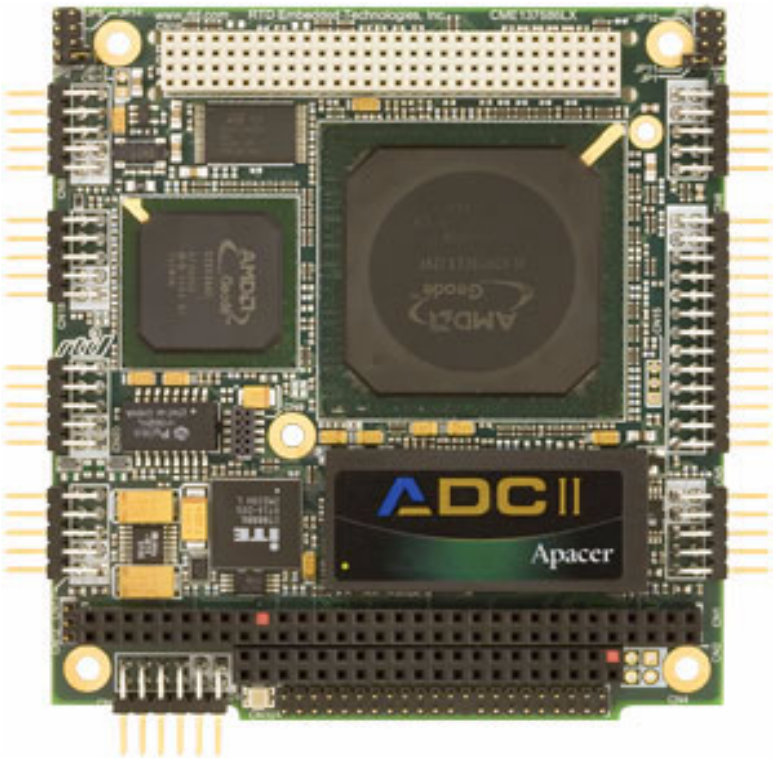
CME137686LX cpuModules™



User's Manual

BDM-610000064 Revision E

www.rtd.com

ISO9001 and AS9100 Certified

"Accessing the Analog World"®

CME137686LX cpuModules™ User's Manual

RTD Document Number: BDM-610000064 Revision E

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CME137686LX cpuModules™

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Revision History

Revision	Date	Reason for Change
Prelim.	05/22/08	Preliminary release
A	08/14/08	Update cpuModule picture (throughout) Correct number pins for CN15 (*CME137686LX Basic Connectors* — page 35) Update footnote to note that the ATX power signals are also available on the PC/104-*Plus* connector (*Auxiliary Power Connector (CN3)* — page 37) Add note that jumpers to configure dual serial port mode should be configured prior to installing the cpuModule in a chasis (*Dual Serial Port Modes* — page 49) Add new section to describe Non-Standard Serial Port Modes (*Non-Standard Serial Port Modes* — page 72) Update the instructions for using a multiPort Floppy Drive (*multiPort: Floppy Drive* — page 76) Updated the RTC registers table (*Real Time Clock Registers* — page 80) • Add registers 01h, 03h, 05h, 32h, 7Eh, and 7Fh • Set bits 5:0 as reserved in register 0Dh Add new section to describe Advanced Power Management (*Advanced Power Management (APM)* — page 85) Add new section for EMI Management (*EMI Management* — page 89) Document that the Multi-Color LED turns white to indicate that the cpuModule is reaching thermal limit (*LED Colors* — page 90) Add table to describe manual control of the Multi-Color LED (*Multi-Color LED I/O Address 46Ch* — page 90) Add more dimensions to dimensional drawing of cpuModule (*Physical Dimensions* — page 101)
B	09/25/08	Add IDAN dimensions and pinout appendix (*IDAN™ Dimensions and Pinout* — page 107) Updated USB electrical characteristics to specify current per port (*Electrical Characteristics* — page 21) Corrected reference to the Ethernet controller's model number in the Ethernet pinout section (*Ethernet (10/100Base-T and -TX) Connector (CN20)* — page 55)
C	04/07/10	Add new "ISO9001 and AS9100 Certified" logo Add 128MB variation of the CME137686LX. Remove 512MB variation of the CME137686LX. For 512MB variations, refer to the CME137686LX-W hardware manual (BDM-610000072) Corrected power measurements Corrected power options for +3.3V on the PCI bus Increased the maximum available disk chip capacity to 8GB Update serial port descriptions to include jumperless serial port configuration Revised serial port descriptions to note that baud rates above 115.2kbaud are supported. Improved descriptions of the BIOS Setup to accurately call out the names of the BIOS screens. Corrected the I/O base address ranges used for the Floppy Controller and 8237 DMA Low Page Registers (Table 38, *I/O Addresses Reserved for the CME137686LX cpuModule* — 68). Add I/O base address ranges for ISA Bridge DDMA Slave Channels 0 to 7. Modified the Hardware Interupts table (Table 55, *Hardware Interrupts on the CME137686LX cpuModule* — 94). Noted that IRQ14 is user configurable and that IRQ15 may be available. Corrected timings in description for Event Mode deglitching logic (*Event Mode* on page 75) Improved configuration section for the ATA/IDE Disk Chip Socket (*Configuring the ATA/IDE Disk Chip Socket* on page 78) • Removed reference to the secondary IDE controller. The Disk Chip socket is shared on the primary IDE controller with the onboard IDE connector. • Added support for UDMA mode and described ATA/IDE mode audodetection. • Specified the maximum ATA modes and transfer speeds supported by various disk chips • Added warning explaining not to use UDMA mode devices higher than UDMA mode-2 if an IDE device is on the IDE connector.

Revision History

Revision	Date	Reason for Change
C (continued)	04/07/10	Added PXE firmware to the memory map (Table 37, *Memory Addresses Reserved for the CME137686LX cpuModule*—67) Add note explaining to configure the PCI-to-ISA bridge before adding memory-mapped ISA peripherals to the system. (Table 37, *Memory Addresses Reserved for the CME137686LX cpuModule*—67) Correct the watchdog timer section (*Watchdog Timer Control*) General readability improvements throughout (verbage, spelling, formatting, and labeling)
D	01/13/14	Display the 512MB model numbers Add MTBF Correct storage temperature range Improve connector tables to show connector pitches and mating connector model numbers Add a table to show the supported ACPI wake mechanisms Note that serial port handshaking is not available in RS-422/485 mode Improve memory map table Cosmetic improvements
E	5/18/15	Split the row for pin 9&10 in the Dual Serial Port mode tables. Added Dual Serial Port tables to the IDAN Pinout section.

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Chapter 1 Introduction

This manual provides comprehensive hardware and software information for users developing with the CME137686LX PC/104-*Plus* cpuModule.

Note *Read the specifications beginning on page 19 prior to designing with the cpuModule.*

This manual is organized as follows:

Chapter 1	***Introduction*** introduces main features and specifications
Chapter 2	***Getting Started*** provides abbreviated instructions to get started quickly
Chapter 3	***Connecting the cpuModule*** provides information on connecting the cpuModule to peripherals
Chapter 4	***Using the cpuModule*** provides information to develop applications for the cpuModule, including general cpuModule information, detailed information on storing both applications and system functions, and using utility programs
Appendix A	***Hardware Reference*** lists jumper locations and settings, physical dimensions, and processor thermal management
Appendix B	***Troubleshooting*** offers advice on debugging problems with your system
Appendix C	***IDAN™ Dimensions and Pinout*** provides connector pinouts for the cpuModule installed in an RTD Intelligent Data Acquisition Node (IDAN) frame
Appendix D	***Additional Information*** lists sources and websites to support the cpuModule installation and configuration
Appendix E	***Limited Warranty***

CME137686LX cpuModules

RTD's CME137686LX cpuModule represents the latest in reliable low-power performance embedded computing solutions. It includes a 500 or 333MHz AMD Geode LX processor with 128kB L1 cache (64kB instruction and 64kB data) and 128kB L2 cache. It uses a 333MHz DDR-SDRAM controller that can support up to 2.7 G-Bytes per second of memory bandwidth.

The video interface is provided by an Analog SVGA output. The two outputs are independent, and can display separate images and display timings. Maximum resolution is 1920 x 1440.

High-speed peripheral connections include USB 2.0, with up to 480 Mb/sec data throughput. An ATA-100/66/33 IDE controller provides a fast connection to the hard drive. Network connectivity is provided by an Intel 82551QM Ethernet controller. Other features include two RS-232/422/485 COM ports (four ports if in dual-port mode).

RTD has gone the extra mile to include additional advanced features for maximum flexibility. These include an ATA/IDE Disk Chip socket which allows a true IDE drive to be attached to the board, either socketed or soldered. A multiPort can be configured as a standard EPP/ECP parallel port, a floppy drive port, or an Advanced Digital I/O (aDIO) port. An Advanced Watchdog Timer is provided that can generate an interrupt or reset when the timer expires. SDRAM is soldered directly to the board for high vibration resistance. The CME137686LX is also available in a rugged, fanless IDAN enclosure.

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

The cpuModule uses the RTD Enhanced AMI BIOS. Drivers in the BIOS allow booting from floppy disk, hard disk, ATA/IDE Disk Chip, or boot block flash, thus enabling the system to be used with traditional disk drives or nonmechanical drives. Booting from USB devices and network are also supported.

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 aDIO and watchdog timer.

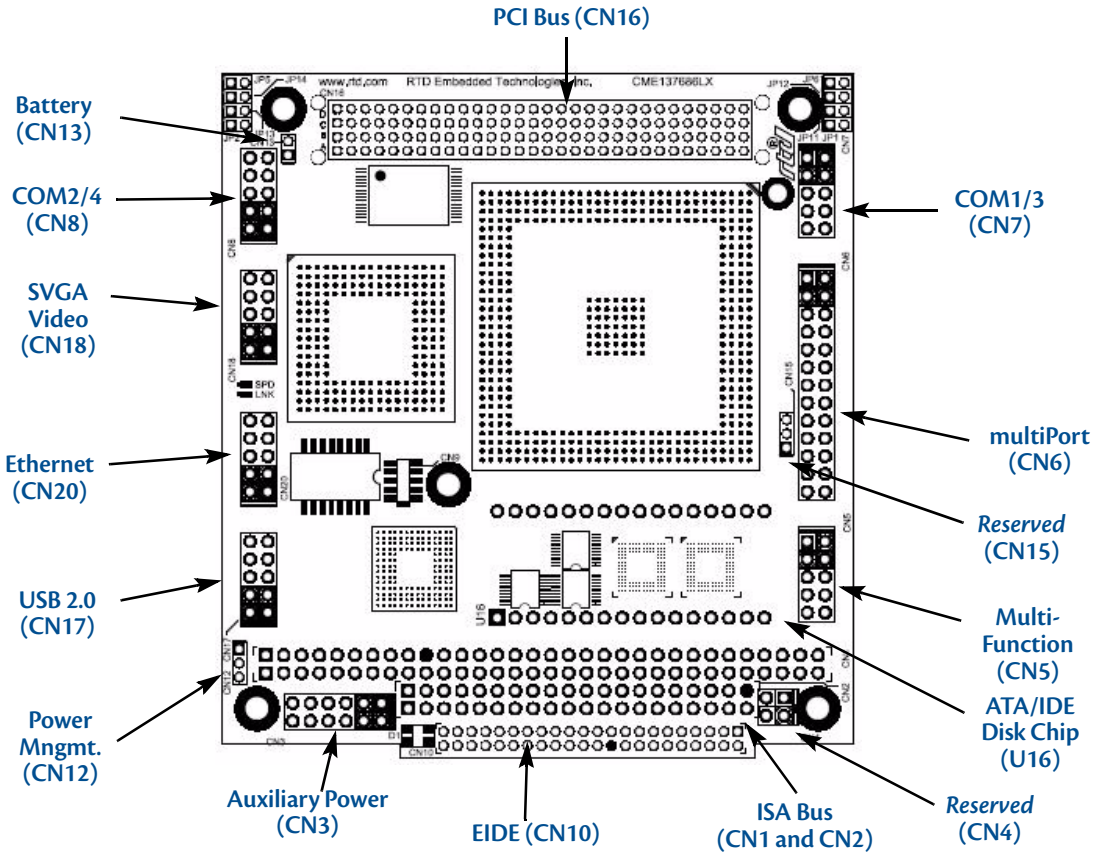

Figure 1 CME137686LX cpuModule (top view)

aDIO

RTD's exclusive multiPort™ allows the parallel port to be configured as an Advanced Digital I/O (aDIO™), ECP/EPP parallel port, or a floppy drive. aDIO™ is 16 digital bits configured as 8 bit-direction programmable and 8-bit port-direction programmable I/O giving you any combination of inputs and outputs. Match, event, and strobe interrupt modes prevent wasting valuable processor time polling digital inputs. Interrupts are generated when the 8 bit-direction programmable digital inputs match a pattern or on any value change event. Bit masking allows selecting any subgroup of eight bits. The strobe input latches data into the bit-programmable port and generates an interrupt.

Ordering Information

The CME137686LX cpuModule is available with a 500MHz or 333MHz GeodeL LX processor and 256MB or 128MB of DDR SDRAM. The cpuModule can also be purchased as part of an Intelligent Data Acquisition Node (IDAN™) building block, which consists of the cpuModule and a milled aluminum IDAN frame. The IDAN building block can be used in just about any combination with other IDAN building blocks to create a simple but rugged PC/104 stack. Refer to Appendix C, *IDAN™ Dimensions and Pinout*, for more information. The CME137686LX cpuModule can also be purchased as part of a custom-built RTD HiDAN™ or HiDAN*plus* High Reliability Intelligent Data Acquisition Node. Contact RTD for more information on its high reliability PC/PCI-104 systems.

CME137686LX Model Options

The basic cpuModule model options are shown below. Refer to the RTD website (www.rtd.com) for more detailed ordering information.

Table 1 CME137686LX cpuModule Model Options

Part Number	Description
CME137686LX500HR-512	500MHz Geode LX, 512MB DDR-SDRAM cpuModule
CME137686LX500HR-256	500MHz Geode LX, 256MB DDR-SDRAM cpuModule
CME137686LX500HR-128	500MHz Geode LX, 128MB DDR-SDRAM cpuModule
CME137686LX333HR-512	333MHz Geode LX, 512MB DDR-SDRAM cpuModule
CME137686LX333HR-256	333MHz Geode LX, 256MB DDR-SDRAM cpuModule
CME137686LX333HR-128	333MHz Geode LX, 128MB DDR-SDRAM cpuModule

Cable Kits and Accessories

For maximum flexibility, RTD does not provide cables with the cpuModule. You may wish to purchase the CME137686LX cpuModule cable kit (P/N XK-CM81), which contains:

- Multi-function utility harness: keyboard, mouse, battery, reset button, ATX power button, speaker
- Two serial port cables (DIL-10 to DSUB-9)
- Parallel port cable (DIL-26 to DSUB-25)
- One 40-conductor IDE cable with a connection for one IDE device[1]
- One 80-conductor IDE cable with connections for two off-board IDE devices
- VGA monitor cable (DIL-10 to high density 15-pin DSUB)
- Power cable (DIL-12 to wire leads)
- Two USB cables (5-pin SIL to USB A)
- One Ethernet cable (DIL-10 to RJ-45)

A floppy drive cable kit (P/N XK-CM49) is also available for connecting to the multiPort. This cable kit comes with:

- 3.5" HDD Floppy Drive with a multiPort interface board
- Two floppy cables

For additional accessories, refer to the RTD website.

1. When an ATA/IDE Disk Chip is installed in the ATA/IDE Disk Chip socket, only one device may be connected to the IDE connector. For more information, refer to Chapter 4, *IDE Controller Configuration*.

