexibility, cables are not provided with the cpuModule. You may wish to purchase our cable kit for the cpuModule.

The XK-CM27 cable kit contains the following:

- Multifunction cable (keyboard socket, battery, reset, speaker)
- Two serial port cables (DIL10 to DSUB9)
- Parallel port cable (DIL26 to DSUB25)
- Power cable (DIL12 to wire leads)

Connecting Power

WARNING!	If you improperly connect power, the module will almost certainly be *damaged* or *destroyed*. Such damage is not warranted! Please verify connections to the module *before* applying power.

Power is normally supplied to the cpuModule through the PC/104 bus, connectors P4 and P7. If you are placing the cpuModule onto a PC/104 stack that has a power supply, you do not need to make additional connections to supply power.

If you are using the cpuModule without a PC/104 stack or with a stack that does not include a power supply, refer to ***Auxiliary Power, P9*** on page 26 for more details.

Connecting the utility cable

The Multifunction connector, P8, implements the following interfaces:

- AT keyboard
- Speaker output
- System reset input
- Battery input

To use these interfaces, you must connect to the Multifunction connector, making sure the orientation of pin 1 is correct. If you are using the Multifunction cable from our cable kit, the cable provides a small speaker, a 5-pin circular DIN connector for the keyboard, a push-button for resetting the PC/104 system, and a lithium battery to provide backup power to the Real Time Clock.

To connect individual devices to the Multifunction connector, please see ***Connecting the utility cable*** on page 17.

Connecting a Keyboard

You may plug a PC/AT compatible keyboard directly into the circular DIN connector of the Multi-function cable in our cable kit. Some newer keyboards may use a smaller "mini-DIN" connector; you will need an adapter to plug these keyboards into the cpuModule.

NOTE!	Many keyboards are switchable between PC/XT and AT operating modes, with the mode usually selected by a switch on the back or bottom of the keyboard. For correct operation with this cpuModule, you must select AT mode.

Connecting to the PC/104 Bus

The PC/104 bus connectors of the cpuModule are simply plugged onto a PC/104 stack to connect to other devices.

We recommend you follow the procedure below to ensure that stacking of the modules does not damage connectors or electronics.

WARNING! Do not force the module onto the stack! Wiggling the module or applying too much pressure may damage it. If the module does not readily press into place, remove it, check for bent pins or out-of-place keying pins, and try again.

- Turn off power to the PC/104 system or stack.
- Select and install standoffs to properly position the cpuModule on the PC/104 stack.
- Touch a grounded metal part of the rack to discharge any buildup of static electricity.
- Remove the cpuModule from its anti-static bag.
- Check that keying pins in the bus connector are properly positioned.
- Check the stacking order; make sure an XT bus card will not be placed between two AT bus cards or it will interrupt the AT bus signals.
- Hold the cpuModule by its edges and orient it so the bus connector pins line up with the matching connector on the stack.
- Gently and evenly press the cpuModule onto the PC/104 stack.

Booting the cpuModule for the First Time

You can now apply power to the cpuModule. You will see a greeting message from the VGA BIOS and then:

- the cpuModule BIOS version information
- a message requesting you press {F2} to enter the Setup program

If you don’t press {F2}, the cpuModule will try to boot from the current settings.

If you press {F2}, the cpuModule will enter Setup. Once you have configured the cpuModule using Setup, save your changes and reboot.

If You Misconfigure the cpuModule

It is possible that you may incorrectly configure the cpuModule using Setup. If this happens you the procedure is to:

- Re-boot the cpuModule.
- Press the {F2} key until the cpuModule enters Setup.
- Change the parameters to correctly match your system.

For More Information

This chapter has been intended to get the typical user up and running quickly. If you need more details, please refer to the following chapters for more information on configuring and using the cpuModule.

CHAPTER 3: CONNECTING THE CPUMODULE

This chapter contains information necessary to use all connectors of the cpuModule.

I/O Connections

The cpuModule comes from the factory ready to connect to the peripherals shown in the following table.

Default Peripheral Settings

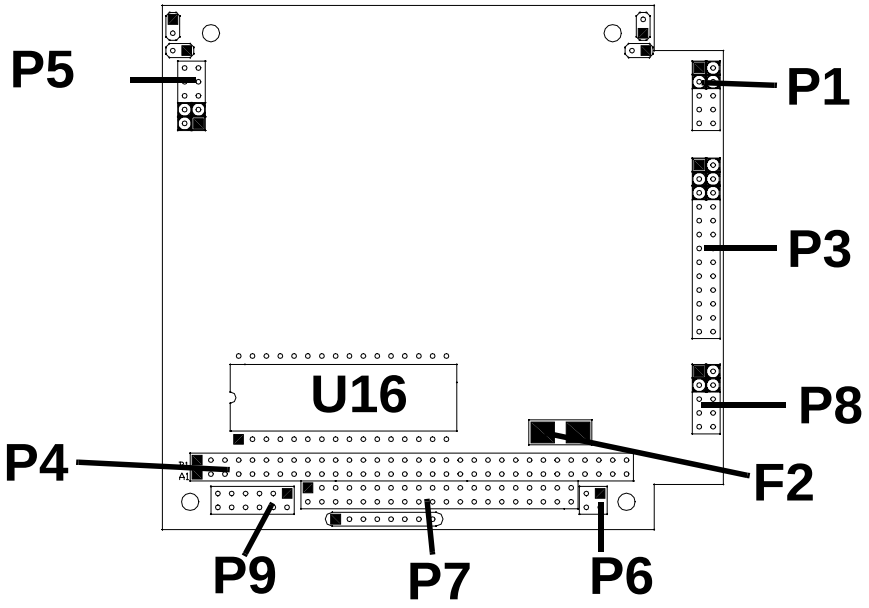
Item	Setting	Controlled by
Boot device	Floppy / DOC	Setup
Serial Port #1	RS232 at 3F8H, IRQ 4	Setup
Serial Port #2	RS232 at 2F8H, IRQ 3	Setup
Parallel Port	Bi-directional at 378H, IRQ 7	Setup
Floppy Drive 1	1.44M 3.5"	Setup
Floppy Drive 2	Not installed	Setup
All IDE Drives	Auto Detect	Setup

If you are using peripherals compatible with this list, you do not need to configure any jumpers or software settings before connecting peripherals.

If you are using different peripherals, you may need to change the cpuModule settings. In that case, please see ***Configuring with the RTD Enhanced Phoenix BIOS*** on page 47.

Connector Locations

The figure and table below show all connectors and the SSD socket of the cpuModule.



CMR Connector Locations

CMR Connectors

Connector	Function	Size
P1	Serial port 1	10 pin
P3	Parallel port	26 pin
P4	PC/104 bus (XT)	64 pin
P5	Serial port 2	10 pin
P6	Bus Mouse	4 pin
P7	PC/104 bus (AT)	40 pin
P8	Multifunction	10 pin
P9	Auxiliary Power	8 pin

NOTE! Pin 1 of each connector is indicated by a square solder pad on the bottom of the PC board and a white box silkscreened on the top of the board.

Auxiliary Power, P9

WARNING!	If you improperly connect power, the module will almost certainly be *destroyed*. Please verify power connections to the module *before* applying power.

The power supply can be conveyed to the module either through the PC/104 bus (P4 and P7) or through the Auxiliary Power connector, J8 The cpuModule only uses +5 VDC and ground. +12 VDC, -12 VDC and -5 VDC may be required on other PC/104 boards in the system..

Auxiliary Power Connector P9

Pin	Signal	Function
1	GND	Ground
2	+5 V	+5 Volts DC
3	N/C	Not Connected
4	+12 V	+12 Volts DC
5	-5 V	-5 Volts DC
6	-12 V	-12 Volts DC
7	GND	Ground
8	+5 V	+5 Volts DC
9	GND	Ground
10	+3.3 V	See Note
11	CPU V+	See Note
12	+3.3 V	See Note

Facing the connector pins, the pinout of the Auxiliary Power connector is:

11	9	7	5	3	1
CPU V+	GND	GND	-5V		GND
3.3 V	3.3 V	+5V	-12V	+12V	+5V
12	10	8	6	4	2

NOTES! -5 VDC, +12 VDC and -12 VDC voltages are not used by the module, but are connected to the PC/104 bus connectors, P4 and P7.

The 3.3 V pins are used to monitor the onboard 3.3 volt regulator. Don't use this as source of 3.3 volts and don't connect this pin to a 3.3 volt power supply.

The CPU V+ pin is used to monitor the onboard CPU regulator which is 2.9 volts. Don't use this as source of 2.9 volts and don't connect this pin to a 2.9 volt power supply.

Power Supply Protection

The cpuModule has protection circuitry which helps prevent damage due to problems with the +5V supply, such as:

- Reversed polarity
- Overvoltage
- Overcurrent

The circuitry includes a user-replaceable fuse, which is located near the PC/104 bus connector. This fuse is a:

- 3 amp Nano fuse
- Littelfuse part number R451 003

Serial Port 1, P1

The first serial port is implemented on connector P1. It is normally configured as a PC compatible full-duplex RS232 port, but you may use the Setup program to re-configure is as half- or full-duplex RS422 or RS485. The I/O address and corresponding interrupt must also be selected using Setup. The available I/O addresses and the corresponding interrupts are shown in the following table

First Serial Port Settings	
I/O Address	**IRQ**
03F8H	IRQ4
02F8H	IRQ3
03E8H	IRQ4
02E8H	IRQ3

First Serial Port UART

The first serial port is implemented with a 16550-compatible UART (Universal Asynchronous Receiver/Transmitter). This UART is capable of baud rates up to 115.2 kbaud in 16450 and 16550A compatible mode and 1.5 Mbaud in Enhanced UART mode, and includes 16-byte FIFO. Please refer to any standard PC-AT hardware reference for the register map of the UART.

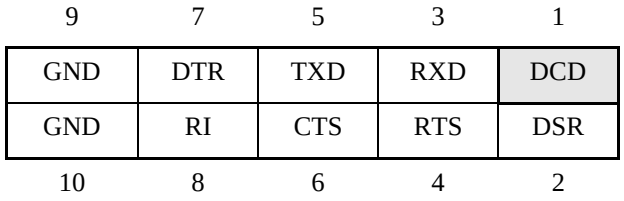
RS232 Serial Port (Default)

The full-duplex RS232 mode is the default setting on the cpuModule. With this mode enabled, connector P1 must be connected to RS232 compatible devices. The following table gives the connector pinout and shows how to connect to an external serial connector, either DB25 or DB 9 compatible.

Connector P1 in RS-232 Mode

Pin	Signal	Function	in/out	DB25	DB9
1	DCD	Data Carrier Detect	in	8	1
2	DSR	Data Set Ready	in	6	6
3	RXD	Receive Data	in	3	2
4	RTS	Request To Send	out	4	7
5	TXD	Transmit data	out	2	3
6	CTS	Clear To Send	in	5	8
7	DTR	Data Terminal Ready	out	20	4
8	RI	Ring Indicate	in	22	9
9,10	GND	Signal Ground	--	7	5

Facing the connector pins, the pinout is:



RS422 or RS485 Serial Port

You may use Setup to configure the first serial port as RS422 or RS485. In this case, you must connect P1 to an RS422 or RS485 compatible device.

When using RS422 or RS485 mode, you can use the port in either half-duplex (two-wire) or full-duplex (four-wire) configurations. For half-duplex (2-wire) operation, you must connect RXD+ to TXD+, and connect RXD- to TXD-.

NOTE! A 120 ohm termination resistors is provided on the cpuModule. Termination is usually necessary on all RS422 receivers and at the ends of the RS485 bus.

If the termination resistor is required, it can be enabled by closing jumper JP1.

RS422 and RS485 Mode Pinout

The following table gives the pinout of connector J3 when RS422 or RS485 modes are enabled.

Connector P1 in RS-422/485 Mode

Pin	Signal	Function	in/out
1		Not connected	--
2		Not connected	--
3	RXD+	Receive Data (+)	in
4	TXD-	Transmit Data (-)	out
5	TXD+	Transmit Data (+)	out
6	RXD-	Receive Data (-)	in
7		Not connected	--
8		Not connected	--
9,10	gnd	Signal ground	--

Facing the connector pins, the pinout is:

9	7	5	3	1
GND	-	TXD+	RXD+	-
GND	-	RXD-	TXD-	-
10	8	6	4	2

Note when using RS422 or RS485 Mode

When using the serial port in RS422 or RS485 mode, the serial transmitters are enabled and disabled under software control; the receivers are always enabled.

The transmitters are enabled by manipulating the Request To Send (RTS*) signal of the first serial port controller. This signal is controlled by writing bit 1 of the Modem Control Register (MCR) as follows:

- If MCR bit 1 = 1, then RTS* = 0, and serial transmitters are disabled
- If MCR bit 1 = 0, then RTS* = 1, and serial transmitters are enabled

For more information on the serial port registers, including the MCR, please refer to a standard PC-AT hardware reference for the 16550-type UART.

Serial Port 2, P5

The second serial port is implemented on connector P5. It is normally configured as a PC compatible full-duplex RS232 port, but you may use the Setup program to re-configure is as half- or full-duplex RS422 or RS485. The I/O address and corresponding interrupt must also be selected using Setup. The available I/O addresses and the corresponding interrupts are shown in the following table

Second Serial Port Settings	
I/O Address	**Default IRQ**
03F8H	IRQ4
02F8H	IRQ3
03E8H	IRQ4
02E8H	IRQ3

Second Serial Port UART

The second serial port is implemented with a 16550-compatible UART (Universal Asynchronous Receiver/Transmitter). This UART is capable of baud rates up to 115.2 kbaud in 16450 and 16550A compatible mode and 1.5 Mbaud in Enhanced UART mode, and includes 16-byte FIFO. Please refer to any standard PC-AT hardware reference for the register map of the UART.

RS232 Serial Port (Default)

The full-duplex RS232 mode is the default setting on the cpuModule. With this mode enabled, connector P5 must be connected to RS232 compatible devices. The following table gives the connector pinout and shows how to connect to an external serial connector, either XT (DB25) or AT(DB 9) compatible.

Connector P5 in RS-232 Mode

Connector P5**: Pin Assignment in RS232 Mode**					
Pin	**Signal**	**Function**	**in/out**	**DB25**	**DB9**
1	DCD	Data Carrier Detect	in	8	1
2	DSR	Data Set Ready	in	6	6
3	RXD	Receive Data	in	3	2
4	RTS	Request To Send	out	4	7
5	TXD	Transmit data	out	2	3
6	CTS	Clear To Send	in	5	8
7	DTR	Data Terminal Ready	out	20	4
8	RI	Ring Indicate	in	22	9
9,10	GND	Signal Ground	--	7	5

Facing the connector pins, the pinout is:

9	7	5	3	1
GND	DTR	TXD	RXD	DCD
GND	RI	CTS	RTS	DSR
10	8	6	4	2

RS422 or RS485 Serial Port

You may use Setup to configure the second serial port as RS422 or RS485. In this case, you must connect P5 to an RS422 or RS485 compatible device.

When using RS422 or RS485 mode, you can use the port in either half-duplex (two-wire) or full-duplex (four-wire) configurations. For half-duplex (2-wire) operation, you must connect RXD+ to TXD+, and connect RXD- to TXD-..

NOTE! A 120 ohm termination resistors is provided on the cpuModule. Termination is usually necessary on all RS422 receivers and at the ends of the RS485 bus.

If the termination resistor is required, it can be enabled by closing jumper JP2.

RS422 and RS485 Mode Pinout

The following table gives the pinout of connector J4 when RS422 or RS485 modes are enabled.

Connector P5 in RS-422/485 Mode

Pin	Signal	Function	in/out
1		Not connected	--
2		Not connected	--
3	RXD+	Receive Data (+)	in
4	TXD-	Transmit Data (-)	out
5	TXD+	Transmit Data (+)	out
6	RXD-	Receive Data (-)	in
7		Not connected	--
8		Not connected	--
9,10	gnd	Signal ground	--

Facing the connector pins, the pinout is:

9	7	5	3	1
GND	-	TXD+	RXD+	-
GND	-	RXD-	TXD-	-
10	8	6	4	2

Note when using RS422 or RS485 Mode

When using the serial port in RS422 or RS485 mode, the serial transmitters are enabled and disabled under software control; the receivers are always enabled.

The transmitters are enabled by manipulating the Request To Send (RTS*) signal of the second serial port controller. This signal is controlled by writing bit 1 of the Modem Control Register (MCR) as follows:

- If MCR bit 1 = 1, then RTS* = 0, and serial transmitters are disabled
- If MCR bit 1 = 0, then RTS* = 1, and serial transmitters are enabled

For more information on the serial port registers, including the MCR, please refer to a standard PC-AT hardware reference for the 16550-type UART.

Parallel Port, P3

The parallel port is available on connector P3. You can use Setup to select its address, associated interrupt, and choose between its operational modes (SPP, ECP, EPP 1.7 and EPP 1.9).

The pinout of the connector allows a ribbon cable to directly connect it to a DB25 connector, thus providing a standard PC compatible port.

The following tables lists the parallel port signals and explains how to connect it to a DB25 connector to obtain a PC compatible port.

NOTE! For correct operation, keep the length of the cable connecting the cpuModule and parallel device less than 3 meters (10 feet).

Parallel Port Connector, P3

Parallel Port Connector, P3				
Pin	**Signal**	**Function**	**in/out**	**DB25**
1	STB	Strobe Data	out	1
2	AFD	Autofeed	out	14
3	PD0	Printer Data 0 (LSB)	out	2
4	ERR	Printer Error	in	15
5	PD1	Parallel Data 1	out	3
6	INIT	Initialize printer	out	16
7	PD2	Printer Data 2	out	4
8	SLIN	Select printer	out	17
9	PD3	Printer Data 3	out	5
10	GND	Signal ground	--	18
11	PD4	Printer Data 4	out	6
12	GND	Signal ground	--	19
13	PD5	Printer Data 5	out	7
14	GND	Signal ground	--	20
15	PD6	Printer Data 6	out	8
16	GND	Signal ground	--	21
17	PD7	Printer Data 7 (MSB)	out	9
18	GND	Signal ground	--	22
19	ACK	Acknowledge	in	10
20	GND	Signal ground	--	23

Parallel Port Connector, P3

21	BSY	Busy	in	11
22	GND	Signal ground	--	24
23	PE	Paper End	in	12
24	GND	Signal ground	--	25
25	SLCT	Ready To Receive	in	13
26	GND	Signal ground	--	26

Multifunction Connector, P8

The Multifunction connector on P8 implements the following functions:

- Speaker output
- AT keyboard
- System reset input
- Watchdog Timer output
- Battery Input

The following table gives the pinout of the Multifunction connector.