Board Features

- 500 or 333MHz AMD Geode LX
  - Integrated FPU that supports the MMX and AMD 3DNow! instruction sets
  - Internal Cache
    - L1 - 64KB of instruction and 64KB data
    - L2 - 128KB
- 256 or 128Mbytes BGA DDR SDRAM
  - Up to 333 MHz Data Rate
- Stackable 104-pin ISA bus
  - Full ISA bus operation
  - Supports 8-bit (XT) and 16-bit (AT) peripherals
  - All ISA IRQ lines supported
  - DMA Supported via DDMA (Software-transparent)
  - Supports both I/O-mapped and Memory-mapped expansion cards
  - Positive Decode of PCI cycles
    - I/O and Memory ranges selectable in BIOS
- Advanced Thermal Management
  - Temperature Monitor for CPU and board temperature
  - Rugged Passive Heatsink standard on board configurations
  - Passive Structural Heatsink & Heatpipes in IDAN and HiDAN System Configurations
- Advanced Configuration and Power Interface (ACPI)
  - ACPI 1.0 Compliant
  - Supported power down modes: S1 (Power On Suspend), S3 (Suspend to RAM), S4 (Hibernate), and S5 (Soft-Off)
- Network Boot supported by Intel PXE
- Nonvolatile storage of CMOS settings without battery
- Watchdog timer
- Complete PC-compatible Single Board Computer

I/O

- Fast Ethernet
  - Ethernet Controller
    - Intel 82551QM Fast Ethernet PCI Controller
    - Integrated 3KByte Transmit and 3Kbyte Receive FIFOs
  - Physical Layer
    - 100Base-Tx and 10Base-T
    - Full Duplex support
  - Network Boot supported by Intel PXE
  - Easy to Use
    - Low Power Features
    - LED Status

        - Software configuration
- VGA controller
    - Analog SVGA Output
    - Resolution up to 1920 x 1440 pixels
    - VGA, SVGA, XGA, XGA+, SXGA, and UXGA
    - Up to 4,294 million colors
    - 24MB of shared DDR SDRAM high-performance memory
- Software-configurable RS-232/422/485 serial ports
    - 16550 compatible UARTs for high-speed
    - Termination resistors for RS-422/485
    - Each serial port connector can be configured as two limited serial ports, for a total of four serial ports
- multiPort function connector
    - Parallel port
        - SPP, PS/2 bi-directional, EPP & ECP
    - Advanced Digital I/O (aDIO)
        - One 8-bit port programmable as input or output
        - Eight bit-programmable I/O with Advanced Digital Interrupt Modes
        - Event Mode Interrupt generates an interrupt when any input bit changes
        - Match Mode Interrupt generates an interrupt when input bits match a preset value
        - External Strobe Mode latches 8 data inputs and generates and interrupt
        - Two Strobes can be configured as readable inputs
    - Floppy controller interface
        - Interfaces with RTD's multiPort Floppy Drive and Cable Kit
    - ESD protection
- Two USB 2.0 (Universal Serial Bus) Ports
    - Supports 480 Mb/s (high-speed), 12Mb/s (full-speed), and 1.5Mbs (low speed) peripherals
    - 500 mA @ 5 Vdc provided per port
    - USB Boot capability
    - USB keyboard, mouse, and disk support for legacy OSes (e.g. ROM-DOS)
- UltraDMA-100 / 66 / 33 Master Mode PCI EIDE Controller
    - Single Channel
    - Transfer rate up to 100MB/sec using UltraDMA
    - Increased reliability using UltraDMA-33 transfer protocols
    - Support ATAPI compliant devices including DVD drives
    - 48-bit LBA support for hard drives larger than 137GB up to 2.2 terabytes
- 32 pin ATA/IDE Disk Chip Socket
    - Miniature ATA/IDE Flash Disk Chip
    - Capacities up to 8GB[1]
    - Natively supported by all major operating systems

1. During the time of this manual's publication, 8GB was the largest available ATA/IDE Disk Chip capacity. Higher capacities may be supported when available.

- Utility port
  - PC/AT compatible keyboard port
  - PS/2 Mouse Port
  - Speaker port (0.1W output)
  - Hardware Reset input
  - Battery input for Real Time Clock
  - Soft Power Button input
- Power I/O
  - Access to PC/104 and PCI-104 Bus pins
  - Power ground, ±12, 5 & 3.3 VDC
  - PS_ON# (Power Supply On) and +5V Standby power provide support for ATX power supplies

BIOS

- RTD Enhanced AMI BIOS
- User-configurable using built-in Setup program
- Nonvolatile storage of CMOS settings without battery
- Boot Devices
  - Standard Devices (floppy disk, hard disk, etc.)
  - ATA/IDE Disk Chip
  - USB Device
  - Network
  - Fail Safe Boot ROM
    - Surface-mount Flash chip that holds ROM-DOS™
- Quick Boot mode
- USB legacy support enables USB keyboards, mice, and storage devices to be used under legacy OSes (e.g. ROM-DOS)

Block Diagram

The next figure shows a simplified block diagram of the CME137686LX cpuModule.

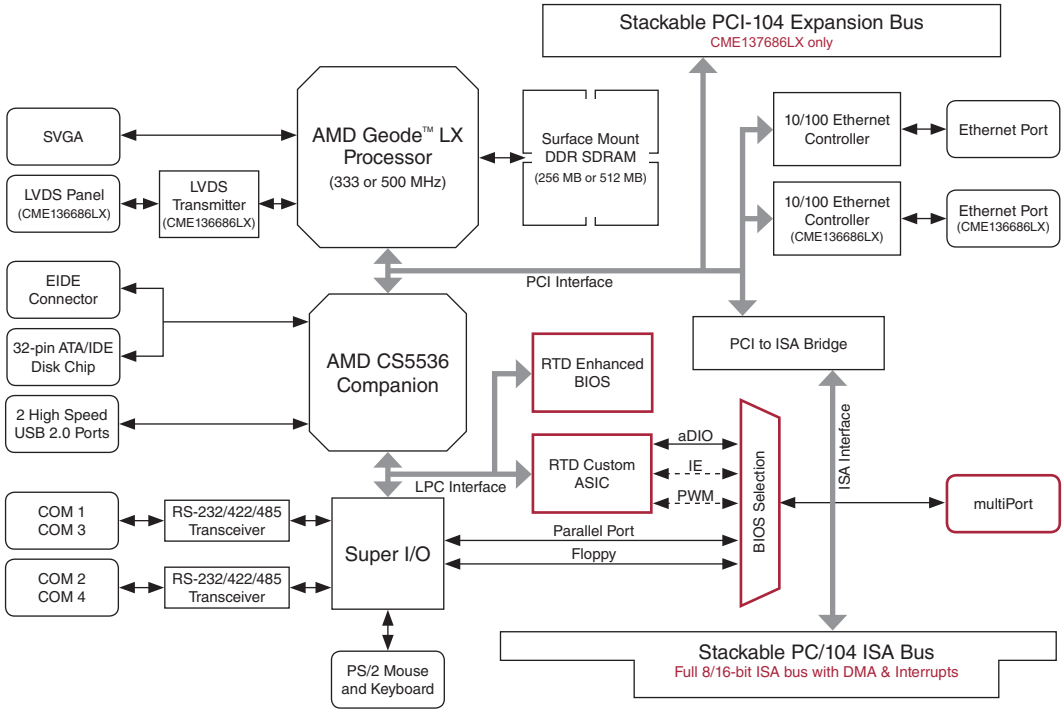

Figure 2 CME137686LX cpuModule Simplified Block Diagram

Specifications

Physical Characteristics

- Dimensions: 90.17mm L x 95.89mm W x 15mm H (3.550"Lx 3.775"W x 0.6"H)
- Weight: Approximately 0.13 Kg (0.28 lbs.)

Power Consumption

Exact power consumption depends on the actual application. Table 2 lists power consumption for typical configurations and clock speeds.

Table 2 cpuModule Power Consumption

Module	Speed	RAM	Power, typ.
CME137686LX	500 MHz	512 MB	5.7 W
CME137686LX	500 MHz	256 MB	5.6 W
CME137686LX	500 MHz	128 MB	5.5 W
CME137686LX	333 MHz	512 MB	5.3 W
CME137686LX	333 MHz	256 MB	5.2 W

Table 2 cpuModule Power Consumption

Module	Speed	RAM	Power, typ.
CME137686LX	333 MHz	128 MB	5.1 W

Operating Conditions

Table 3 Operating Conditions

Symbol	Parameter	Test Condition	Min.	Max.
V_{CC5}	5V Supply Voltage		4.75V	5.25V
V_{CC3}	3.3V Supply Voltage		n/a[1]	n/a
V_{CC12}	12V Supply Voltage		n/a[1]	n/a
V_{CC-12}	-12V Supply Voltage		n/a[1]	n/a
V_{CCSTBY}	5V Standby Voltage[2]		4.75V	5.25V
I_{CCSTBY}	5V Standby Current[2]		-	500mA
Ta	Ambient Operating Temperature	Standard	-40C	+85C
Ts	Storage Temperature		-55C	+125C
Rh	Humidity	Non-Condensing	0	90%
MTBF	Mean Time Before Failure	128 MB @ 23 C	602,575 hours	
MTBF	Mean Time Before Failure	256 MB @ 23 C	599,620 hours	
MTBF	Mean Time Before Failure	512 MB @ 23 C	524,624 hours	

1. The 12V, -12V, and external +3.3V rails are not used by the cpuModule. Any requirements on these signals are driven by other components in the system, such as a PCI device.
2. 5V Standby is used to power the board when the main supply is turned off (power down modes S3-S5). It is not required for board operation.

Electrical Characteristics

The table below lists the Electrical Characteristics of the CME137686LX. Operating outside of these parameters may cause permanent damage to the cpuModule.

Table 4 Electrical Characteristics

Symbol	Parameter	Test Condition	Min.	Max.
		PCI		
V_{OH}	Output Voltage High	I_{OH} = −0.5 mA	2.9 V	3.3 V
V_{OL}	Output Voltage Low	I_{OL} = 6.0 mA	0.0 V	0.55 V
V_{IH}	Input Voltage High	—	1.8 V	5.5 V
V_{IL}	Input Voltage Low	—	-0.5 V	0.9
$I_{3.3V}$	3.3V supplied to PCI bus from power connector (**CN3**)	—	—	2 A
		ISA		
V_{OH}	Output Voltage High	I_{OH} = −4.0 mA	3.5V	5.0V
V_{OL}	Output Voltage Low	I_{OL} = 8.0 mA	0.0V	0.4V
V_{IH}	Input Voltage High	—	2.2V	5.0V
V_{IL}	Input Voltage Low	—	0.0V	0.8V
		IDE & ATA/IDE Disk Chip Socket[1]		
V_{OH}	Output Voltage High	I_{OH} = −6.0 mA	2.8 V	3.3 V
V_{OL}	Output Voltage Low	I_{OL} = 6.0 mA	0.0 V	0.51 V
V_{IH}	Input Voltage High	—	2.0 V	5.5 V
V_{IL}	Input Voltage Low	—	-0.5 V	0.8 V
		USB Ports		
Ioc	Overcurrent Limit	For each port	1.0A	5.0A
		SVGA Port		
V_{OH}	Output Voltage High HSYNC, VSYNC	I_{OH} = −32.0 mA	3.8 V	5.0 V
V_{OL}	Output Voltage Low HSYNC, VSYNC	I_{OL} = 32.0 mA	0.0 V	0.55 V
V_{OH}	Output Voltage High DDC_*	I_{OH} = −4.0 mA	2.4 V	3.3 V
V_{OL}	Output Voltage Low DDC_*	I_{OL} = 8.0 mA	0.0 V	0.4 V
V_{IH}	Input Voltage High DDC_*	—	2.0 V	5.5 V
V_{IL}	Input Voltage Low DDC_*	—	-0.3 V	0.8 V
I_{DDCvcc}	Supply Current for DDC Electronics	—		100 mA

Table 4 Electrical Characteristics

Symbol	Parameter	Test Condition	Min.	Max.
		Serial Ports - RS-232		
V_{OH}	Output Voltage High	R_L = 3 k	5.0 V	10.0 V
V_{OL}	Output Voltage Low	R_L = 3 k	-10.0 V	-5.0 V
V_{IH}	Input Voltage High	—	2.4 V	25 V
V_{IL}	Input Voltage Low	—	-25 V	0.8 V
		Serial Ports - RS-422/485		
V_{OD1}	Differential Output	R_L = 50 Ohm	2.0 V	6.0 V
V_{OD2}	Differential Output	R_L = 27 Ohm	1.5 V	6.0 V
V_{OC}	Common Mode Output	R_L = 27 or 50 Ohm	0.0 V	3.0 V
V_{TH}	Differential Input Threshold	-7V < V_{CM} < 7V	-0.3 V	0.3 V
V_I	Absolute Max Input Voltage	—	-25 V	25 V
		multiPort - all modes		
V_{OH}	Output Voltage High	I_{OH} = –4.0 mA	2.4 V	3.3 V
V_{OL}	Output Voltage Low	I_{OL} = 8.0 mA	0.0 V	0.4 V
V_{IH}	Input Voltage High[2]	—	2.0 V	5.5 V
V_{IL}	Input Voltage Low[2]	—	-0.5 V	0.8 V
I_{vcc}	Supply current	—		500 mA
		Utility Port Connector (CN5)		
V_{RTC}	Input RTC Voltage[3]	—	2.0V	3.6 V
$I_{UTILvcc}$	Utility Supply Current	—		500 mA
		External Power Management (CN12) - PME#		
V_{IH}	Input Voltage High	—	2.0 V	5.5 V
V_{IL}	Input Voltage Low	—	-0.5 V	0.8 V

1. Applies to modes up to UltraDMA Mode 4 (ATA/66)
2. Maximum DC undershoot below ground must be limited to either 0.5V or 10mA. During transitions, the device pins may undershoot to -2.0V or overshoot to 7.0V, provided it is less than 10ns, with the forcing current limited to 200 mA.
3. Only required to maintain date and time when power is completely removed from the system. Not required for board operation.

Contact Information

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Chapter 2 Getting Started

For many users, the factory configuration of the CME137686LX cpuModule can be used to get a PC/104 system operational. You can get your system up and running quickly by following the simple steps described in this chapter, which are:

1. Before connecting the cpuModule, the user must be properly grounded to prevent electrostatic discharge (ESD). For more information, refer to *Proper Grounding Techniques* on page 34.
2. Connect power.
3. Connect the utility harness.
4. Connect a keyboard.
5. Default BIOS configuration.
6. Fail Safe Boot ROM.
7. Connect a VGA monitor to the SVGA connector.

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

Connector Locations

Figure 3 shows the locations of the connectors and ATA/IDE Disk Chip socket of the CME137686LX cpuModule.

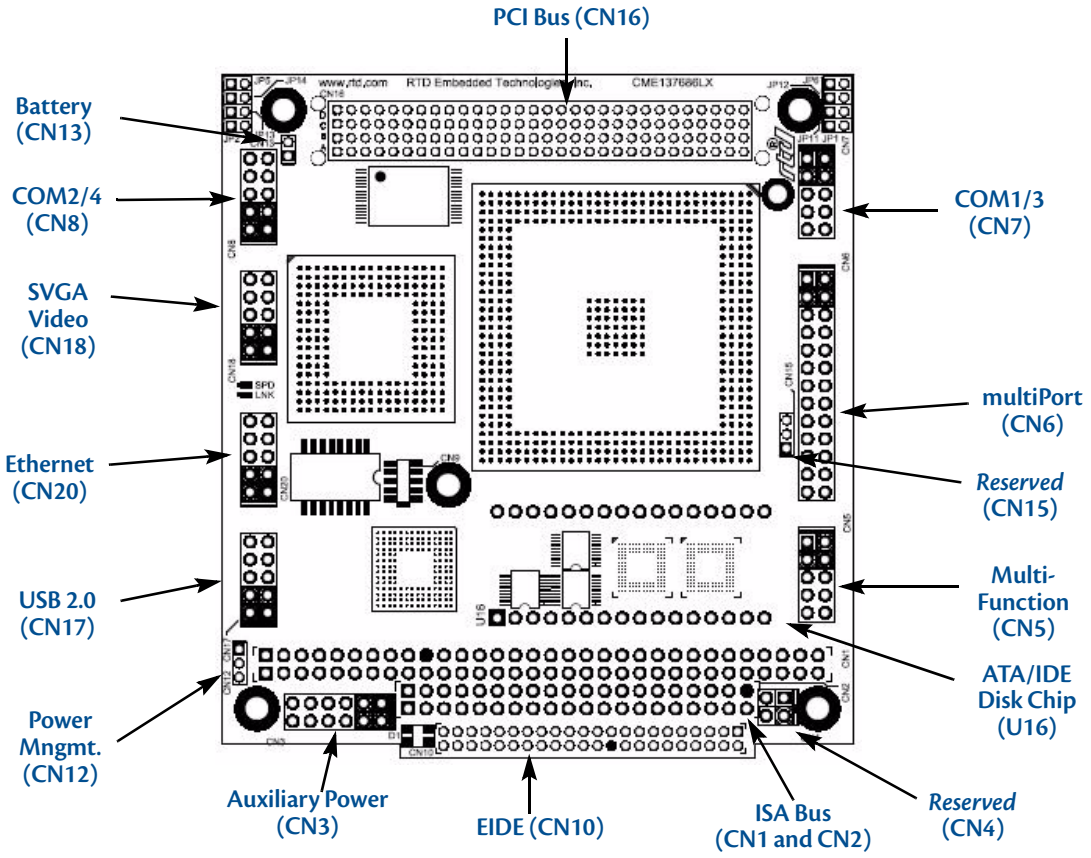


Figure 3 CME137686LX Connector Locations

Note *Pin 1 of each connector is indicated by a white silk-screened square on the top side of the board and a square solder pad on the bottom side of the board. Pin 1 of the bus connectors match when stacking PC/104, PC/104-Plus, or PCI-104 modules.*