P8

Pin	Signal	Function	in/out
1	SPKR+	Speaker output (open collector)	out
2	SPKR-	Speaker output (+5 volts)	out
3	RESET	Manual push button reset	in
4		Not connected	out
5	KBD	Keyboard Data	in
6	KBC	Keyboard Clock	out
7	GND	Ground	--
8	KBP	Keyboard Power (+5 volts)	out
9	BAT	Battery input	in
10		Not Connected	

Facing the connector pins, the pinout is:

9	7	5	3	1
BAT	GND	KBD	RESET	SPKR+
	KBP	KBC		SPKR-
10	8	6	4	2

Speaker

A speaker output is available on two pins of the Multifunction connector. These outputs are controlled by a transistor to supply 0.1 watt of power to an external speaker. The external speaker should have 8 ohm impedance and be connected between pin 1 and pin 2.

Keyboard

An AT compatible keyboard can be connected to the Multifunction connector. Usually PC keyboards come with a cable ending with a 5-pin male 'DIN' connector. The following table lists the relationship between the Multifunction connector pins and a standard 'DIN' keyboard connector.

To ensure correct operation, check that the keyboard is either an AT compatible keyboard or a switchable XT/AT keyboard set to AT mode. Switchable keyboards are usually set by a switch on the back or bottom of the keyboard.

Keyboard Connector			
Pin	**Signal**	**Function**	**DIN**
5	KBD	Keyboard Data	2
6	KBC	Keyboard Clock	1
7	GND	Ground	4
8	KBP	Keyboard Power (+5 Volts)	5

System Reset

Pin 3 of the multifunction connector allows connection of an external push-button to manually reset the system. The push-button should be normally open, and connect to ground when pushed.

Battery

Pin 9 of the multifunction connector is the connection for an external backup battery (in the range 2.40 V to 4.15 V; typically 3.0 or 3.6 V). This battery is used by the cpuModule when system power is removed, to preserve the date and time in the Real Time Clock

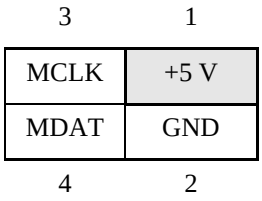
Bus Mouse Connector, P6

The Bus Mouse is available on P6. The following table gives the pinout of the Bus Mouse connector.

Bus Mouse Connector, P6

Pin	Signal	Function	in/out
1	+5 V	+5 Volts	out
2	GND	Ground	out
3	MCLK	Mouse Clock	out
4	MDAT	Mouse Data	bidi

Facing the connector pins, the pinout is:



PC/104 Bus, P4 and P7

Connectors P4 and P7 carry signals of the PC/104 bus; these signals match definitions of the IEEE P996 standard. The following tables list the pinouts of the PC/104 bus connectors.

The following table lists the signals of the XT portion of the PC/104 bus.

PC/104 XT Bus Connector, P4

Pin	Row A	Row B
1	N.C.	0V
2	SD7	RESETDRV
3	SD6	+5V
4	SD5	IRQ2
5	SD4	-5V
6	SD3	DRQ2
7	SD2	-12V
8	SD1	N.C.
9	SD0	+12V
10	IOCHRDY	(Keying pin)
11	AEN	SMEMW*
12	SA19	SMEMR*
13	SA18	IOW*
14	SA17	IOR*
15	SA16	DACK3*
16	SA15	DRQ3
17	SA14	DACK1*
18	SA13	DRQ1
19	SA12	REFRESH*
20	SA11	SYSCLK
21	SA10	IRQ7
22	SA9	IRQ6
23	SA8	IRQ5
24	SA7	IRQ4
25	SA6	IRQ3
26	SA5	DACK2*
27	SA4	TC
28	SA3	BALE
29	SA2	+5V
30	SA1	OSC
31	SA0	0V
32	0V	0V

The following table lists signals of the AT portion of the PC/104 bus.

PC/104 AT Bus Connector, P7

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

Notes:

Keying pin positions have the pin cut on the bottom of the board and the hole plugged in the connector to prevent misalignment of stacked modules. This is a feature of the PC/104 specification and should be implemented on all mating PC/104 modules.

Signals marked with (*) are active-low.

All bus lines can drive a maximum current of 4 mA at TTL voltage levels.

PC/104 Bus Signals

The following table contains brief descriptions of the PC/104 bus signals.

PC/104 Bus Signals

Signal	I/O	Description
AEN	O	Address ENable: when this line is active (high), it means a DMA transfer is being performed and therefore the DMA controller has control over the data bus, the address bus, and the control lines.
BALE	O	Bus Address Latch Enable, active high. When active, it indicates that address lines SA0 to SA19 are valid.
DACKx*	O	DMA ACKnowledge x=0-7, active low, used to acknowledge DMA requests.
DRQx	I	DMA Request x=0-7: these are asynchronous lines used by peripheral devices to request DMA service. They have increasing priority from DRQ0 up to DRQ7. A DMA request is performed by setting the DRQ line high and keeping it high until the corresponding DACK line is activated.
ENDXFR*	I/O	This is the only synchronous signal of the PC/104 bus and it is active low. It indicates that the current bus cycle must be performed with 0 wait states. It is used only for 16-bit boards.
IOCHCHK*	I	I/O Channel Check, active low, indicates an error condition that cannot be corrected.
IOCHRDY	I	I/O Channel Ready: this line, usually high (ready) is pulled to a low level by devices which need longer bus cycles.
IOCS16*	I	I/O Chip Select 16-bit: this line, active low, is controlled by devices mapped in the I/O address space. It indicates they have a 16-bit bus width.
IOR*	O	I/O Read, active low, indicates when the devices present on the bus can send their information on the data bus.
IOW*	O	I/O Write, active low. When active, it allows the peripheral devices to read data present on the data bus.
IRQx	I	Interrupt Request: x = 2 to 15, active on rising edge. IRQ15 has top priority; the other lines have decreasing priority starting from IRQ14 down to IRQ2. An interrupt request is performed by changing the level of the corresponding line from low to high and keeping it high until the microprocessor has recognized it.
KEY	N/A	These locations contain mechanical keying pins to help prevent incorrect connector insertion.
LA23..LA17	O	These signals select a 128kbyte window in the 16Mbyte address space available on the bus.

PC/104 Bus Signals

MASTER*	I	During a DMA cycle, this active-low signal, indicates that a resource on the bus is about to drive the data and address lines.
MEMCS16*	I	Memory Chip Select 16-bit: this line, active low, is controlled by devices mapped in the memory address space and indicates they have a 16-bit bus width.
MEMR*	I/O	This active-low signal indicates a memory read operation. Devices using this signal must decode the address on lines LA23..LA17 and SA19..SA0.
MEMW*	I/O	This active-low signal indicates a memory write operation. Devices using this signal must decode the address on lines LA23..LA17 and SA19..SA0.
OSC	O	OSCillator: clock with a 70 ns period and a 50% duty cycle. It is a 14.31818 MHz always presents.
REFRESH*	O	This line is active low and indicates that the current bus cycle is a DRAM refresh cycle. The refresh cycles are activated every 15 microseconds.
RESETDRV	O	This line, active high, is used to reset the devices on the bus, at power-on or after a reset command.
SA0..19	O	Address bits 0 to 19: these lines are used to address the memory space and the I/O space. SA0 is the least significant bit while SA19 is the most significant bit.
SBHE*	O	This active-low signal indicates a transfer of the most significant data byte (SD15..SD8).
SD8..15	I/O	Data bits: these are the high-byte data bus lines. SD8 is the least significant bit; SD15 the most significant bit.
SD0..7	I/O	Data bits: these are the low-byte data bus lines. SD0 is the least significant bit; SD7 the most significant bit.
SMEMR*	O	Memory Read command, active low.
SMEMW*	O	Memory Write command, active low.
SYSCLK	O	System Clock, 8.0MHz with a 50% duty cycle. Only driven during external bus cycles.
TC	O	Terminal Count: this line is active high and indicates the conclusion of a DMA transfer.

PC/104 Bus Termination

Termination of PC/104 bus signals is not recommended since this cpuModule incorporates source termination on bus signals and may cause malfunctions of the cpuModule.

CHAPTER 4: CONFIGURING THE CPUMODULE

This chapter contains information to configure the cpuModule.

Topics covered in this chapter include:

- Adding SSD Memory
- Configuring Using the Setup Program

Installing SSD Memory

This section explains how to add devices to the cpuModule. This procedure is only necessary when you wish to add or change Solid State Disk memory devices

Installing SSD Memory

You may wish to install SSD memory to use the cpuModule as a "diskless" stand-alone device. The cpuModule is shipped with a 2 MB M-Systems DiskOnChip, however other devices may be used in the SSD socket.

Refer to ***Storing Applications On-board*** on page 71 for more information on various SSD device types. Solid State Disk memories are placed in socket U16.

The following table lists possible configurations for the SSD socket:

SSD Support				
Type	**Part**	**Operation**	**Capacity**	**Notes**
BIOS Extension Devices	DiskOnChip and PromDisk	read/write	to 144 MB+	

Configuring with the RTD Enhanced Phoenix BIOS

The cpuModule Setup program allows you to customize the cpuModule's configuration. Selections made in Setup are stored on the board and read by the BIOS at power-on.

Starting Setup

You can run Setup by:

- Re-boot the cpuModule, and press the {F2} key.

When you are finished with Setup, save your changes and exit. The system will automatically reboot.

Using the Setup Program

All displays in Setup consist of two areas. The left area lists the available selections. The right area displays help messages which you should always read.

Main Menu Options

From the Main menu, you may choose:

- *Main* -- to access commonly used settings for the keyboard, floppy drives, hard disks, and SSD.
- *Advanced* -- to access less-used settings for I/O, clock speed and SSD window.
- *Security* -- to set supervisor and user access.
- *Boot* -- to access system boot options.
- *Exit* -- to selectively save your changes and exit Setup.

Normally you will use the first four selections to make changes to the cpuModule configuration, then use the *Save Changes and Exit* selection.

The following sections describe each of these choices in detail.

Field Selection

You move between fields in Setup using the keys listed below.

Setup Keys

Key	Function
↓	selects next field
↑	selects previous field
+	selects next value in field
-	selects former value in field
<Enter>	if a field is preceded by an arrow then <Enter> will take you to the submenu for the field.
<Esc>	to previous menu then to exit menu

Main Setup Fields

The following is an alphabetical list of Standard Setup fields.

Main Setup Fields

Field	Active keys	Selections
Time	{0...9},{↵}	Sets the time with the format: • hours : minutes : seconds You must connect a backup battery or this setting will be lost at power down.
Date	{0..9},{↵}	Sets the date with the format: • month / day / year • You must connect a backup battery, or this setting will be lost at power down.
Legacy Diskette A Legacy Diskette B	Enter to select floppy disk size and type	Selects the format of floppy disk 1: Selections are: • Disabled • 360 KB, 5¼" Floppy • 1.2 MB, 5¼" Floppy • 720 KB, 3½" Floppy • 1.44/1.25 MB, 3½" Floppy • 2.88 MB, 3½" Floppy •
IDE Adapter 0 Master IDE Adapter 0 Slave IDE Adapter 1 Master IDE Adapter 1 Slave	Enter to select IDE parameters	Selects the IDE hard disk type for each interface. An interface must have a master before a slave can be added. Make sure you configure the drive jumpers correctly. Selections are: • None • Auto (Auto detect drive parameters, not all drives can be auto detected) • CD-ROM • USER (User enters drive parameters)
Memory Cache	Enter to set cache properties	Enable or disable cache
Keyboard Features	Enter to setup features	Features are: • Keyboard -- Enable or disable the famous "Keyboard error, hit <F1> to continue". • NumLock -- on/off • Key Click -- Enable/disable • Repeat rate -- 2, 6, 10, 13.3, 18.5, 21.8, 26.7, or 30 per second • Repeat delay --1/4, 1/2, 3/4, or 1 second

Advanced Setup Fields

The following is a list of Advanced Setup fields.

Advanced Setup Fields

Field	Active keys	Selections
I/O Device Configuration	Enter to set options	See I/O Device Configuration Sub-menu below
PCI Configuration	Enter to set PCI options	See PCI Configuration Sub-menu below
BIOS Extension	+/-	Disable or enable a memory window for a BIOS extension device, such as DiskOnChip, in the SSD socket. Options are: • BIOS Extension window -- Disable, D000:0000 or D800:0000
Secured Setup Configurations	+/-	Options are yes and no. Yes prevents a Plug and Play operating system from changing the system settings. Yes is the default setting and the recommended setting for loading Windows 95/98/NT.
Installed O/S	+/-	Operating system to be used. Options are Other and Win95
Reset Configuration Data	+/-	Select Yes to clear the Extended System Configuration Data (ESCD) area. This will make the CPU search for legacy devices and store the updated info. This field will return to no after the next boot.
Large disk access mode	+/-	Select DOS if you are using DOS compatible disk access, otherwise select other.
I/O Device Configuration Sub-menu		
Serial port A:	+/-	Serial port A, connector P1 settings: • Serial port -- Enable/disable/auto/OS controlled • Mode -- RS-232 or RS-422/485 • Base I/O -- 03F8H, 02F8H, 03E8H,or 02E8H • Interrupt -- IRQ 3 or IRQ 4
Serial port B:	+/-	Serial port B, connector P5 settings: • Serial port -- Enable/disable/auto/OS controlled • Mode -- RS-232 or RS-422/485 • Base I/O -- 03F8H, 02F8H, 03E8H,or 02E8H • Interrupt -- IRQ 3 or IRQ 4 • Mode -- Normal

Advanced Setup Fields

Parallel Port settings	+/-	Selects parallel port address and mode. address/interrupt: • Parallel port -- enable/disable/auto/OS controlled • Mode -- Output only, bi-directional, EPP, ECP • Base I/O -- 278h or 378h • Interrupt -- IRQ 5 or IRQ 7 • DMA -- DMA 1 or DMA 3
PS/2 Mouse	+/-	PS/2 mouse -- disabled, enabled, or auto detect
PCI Configuration Sub-menu		
PCI/PNP UMB	Enter to set parameters	Select upper memory regions to exclude from PCI/PNP usage: • C800-CBFF -- available/reserved • CC00-CFFF -- available/reserved • D000-D3FF -- available/reserved • D400-D7FF -- available/reserved • D800-DBFF -- available/reserved • DC00-DFFF -- available/reserved
PCI/PNP IRQ	Enter to set parameters	Select interrupts exclusion: • IRQ 3 -- available/reserved • IRQ 4 -- available/reserved • IRQ 5 -- available/reserved • IRQ 7 -- available/reserved • IRQ 9 -- available/reserved • IRQ 10 -- available/reserved • IRQ 11 -- available/reserved • IRQ 15 -- available/reserved
PCI/PNP DMA	Enter to set parameters	Select DMA exclusion: • DMA 0 -- available/reserved • DMA 1 -- available/reserved • DMA 2 -- available/reserved • DMA 3 -- available/reserved • DMA 5 -- available/reserved • DMA 6 -- available/reserved • DMA 7 -- available/reserved
PCI IRQ line 1 PCI IRQ line 2 PCI IRQ line 3 PCI IRQ line 4	+/-	These should always be set to Auto select or disable

Security Setup Fields

The following is a list of Security Setup fields.

Security Setup Fields

Field	Active keys	Selections
Set Supervisor Password	Enter to set password	Controls access to setup utility. Enter old password, new password and confirm.
Set User Password	Enter to set password	Controls access to system at boot. Only used if a supervisor password is enabled. Enter old password, new password and confirm.
Diskette access	+/-	Sets User or Supervisor access to the floppies.
Fixed disk boot sector	+/-	Sets normal or write protect for the fixed disk boot sector.
Virus check reminder	+/-	Optionally displays a message at boot to do a virus check daily, weekly or monthly.
System back-up reminder	+/-	Optionally displays a message at boot to do a system backup daily, weekly or monthly.
Password on boot	+/-	Disable or enable use of password at boot.

Boot Setup Fields

The following is a list of Boot Setup fields.

Boot Setup Fields

Field	Active keys	Selections
Boot Sequence	+/-	Select a boot sequence through four devices including diskette, hard drive, ATAPI CD-ROM and network boot..
Hard drive	Enter to select	Select hard drive to use for boot.
Summary screen	+/-	Enable or disable display of system configuration information at boot.
Floppy check	+/-	Enable or disable floppy type verify at boot.

Boot Setup Fields

Hard disk pre-delay	+/-	Adds a delay before the first hard disk access by BIOS to ensure hard disk is initialized. Options are Disabled, 3, 6, 9, 12, 15, 21 and 30 seconds.

Exit Setup Fields

The following is a list of Exit Setup fields.

Exit Setup Fields

Field	Active keys	Selections
Exit and save changes	<Enter>	Exit setup and save changes.
Exit discarding changes	<Enter>	Exit setup without saving the changes.
Load setup de-faults	<Enter>	Loads default values for all setup items.
Discard changes	<Enter>	Loads previous values for all setup items.
Save changes	<Enter>	Saves all setup items in non-volatile device.

CHAPTER 5: USING THE CPUMODULE

This chapter provides information for users who wish to develop their own applications programs for the cpuModule.

This chapter includes information on the following topics:

- Memory map
- I/O Address map
- Interrupts
- Power On Self Tests (POSTs)
- System Functions (Watchdog Timer, Real Time Clock)
- Storing Applications in Solid State Disk
- Utility Programs

Memory Map

The module addresses memory using 24 address lines. This allows a maximum of 2^{24} locations, or 16 Megabytes of memory.