Table 5 CME137686LX Basic Connectors

Connector	Function	Size and Pitch	Mating Connector
CN1	PC/104 Bus (XT)	2x32, 0.1"	Samtec ESQ-132-14-G-D
CN2	PC/104 Bus (AT)	2x20, 0.1"	Samtec ESQ-120-14-G-D
CN3	Auxiliary Power	2x6, 0.1"	AMP 87456-8
CN4	Reserved	2x2, 0.1"	—
CN5	Utility Port	2x5, 0.1"	3M 89110-0001
CN6	multiPort	2x13, 0.1"	3M 89126-0001
CN7	Serial Port 1 (COM1/3)	2x5, 0.1"	3M 89110-0001
CN8	Serial Port 2 (COM2/4)	2x5, 0.1"	3M 89110-0001
CN9	Reserved	2x5	—
CN10	EIDE Connector	2x22, 2mm	Samtec TCSD-22-D-12.00-01F-P20
CN12	External Power Management	1x3, 2mm	FCI 69305-003LF
CN13	RTC Battery Input (optional)	1x2, 2mm	FCI 69305-002LF
CN15	Reserved	1x3, 2mm	—
CN16	PC/104-*Plus* (PCI) Bus	120-pin	—120-pin
CN18	Video (SVGA)	2x5, 0.1"	3M 89110-0001
CN20	Ethernet	2x5, 0.1"	3M 89110-0001
U16	ATA/IDE Disk Chip Socket	32-pin, 0.1"	—

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

Power is normally supplied to the cpuModule through the ISA bus (**CN1** & **CN2**) and PCI bus connectors (**CN16**). If you are placing the cpuModule onto a PC/104, PC/104-*Plus* or PCI-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, PC/104-*Plus*, or PCI-104 stack or with a stack that does not include a power supply, refer to *Auxiliary Power (CN3)* on page 36 for more details.

Some PCI-104 and PC/104-*Plus* expansion cards may require +3.3V supplied on the PC/104-*Plus* (PCI) connector (**CN16**). To learn how to supply this voltage, refer to *Auxiliary Power (CN3)* on page 36 and *Jumper Settings and Locations* on page 98.

Connecting the Utility Cable

The multi-function connector (**CN5**) implements the following interfaces:

- PC/AT compatible keyboard
- PS/2 mouse port
- Speaker port (0.1W output)
- Hardware Reset input
- Battery input for Real Time Clock
- Soft Power Button input

To use these interfaces, you must connect to the utility port connector (**CN5**). The utility harness from the RTD cable kit provides a small speaker, two connectors for the keyboard and mouse, a push-button for resetting the PC/104 or PC/104-*Plus* system, a soft-power button, and a lithium battery to provide backup power for the real time clock.

Refer to *Utility Port Connector (CN5)* on page 38 to connect devices to the utility port connector.

Connecting a Keyboard

You may plug a PC/AT compatible keyboard directly into the PS/2 connector of the utility harness in the cable kit.

Note *Some older 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. 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.*

1. Turn off power to the PC/104 system or stack.
2. Select and install stand-offs to properly position the cpuModule on the PC/104 stack.
3. Touch a grounded metal part of the rack to discharge any buildup of static electricity.
4. Remove the cpuModule from its anti-static bag.
5. Check that keying pins in the bus connector are properly positioned.
6. 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.
7. Hold the cpuModule by its edges and orient it so the bus connector pins line up with the matching connector on the stack.
8. Gently and evenly press the cpuModule onto the PC/104 stack.

Note *Before installing ISA add-in cards, refer to the section Using ISA Peripheral Cards on page 70 and I/O Address Aliasing on page 71.*

Connecting to the PC/104-*Plus* (PCI) Bus

Other PC/104-*Plus* or PCI-104 expansion boards may be connected to the cpuModule's PC/104-*Plus* (PCI) bus connector. To connect expansion modules to the PC/104-*Plus* bus, 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.*

1. Turn off power to the PC/104-*Plus* or PCI-104 system or stack.
2. Select and install stand-offs to properly position the cpuModule on the stack.
3. Touch a grounded metal part of the rack to discharge any buildup of static electricity.
4. Remove the cpuModule from its anti-static bag.
5. Check that keying pins in the bus connector are properly positioned.
6. Check the stacking order; if there are multiple PC/104-*Plus* boards, make sure their PCI-bus connectivity is not interrupted by a PC/104 (ISA-only) board.
7. Hold the cpuModule by its edges and orient it so the bus connector pins line up with the matching connector on the stack.
8. Gently and evenly press the cpuModule onto the PC/104-*Plus* or PCI-104 stack.

There are three additional considerations to make when using the PCI bus:

- Slot selection switches on add-in boards
- PCI bus expansion card power
- PCI bus signaling levels

Slot Selection Switches

Unlike PC/104 cards, PC/104-*Plus* and PCI-104 expansion cards have a "slot" selection switch or jumpers. In total, there are 4 PCI cards that can be stacked onto the cpuModule with switch positions 0 through 3. The distance from the CPU determines these switch settings. The card closest to the CPU is said to be in slot 0, the next closest slot 1 and so on to the final card as slot 3.

Note *This requirement means that all PC/104-Plus and PCI-104 cards must be stacked either on the top or the bottom of the CPU, not on both sides.*

The "slot" setting method may vary from manufacturer to manufacturer, but the concept is the same. The CPU is designed to provide the correct delay to the clock signals to compensate for the bus length. The correct switch setting ensures the proper clock delay setting, interrupt assignment, and bus grant/request channel assignment. Refer to the expansion board's manual for the proper settings. Each expansion card must be in a different slot.

PCI Bus Expansion Card Power

+5 Volt DC

The +5 V power pins on the PC/104-*Plus* (PCI) bus are connected directly to the +5 V pins on the auxiliary power connector, **CN3** (pins 2 and 8).

+3.3 Volt DC

The +3.3V pins on the PCI bus are supplied from the auxiliary power connector, **CN3** (pins 10 and 12).

PCI Bus Signaling Levels

The PCI bus can operate at +3.3 V or +5 V signaling levels. The default PCI bus signaling level is +3.3 V. For more information, contact RTD Technical Support.

WARNING *You will have to ensure that all your expansion cards can operate together at a single signaling level.*

Booting the CME137686LX cpuModule for the First Time

You can now apply power to the cpuModule. You will see:

- The cpuModule BIOS version information
- A message requesting you press **Delete** to enter the Setup program

If you don't press **Delete**, the cpuModule will try to boot from the current settings. If you press **Delete**, the cpuModule will enter Setup. Once you have configured the cpuModule using Setup, save your changes and reboot.

Note *You may miss the initial sign-on messages if your monitor takes a while to power on.*

Note *By default, cpuModules are shipped with Fail Safe Boot ROM enabled. When Fail Safe Boot ROM is enabled, the system will boot to it exclusively.*

Chapter 3 Connecting the cpuModule

This chapter provides information on all CME137686LX cpuModule connectors.

Proper Grounding Techniques — page 34

Connector Locations — page 34

Auxiliary Power (CN3) — page 36

Utility Port Connector (CN5) — page 38

SVGA Video Connector (CN18) — page 41

EIDE Connector (CN10) — page 43

ATA/IDE Disk Chip Socket (U16) — page 44

Serial Port 1 (CN7) and Serial Port 2 (CN8) — page 46

multiPort™ (CN6) — page 51

USB 2.0 Connector (CN17) — page 54

Ethernet (10/100Base-T and -TX) Connector (CN20) — page 55

PC/104 Bus (CN1 and CN2) — page 56

PC/104-Plus PCI Bus (CN16) — page 59

External Power Management (CN12) — page 62

Optional RTC Battery Input (CN13) — page 62

Proper Grounding Techniques

Before removing the CME137686LX from its static bag, proper grounding techniques must be used to prevent electrostatic discharge (ESD) damage to the cpuModule. Common grounding procedures include an anti-static mat on a workbench, which may connect to an anti-static wrist strap (also known as an ESD wrist strap) on the wrist of the technician or engineer.

Connector Locations

Figure 4 shows the connectors and the ATA/IDE Disk Chip socket of the CME137686LX cpuModule.

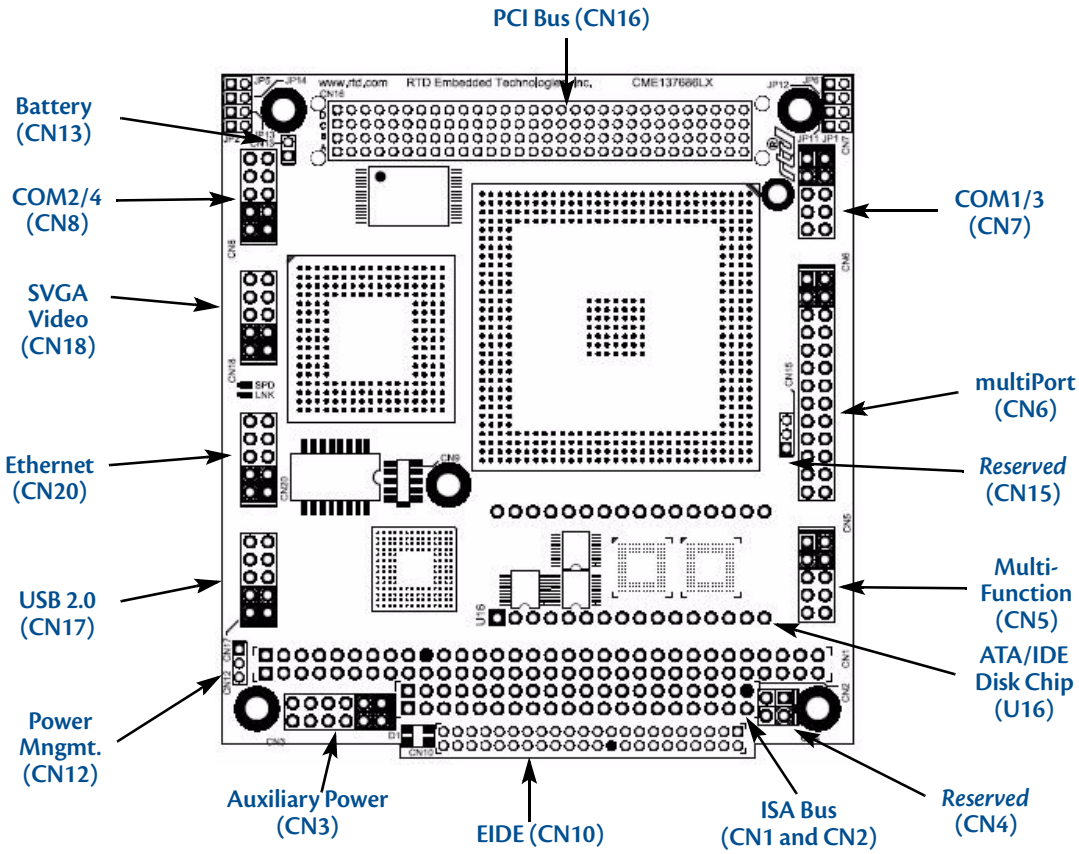


Figure 4 CME137686LX Connector Locations

Note *Pin 1 of each connector is indicated by a white silk-screened square on the top side of the board and a square solder pad on the bottom side of the board. Pin 1 of the bus connectors match when stacking PC/104, PC/104-Plus, or PCI-104 modules.*

Table 6 CME137686LX Basic Connectors

Connector	Function	Size and Pitch	Mating Connector
CN1	PC/104 Bus (XT)	2x32, 0.1"	Samtec ESQ-132-14-G-D
CN2	PC/104 Bus (AT)	2x20, 0.1"	Samtec ESQ-120-14-G-D
CN3	Auxiliary Power	2x6, 0.1"	AMP 87456-8
CN4	Reserved	2x2, 0.1"	—
CN5	Utility Port	2x5, 0.1"	3M 89110-0001
CN6	multiPort	2x13, 0.1"	3M 89126-0001
CN7	Serial Port 1 (COM1/3)	2x5, 0.1"	3M 89110-0001
CN8	Serial Port 2 (COM2/4)	2x5, 0.1"	3M 89110-0001
CN9	Reserved	2x5	—
CN10	EIDE Connector	2x22, 2mm	Samtec TCSD-22-D-12.00-01F-P20
CN12	External Power Management	1x3, 2mm	FCI 69305-003LF
CN13	RTC Battery Input (optional)	1x2, 2mm	FCI 69305-002LF
CN15	Reserved	1x3, 2mm	—
CN16	PC/104-*Plus* (PCI) Bus	120-pin	—120-pin
CN18	Video (SVGA)	2x5, 0.1"	3M 89110-0001
CN20	Ethernet	2x5, 0.1"	3M 89110-0001
U16	ATA/IDE Disk Chip Socket	32-pin, 0.1"	—

Auxiliary Power (CN3)

The Auxiliary Power connector (**CN3**) can be used to supply power to devices that are attached to the cpuModule. These devices include hard drive, front-end boards for data acquisition systems, and other devices.

Power can also be conveyed to the module through the Auxiliary Power connector (**CN3**). The cpuModule only requires +5 VDC and ground for operation; however, other modules in the system may require +3.3V, +12 VDC, −12 VDC, and −5 VDC. In these instances, the corresponding pins on the Auxiliary Power Connector (**CN3**) may be used to supply these voltages.

Note *Although it is possible to power the cpuModule through the Auxiliary Power connector, the preferred method is to power it through the bus connector from a power supply in the stack. The cpuModule can have large current transients during operation, which make powering it through wires difficult. Powering through the bus eliminates such problems as voltage drop and lead inductance.*

If using the Auxiliary Power connector to power the system, care must be taken to ensure a good power connections. The power and ground leads must be twisted together, or as close together as possible to reduce lead inductance. A separate lead must be used for each of the power pins. Both 5V pins must be connected. The gauge of wire must be selected taking into account the total power of the system. A good rule of thumb is to use wire that can supply twice the power required by the system, and do not use less than 18 gauge wire. The length of the wire must not exceed 3 ft. The power supply solution must be verified by measuring voltage at the Auxiliary Power Connector and verifying that it does not drop below 4.75 V. The voltage at the connector should be checked with an oscilloscope while the system is operational.

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

Note *The +3.3 V pins (10 and 12) on the auxiliary power connector (***CN3***) are connected to the +3.3 V pins on the PC/104-Plus bus by default.*

Table 7 Auxiliary Power Connector (CN3)[1]

Pin	Signal	Function
1	GND	Ground
2	+5 V	+5 Volts DC
3	+5V_STDBY	+5V Standby (ATX)
4	+12 V	+12 Volts DC
5	Reserved	Reserved
6	–12 V	–12 Volts DC
7	GND	Ground
8	+5 V	+5 Volts DC
9	GND	Ground
10	+3.3 V	See note below
11	PSON#	Power Supply On (ATX)
12	+3.3 V	See note below

1. For more information on the ATX style signals, +5V Standby and PSON#, refer to the *Power Management* section in Chapter 4, *Using the cpuModule*. These signals are also available on the PC/104-*Plus* connector (**CN16**).

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

11	9	7	5	3	1
PSON#	**GND**	**GND**	**Reserved**	**+5V_STDBY**	**GND**
+3.3 V	**+3.3 V**	**+5 V**	**–12 V**	**+12 V**	**+5 V**
12	10	8	6	4	2

Utility Port Connector (CN5)

The utility port connector implements the following functions:

- PC/AT compatible keyboard port
- PS/2 mouse port
- Speaker port (0.1W output)
- Hardware Reset input
- Battery input for Real Time Clock
- Soft Power Button input

Table 8 provides the pinout of the multi-function connector.

Table 8 Utility Port Connector (CN5)

Pin	Signal	Function	In/Out
1	SPKR+	Speaker Output (open collector)	out
2	PWR	+5 V	out
3	RESET	Manual Push-Button Reset	in
4	PWRSW	Soft Power Button	in
5	KBD	Keyboard Data	in/out
6	KBC	Keyboard Clock	out
7	GND	Ground	—
8	MSC	Mouse Clock	out
9	BAT	Battery Input	in
10	MSD	Mouse Data	in/out

Facing the connector pins, the pinout is:

9	7	5	3	1
BAT	**GND**	**KBD**	**RESET**	**SPKR+**
MSD	**MSC**	**KBC**	**PWRSW**	**PWR**
10	8	6	4	2

Speaker

A speaker output is available on pins 1 and 2 of the multi-function connector. These outputs are controlled by a transistor to supply 0.1 W of power to an external speaker. The external speaker should have 8 Ω impedance and be connected between pins 1 and 2.

Keyboard

A PS/2 compatible keyboard can be connected to the multi-function connector. Usually PC keyboards come with a cable ending with a 5-pin male PS/2 connector. Table 9 lists the relationship between the multi-function connector pins and a standard PS/2 keyboard connector.

Table 9 Keyboard Connector Pins (CN5)

Pin	Signal	Function	PS/2
5	KBD	Keyboard Data	1
6	KBC	Keyboard Clock	5
7	GND	Ground	3
2	PWR	Keyboard Power (+5 V)	4

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.

Mouse

A PS/2 compatible mouse can be connected to the multi-function connector. Table 10 lists the relationship between the multi-function connector pins and a standard PS/2 mouse connector.

Table 10 Mouse Connector Pins (CN5)

Pin	Signal	Function	PS/2
10	MSD	Mouse Data	1
8	MSC	Mouse Clock	5
7	GND	Ground	3
2	PWR	Keyboard Power (+5 V)	4

System Reset

Pin 3 of the multi-function 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.

Soft Power Button

Pin 4 of the multi-function connector allows connection of an external push-button to send a soft power signal to the system. The push-button should be normally open, and connect to ground when pushed. For more information on the modes of the Soft Power Button, refer to the *Power Management* section in Chapter 4, *Using the cpuModule*.

Battery

Pin 9 of the multi-function connector is the connection for an external backup battery. This battery is used by the cpuModule when system power is removed in order to preserve the date and time in the real time clock.

Connecting a battery is only required to maintain time when power is completely removed from the cpuModule. A battery is not required for board operation.

WARNING *The optional RTC battery input connector (**CN13**) should be left unconnected if the multi-function connector (**CN5**) has a battery connected to pin 9.*

SVGA Video Connector (CN18)

Table 11 provides the pinout of the video connector.

Table 11 SVGA Video Connector (CN18)

Pin	Signal	Function	In/Out
1	VSYNC	Vertical Sync	out
2	HSYNC	Horizontal Sync	out
3	DDCSCL	Monitor Communications Clock	out
4	RED	Red Analog Output	out
5	DDCSDA	Monitor Communications Data	bidirectional
6	GREEN	Green Analog Output	out
7	PWR	+5 V	out
8	BLUE	Blue Analog Output	out
9	GND	Ground	out
10	GND	Ground	out

Facing the connector pins of the SVGA Video connector (**CN18**), the pinout is:

9	7	5	3	1
GND	**PWR**	**DDCSDA**	**DDCSCL**	**VSYNC**
GND	**BLUE**	**GREEN**	**RED**	**HSYNC**
10	8	6	4	2

The following table lists the supported video resolutions.

Table 12 SVGA Video Resolutions

Resolution	Colors	Refresh Rates
640 x 480	256, 64k, 16M, 4T	60, 70, 72, 75, 85, 90, 100 Hz
800 x 600	256, 64k, 16M, 4T	60, 70, 72, 75, 85, 90, 100 Hz
1024 x 768	256, 64k, 16M, 4T	60, 70, 72, 75, 85, 90, 100 Hz
1152 x 864	256, 64k, 16M, 4T	60, 70, 72, 75, 85, 90, 100 Hz
1280 x 1024	256, 64k, 16M, 4T	60, 70, 72, 75, 85, 90, 100 Hz
1600 x 1200	256, 64k, 16M, 4T	60, 70, 72, 75, 85, 90, 100 Hz
1920 x 1440	256, 64k, 16M, 4T	60, 70, 72, 75, 85 Hz

EIDE Connector (CN10)

The EIDE connector is a 44-pin, 2 mm connector that can connect to a variety of EIDE or IDE devices. The connector provides all signals and power needed to use a 2.5-inch form factor (laptop) hard drive. Also, the first 40 pins of the connector provide all of the signals needed to interface to a 3.5-inch or 5-inch form factor hard drive, CD-ROM drive, or other EIDE device. The larger form factors use a 40-pin, 0.1 inch spacing connector, so an adapter cable or adapter board is needed to connect to **CN10**.

Table 13 EIDE Connector (CN10)[1]

Pin	Signal	Pin	Signal
1	RESET#	2	GND
3	DD7	4	DD8
5	DD6	6	DD9
7	DD5	8	DD10
9	DD4	10	DD11
11	DD3	12	DD12
13	DD2	14	DD13
15	DD1	16	DD14
17	DD0	18	DD15
19	GND	20	N/C
21	DMARQ	22	GND
23	DIOW#:STOP	24	GND
25	DIOR#:HDMARDY#:HSTROBE	26	GND
27	IORDY:DDMARDY#:DSTROBE	28	GND
29	DMACK#	30	GND
31	INTRQ	32	N/C
33	DA1	34	PDIAG
35	DA0	36	DA2
37	CS0#	38	CS1#
39	DASP#	40	GND
41	+5 V (logic)	42	+5 V (motor)
43	GND	44	N/C

1. Signals marked with (#) are active low.

Note *An 80-conductor cable should not be used with the EIDE connector (**CN10**) if an ATA/IDE Disk Chip is installed in the cpuModule. For more information, refer to the section titled: IDE Controller Configuration in Chapter 4.*

Note *If an ATA/IDE Disk Chip is installed, you will only be able to use a single external IDE device, configured as a SLAVE.*

Note *If no ATA/IDE Disk Chip is installed on the cpuModule, and one device is connected to the EIDE connector (**CN10**), the device must be configured as master.*

ATA/IDE Disk Chip Socket (U16)

The ATA/IDE Disk Chip socket is a 32-pin socket that supports +3.3V or +5V miniature ATA/IDE flash disk chips. The socket allows a true IDE device to be attached to the board with either a socketed or soldered connection. Such true IDE devices are supported by all major operating systems, and do not require special drivers.

WARNING *The ATA/IDE Disk Chip socket does not support conventional SSD memory devices or devices that install as a BIOS extension (such as the M-Systems DiskOnChip®). If such a device is installed, the cpuModule and device will almost certainly be destroyed.*

Table 14 ATA/IDE Disk Chip Socket (U16)[1]

Pin	Signal	Pin	Signal
1	RESET#	32	VDD[2]
2	D7	31	D8
3	D6	30	D9
4	D5	29	D10
5	D4	28	D11
6	D3	27	D12
7	D2	26	D13
8	D1	25	D14
9	D0	24	D15
10	DMARQ/WP#	23	IOWR#
11	IORD#	22	DMACK/CSEL
12	INTRQ	21	IOCS16#
13	A1	20	PDIAG#
14	A0	19	A2
15	CS1FX#	18	CS3FX#
16	GND	17	DASP#

1. Signals marked with (#) are active low.
2. The hardware default configuration for VDD is +3.3 V, but this pin may also be configured as +5 V. For more information, contact RTD Technical Support.

Installing and Configuring the ATA/IDE Disk Disk Chip

To ensure proper installation and of the ATA/IDE Disk Chip, follow the following configuration steps. Note that the first few steps must be performed **before installing the Disk Chip**.

1. Before installing the ATA/IDE Disk Chip in the Disk Chip Socket (**U16**), verify that cpuModule is configured for the correct Disk Chip supply voltage. The hardware default configuration is +3.3V. To use a +5 V Disk Chip with cpuModules, contact RTD Technical Support.
2. If an external IDE device is attached to **CN10**, make sure it is jumpered as SLAVE.
3. Next, apply power to the system, and press the delete key repeatedly to enter the BIOS setup screen. Once in the BIOS, specify the following settings:
    a. Enable the cpuModule's IDE controller

b. Specify the IDE mode of the ATA/IDE Disk Chip. For more information on the supported IDE modes, refer to *Configuring the ATA/IDE Disk Chip Socket* section of this manual on page 78.

c. Save the settings in the BIOS setup

4. Remove power from the system.

WARNING *The preceding steps should be performed before installing the Disk Chip in the ATA/IDE Disk Chip Socket. These steps ensure that the system is properly configured for the correct device and supply voltage, so neither the Disk Chip or cpuModule are damaged.*

5. Insert the Disk Chip in the ATA/IDE Disk Chip Socket (**U16**) aligning pin 1 with the square solder pad on the board.
6. Apply power to the system.
7. Re-enter the BIOS and set the boot order of the system accordingly.

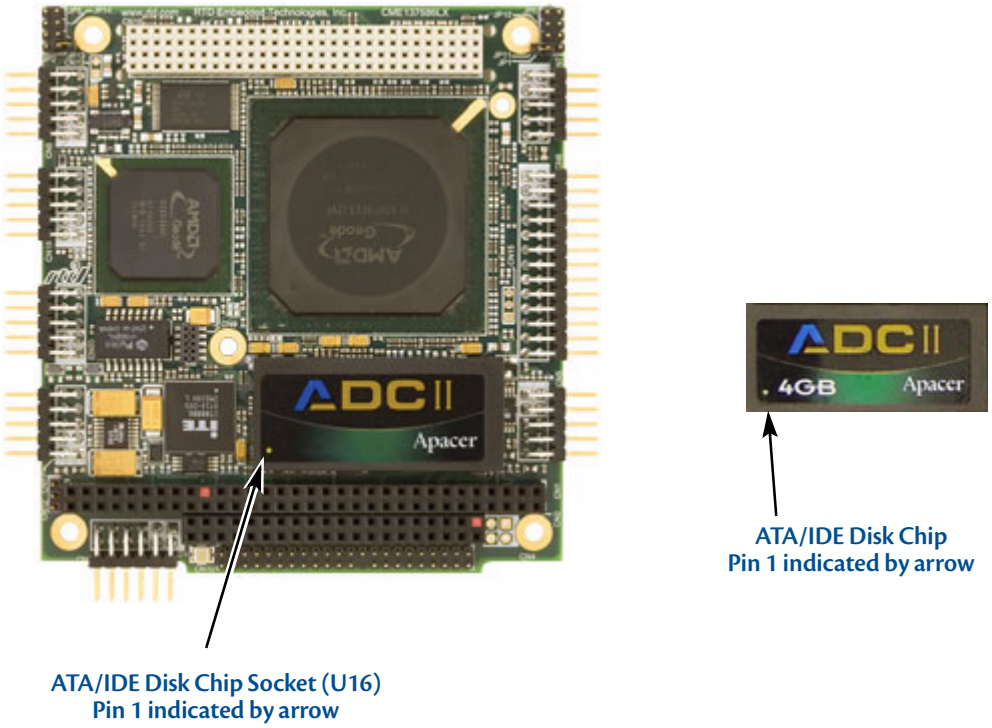


Figure 5 CME137686LX after ATA/IDE Disk Chip Installation

Serial Port 1 (CN7) and Serial Port 2 (CN8)

Serial Port 1 (COM1) is implemented on connector **CN7**, and Serial Port 2 is implemented on connector **CN8**. The serial ports are normally configured as PC compatible full-duplex RS-232 ports, but you may use the BIOS Setup program to reconfigure these ports as half-duplex RS-422 or full-duplex RS-422 or RS-485. If you reconfigure the ports, you must also select the I/O address and corresponding interrupt using Setup. Table 15 provides the available I/O addresses and corresponding interrupts.

Table 15 Serial Port Settings

I/O Address (hex)	IRQ
03F8	IRQ4
02F8	IRQ3
03E8	IRQ4
02E8	IRQ3

Serial Port UART

The serial ports are 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 includes a 16-byte FIFO. The UART also supports non-standard baud rates above 115.2 kbaud.

For more information, refer to *Non-Standard Serial Port Modes* — page 72. Refer to any standard PC-AT hardware reference for the register map of the UART. For more information about programming UARTs, refer to Appendix D.

RS-232 Serial Port (Default)

The default serial port mode is full-duplex RS-232. With this mode enabled, the serial port connectors must be connected to RS-232 compatible devices. Table 16 provides the serial port connector pinout and shows how to connect to an external DB-25 or DB-9 compatible serial connector.

Table 16 Serial Port in RS-232 Mode

Pin	Signal	Function	In/Out	DB-25	DB-9
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	GND	Signal Ground	—	7	5
10	GND	Signal Ground	—	—	—

Facing the serial port's 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

RS-422 or RS-485 Serial Port

You may use Setup to configure the serial ports as RS-422 or RS-485. In this case, you must connect the serial port to an RS-422 or RS-485 compatible device.

When using RS-422 or RS-485 mode, you can use the serial ports 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 *The cpuModule has a 120 Ω termination resistor. Termination is usually necessary on all RS-422 receivers and at the ends of the RS-485 bus.*

Note *If required, the termination for each port can be enabled by BIOS options which appear when the ports are configured for RS-422 or RS-485 modes.*

When using full-duplex (typically in RS-422 mode), connect the ports as shown in Table 17.

Table 17 Full-Duplex Connections

Port 1	Port 2
RXD+	TXD+
TXD+	RXD+
RXD–	TXD–
TXD–	RXD–

When using half-duplex in RS-485 mode, connect the ports as shown in Table 18.

Table 18 Half-Duplex RS-485 Mode

From	To
Port 1 TXD+	Port 1 RXD+
Port 1 TXD–	Port 1 RXD–
Port 1 TXD+	Port 2 RXD+
Port 1 RXD–	Port 2 TXD–

Since the serial pot control signals are unused in RS-422/485 mode, Hardware Handshaking is unavailable. Additionally, the control bits in the UART register for CTS, DTR, DSR, DCD, and RI should be considered *Reserved*. RTS is available, but only in RS-485 mode to enable the transmitters.

RS-422 and RS-485 Mode Pinout

Table 19 provides the serial port connector pinout when RS-422 or RS-485 modes are enabled.

Table 19 Serial Port in RS-422/485 Mode

Pin	Signal	Function	In/Out	DB-9
1	—	Reserved	—	1
2	—	Reserved	—	6
3	RXD–	Receive Data (–)	in	2
4	TXD+	Transmit Data (+)	out	7
5	TXD–	Transmit Data (–)	out	3
6	RXD+	Receive Data (+)	in	8
7	—	Reseved	—	4
8	—	Reseved	—	9
9,10	GND	Signal Ground	out	5

Facing the serial port connector, the pinout is:

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

Note *When using the serial port in RS-485 mode, the serial transmitters are enabled and disabled under software control. The transmitters are enabled by manipulating the Request To Send (RTS*) signal of the 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

Note *For more information on the serial port registers, including the MCR, refer to the Serial Port Programming reference in Appendix D.*

Dual Serial Port Modes

The serial port connectors can be configured as dual serial ports in the BIOS. The mapping between the connectors and COM port numbers is shown in Table 20. The supported combinations of serial port modes are listed in Table 21, which includes a reference to the corresponding connector pinout.