The table below shows how memory in the first megabyte is allocated in the system.

First Megabyte Memory Map_	
FFFFFH-C0000H ROM	256 KB BIOS in Flash EPROM, shadowed into DRAM during runtime.
EFFFFH-C0000H	Run time user memory space. Usually, memory between C0000H and C7FFFH is used for the BIOS of add-on VGA video cards.
BFFFFH-A0000H	Normally used for video RAM as follows: CGA 0B8000H to 0BFFFFH EGA/VGA 0A0000H to 0AFFFFH Monochrome 0B0000H to 0B7FFFH
9FFFFH-00502H	DOS reserved memory area
00501H-00400H	BIOS data area
003FFH-00000H	Interrupt vector area

Memory beyond the first megabyte can be accessed in real mode, by using EMS or a similar memory manager. See your OS or programming language references for information on memory managers.

Input/Output Address Map

As with all standard PC/104 boards, the Input/Output (I/O) space is addressed by 10 address lines (SA0-SA9). This allows 2^{10} or 1024 distinct I/O addresses. Any add-on modules you install must therefore use I/O addresses in the range 0-1023 (decimal) or 000-3FF (hex).

If you add any PC/104 modules or other peripherals to the system you must ensure they *do not* use reserved addresses listed below, or malfunctions will occur.

The table below lists I/O addresses reserved for the cpuModule.

I/O Addresses Reserved for the cpuModule		
Address Range	**Bytes**	**Device**
000H-00FH	16	DMA Controller
010H-01FH	16	Reserved for CPU
020H-021H	2	Interrupt Controller #1
022H-02FH	13	Reserved
040H-043H	4	Timer
060H-064H	5	Keyboard Interface
070H-071H	2	Real Time Clock port
080H-08FH	16	DMA page register
0A0H-0A1H	2	Interrupt controller #2
0C0H-0DFH	32	DMA controller #2
0F0H-0FFH	16	Math co-processor
1F0H-1FFH	16	Hard disk [1]
2F8H-2FFH	8	Serial port [2]
378H-37FH	8	Parallel port [3]
3BCH-3BFH	4	Parallel port [3]
3E8H-3EFH	8	Serial port [2]
3F0H-3F7H	8	Floppy disk [1]
3F8H-3FFH	8	Serial port [2]

[1] If a floppy or IDE controller is not connected to the system, the I/O addresses listed will not be occupied.

[2] Only one of the I/O addresses shown for a Serial port is active at any time. You can use Setup to select which one is active or to disable it entirely.

[3] Only one of the I/O addresses shown for the Parallel printer port is active at any time. You can use Setup to select which one is active or to disable it entirely.

Hardware Interrupts

If you add any PC/104 modules or other peripherals to the system you must ensure they *do not* use interrupts needed by the cpuModule, or malfunctions will occur

The cpuModule supports the standard PC interrupts listed below. Interrupts not in use by hardware on the cpuModule itself are listed as 'available'.

Hardware Interrupts Used on the cpuModule		
Interrupt	**Normal Use**	**Source**
0	Timer 0	On-board ISA device
1	Keyboard	On-board ISA device
2	Cascade of IRQ 8-15	On-board ISA device
3	COM2	On-board ISA device
4	COM1	On-board ISA device
5	available	XT bus
6	Floppy [1]	XT bus
7	Printer	On-board ISA device
8	Real Time Clock	On-board ISA device
9	available, routed to IRQ 2	XT bus
10	available	AT bus
11	available	AT bus
12	Bus mouse	On-board ISA device
14	IDE hard disk [2]	AT bus
15	available	AT bus

[1] Floppy disk interrupt, INT6, is available for use if no floppy disk is present in the system and floppy disk is disabled in Setup.

[2] Hard disk interrupt, INT14, is available for use if no hard disk drive is present in the system and hard disk is disabled in Setup.

The RTD Enhanced Phoenix Pico BIOS™

The RTD Enhanced Phoenix PICO BIOS (Basic Input/Output System) is software that interfaces hardware-specific features of the cpuModule to an operating system (OS). Physically, the BIOS software is stored in a Flash EPROM on the cpuModule. Functions of the BIOS are divided into two parts:

The first part of the BIOS is known as POST (Power-On Self-Test) software, and it is active from the time power is applied until an OS boots (begins execution). POST software performs a series of hardware tests, sets up the machine as defined in Setup, and begins the boot of the OS;

The second part of the BIOS is known as the CORE BIOS. It is the normal interface between cpuModule hardware and the operating system which is in control. It is active from the time the OS boots until the cpuModule is turned off. The CORE BIOS provides the system with a series of software interrupts to control various hardware devices.

The following sections discuss the sections of the BIOS in more detail and describe features of the BIOS which may be useful to you in developing applications.

Power On Self Tests (POSTs)

Recoverable POST Errors

Whenever a recoverable error occurs during POST, PhoenixBIOS displays an error message describing the problem.

PhoenixBIOS also issues a beep code (one long tone followed by two short tones) during POST if the video configuration fails (no card installed or faulty) or if an external ROM module does not properly checksum to zero.

An external ROM module (e.g. VGA) can also issue audible errors, usually consisting of one long tone followed by a series of short tones.

Terminal POST Errors

There are several POST routines that issue a POST Terminal Error and shut down the system if they fail. Before shutting down the system, the terminal-error handler issues a beep code signifying the test point error, writes the error to port 80h, attempts to initialize the video, and writes the error in the upper left corner of the screen (using both mono and color adapters).

The routine derives the beep code from the test point error as follows:

1. The 8-bit error code is broken down to four 2-bit groups (Discard the most significant group if it is 00).

2. Each group is made one-based (1 through 4) by adding 1.

3. Short beeps are generated for the number in each group.

Example:

Testpoint 01Ah = 00 01 10 10 = 1-2-3-3 beeps

Test Points and Beep Codes

At the beginning of each POST routine, the BIOS outputs the test point error code to I/O address 80h. Use this code during trouble shooting to establish at what point the system failed and what routine was being performed.

Some motherboards are equipped with a seven-segment LED display that displays the current value of port 80h. For production boards which do not contain the LED display, you can purchase a card that performs the same function.

If the BIOS detects a terminal error condition, it halts POST after issuing a terminal error beep code (See above) and attempting to display the error code on upper left corner of the screen and on the port 80h LED display. It attempts repeatedly to write the error to the screen. This may cause "hash" on some CGA displays.

If the system hangs before the BIOS can process the error, the value displayed at the port 80h is the last test performed. In this case, the screen does not display the error code.

The following is a list of the checkpoint codes written at the start of each test and the beep codes issued for terminal errors. Unless otherwise noted, these codes are valid for PhoenixBIOS 4.0 Release 6.0.

RTD Enhanced Phoenix PICO BIOS POST Codes

Code	Beeps	POST Routine Description
02h		Verify Real Mode
03h		Disable Non-Maskable Interrupt (NMI)
04h		Get CPU type
06h		Initialize system hardware

RTD Enhanced Phoenix PICO BIOS POST Codes

Code	Beeps	POST Routine Description
08h		Initialize chipset with initial POST values
09h		Set IN POST flag
0Ah		Initialize CPU registers
0Bh		Enable CPU cache
0Ch		Initialize caches to initial POST values
0Eh		Initialize I/O component
0Fh		Initialize the local bus IDE
10h		Initialize Power Management
11h		Load alternate registers with initial POST values new
12h		Restore CPU control word during warm boot
13h		Initialize PCI Bus Mastering devices
14h		Initialize keyboard controller
16h	1-2-2-3	BIOS ROM checksum
17h		Initialize cache before memory Autosize
18h		8254 timer initialization
1Ah		8237 DMA controller initialization
1Ch		Reset Programmable Interrupt Controller
20h	1-3-1-1	Test DRAM refresh
22h	1-3-1-3	Test 8742 Keyboard Controller
24h		Set ES segment register to 4 GB
26h		Enable A20 line
28h		Autosize DRAM
29h		Initialize POST Memory Manager
2Ah		Clear 512 kB base RAM
2Ch	1-3-4-1	RAM failure on address line xxxx*
2Eh	1-3-4-3	RAM failure on data bits xxxx* of low byte of memory bus
2Fh		Enable cache before system BIOS shadow
30h	1-4-1-1	RAM failure on data bits xxxx* of high byte of memory bus
32h		Test CPU bus-clock frequency
33h		Initialize Phoenix Dispatch Manager
36h		Warm start shut down
38h		Shadow system BIOS ROM
3Ah		Autosize cache
3Ch		Advanced configuration of chipset registers
3Dh		Load alternate registers with CMOS valuesnew
42h		Initialize interrupt vectors
45h		POST device initialization
46h	2-1-2-3	Check ROM copyright notice
47h		Initialize I20 support
48h		Check video configuration against CMOS
49h		Initialize PCI bus and devices
4Ah		Initialize all video adapters in system
4Bh		QuietBoot start (optional)