Table 20 Dual Serial Port Connections

Connector	COM A	COM B
CN7	COM 1	COM 3
CN8	COM 2	COM 4

Table 21 Dual Serial Port Modes

COM A	COM B	Pinout Reference
RS-232	RS-232	Table 22
RS-422	RS-232	Table 23
RS-422	RS-422	Table 24
RS-485	RS-232	Table 23
RS-485	RS-485	Table 24

Table 22 COM A (RS-232) and COM B(RS-232)

Pin	Signal	Function	In/Out	DB-9
1	DCD1	COM A- Data Carrier Detect	in	1
2	RXD2	COM B- Receive Data	in	6
3	RXD1	COM A - Receive Data	in	2
4	RTS1	COM A - Request To Send	out	7
5	TXD1	COM A - Transmit Data	out	3
6	CTS1	COM A - Clear To Send	in	8
7	TXD2	COM B - Transmit Data	out	4
8	RI1	COM A - Ring Indicate	in	9
9	GND	Signal Ground	—	5
10	GND	Signal Ground	—	—

Table 23 COM A (RS-422/485) and COM B (RS-232)

Pin	Signal	Function	In/Out	DB-9
1	DCD1	COM A - Data Carrier Detect	in	1
2	RXD2	COM B - Receive Data	in	6
3	RXD1-	COM A - Receive Data (–)	in	2
4	TXD1+	COM A - Transmit Data (+)	out	7
5	TXD1-	COM A - Transmit Data (–)	out	3
6	RXD1+	COM A - Receive Data (+)	in	8
7	TXD2	COM B - Transmit Data	out	4
8	RI1	COM A - Ring Indicate	in	9
9	GND	Signal Ground	—	5
10	GND	Signal Ground	—	—

Table 24 COM A (RS-422/485) and COM B (RS-422/485)

Pin	Signal	Function	In/Out	DB-9
1	RXD2+	COM B - Receive Data (+)	in	1
2	RXD2-	COM B - Receive Data (–)	in	6
3	RXD1-	COM A - Receive Data (–)	in	2
4	TXD1+	COM A - Transmit Data (+)	out	7
5	TXD1-	COM A - Transmit Data (–)	out	3
6	RXD1+	COM A - Receive Data (+)	in	8
7	TXD2-	COM B - Transmit Data (–)	out	4
8	TXD2+	COM B - Transmit Data (+)	out	9
9	GND	Signal Ground	—	5
10	GND	Signal Ground	—	—

multiPort™ (CN6)

RTD's exclusive multiPort can be configured as an Advanced Digital I/O (aDIO™), a parallel port, or a floppy drive. Refer to Chapter 4, *Using the cpuModule*, to configure the multiPort.

multiPort Electrostatic Discharge (ESD) and Undershoot Protection

The multiPort interface provides electrostatic discharge (ESD) protection allowing the aDIO port, parallel port, and floppy port circuits to be protected from electrically charged external objects that may come in contact with the cpuModule.

The ESD protection minimizes susceptibility of the circuitry to ESD from human contact, and is rated to withstand up to 2000V with the Human Body Model (HBM) standardized ESD test. The protected circuitry is also rated to protect against up to 1000V with the Charged Device Model (CDM) standardized ESD test.

In addition to the ESD protection, the circuitry also provides -2V undershoot protection by ensuring that the pins remain in the off state when such voltage levels are connected as inputs to the cpuModule.

For specific electrical characteristics, refer to Table 4 on page 21.

multiPort Configured as an Advanced Digital I/O (aDIO™) Port

The mulitPort connector (**CN6**) can be configured as an aDIO port. aDIO is 16 digital bits configured as 8-bit programmable and 8-bit port programmable I/O, providing any combination of inputs and outputs. Match, event, and strobe interrupt modes mean no more wasting valuable processor time polling digital inputs. Interrupts are generated when the 8-bit programmable digital inputs match a pattern, or on any value change event. Bit masking allows selecting any subgroup of 8 bits. The strobe input latches data into the bit programmable port and generates an interrupt. Refer to *multiPort: Advanced Digital I/O Ports (aDIO™)* on page 73 for information on programming the multiPort.

Table 25 multiPort aDIO Pinout

CN6 Pin	Function	CN6 Pin	Function
1	strobe 0	2	P0-4
3	P1-0	4	P0-5
5	P1-1	6	P0-6
7	P1-2	8	P0-7
9	P1-3	10	strobe 1
11	P1-4	12	GND
13	P1-5	14	GND
15	P1-6	16	GND
17	P1-7	18	GND
19	P0-0	20	GND
21	P0-1	22	GND
23	P0-2	24	GND
25	P0-3	26	+5 V

multiPort Configured as a Parallel Port

The parallel port is available on connector **CN6**. Make sure the multiPort in the BIOS Setup is configured to parallel port. You can use the BIOS Setup to select the parallel port's address and associated interrupt, and choose between its operational modes (SPP, ECP, EPP 1.7, and EPP 1.9).

The pinout of the connector enables a ribbon cable to be connected directly to a DB-25 connector, thus providing a standard 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).*

Table 26 lists the parallel port signals and explains how to connect it to a DB-25 connector to obtain a PC compatible port.

Table 26 multiPort Connector (CN6) as a Parallel Port

CN6 Pin	Signal	Function	In/Out	DB-25
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
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	—	+5 V	—	—

multiPort Configured as a Floppy Drive Controller

The multiPort (**CN6**) can be configured to be a floppy drive controller. This can be configured in the BIOS Setup under the Advanced tab. For more information on configuring the multiPort in the BIOS Setup, refer to page 76

Table 27 shows the pin assignments to connect a floppy drive to the multiPort.

Table 27 multiPort Connector Floppy Pinout (CN6)[1]

CN6 Pin	Function	DB-25	Floppy Drive Pin
1	DS0#	1	14
2	DR0	14	2
3	INDEX#	2	8[2]
4	HDSEL#	15	32
5	TRK0#	3	26[2]
6	DIR#	16	18
7	WRTPRT#	4	28[2]
8	STEP#	17	20
9	RDATA#	5	30[2]
10	GND	18	—
11	DSKCHG	6	34[2]
12	GND	19	odd pins
13	—	7	—
14	GND	20	odd pins
15	MTR0#	8	10
16	GND	21	odd pins
17	—	9	—
18	GND	22	odd pins
19	DS1#	10	12
20	GND	23	odd pins
21	MTR1#	11	16
22	GND	24	odd pins
23	WDATA#	12	22
24	GND	25	odd pins
25	WGATE#	13	24
26	+5 V	—	—

1. Signals marked with (#) are active low.
2. These signals must be pulled to 5V with separate 470 Ohm resistors.

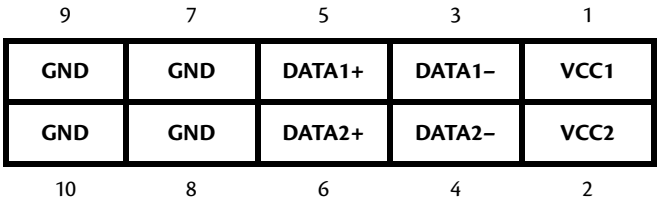
USB 2.0 Connector (CN17)

Two USB 2.0 compliant connectors are available on connector **CN17**. Table 28 provides the pinout of the USB connector.Facing the connector pins, the pinout of CN17 is:

Note *For proper operation at USB 2.0 speeds, be sure to use a cable that is rated for USB 2.0, such as the cable kit supplied by RTD.*

Table 28 USB Connector (CN17)

Pin	Signal	Function	In/Out
1	VCC1	Supply +5 V to USB1	out
2	VCC2	Supply +5 V to USB2	out
3	DATA1–	Bidirectional data line for USB1	in/out
4	DATA2–	Bidirectional data line for USB2	in/out
5	DATA1+	Bidirectional data line for USB1	in/out
6	DATA2+	Bidirectional data line for USB2	in/out
7	GND	Ground	out
8	GND	Ground	out
9	GND	Ground	out
10	GND	Ground	out

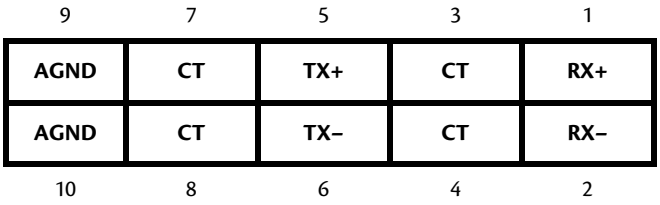


Ethernet (10/100Base-T and -TX) Connector (CN20)

The functionality of the Ethernet port is based on the Intel 82551QM Fast Ethernet PCI controller. Table 29 provides the pinout of the Ethernet connector.

Table 29 Ethernet Connector (CN20)

RJ-45 Pin	10-Pin DIL Pin	Signal	Function	In/Out
3	1	RX+	Receive+	in
6	2	RX–	Receive–	in
1	5	TX+	Transmit+	out
2	6	TX–	Transmit–	out
4	3	CT	Termination connected to pin 4	—
5	4	CT	Termination connected to pin 3	—
7	7	CT	Termination connected to pin 8	—
8	8	CT	Termination connected to pin 7	—
—	9	AGND	Ground	—
—	10	AGND	Ground	—



PC/104 Bus (CN1 and CN2)

Connectors **CN1** and **CN2** carry signals of the PC/104 bus; these signals match definitions of the IEEE P996 standard. Table 30 list the pinouts of the PC/104 bus connectors, with the CME137686LX cpuModule oriented with the PC/104 bus at the nine o' clock position (toward the left).

Table 30 PC/104 (ISA) Bus Connectors (AT and XT Connectors)[1]

CN2		
Pin	Row D	Row 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 V	SD13
17	MASTER#	SD14
18	GND	SD15
19	GND	KEY

CN1		
Pin	Row A	Row B
1	IOCHK#	GND
2	SD7	RESET
3	SD6	+5 V
4	SD5	IRQ9
5	SD4	–5 V
6	SD3	DRQ2
7	SD2	–12 V
8	SD1	SRDY#
9	SD0	+12 V
10	IOCHRDY	KEY
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	BCLK
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	+5 V
30	SA1	OSC
31	SA0	GND
32	GND	GND

1.Signals marked with (#) are active low.

Note *This cpuModule does not support ISA masters or ISA bus refresh.*

Note *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.*

PC/104 Bus Signals

Table 31 provides brief descriptions of the PC/104 bus signals.

Table 31 PC/104 Bus Signals[1]

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 to 7, active low, used to acknowledge DMA requests.
DRQx	I	DMA Request x=0 to 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	—	These locations contain mechanical keying pins to help prevent incorrect connector insertion.
LA[23:17]	O	These signals select a 128 KB window in the 16 MB address space available on the bus.
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 LA[23:17] and SA[19:0].
MEMW#	I/O	This active-low signal indicates a memory write operation. Devices using this signal must decode the address on lines LA[23:17] and SA[19:0].
OSC	O	OSCillator: clock with a 70 ns period and a 50% duty cycle. It is a 14.31818 MHz always presents.
REFRESH#	I	This cpuModule does not support refresh on the ISA bus. This pin is pulled high with a 4.7 kΩ resistor and may be driven by another card in the PC/104 stack.

Table 31 PC/104 Bus Signals[1] (cont'd)

Signal	I/O	Description
RESETDRV	O	This line, active high, is used to reset the devices on the bus, at power-on or after a reset command.
SA[19:0]	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 (SD[15:8]).
SD[15:8]	I/O	Data bits: these are the high-byte data bus lines. SD8 is the least significant bit; SD15 the most significant bit.
SD[7:0]	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, 8.0 MHz 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.

1. Signals marked with (#) are active low.

PC/104 Bus Termination

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

PC/104-*Plus* PCI Bus (CN16)

Connector **CN16** carries the signals of the PC/104-*Plus* PCI bus. These signals match definitions of the PCI Local Bus specification Revision 2.1. Table 32 list the pinouts of the PC/104-*Plus* bus connector.

Table 32 PC/104-*Plus* Bus Signal Assignments[1]

Pin	A	B	C	D
1	GND	Reserved/+5V_STDBY[2]	+5 V	AD00
2	VIO	AD02	AD01	+5 V
3	AD05	GND	AD04	AD03
4	C/BE0#	AD07	GND	AD06
5	GND	AD09	AD08	GND
6	AD11	VIO	AD10	M66EN
7	AD14	AD13	GND	AD12
8	+3.3 V	C/BE1#	AD15	+3.3 V
9	SERR#	GND	Reserved / PSON#[2]	PAR
10	GND	PERR#	+3.3 V	Reserved / PME#[2]
11	STOP#	+3.3 V	LOCK#	GND
12	+3.3 V	TRDY#	GND	DEVSEL#
13	FRAME#	GND	IRDY#	+3.3 V
14	GND	AD16	+3.3 V	C/BE2#
15	AD18	+3.3 V	AD17	GND
16	AD21	AD20	GND	AD19
17	+3.3 V	AD23	AD22	+3.3 V
18	IDSEL0	GND	IDSEL1	IDSEL2
19	AD24	C/BE3#	VIO	IDSEL3
20	GND	AD26	AD25	GND
21	AD29	+5 V	AD28	AD27
22	+5 V	AD30	GND	AD31
23	REQ0#	GND	REQ1#	VIO
24	GND	REQ2#	+5 V	GNT0#
25	GNT1#	VIO	GNT2#	GND
26	+5V	CLK0	GND	CLK1
27	CLK2	+5 V	CLK3	GND
28	GND	INTD#	+5 V	RST#
29	+12 V	INTA#	INTB#	INTC#
30	–12V	REQ3#	GNT3#	GND

1. Signals marked with (#) are active low.
2. Optional signals for ATX power management

PC/104-*Plus* PCI Bus Signals

The following are brief descriptions of the PC/104-*Plus* PCI bus signals.

Address and Data

AD[31:00] — Address and Data are multiplexed. A bus transaction consists of an address cycle followed by one or more data cycles.

C/BE[3:0]# — Bus Command/Byte Enables are multiplexed. During the address cycle, the command is defined. During the Data cycle, they define the byte enables.

PAR — Parity is even on AD[31:00] and C/BE[3:0]# and is required.

Interface Control Pins

FRAME# — Frame is driven by the current master to indicate the start of a transaction and will remain active until the final data cycle.

TRDY# — Target Ready indicates the selected devices ability to complete the current data cycle of the transaction. Both IRDY# and TRDY# must be asserted to terminate a data cycle.

IRDY# — Initiator Ready indicates the master's ability to complete the current data cycle of the transaction.

STOP# — Stop indicates the current selected device is requesting the master to stop the current transaction.

DEVSEL# — Device Select is driven by the target device when its address is decoded.

IDSEL[3:0] — Initialization Device Select is used as a chip-select during configuration.

LOCK# — Lock indicates an operation that may require multiple transactions to complete.

Error Reporting

PERR# — Parity Error is for reporting data parity errors.

SERR# — System Error is for reporting address parity errors.

Arbitration (Bus Masters Only)

REQ[3:0]# — Request indicates to the arbitrator that this device desires use of the bus.

GNT[3:0]# — Grant indicates to the requesting device that access has been granted.

System

CLK — Clock provides timing for all transactions on the PCI bus.

RST# — Reset is used to bring PCI-specific registers to a known state.

Interrupts

INTA# — Interrupt A is used to request Interrupts.

INTB# — Interrupt B is used to request Interrupts only for multi-function devices.

INTC# — Interrupt C is used to request Interrupts only for multi-function devices.

INTD# — Interrupt D is used to request Interrupts only for multi-function devices.

Power Supplies and VIO

+5 V — +5 V supply connected to the PC/104 bus and Auxiliary Power Connector (**CN3**) +5 V supplies. This is the only power supply that is required for board operation.

+12 V — +12 V supply connected to the PC/104 bus and Auxiliary Power Connector (**CN3**) +12 V supplies.

–12 V — –12 V supply connected to the PC/104 bus and Auxiliary Power Connector (**CN3**) –12 V supplies.

+3.3 V — The +3.3 V pins on the PC/104-*Plus* (PCI) connector are connected to the Auxiliary Power Connector (**CN3**).

VIO — This signal is typically the I/O power to the bus drivers on a PCI bus card, or used by the clamp diodes on a PCI bus card. This is always driven by the cpuModule. By default, the signaling level is set to +3.3 V. For information on configuring VIO for +5 V, contact RTD Technical Support.

ATX Power Management Signals

If an ATX power supply is connected to the system, the following signals listed below may be used to wake the system from low power modes. For more information on these signals, refer to the *Power Management* section on page 85.

+5V_STDBY — Some low power modes require that +5 V standby power is applied to the cpuModule during the wake event. This signal is an input to the CPU.

PME# — Power Management Event input

PSON# — This is an active low open-drain output used to turn the power supply on when the system is exiting a low power state.

External Power Management (CN12)

An external power management connector (**CN12**) is available for external devices to wake the system from low power states. Some low power modes require that +5 V standby power is applied to the cpuModule during the wake event.

For more information on power management, including a description of the board's supported wake options, refer to the *Power Management* section on page 85.

Table 33 External Power Management (CN12)

Pin	Signal	Function
1	+5V_STDBY	+5 V standby Power
2	GND	Ground
2	PME#	Power Management Event input

Optional RTC Battery Input (CN13)

The optional RTC battery input is the connection for an external backup battery. This battery is used by the cpuModule when system power is removed in order to preserve the date and time in the real time clock.

Connecting a battery is only required to maintain time when power is completely removed from the cpuModule. A battery is not required for board operation.

Table 34 Optional RTC Battery Input (CN13)

Pin	Signal	Function
1	BAT	RTC Battery Input
2	GND	Ground

WARNING *This optional RTC battery connector (**CN13**) should be left unconnected if the utility port connector (**CN5**) has a battery connected.*

Chapter 4 Using the cpuModule

This chapter provides information for users who wish to develop their own applications programs for the CME137686LX cpuModule.

This chapter includes information on the following topics:

The RTD Enhanced AMI BIOS — page 64

Memory Map — page 67

I/O Address Map — page 68

Using ISA Peripheral Cards — page 70

I/O Address Aliasing — page 71

Non-Standard Serial Port Modes — page 72

multiPort: Advanced Digital I/O Ports (aDIO™) — page 73

multiPort: Parallel Port — page 76

multiPort: Floppy Drive — page 76

Ethernet (10/100Base-T and -TX) — page 76

IDE Controller Configuration — page 78

Real Time Clock Control — page 80

Watchdog Timer Control — page 83

Thermal Management — page 85

Power Management — page 85

EMI Management — page 89

Multi-Color LED — page 90

Features and Settings That Can Affect Boot Time — page 91

System Recovery — page 92

Basic Interrupt Information for Programmers — page 93

The RTD Enhanced AMI BIOS

The RTD Enhanced AMI BIOS is software that interfaces hardware-specific features of the cpuModule to an operating system (OS). 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 OS 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.

Configuring the RTD Enhanced AMI BIOS

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

Entering the BIOS Setup

You can run Setup by rebooting the cpuModule and repeatedly pressing the **Delete** key. When you are finished with Setup, save your changes and exit. The system will automatically reboot

Field Selection

To move between fields in Setup, use the keys listed below.

Table 35 Setup Keys

Key	Function
→, ←, ↓, ↑	Move between fields
+, **–**, **PgUp**, **PgDn**	Selects next/previous values in fields
Enter	Go to the submenu for the field
Esc	To previous menu then to exit menu

Main Menu Setup Fields

The following is a list of Main Menu Setup fields.

Table 36 Main Menu Setup Fields

Field	Active Keys	Selections
Main	Press **Enter** to select	Access system information such as BIOS version, EPLD version, and CMOS time and date settings
Advanced	Press **Enter** to select	Setup advanced cpuModule features
PCIPnP	Press **Enter** to select	Set PnP and PCI options and control system resources
Boot	Press **Enter** to select	Set the system boot sequence
Security	Press **Enter** to select	Setup the supervisor and user access passwords or enable boot sector virus protection
Power	Press **Enter** to select	Control power management settings, including power supply type, and system wake functions
Health	Press **Enter** to select	Monitor the cpuModule temperature
Exit	Press **Enter** to select	Save or discard changes and exit the BIOS, or load the default BIOS settings

Note *Future BIOS versions may have slightly different setup menus and options.*

Power On Self Test (POST) Codes

Each POST Code represents a series of events that take place in a system during the POST. If the POST fails during a particular POST Code, the system will not boot as expected.

The BIOS uses I/O port 80h to store the active POST Code. A POST Code board is a tool that is used to display the POST Codes on I/O port 80h. This is usually accomplished with two 7-segment LEDs. Such a board is useful for debugging a system that is unable to boot.

Booting to Boot Block Flash with Fail Safe Boot ROM

Note *Boards are shipped with Fail Safe Boot ROM enabled. When Fail Safe Boot ROM is enabled, the system will boot to it exclusively.*

The Fail Safe Boot ROM is a minimal build of ROM-DOS™ located inside a surface-mounted Boot Block Flash chip. Boot Block Flash is a write-protected flash device that contains the BIOS and extra room where the Fail Safe Boot ROM is stored. Additionally, Fail Safe Boot ROM is an emergency interface accessible by an external computer. The ROM DISK contains utilities for remote access to the system's disk drives. Due to the size of the flash chip, Fail Safe Boot ROM contains an abbreviated selection of the ROM-DOS™ utilities; however, the complete ROM-DOS™ is contained on a CD shipped with the cpuModule.

The purpose of the Fail Safe Boot ROM is to make the cpuModule bootable upon receipt. The Fail Safe Boot ROM can be used as an indicator of the module's functionality when booting problems arise with another operating system. This test can be accomplished by enabling the Fail Safe Boot ROM in the Boot section of the BIOS Setup Utility. Enabling this option forces the cpuModule to boot to Fail Safe Boot ROM.

To boot to the Fail Safe Boot ROM, install jumper **JP5**, and apply power to the system.

Note *If power is applied to the system while **JP5** is installed, the multi-color LED will turn magenta (purple).*

Memory Map

The CME137686LX is a 32-bit processor with a 4GB address space (0x00000000 through 0xFFFFFFFF). The first one megabyte of memory follows the standard x86 PC architecture, which is listed below.

WARNING *Installing a peripheral that conflicts with any of the addresses listed below may prevent the system from functioning!*

Table 37 Memory Addresses Reserved for the CME137686LX cpuModule

Memory Address Range	Device
0x00000 - 0x003FF	Interrupt Vector Table
0x00400 - 0x00500	BIOS Data Area
0x00501 - 0x9FBFF	Available Memory
0x9FC00 - 0x9FFFF	Extended BIOS Area
0xA0000 - 0xBFFFF	EGA/VGA Video Buffer
0xC0000 - 0xC7FFF	Geode LX VGA BIOS
0xC8000 - 0xC9FFF	PXE Firmware (*address may vary*) [1]
0xD0000 - 0xDFFFF	Available for Memory Mapped ISA Boards
0xE0000 - 0xFFFFF	BIOS

1. The location of the PXE Firmware is dynamically allocated by the BIOS at boot time. It uses 8KB, and is typically located at 0xC8000. However, this can change based on BIOS settings and other devices in the system. If Ethernet is disabled, the PXE Firmware will be removed from the memory map.

Memory addresses beyond the first megabyte can be accessed either via Protected Mode or a memory manager such as EMS. Consult your Operating System programming documentation for more information.

Note *When installing a memory-mapped ISA peripheral, make sure that the PCI-to-ISA Bridge is configured correctly. Refer to Using ISA Peripheral Cards on page 70.*

Note *The cpuModule has onboard PCI devices (e.g. Ethernet) that may claim I/O resources not listed above. Memory mapped PCI devices are typically located above 80000000h to prevent conflicts with legacy ISA devices. Since PCI devices are dynamically configured at boot time, their memory addresses are not fixed.*

I/O Address Map

The table below indicates the I/O regions that are used by the onboard hardware of the CME137686LX. This tables represents a default (or near default) cpuModule configuration. Any I/O addresses not listed can be considered available for use by peripheral boards.

WARNING *Installing a peripheral that conflicts with any of the addresses listed below will prevent the system from functioning!*

Depending on your cpuModule configuration, the list of used I/O addresses may change slightly. In particular, devices indicated by an asterisk (*) are user-configurable, and may be enabled/disabled/modified from the BIOS setup.

Table 38 I/O Addresses Reserved for the CME137686LX cpuModule

Address Range	Device
0x0000 - 0x000F	8237 DMA Controller #1
0x0020 - 0x0021	8259 Programmable Interrupt Controller #1
0x002E - 0x002F	Super I/O Configuration
0x0040 - 0x0043	8253 Timer/Counter
0x0060 - 0x0064	8742 Keyboard/Mouse Controller
0x0070 - 0x0071	Real Time Clock and CMOS
0x0072 - 0x0073	High RTC and CMOS
0x0081 - 0x008F	8237 DMA Low Page Registers
0x0092	System Control Port A
0x00A0 - 0x00A1	8259 Programmable Interrupt Controller #2
0x00C0 - 0x00CF	8237 DMA Controller #2
0x00D0 - 0x00DF	8237 DMA Controller #2 (write-only)
0x00F0 - 0x00FF	x87 Math Coprocessor
0x0170 - 0x0177	IDE Controller - Secondary Channel
0x01F0 - 0x01F7	IDE Controller - Primary Channel
0x0200 - 0x0208	Reserved for Geode VSA
0x02E8 - 0x02EF	Serial Port - COM4 *
0x02F8 - 0x02FF	Serial Port - COM2 *
0x0376	IDE Controller - Secondary Channel
0x0378 - 0x037F	Parallel Port - LPT1
0X03B0 - 0x03BA	VGA Controller
0x03C0 - 0x03DF	VGA Controller
0x03E8 - 0x03EF	Serial Port - COM3 *
0x03F0 - 0x03F5	Floppy Controller *
0x03F6	IDE Controller - Primary Channel
0x03F7	Floppy Controller *
0x03F8 - 0x03FF	Serial Port - COM1 *
0x0450 - 0x0454	RTD aDIO *
0x0455 - 0x0464	RTD Control Logic
0x0465	RTD Watchdog Timer *
0x0466 - 0x046F	RTD Control Logic
0x0480 - 0x048F	8237 DMA High Page Registers
0x04D0	8259 PIC #1 Level/Edge
0x04D1	8259 PIC #2 Level/Edge

Table 38 I/O Addresses Reserved for the CME137686LX cpuModule

Address Range	Device
0x0900 - 0x097F	Super I/O Runtime
0x0CF8 - 0x0CFF	PCI Configuration Space Index/Data
0x2000 - 0x200F	ISA Bridge DDMA Slave Channel 0 *
0x2100 - 0x210F	ISA Bridge DDMA Slave Channel 1 *
0x2200 - 0x220F	ISA Bridge DDMA Slave Channel 2 *
0x2300 - 0x230F	ISA Bridge DDMA Slave Channel 3 *
0x2500 - 0x250F	ISA Bridge DDMA Slave Channel 5 *
0x2600 - 0x260F	ISA Bridge DDMA Slave Channel 6 *
0x2700 - 0x270F	ISA Bridge DDMA Slave Channel 7 *
0x6000 - 0x6008	SMBus
0x6100 - 0x6200	Geode CS5536 Chipset GPIO and ICFs
0x6400 - 0x6440	Geode CS5536 Chipset MFGPTs
0x9000 - 0x9040	Geode CS5536 Chipset PM Support
0x9C00 - 0x9C10	Geode CS5536 Chipset ACPI
0xFFF0 - 0xFFFF	IDE Controller

Note *When installing an I/O-mapped ISA peripheral, make sure that the PCI-to-ISA Bridge is configured correctly. Refer to Using ISA Peripheral Cards on page 70.*

Note *The cpuModule has onboard PCI devices (e.g. Ethernet) that may claim I/O resources not listed above. I/O mapped PCI devices are typically located above 1000h to prevent conflicts with legacy ISA devices. Since PCI devices are dynamically configured at boot time, their I/O addresses can change from boot to boot.*

Using ISA Peripheral Cards

PCI-to-ISA Bridge

The CME137686LX uses an ITE IT8888 PCI-to-ISA bridge to provide ISA bus support (the Geode LX chipset does not directly support the ISA bus). This has the following implications:

- The ISA bus is positively decoded. I/O and Memory addresses must be explicitly reserved for the ISA bus. These can be reserved in the BIOS setup.
- ISA DMA is virtualized using System Management Mode (SMM) and Distributed DMA (DDMA). This enables PC/104 ISA cards that use DMA to function properly, without any modifications to drivers or application software. However, the DDMA channel must be explicitly enabled in the BIOS setup.
- Certain types of ISA devices are not compatible with the CME137686LX:
  - Video Controllers (e.g. CM110, CM112)
  - IDE Controllers (e.g. CMT6107, CMT6104, CMT6118, etc)
  - Floppy Controllers (e.g. CMT6107, CMT6118)

Note *If you do not setup the BIOS properly before you install a PC/104 peripheral card, your system may not function correctly.*

Before Installing a PC/104 Peripheral Card

Before installing a PC/104 peripheral card, be sure to perform the following steps.

- Read the manual for the peripheral card. Determine which I/O and Memory Addresses the card will use (e.g. I/O ports 300h-31Eh)

.

Note *If the card uses aliased I/O windows (e.g. Base Address + 400h), be sure to read the section on I/O Address Aliasing later in this chapter.*

- If the card uses interrupts, determine which IRQ(s) it will use. Configure the card accordingly.
- If the card uses DMA, determine which DMA channel(s) it will use. Configure the card accordingly.
- Boot the CME137686LX and enter the BIOS setup. Configure the BIOS as follows:
  - Under the BIOS screen for PCI-to-ISA Bridge setup, configure the appropriate I/O and memory windows for your peripheral card.
  - Under the BIOS screen for PCI-to-ISA Bridge setup, enable the appropriate DDMA channels for the card.
  - Under the PCIPnP setup, set the IRQs for the card as Reserved.
  - If the card is memory-mapped, under the PCIPnP setup, configure the Reserved Memory Size and Reserved Memory Address options to match the memory window of the card.
  - Press F10 to save your settings.
- Once the cpuModule has been properly configured, you can install the peripheral card.
- After the card is installed, boot the system and run some diagnostic/test software on the card to verify that the module can be accessed properly. Be sure the verify that IRQs and DMA are working correctly.

I/O Address Aliasing

Traditionally, ISA peripheral cards only decode 10 bits of the 16-bit I/O address. This allows a peripheral card to be addressable at its base address (e.g. 300h), and also at 400h aliases of this base address (e.g. 700h, B00h, F00h, etc).

Some ISA peripheral cards take advantage of these aliased I/O regions to implement additional functionality. Consult the documentation for your peripheral card to determine whether or not this is the case.

For compatibility with aliased peripheral cards, the PCI-to-ISA bridge on the CME137686LX will automatically decode any aliases of assigned I/O windows. If an I/O decode window is enabled at 300h, the bridge will also automatically decode addresses at 700h, B00h, F00h, etc.

In some cases, these aliased I/O decode windows may conflict with onboard devices. If so, it may be necessary to disable the I/O Address Aliasing feature. This feature may be disabled in the BIOS setup.

Consult the Used I/O Addresses section of the manual for a list of I/O regions that are in use by onboard devices. If your peripheral card aligns with a 400h alias of these onboard devices, you will need to disable the I/O Address Aliasing.

Note *If you do disable I/O Address Aliasing, and you have a card that depends on this functionality, you must explicitly configure all of the necessary I/O Decode Windows in the BIOS setup.*

Note *If you have a peripheral card that conflicts with onboard system resources, it may prevent the system from booting. Make sure you resolve any I/O conflicts before you install the peripheral module!*

Non-Standard Serial Port Modes

It is possible to change the input clock rate for the UARTs of the cpuModule by selecting the Serial Port Baud Rates option in the Serial Port Configuration menu of the BIOS Setup. Changing the option from **Normal** to **Non-Standard** will allow the serial port to operate at higher speeds.

This transforms bits [7:5] of the Divisor Latch High Byte of the UART into selections for alternate clock rates. The following table describes the bit operations and the resulting divide-by-one baud rate:

Table 39 Divisor Latch High and Low Bytes

Divisor Latch High Byte				Divisor Latch Low Byte	Baud Rate	% Error
Bit 7	Bit 6	Bit 5	Bits [4:0]			
0	0	0	0x00	0x01	115,200	0.16
1	0	0	0x00	0x01	460,800	0.16
1	1	0	0x00	0x01	921,600	0.16
0	0	1	0x00	0x01	1,500,000	0.16

To achieve non-standard baud rates, divide the baud rate you require by one of the non-standard divisors (460,800, 921,600, and 1,500,000). If the result is a whole number, substitute that value for the Divisor Latch Low Byte. For example, to achieve a baud rate of 750,000, select the Divisor Latch High Byte for 1,500,000 and set the Divisor Latch Low Byte to 2.

Note *The signaling mode of the output will limit the highest baud rate achievable. For RS-232 mode the maximum suggested baud rate is 230,400. For 422/485 modes the maximum is 1,500,000.*

Note *When using the non-standard high speed serial port modes, it is highly recommended to use hardware flow control, whenever possible.*

multiPort: Advanced Digital I/O Ports (aDIO™)

Ensure that the BIOS setup has the multiPort set to aDIO mode. This board supports 16 bits of TTL/CMOS compatible digital I/O (TTL signaling). These I/O lines are grouped into two ports, Port 0 and Port 1. Port 0 is bit programmable; Port 1 is byte programmable. Port 0 supports RTD's Advanced Digital Interrupt modes. The three modes are strobe, match and event. Strobe mode generates an interrupt and latches Port 0 when the strobe input transitions from low to high. Match mode generates an interrupt when an 8-bit pattern is received in parallel that matches the match mask register. Event mode generates an interrupt when a change occurs on any bit. In any mode, masking can be used to monitor selected lines.

When the CPU boots, all digital I/O lines are programmed as inputs, meaning that the digital I/O line's initial state is undetermined. If the digital I/O lines must power up to a known state, an external 10 kΩ resistor must be added to pull the line high or low.