RTD Enhanced Phoenix PICO BIOS POST Codes

Code	Beeps	POST Routine Description
4Ch		Shadow video BIOS ROM
4Eh		Display BIOS copyright notice
50h		Display CPU type and speed
51h		Initialize EISA board
52h		Test keyboard
54h		Set key click if enabled
58h	2-2-3-1	Test for unexpected interrupts
59h		Initialize POST display service
5Ah		Display prompt "Press F2 to enter SETUP"
5Bh		Disable CPU cache
5Ch		Test RAM between 512 and 640 kB
60h		Test extended memory
62h		Test extended memory address lines
64h		Jump to UserPatch1
66h		Configure advanced cache registers
67h		Initialize Multi Processor APIC
68h		Enable external and CPU caches
69h		Setup System Management Mode (SMM) area
6Ah		Display external L2 cache size
6Bh		Load custom defaults (optional)
6Ch		Display shadow-area message
6Eh		Display possible high address for UMB recovery
70h		Display error messages
72h		Check for configuration errors
76h		Check for keyboard errors
7Ch		Set up hardware interrupt vectors
7Eh		Initialize coprocessor if present
80h		Disable onboard Super I/O ports and IRQs
81h		Late POST device initialization
82h		Detect and install external RS232 ports
83h		Configure non-MCD IDE controllers
84h		Detect and install external parallel ports
85h		Initialize PC-compatible PnP ISA devices
86h		Re-initialize onboard I/O ports.
87h		Configure Motheboard Configurable Devices (optional)
88h		Initialize BIOS Data Area
89h		Enable Non-Maskable Interrupts (NMIs)
8Ah		Initialize Extended BIOS Data Area
8Bh		Test and initialize PS/2 mouse
8Ch		Initialize floppy controller
8Fh		Determine number of ATA drives (optional)
90h		Initialize hard-disk controllers
91h		Initialize local-bus hard-disk controllers

RTD Enhanced Phoenix PICO BIOS POST Codes

Code	Beeps	POST Routine Description
92h		Jump to UserPatch2
93h		Build MPTABLE for multi-processor boards
95h		Install CD ROM for boot
96h		Clear huge ES segment register
97h		Fixup Multi Processor table
98h	1-2	Search for option ROMs. One long, two short beeps on checksum failure
99h		Check for SMART Drive (optional)
9Ah		Shadow option ROMs
9Ch		Set up Power Management
9Dh		Initialize security engine (optional)
9Eh		Enable hardware interrupts
9Fh		Determine number of ATA and SCSI drives
A0h		Set time of day
A2h		Check key lock
A4h		Initialize typematic rate
A8h		Erase F2 prompt
AAh		Scan for F2 key stroke
ACh		Enter SETUP
AEh		Clear Boot flag
B0h		Check for errors
B2h		POST done - prepare to boot operating system
B4h	1	One short beep before boot
B5h		Terminate QuietBoot (optional)
B6h		Check password (optional)
B9h		Prepare Boot
BAh		Initialize DMI parameters
BBh		Initialize PnP Option ROMs
BCh		Clear parity checkers
BDh		Display MultiBoot menu
BEh		Clear screen (optional)
BFh		Check virus and backup reminders
C0h		Try to boot with INT 19
C1h		Initialize POST Error Manager (PEM)
C2h		Initialize error logging
C3h		Initialize error display function
C4h		Initialize system error handler
C5h		PnPnd dual CMOS (optional)
C6h		Initialize note dock (optional)
C7h		Initialize note dock late
C8h		Force check (optional)
C9h		Extended checksum (optional)
D2h		Unknown interrupt
		The following are for boot block in Flash ROM

RTD Enhanced Phoenix PICO BIOS POST Codes

Code	Beeps	POST Routine Description
E0h		Initialize the chipset
E1h		Initialize the bridge
E2h		Initialize the CPU
E3h		Initialize system timer
E4h		Initialize system I/O
E5h		Check force recovery boot
E6h		Checksum BIOS ROM
E7h		Go to BIOS
E8h		Set Huge Segment
E9h		Initialize Multi Processor
EAh		Initialilze OEM special code
EBh		Initialize PIC and DMA
ECh		Initialize Memory type
EDh		Initialize Memory size
EEh		Shadow Boot Block
EFh		System memory test
F0h		Initialize interrupt vectors
F1h		Initialize Run Time Clock
F2h		Initialize video
F3h		Initialize System Management Manager
F4h		Output one beep
F5h		Boot to Mini DOS
F6h		Clear Huge Segment
F7h		Boot to Full DOS

* If the BIOS detects error 2C, 2E, or 30 (base 512K RAM error), it displays an additional word-bitmap (xxxx) indicating the address line or bits that failed. For example, "2C 0002" means address line 1 (bit one set) has failed. "2E 1020" means data bits 12 and 5 (bits 12 and 5 set) have failed in the lower 16 bits. Note that error 30 cannot occur on 386SX systems because they have a 16 rather than 32-bit bus. The BIOS also sends the bitmap to the port-80 LED display. It first displays the check point code, followed by a delay, the high-order byte, another delay, and then the low-order byte of the error. It repeats this sequence continuously.

Default Configuration

In addition to the Setup configuration stored on the board, the cpuModule has a permanent default configuration. The system will resort to using this default if an error occurs when accessing the EPROM which holds the Setup on the module.

The default configuration is listed below.

BIOS Default Configuration	
Function	**Default selection**
IDE Interface 0 Master	Auto detect
IDE Interface 0 Slave	Auto detect
IDE Interface 1 Master	Auto detect
IDE Interface 1 Slave	Auto detect
Boot device	Floppy then hard disk
BIOS Extension	Disabled
Floppy Drive 1	3.5" 1.44 Meg
Floppy Drive 2	not installed
Serial port 1	RS232 at 3F8H
Serial port 2	RS232 at 2F8H
Parallel Port	LPT1 at 378H
Keyboard	Enabled if connected

Bypassing the Stored Configuration

Under certain circumstances, you may want to bypass the configuration stored on the board. To do this press the {F2} key to enter Setup and then you can then reconfigure the cpuModule correctly.

Direct Hardware Control

Some of the cpuModule hardware is controlled directly without using BIOS routines. These include:

- Watchdog Timer
- Real Time Clock Control
- Parallel Port Control

The following sections describe use of these features.

Watchdog Timer Control

The cpuModule includes a Watchdog Timer, which provides protection against programs "hanging", or getting stuck in an execution loop where they cannot respond correctly. When enabled, the Watchdog Timer must be periodically reset by your application program. If it is not reset before the time-out period of 1.2 seconds expires, it will cause a hardware reset of the cpuModule.

Three functions have been implemented on the cpuModule for Watchdog Timer control. These are:

- Watchdog Timer enable
- Watchdog Timer disable
- Watchdog Timer reset

To enable the watchdog timer you must write a 1 to to Bit 0 of I/O register 1Eh. To ensure compatability with future designs, you should read the register and only change the bit you need to change.

After you enable the watchdog timer, you must reset it at least once every 1.2 seconds by reading I/O 1Eh. The data read does not matter.

To disable the watchdog timer you must write a 0 to to Bit 0 of I/O register 1Eh.

Enabling the watchdog timer is illustrated in the following QuickBasic program fragment:

```
temp = INP(&H1E)          'Read I/O port 1Eh
temp = temp OR 1          'Set LSB to 1
OUTPUT &H1E, temp         'Enable WDT
```

When the watchdog timer is enabled it must be refreshed before it times out or it hardware reset the system. Refreshing the watchdog timer is illustrated in the following QuickBasic program fragment:

```
temp = INP(&H1E)          'Read I/O port 1Eh to refresh the WDT
```

Disabling the watchdog timer is illustrated in the following QuickBasic program fragment:

```
temp = INP(&H1E)          'Read I/O port 1Eh
temp = temp AND &HFE      'Clear LSB to 0
OUTPUT &H1E, temp         'Disable WDT
```

Real Time Clock Control

The cpuModule is equipped with a Real Time Clock (RTC) which provides system date and time functions, and also provides 128 non-volatile memory locations. The contents of these memory locations are retained whenever an external backup battery is connected, whether or not system power is connected.

You may access the RTC date, time, and memory using an index and data register at I/O addresses 70h and 71h. Address 70h is the Index register. It must be written with the number of the register to read or write. Refer to the map below for valid choices for the index. Data is then written to or read from the selected register by writing or reading (respectively) the data register at address 71h.

Do *not* change values stored in the RTC registers listed as RESERVED in the table below. Doing so will interfere with proper cpuModule operation.

Registers of the Real Time Clock are shown below:.

Real Time Clock Registers			
Registers (hex)	**Registers (decimal)**	**Number of Bytes**	**Function**
00h	0	1	BCD Seconds
02h	2	1	BCD Minutes
04h	4	1	BCD Hours
06h	6	1	Day of week
07h	7	1	Day of month
08h	8	1	Month
09h	9	1	Year
0A-31h	10-49	40	**RESERVED- Do not modify!**
32h	50	1	BCD Century
33-3Fh	51-63	13	**RESERVED - Do not modify!**
40-7Fh	64-127	64	User RAM

RTC access is illustrated in the following QuickBasic program fragment:

```
input "Enter address to write:", i%
input "Enter value to write:", j%
output &h70, i%
output &h71, j%

output &h70,i%
j% = input (&h71)
print "Read back value ";i%;" at address ";j%
```

Parallel Port Control

The parallel port may be operated in SPP (output-only), EPP (bi-directional), and ECP (extended capabilities) modes. The mode may be selected in Setup, or by application software.

Processor Clock Control

The processor clock is controller by solder jumpers on the board. These are set at the factory and should not be adjusted.

Please see ***Power Consumption*** on page 11 for a listing of Power Consumption.

Storing Applications On-board

The cpuModule was designed to be used in embedded computing applications. In these applications, magnetic media like hard disks and floppy disks are not very desirable. It is better to eliminate magnetic storage devices and place your operating system and application software into the cpuModule's Solid State Disk (SSD).

The following section describes two distinctly different ways you may use the Solid State Disk sockets of the cpuModule. These methods allows you to use a wide variety of memory devices to implement on-board Solid State Disk storage, each with its advantages and disadvantages.

Ways to Use the Solid State Disk Socket

The way to utilize the Solid State Disk socket of the cpuModule.

- Using a device which installs as a BIOS Extension

BIOS Extension Devices such as Disk On Chip and PromDisk provide a relatively large amount of read/write disk space. These devices generally appear similar to a conventional hard disk to DOS, allowing you to copy, delete, and rename files without using any special utilities.

BIOS Extension Devices

You can use BIOS Extension Devices like M-Systems Disk On Chip and MCSI PromDisk to implement a Solid State Disk which can be read and written using normal disk commands.

Advantages of using these devices include:

- Storage capacity up to 144 MB per socket (more in the future)
- Full read/write capability using standard OS file commands
- Integrated support for other operating systems is possible
  (contact M-Systems for information)

Parts supported by the cpuModule include:

- M-Systems 2000 series: MD2200-D144 (144MB)
  down to...
- M-Systems 2000 series: MD2200-D02 (2MB)
- Optional alternate operating system versions of the above parts

- MCSI PromDisk: 72300 (4MB)
- MCSI PromDisk: 72301 (8MB)

Our website at www.rtdusa.com provides links to the websites of these manufacturers.

Installing BIOS Extension Devices

To install these devices, follow this procedure:

- Apply power to the cpuModule and run Setup.
- Set A BIOS Extension Window on the advanced setup page. .

NOTE!	The memory window selected for a BIOS extension device must not be used by any other program or hardware device. Make sure this window is not used by EMM386 or another memory manager, Ethernet card, PCMCIA card, etc.

- Save your changes and exit Setup.
- Turn off the cpuModule.
- Install the BIOS Extension Device into the socket.
- Reboot the cpuModule. The BIOS Extension Device should appear as the next available hard drive in your system. If there is no other hard drive installed, it will appear as drive C:.
- Format the new drive using the DOS format command.

NOTE!	If you wish to make the drive bootable, you must format it using the **/s** switch of the format command. Refer to your OS manual for more information.

- If you wish to boot from the BIOS Extension Device, run Setup and disable any other hard drive. Set the boot device to Hard Drive. The cpuModule will not boot to a BIOS Extension Device if another hard drive is enabled.

Utility Programs

The cpuModule is supplied with a utility program needed for reprogramming the BIOS. The following sections discuss this utility in detail.

BIOS Programming Utility (CMR_PROG.EXE)

The BIOS Build utility program, CMR_PROG.EXE, allows you to re-program the BIOS.

Incorrectly programming the BIOS can completely halt operation of the cpuModule, requiring it to be returned to the factory. Do not attempt to reprogram the BIOS unless you fully understand the procedure.

BIOS Organization

The cpuModule BIOS is in a 512k byte Flash EPROM. The BIOS portion of the ROM is at addresses C0000H through FFFFFH.

Using CMR_PROG

The program is designed to program the Intel 512 KB Boot block Flash BIOS part and is run by entering the following command line:

CMR_PROG <file_name>

Where:

<file_name>: Name of the file to be programmed into the Flash EPROM.

The program uses memory block C8000-CBFFF to program the device. You must make sure there is no conflict in this area and no memory managers are loaded.

To reprogram the BIOS with the file MYROM.400 (which is 256 KB long), you would use the command line:

cmr_prog myrom.400

CHAPTER 6: HARDWARE REFERENCE

This appendix gives information on the cpuModule hardware, including:

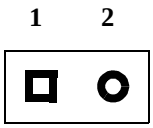
- jumper settings and locations
- solder jumper settings and locations
- mechanical dimensions
- processor thermal management

Jumpers

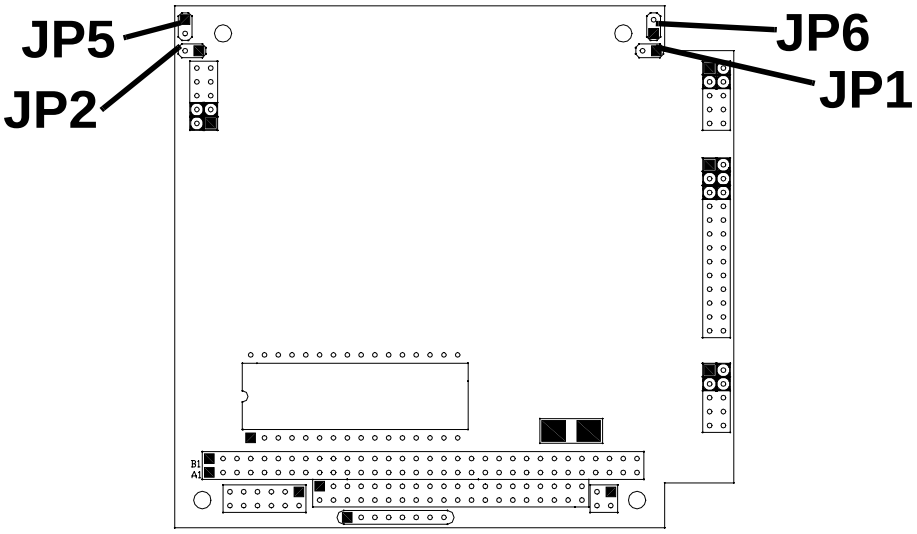
Many cpuModule options are configured by positioning jumpers. Jumpers are labeled on the board as **"JP"** followed by a number.

Some jumpers are two-pin, allowing two settings:

- pins 1 and 2 connected (indicated as "closed")
- pins 1 and 2 un-connected (indicated as "open")



The figure below shows the locations of the jumpers used to configure the cpuModule. To use the figure, position the module with the PC/104 bus connector at the six o'clock position and the component side facing up. The table below lists the jumpers and their settings.



Jumper	Use
JP1	2-pin jumper Used to enable/disable 120 ohm termination resistor on first serial port for RS-422/485 mode. Factory Default: Open (no termination)
JP2	2-pin jumper Used to enable/disable 120 ohm termination resistor on second serial port for RS-422/485 mode. Factory Default: Open (no termination)
JP5	Factory use only; do not close.

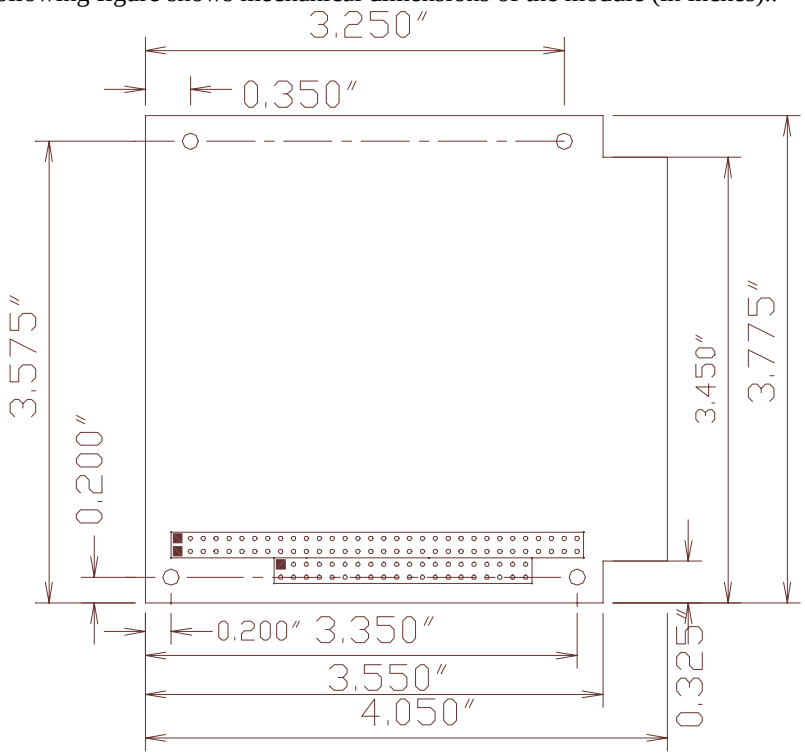
JP6	Factory use only; do not close.

Solder Jumpers

Solder jumpers are set at the factory and you will not need to change them.

Mechanical Dimensions

The following figure shows mechanical dimensions of the module (in inches)..