The 8-bit control read/write registers for the digital I/O lines are located from I/O address 450h to 453h. These registers are written to zero upon power up. From 450h to 453h, the name of these registers are **Port 0 data**, **Port 1 data**, **Multi-Function**, and **DIO-Control** register.

The 8-bit control read/write registers for the digital I/O lines are located from I/O address 450h to 454h. These registers are written to zero upon power up. From 450h to 454h, the name of these registers are **Port 0 data**, **Port 1 data**, **Multi-Function**, **DIO-Control**, and **Wake Control** register.

Note *RTD provides drivers that support the aDIO interface on popular operating systems. RTD recommends using these drivers instead of accessing the registers directly.*

Digital I/O Register Set

Table 40 Port 0 Data I/O Address 450h

D7	D6	D5	D4	D3	D2	D1	D0
P0.7	P0.6	P0.5	P0.4	P0.3	P0.2	P0.1	P0.0

Port 0 Data register is a read/write bit direction programmable register. A particular bit can be set to input or output. A read of an input bit returns the value of port 0. A read of an output bit returns the last value written to Port 0. A write to an output bit sends that value to port 0.

Table 41 Port 1 Data I/O Address 451h

D7	D6	D5	D4	D3	D2	D1	D0
P1.7	P1.6	P1.5	P1.4	P1.3	P1.2	P1.1	P1.0

Port 1 Data register is a read/write byte direction programmable register. A read on this register when it is programmed to input will read the value at the aDIO connector. A write on this register when it is programmed as output will write the value to the aDIO connector. A read on this register when it is set to output will read the last value sent to the aDIO connector.

Table 42 Multi-Function I/O Address 452h

D7	D6	D5	D4	D3	D2	D1	D0

The multi-function register is a read/write register whose contents are set by the DIO-Control register. See the DIO-Control register description for a description of this register.

Table 43 DIO-Control I/O Address 453h—Read Access

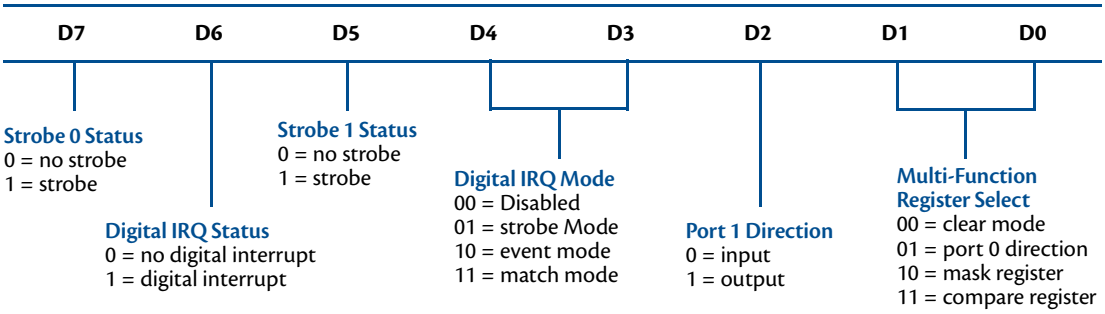


Table 44 DIO-Control I/O Address 453h—Write Access

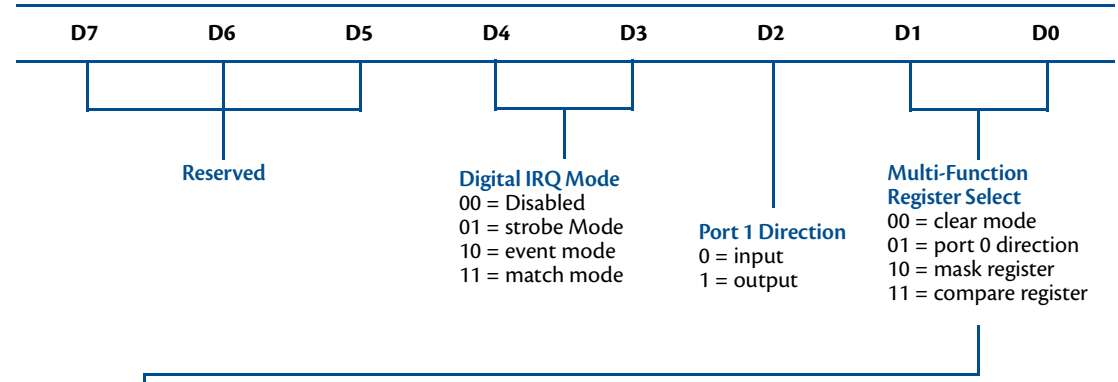


Table 45 Multi-Function at Address 452h[1]

read/write	00 clear	X	X	X	X	X	X	X	X
0 in, 1 out	01 Port 0 direction	I/O	I/O	I/O	I/O	I/O	I/O	I/O	I/O
0 no mask, 1 mask	10 DIO mask	M7	M6	M5	M4	M3	M2	M1	M0
read/write	11 compare	C7	C6	C5	C4	C3	C2	C1	C0

1. Contents based on bits D0 and D1 of DIO-Control.

Clear Register:

A read to this register Clears the IRQs and a write to this register sets the DIO-Compare, DIO- Mask, DIO-Control, Port 1, and Port 0 to zeros. A write to this register is used to clear the board.

Port 0 Direction Register:

Writing a zero to a bit in this register makes the corresponding pin of the aDIO connector an input. Writing a one to a bit in this register makes the corresponding pin of the aDIO connector an output.

Mask Register:

Writing a zero to a bit in this register will not mask off the corresponding bit in the DIO-Compare register. Writing a one to a bit in this register masks off the corresponding bit in the DIO-Compare register. When all bits are masked off the aDIOs comparator is disabled. This condition means Event and Match mode will not generate an interrupt. This register is used by Event and Match modes.

Compare Register:

A Read/Write register used for Match Mode. Bit values in this register that are not masked off are compared against the value on Port 0. A Match or Event causes bit 6 of DIO-Control to be set and if the aDIO is in Advanced interrupt mode, the Match or Event causes an interrupt.

Table 46 Interrupt Mask Enable 454h

D7	D6	D5	D4	D3	D2	D1	D0
Reserved						Int Mask 1 = Interrupt is masked 0=Interrupt is enabled	Reserved

Interrupts

In order to use an interrupt with aDIO, the interrupt must first be selected in the BIOS setup utility under **Advanced, I/O Devices, aDIO Configuration, aDIO Interrupt**. The Digital I/O can use interrupts 3, 5, 6, 7, 10, 11, and 12. The interrupt must also be reserved so that is it not assigned to PCI devices. To reserve the interrupt, enter the BIOS under **PCIPnP** and change the interrupt you wish to use to "Reserved." Then, select the appropriate interrupt mode in the DIO Control register. Also, verify that the Int Mask bit is cleared in the Wake Control register

Advanced Digital Interrupts

There are three Advanced Digital Interrupt modes available. These three modes are Event, Match, and Strobe. The use of these three modes is to monitor state changes at the aDIO connector. Interrupts are enabled by writing to the **Digital IRQ Mode** field in the **DIO-Control** register.

Event Mode

When this mode is enabled, Port 0 is latched into the DIO-Compare register at 8.33 MHz. The aDIO circuitry includes deglitching logic. The deglitching requires pulses on Port 0 to be at least 240 ns in width. As long as changes are present longer than that, the event is guaranteed to register. Pulses as small as 120 ns can register as an event, but they must occur between the rising and falling edge of the 8.33 MHz clock. To enter Event mode, set bits [4:3] of the DIO-Control register to "10".

Match Mode

When this mode is enabled, Port 0 is latched into the DIO-Compare register at 8.33 MHz. The aDIO circuitry includes deglitching logic. The deglitching requires pulses on Port 0 to be at least 120 ns in width. As long as changes are present longer than that, the match is guaranteed to register. Pulses as small as 60 ns can register as a match, but they must occur between the rising and falling edge of the 8.33 MHz clock. To enter Match mode, set bits [4:3] of the DIO-Control register to "11".

Note *Make sure bits [4:3] are set BEFORE writing the DIO-Compare register. If you do not set them first, the contents of the DIO-Compare register could be lost because the Event mode latches in Port 0 into the DIO-Compare register.*

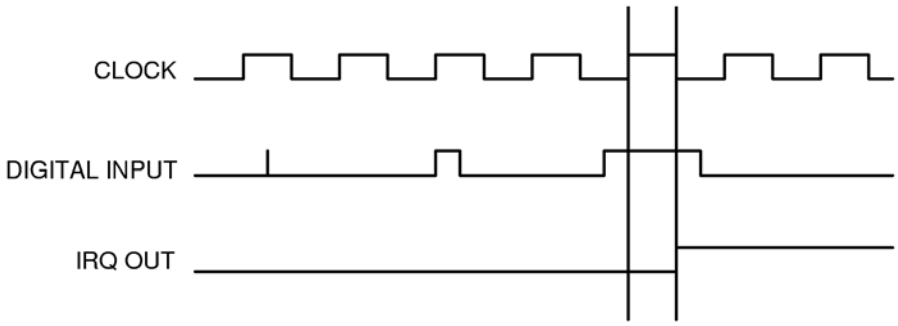


Figure 6 aDIO Match Mode

Strobe Mode

Another interrupt mode supported by aDIO is Strobe mode. This allows the strobe pin of the DIO connector to trigger an interrupt. A low to high transition on the strobe pin will cause an interrupt request. The request will remain high until the Clear Register is read from. Additionally, the Compare Register latched in the value at Port 0 when the Strobe pin made a low to high transition. No further strobes will be available until a read of the Compare Register is made. You must read the Compare Register, and then clear interrupts so that the latched value in the compare register is not lost. To enter Strobe mode, set bits [4:3] of the DIO-Control register to "01".

multiPort: Parallel Port

The parallel port may be operated in SPP (output-only), EPP (bidirectional), and ECP (extended capabilities) modes. The mode may be selected in the BIOS.

To configure the multiPort as a parallel port in the BIOS, enter the BIOS, and follow the steps below:

1. Set the multiPort mode to "Parallel Port" in BIOS setup (it may also be configured as a floppy controller interface)
2. When a new "Parallel Port Configuration" appears, select it and configure the parallel port base address, parallel port mode, and IRQ

multiPort: Floppy Drive

The multiPort connector can be configured as a floppy drive. To utilize the floppy controller, the multiPort mode must be first be set to Floppy Drive in the BIOS. The complete process for setting up the multiPort as a floppy drive is described below.

1. With the system powered off, attach a floppy drive with an adapter board to **CN6**.
2. Power on the system and enter the BIOS setup screen by pressing the delete key as the system boots.
3. Under the Floppy Configuration section of the BIOS setup, set Floppy Drive A to **Enabled**.
4. Set the multiPort to **Floppy** in the BIOS Setup.
5. If booting to the floppy drive is required, set the first boot device in the boot sequence to floppy drive

When the floppy drive is enabled, a special cable and adapter board is required. For more information about this cable kit, refer to the *Cable Kits and Accessories* section in page 15.

Ethernet (10/100Base-T and -TX)

To use the onboard 10/100 Ethernet controller, Ethernet must first be enabled in the BIOS.

Status LEDs

- **Link**: When Ethernet is enabled, the Ethernet link LED will blink to indicate Ethernet connectivity if an active connection is present.
- **Speed:** This green LED will turn on to indicate a 100 Mbit connection. A 10Mbit connection exists If the speed LED is off while Ethernet is enabled and an active link is present.

IDE Controller Configuration

The CPU's onboard EIDE connector (**CN10**) supports several different drive speed modes, which are BIOS configurable. Supported drive modes will depend on whether a 40-conductor or 80-conductor cable is connecting the EIDE device. The modes and cable detection schemes described below may be set in the BIOS Setup. Similarly, the ATA/IDE Disk Chip socket (**U16**) is BIOS configurable.

Configuring the ATA/IDE Disk Chip Socket

The cpuModule was designed to be used in embedded computing applications. In such environments, rotating media like hard disks and floppy disks are not very desirable. It is possible to eliminate rotating storage devices by placing your operating system and application software into the cpuModule's ATA/IDE Disk Chip socket.

To allow read and write access to the device, the IDE controller must be enabled in the BIOS. When a device is installed in the socket, it will always appear as a master on the cpuModule's IDE controller. During the boot sequence, the BIOS will autodetect the mode of the device within the socket.

WARNING *Older versions of the BIOS do not support autodection of the disk chip device mode. For these configurations, it is recommended to first configure the IDE controller and device mode in the BIOS setup.*

The ATA/IDE Disk Chip socket supports three different types of disk chips:

Table 47 ATA/IDE Disk Chip Types

Disk Chip Type	Maximum ATA Mode	Max Transfer Rate	Reduced CPU Overhead	Supports Write Protection
UDMA Mode	UDMA Mode-4	66.7 MB/s	Yes	No
MWDMA Mode	MWDMA Mode-2	16.7 MB/s	Yes	No
PIO Mode	PIO Mode-4	16.7 MB/s	No	Yes

Note *UDMA mode devices are not supported by older PCB revisions.*

WARNING *If a device is connected to the IDE connector (**CN10**), it is not recommended to use a UDMA mode disk chip in modes higher than Ultra DMA mode-2.*

Using the ATA/IDE Disk Chip and EIDE

The CME137686LX has one IDE channel. Therefore, if an ATA/IDE Disk Chip (**U16**) is installed in the cpuModule, only one additional device may be connected to the EIDE connector (**CN10**). The cable used under this circumstance should be a 40 conductor cable. On 80-conductor cable, a connection exists between the two device headers which allows one device to know when the other has completed initialization. This special initialization connection does not extend for the full length of the cable, and therefore does not have any connection to the cpuModule's EIDE connector (**CN10**). Therefore, using an 80-conductor cable to connect an IDE device to the EIDE connector (**CN10**) is not recommended when an ATA/IDE Disk Chip is installed.

The ATA/IDE Disk Chip will be the master device. The peripheral device connected to **CN10** must be the slave.

Cable Modes

There are two types of cables that may be used for connecting drives to the EIDE connector: 40 conductor cables or 80 conductor cables. Depending on the cable used, different drive speeds are supported. A 40 conductor cable can be used for speeds up to UDMA Mode 2 (Ultra ATA/33).

In order to use drive speeds faster than UDMA Mode 2 (Ultra ATA/33), an 80 conductor cable is required. The BIOS can be configured to detect the presence of an 80 conductor cable. The 80 conductor cable adds a ground wire between each signal, and uses standard 40 pin connectors.

Note *An 80-conductor cable should not be used if an ATA/IDE Disk Chip is installed in the cpuModule. For more information, refer to the section titled: Using the ATA/IDE Disk Chip and EIDE*

Cable Detection

Every time the cpuModule is powered on or a hardware reset is issued, the BIOS will automatically determine if a 40 conductor or 80 conductor cable is being used to connect a device to **CN10**. The user selectable cable detection modes are described below.

Device and Host Mode

For this method, there is a capacitor on the CBLID pin at the CPU, and a pull-up at the hard drive. The CPU sends a command to the hard drive to drive the CBLID pin low, and then release it. The CPU then waits a certain amount of time, and instructs the hard drive to read the status of the CBLID pin. If an 80 conductor cable is attached, the CBLID signal is not connected between the CPU and the hard drive, and the hard drive will read the signal as a logic high. If a 40 conductor cable is attached, the CBLID pin is connected between the CPU and the hard drive, the capacitor delays the signal from going high, and the hard drive reads it as a logic low.

Host Determination of Cable Type

For this method of detection, the CPU reads the CPBLID pin, which determines if a 40-conductor or 80-conductor cable is connected between the CPU and device. An 80-conductor cable has this signal grounded at the CPU end, and not connected to the hard drive. A 40-conductor cable connects the CBLID signal to the hard drive, where it is pulled to a logic high.

Device Detect

For device detect mode, the CPU issues a command to the device, which tells the CPU the fastest drive speed mode it can use. The CPU then sets the transfer mode to the fastest speed supported by the device.

WARNING *When this cable detection method is enabled, the highest transfer speed supported by the device will be used regardless of whether a 40-conductor or 80-conductor cable is used. If the device speed does not match the cable, data corruption and unexpected behaviors may occur. This mode should not be selected unless the user knows the cable type and the modes supported by the connected EIDE device.*

Legacy Mode IDE

The onboard EIDE controller operates in Legacy Mode. The controller will be fixed to use two interrupts: IRQs 14 and 15. Similarly, the I/O address of the controller will be fixed in the system. When in Legacy Mode, only a primary and secondary channel may be used in the system.