CMR686GX233 Mechanical Dimensions (+/- 0.005")

686GX233 Processor Thermal Management

The industrial grade processor IC of the cpuModule must receive adequate cooling to ensure proper operation and good reliability. The case temperature of the processor must not exceed +85°C The processor is therefore supplied with an attached fan and heatsink with a thermal resistance of 5° C/ W. .

NOTE!	This cpuModule is *not* warranted against damage caused by overheating due to improper or insufficient heatsinking or airflow.

The table below shows the maximum ambient temperature allowed.

Case Temperature 85° C		θ_{CA} for Different Ambient Temperatures (°C/W)				
Part Number	Frequency	20° C	25° C	30° C	35° C	40° C
CMR686GX233	233 MHz	6.59	6.08	5.57	5.07	4.56

CHAPTER 7: TROUBLESHOOTING

Many problems you may encounter with operation of your cpuModule are due to common errors. This chapter will help you get your system operating properly.

It contains:

- Common problems and solutions
- Troubleshooting a PC/104 system
- How to obtain technical support
- How to return a product

Common Problems and Solutions

The following table lists some of the common problems you may encounter while using your cpuModule, and suggests possible solutions.

If you are having problems with your cpuModule, please review this table *before* contacting technical support.

Problem	Cause	Solution
cpuModule "will not boot"	no power or wrong polarity	check for correct power on PC/104 bus connectors
	incorrect Setup (video disabled, etc.)	reboot and press {F2} key to run Setup
	defective or mis-connected device on bus	check for misaligned bus connectors; remove other cards from stack
	cable connected backwards	verify all cables are connected correctly
	SSD installed backwards	check for an SSD memory installed in socket backwards
will not boot from particular drive or device	device not bootable	use sys command on drive or re-format the device using the **/s** switch
	device not formatted	format drive using **/s** switch
	power not connected to boot drive	connect power cable to floppy or hard drive
Atmel Flash shows disk space available, but it cannot be written	part smaller than 1.44MB was formatted as 1.44MB; it will show space available even when full	ignore "disk space remaining" messages from DOS REMEMBER! A bootable disk contains 3 hidden files plus format info, totalling about 150kB
will not boot from DiskOnChip	DiskOnChip is not the only hard drive in system	disable other hard drive(s) in system
	using wrong DiskOnChip device (not 32 pin)	change to correct (32 pin) DiskOnChip
	Boot device not set to Hard disk	run Setup and set boot device to Hard Drive

erratic operation	excessive bus loading	reduce number of PC/104 modules in stack; remove termination components from bus signals; remove any power supply bus terminations
	power supply noise	examine power supply output with oscilloscope; glitches below 4.75Vdc will trigger a reset; add bypass caps
	power supply limiting	examine power supply output with oscilloscope; check for voltage drop below 4.75V when hard drive or floppy drive starts; add bypass caps
	temperature too high	add fan, processor heatsink, or other cooling device(s) See ***686GX233 Processor Thermal Management*** on page 82.
	memory address conflict	check for two hardware devices (e.g. Ethernet, SSD, Arcnet, PCMCIA) trying to use the same memory address check for two software devices (e.g. EMM386, PCMCIA drivers, etc.) trying to use the same memory addresses check for hardware and software devices trying to use the same memory address check for an address range shadowed (see Advanced Setup screen) while in use by another hardware or software device
	I/O address conflict	check for another module trying to use I/O addresses reserved for the cpuModule between 010h and 01Fh check for two modules (e.g. dataModules, PCMCIA cards, Ethernet) trying to use the same I/O addresses
keyboard does not work	keyboard interface damaged by misconnection	check if keyboard LEDs light
	wrong keyboard type	verify keyboard is an 'AT' type or switch to 'AT' mode
Windows 3.1x installation program hangs	smartdrive enabled	remove smartdrive command from config.sys, reboot, run install program
floppy drive light always on	cable misconnected	check for floppy drive cable connected backwards

two hard drives will not work, but one does	both drives configured for master	set one drive for master and the other for slave operation (consult drive documentation)
floppy does not work	"data error" due to drive upside down	orient drive properly (upright or on its side)
will not boot when video card is removed	illegal calls to video controller	look for software trying to access non-existent video controller for video, sound, or beep commands
won't boot from PCMCIA hard drive	booting from PCMCIA is not supported	boot from SSD, use autoexec.bat to load PCMCIA drivers, run application from PCMCIA card
COM port will not work in RS422 or RS485 modes	not configured for RS422/485	correctly configure serial port in Setup program
COM port will not transmit in RS422 or RS485 mode	not enabling transmitters	control RTS* bit of Modem Control Register to enable transmitters; see Serial Port descriptions
date and time not saved when power is off	no backup battery	connect a backup battery to the Multifunction connector

Troubleshooting a PC/104 System

If you have reviewed the preceding table and still cannot isolate the problem with your cpuModule, please try the following troubleshooting steps. Even if the resulting information does not help you find the problem, it will be very helpful if you contact technical support.

Simplify the system. Remove items one at a time and see if one particular item seems to cause the problem.

Swap components. Try replacing items in the system one-at-a-time with similar items.

How to Obtain Technical Support

If after following the above steps, you still cannot resolve a problem with your cpuModule, please assemble the following information:

- cpuModule **model**, **BIOS version**, and serial number
- list of **all boards in system**
- list of settings from cpuModule Setup program
- printout of autoexec.bat and config.sys files (if applicable)
- description of problem
- circumstances under which problem occurs

Then contact factory technical support:

Phone: 814 234-8087

Fax: 814 234-5218

E-mail: techsupport@rtdusa.com

How to Return a Product

NOTE!	You *must* have authorization from the factory before returning *any* item for *any* reason!

If you wish to return a product to the factory for service, please follow this procedure:

1) Read the Limited Warranty to familiarize yourself with our warranty policy.

2) Contact the factory for a Return Merchandise Authorization (RMA) number.

3) **Write a detailed description** of the situation or problem.
   Include as much information as possible!

4) **List the name of a contact person**, familiar with technical details of the problem or situation, **along with their phone and fax numbers, address, and e-mail address** (if available).

5) **List your shipping address!!**

6) Indicate the shipping method you would like used to return the product to you.
   We will not ship by next-day service without your pre-approval.

7) Carefully package the product, *using proper anti-static packaging.*

8) Write the RMA number in large (1") letters on the outside of the package.

9) Return the package to:

   Real Time Devices USA, Inc.
   200 Innovation Blvd.
   State College PA 16803
   USA

CHAPTER 8: LIMITED WARRANTY

Real Time Devices USA, Inc. warrants the hardware and software products it manufactures and produces to be free from defects in materials and workmanship for one year following the date of shipment from REAL TIME DEVICES USA, INC. This warranty is limited to the original purchaser of product and is not transferable.

During the one year warranty period, REAL TIME DEVICES USA will repair or replace, at its option, any defective products or parts at no additional charge, provided that the product is returned, shipping prepaid, to REAL TIME DEVICES USA. All replaced parts and products become the property of REAL TIME DEVICES USA. Before returning any product for repair, customers are required to contact the factory for an RMA number.

THIS LIMITED WARRANTY DOES NOT EXTEND TO ANY PRODUCTS WHICH HAVE BEEN DAMAGED AS A RESULT OF ACCIDENT, MISUSE, ABUSE (such as: use of incorrect input voltages, improper or insufficient ventilation, failure to follow the operating instructions that are provided by REAL TIME DEVICES USA, "acts of God" or other contingencies beyond the control of REAL TIME DEVICES USA), OR AS A RESULT OF SERVICE OR MODIFICATION BY ANYONE OTHER THAN REAL TIME DEVICES USA. EXCEPT AS EXPRESSLY SET FORTH ABOVE, NO OTHER WARRANTIES ARE EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, AND REAL TIME DEVICES USA EXPRESSLY DISCLAIMS ALL WARRANTIES NOT STATED HEREIN. ALL IMPLIED WARRANTIES, INCLUDING IMPLIED WARRANTIES FOR MECHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED TO THE DURATION OF THIS WARRANTY. IN THE EVENT THE PRODUCT IS NOT FREE FROM DEFECTS AS WARRANTED ABOVE, THE PURCHASER'S SOLE REMEDY SHALL BE REPAIR OR REPLACEMENT AS PROVIDED ABOVE. UNDER NO CIRCUMSTANCES WILL REAL TIME DEVICES USA BE LIABLE TO THE PURCHASER OR ANY USER FOR ANY DAMAGES, INCLUDING ANY INCIDENTAL OR CONSEQUENTIAL DAMAGES, EXPENSES, LOST PROFITS, LOST SAVINGS, OR OTHER DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE PRODUCT.

SOME STATES DO NOT ALLOW THE EXCLUSION OR LIMITATION OF INCIDENTAL OR CONSEQUENTIAL DAMAGES FOR CONSUMER PRODUCTS, AND SOME STATES DO NOT ALLOW LIMITATIONS ON HOW LONG AN IMPLIED WARRANTY LASTS, SO THE ABOVE LIMITATIONS OR EXCLUSIONS MAY NOT APPLY TO YOU.

THIS WARRANTY GIVES YOU SPECIFIC LEGAL RIGHTS, AND YOU MAY ALSO HAVE OTHER RIGHTS WHICH VARY FROM STATE TO STATE.