Real Time Clock Control

Overview

The cpuModule is equipped with a Real Time Clock (RTC) which provides system date and time functions. When the cpuModule is turned off, a battery must be attached to the utility connector to provide power to the RTC. Without power, the RTC will lose the date/time information when the system is turned off.

The RTC also provides an "alarm" function. This may be used to generate an interrupt at a particular time and day. This feature is commonly used to wake up the system from Sleep/Standby to run a scheduled task (defragment the hard drive, back up files, etc.). For more information on power management, including a description of the board's supported wake options, refer to the *Power Management* section on page 85.

In addition to the date/time/alarm functions, the RTC contains several bytes of battery-backed RAM, commonly called CMOS memory. In a typical desktop PC, the CMOS memory is used by the BIOS to store user settings. This RTD cpuModule uses an EEPROM to store user BIOS settings. To preserve compatibility with traditional PCs, the RTD Enhanced BIOS also mirrors the user settings from flash in CMOS. Therefore, the contents of CMOS may be overwritten at boot time, and should be treated as "read only".

Accessing the RTC Registers

You may access the RTC date/time and CMOS memory using the Index and Data Registers located 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. Valid values are 00h to 7Fh.
- Address 71h is the Data register. It contains the contents of the register pointed to by the Index.

To read/write an RTC register, you must first set the Index register with the register number, and then read/write the Data register.

A list of key RTC registers is shown in Table 48 below:

Table 48 Real Time Clock Registers

Registers (hex)	Registers (decimal)	Function
00h	0	RTC Seconds
01h	1	RTC Alarm Seconds
02h	2	RTC Minutes
03h	3	RTC Alarm Minutes
04h	4	RTC Hours
05h	5	RTC Alarm Hours
06h	6	RTC Day of Week
07h	7	RTC Day of Month
08h	8	RTC Month
09h	9	RTC Year

Table 48 Real Time Clock Registers

Registers (hex)	Registers (decimal)	Function
0Ah	10	RTC Status Register A • **Bit 7:** RTC Update In Progress (Read Only) - RTC registers should not be accessed when this bit is high. • **Bits 6-4:** Divider for 32.768 KHz input (should always be 010) • **Bits 3-0:** Rate select for periodic interrupt.
0Bh	11	RTC Status Register B • **Bit 7:** Inhibit Update - When high, the RTC is prevented from updating. • **Bit 6:** Periodic Interrupt Enable - When high, the RTC IRQ will be asserted by the periodic interrupt. • **Bit 5:** Alarm Interrupt Enable - When high, the RTC IRQ will be asserted when the current time matches the alarm time. • **Bit 4:** Update Ended Interrupt Enable - When high, the RTC IRQ will be asserted every time the RTC updates (once per second). • **Bit 3:** Square Wave Enable - Not used. • **Bit 2:** Data Mode - Sets the data format of the RTC clock/calendar registers (0=BCD, 1=binary). This is typically set to BCD mode. • **Bit 1:** Hours Byte Format - Sets the hour byte to 12 or 24 hour time (0=12 hour, 1=24 hour). This is typically set to 24 hour mode. • **Bit 0:** Daylight Savings Enable - When high, the RTC will automatically update itself for Daylight Savings Time. It is recommended to leave this bit low and let the operating system manage time zones and DST.
0Ch	12	RTC Status Register C (Read Only) • **Bit 7:** IRQ Flag - Indicates that the Real Time Clock IRQ is asserted. Goes high whenever one of the enabled interrupt conditions in Register B occurs. • **Bit 6:** Periodic Flag • **Bit 5:** Alarm Flag • **Bit 4:** Update Ended Flag • **Bit 3-0:** Reserved Reading this register will also clear any of set flag (IRQ, Periodic, Alarm, Update Ended). Note that even if the interrupt source is not enabled in Register B, the flags in Register C bits 4, 5, and 6 may still be set.
0Dh	13	RTC Status Register D • **Bit 7:** Valid Time/Date (always reads 1) • **Bit 6-0:** Reserved
32h	50	RTC Century
7Eh	126	RTC Alarm Day of Month
7Fh	127	RTC Alarm Month

Note *RTC registers that are not listed above are used by the BIOS and should be considered "Reserved". Altering the contents of any unlisted RTC register may interfere with the operation of your cpuModule. The specific uses of the unlisted RTC registers will depend on the BIOS version loaded on the cpuModule. Contact RTD's technical support for more information.*

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. The watchdog timer consists of a counter, a reset generator, and an interrupt generator. When the counter reaches the interrupt time-out, it can generate an interrupt. When the counter reaches the reset time-out, the system is reset. The counter is "refreshed," or set back to zero by reading from a specific register. The watchdog can also be put into an "inactive" state, in which no resets or interrupts are generated.

The ability to generate an interrupt allows the application to gracefully recover from a bad state. For example, consider a system that has a reset time-out of 2 seconds, interrupt time-out of 1 second, and the watchdog timer is refreshed every 0.5 seconds. If something goes wrong, an interrupt is generated. The Interrupt service routine then attempts to restart the application software. If it is successful, the application is restarted in much less time than a full reboot would require. If it is not successful, the system is rebooted.

Due to system latency, it is recommended that the Watchdog be refreshed at about half of the reset time-out period, or half of the interrupt time-out period, whichever is applicable.

Register Description

The Advanced Watchdog Timer has a Setup Register and a Runtime Register. The Setup Register is set by the BIOS, and can be adjusted by entering the BIOS Setup Utility, and going to "Advanced/Miscellaneous Configuration". The Setup Register may also be read by the driver to determine if the Watchdog is enabled, and the interrupt and base address that it is using.

Note *Enabling the watchdog timer in the BIOS does not actually arm it. The watchdog timer can be armed by accessing I/O address 465h, as explained below.*

Table 49 Advanced Watchdog Setup Register 46Dh

D7	D6	D5	D4	D3	D2	D1	D0
Reserved				WDT_IRQ Select Interrupt for WDT 000=Disabled 001 = IRQ5 010 = IRQ7 011 = IRQ10 100 = IRQ11 101 = IRQ12 110 = IRQ3 111 = IRQ6			Reg_Enable 0=Watchdog timer is disabled and Runtime Register will not appear in I/O map 1=Watchdog Timer is enabled. Runtime Register will appear in I/O map

Table 50 Advanced Watchdog Runtime Register 465h

D7	D6	D5	D4	D3	D2	D1	D0
WDT_Active 0=Watchdog timer is disabled. 1=Watchdog is armed and can generate resets and interrupts.	WDT_IRQ_Ena 0=Watchdog interrupt is disabled. 1=Watchdog interrupt is enabled.	Reserved		WDT_IRQ_Time Select Interrupt time for WDT 00=0.25s 01 = 0.50s 10 = 0.75s 11 = 1.00s		WDT_RST_Time Select Reset time for WDT 00=1.55-2.10s 01 = 0.50s 10 = 0.75s 11 = 1.00s	

Reading the Runtime Register also refreshes the watchdog timer.

Thermal Management

The cpuModule has several thermal features which can be used to monitor and control the board's temperature when extreme operating conditions are prevalent.

Board Temperature

The CPU and PCB temperature are displayed in the *Thermal* section of the BIOS setup.

Note *The CPU and PCB temperatures displayed in the BIOS are approximate and should not be used to validate a cooling solution.*

Further Temperature Reduction

The cpuModule's temperature is directly related to power consumption. Reducing the power consumption of the CPU will have an effect on the CPU's temperature. Suggested methods for reducing the CPU's power consumption can be found in the *Power Management* section on page 85.

Power Management

The CME137686LX cpuModule supports various powering mechanisms which allow the cpuModule to monitor power consumption and temperature, and achieve minimal power consumption states. These unique features include thermal monitoring as well as low power modes including APM and ACPI configurations. Various wake options are also available to resume normal system power.

Advanced Power Management (APM)

Legacy Advanced Power Management (APM) options such as setting suspend and standby timeout intervals, can be configured in the BIOS on the cpuModule.

Advanced Configuration and Power Interface (ACPI)

The cpuModule supports several different ACPI low power modes, including the S1, S3, S4, and S5 sleeping states. The BIOS setup utility provides an option to select between S1 and S3 as the Standby state. Sleep modes S4 and S5 are setup by the operating system.

The cpuModule's ACPI suspend modes are described below

- **S1 (Power on Suspend):** The S1 low power state consumes the most power of all supported ACPI sleep modes. In this mode, the CPU stops executing instructions, but power to the CPU and RAM is maintained.
- **S3 (Suspend to RAM):** Everything in the system is powered off except for the system memory. When the system wakes from this mode, operating systems allow applications to resume where they left off, as the state of the application is preserved in memory.
- **S4 (Hibernate):** When the system enters this state, the operating system will save the current state of applications and relevant data to disk, thus allowing the system RAM to be powered down.
- **S5 (Soft-Off):** The system is in a soft off state, and must be rebooted when it wakes.

Power Button Modes

The soft power button input of the utility port connector (**CN5**) can be configured by the operating system as a suspend button (transition to S1 or S3) or as soft power button (transition to S5). Consult your operating system documentation for information on how to configure it. The power button will always cause a transition to S5 if pressed for 4 seconds or longer, without interaction from the operating system.

Low-Power Wake Options

While the soft power button input on the utility power connector (**CN5**) may be used to enter a low power sleep state, it may also be used to wake the system.

The reset button input, also on the utility power connector (**CN5**), may be configured as a power button to wake this system. This is especially useful in a chasis which has access to the reste button, but the power button is not accessable. The settings to setup the behavior of the reset button input can be found in the BIOS setup.

The only hardware mechanism capable of wake from S3 and S4 is the power button input of the utility port connector (**CN5**). All other hardware wake mechanisms only support wake from S1. A list of the supported ACPI wake mechanisms is below.

Table 51 Supported ACPI Wake Mechanisms

Wake Mechanism	S1	S3	S4	S5
Wake from PS/2 Keyboard	Y	—	—	—
Wake from PS/2 Mouse	Y	—	—	—
Wake from USB	Y	—	—	—
Wake from RTC Timeout	Y	—	—	—
Wake from Ethernet PME	Y	—	—	—
Wake from aDIO	Y	—	—	—
Wake from External PME (**CN12**)	Y	—	—	—
Power Button Input (**CN5**)	Y	Y	Y	Y

AT vs. ATX Power Supplies

Both AT and ATX power supplies may be used with the CME137686LX cpuModule, however AT power supplies do not provide any standby power to the cpuModule. When an AT power supply is used to power the system, low power modes that require a standby power to wake the system will not be fully supported.

ATX power supplies do provide a standby power, thus allowing the system to utilize all low power modes supported by the hardware. When an ATX supply is used to power the cpuModule, lower power modes can be achieved. During these low power modes, the standby power from the ATX power supply provides power to a small circuit on the CPU, which is used to watch for a system wake event.

ATX Power Supply Signals

The auxiliary power connector (**CN3**) provides two ATX style signals., +5V Standby and PSON#. The +5V Standby rail is used to power certain parts of the cpuModule when the main power supply is turned off, i.e. during Suspend-to-RAM (S3), Hibernate (S4), or Soft-Off (S5) power modes. The PSON# signal is an active low open-drain output that signals the power supply to turn on. Use of these signals allows the power consumption to drop to below 1W during standby modes, and still enable any of the wake events.

Note *The ATX signals, +5V Standby and PSON# are also available on the PC/104-Plus connector (**CN16**).*

Reducing Power Consumption

In addition to the CPU's low power modes, power consumption can further be reduced by making some modifications to the BIOS setup. When the following features are modified, the CPU's power consumption will decreases:

- **CPU Speed:** Setting the processor to its minimum speed in the BIOS will reduce power consumption
- **Memory Speed:** Changing the DDR DRAM clock frequency will reduce power consumption, however memory performance will also be reduced.
- **Ethernet:** Can be disabled in the BIOS
- **Serial Ports:** Can be disabled in the BIOS
- **Multi-Color LED:** Can be disabled in the BIOS

EMI Management

Electromagnetic interference (EMI) is an undesired disturbance that affects an electrical circuit and is due to radiation emitted from nearby electrical components or signals with rapidly changing level transitions. Effects from a noisy source can sometimes be seen on signals that transition infrequently or on analog inputs where any slight deviation on an input affects the quality of data read by the system. To improve both the levels of onboard radiation and simplify the design of offboard filtering circuits, RTD has designed the CME137686LX cpuModule with synchronized power supplies as well as components that support optional spread spectrum modulation.

Power Supply Switching Synchronization

In a system that has multiple high speed signals operating at different frequencies, unwanted frequencies called beat frequencies can appear in the frequency domain. Beat frequencies are a mathematical combination of two different frequencies. To reduce the impact of system-level beat frequencies, the cpuModule's power supplies have been synchronized to one switching frequency. This reduces the possibility of noise during data acquisition by having fewer combinations of different frequencies in the system.

Synchronizing the power supplies also inherently simplifies EMI filtering. A data acquisition system can eliminate EMI by filtering known frequencies that are causing unwanted signal interference. Filtering the EMI source in a system with more high frequencies is more challenging than filtering on a system with fewer high frequencies.

Spread Spectrum

Another method to manage EMI is to reduce the peaks of onboard frequencies. One method of doing this is by enabling spread spectrum. Components that support spread spectrum have the ability to reduce the intensity of an onboard frequency by dithering, or lowering the frequency's amplitude by modulating the frequency of a signal over a wider frequency range.

The clock generator on the CME137686LX optionally supports spread spectrum. This feature can be enabled or disabled in the BIOS. When enabled, the frequencies of the onboard PCI clocks and the PCI clocks on the PC/104-*Plus* connector (**CN16**) are modulated.

Similarly, the onboard power supplies support spread spectrum, which may also be enabled or disabled in the BIOS setup.

Multi-Color LED

The CME137686LX has a Multi-Color LED located beside the EIDE connector (**CN10**) which can be enabled or disabled in the BIOS setup screen. The color of the LED indicates the status of the board, as shown in Table 52.

Table 52 LED Colors

Color	Description
Green	Normal Operation
Blue	On Board IDE Activity
Red	cpuModule is in reset
Yellow (Red + Green)	cpuModule is in Standby
Magenta (Blue + Red)	JP5 is installed
White (R+G+B)	cpuModule is approaching thermal limit[1]

1. The LED will remain White until the system is shut down.

The LED can also be controlled manually by writing to I/O Port 46Ch, as shown in Table 53 and Table 54.

Table 53 Multi-Color LED I/O Address 46Ch

D7	D6	D5	D4	D3	D2	D1	D0
Reserved	**Reserved**	**Reserved**	**Reserved**	**Reserved**	**Multi-Color LED**		

Note *When writing to I/O Port 46Ch, only the lower three bits of the register should be modified. Modifying the upper bits will effect other onboard devices.*

The following table lists the color displayed and the value written.

Table 54 Manual LED Colors

I/O Port 46Ch Value	Color
0x00	Automatic (see Table 52)
0x08	Off[1]
0x09	Blue
0x0A	Green
0x0B	Cyan (Green + Blue)
0x0C	Red
0x0D	Magenta (Red + Blue)
0x0E	Yellow (Red + Green)
0x0F	White (Red + Green + Blue)

1. Disabling the LED will reduce system power consumption.

Features and Settings That Can Affect Boot Time

The boot time of a system is dependent upon numerous system settings as well as devices attached to a system. This section addresses some devices and settings that can increase or decrease a system's boot time.

Quick Boot

The BIOS contains a Quick Boot option that minimizes the boot time of the system. Quick Boot eliminates the exhaustive tests that are performed during Power On Self Test (POST) while maintaining the functionality of the board. By enabling the Quick Boot feature, your system can achieve 5-second boot times.

Add-On Cards With BIOS Extensions

Some add-on cards have an integrated BIOS extension. The most common examples are SCSI controllers and network cards with boot ROMs. During POST, the BIOS executes the card's extension code. This extension code is third-party code, which is beyond RTD's control. The BIOS extension will most likely increase the boot time. Exactly how much it increases boot time will depend on the particular card and firmware version.

VGA Controller

VGA controllers have a VGA BIOS that must be initialized during POST. It can take some time to initialize the VGA BIOS. Exactly how long will depend on the particular VGA controller and BIOS version.

Hard Drive Type

During IDE initialization, each IDE device must be probed. Some devices take longer to probe. 2.5-inch hard drives tend to take longer than 3.5-inch ones, because they spin at a lower RPM.

Monitor Type

Some monitors take a while to power on. Desktop flat panels are especially slow. This does not affect the actual boot time of the CPU. However, the CPU may boot before the monitor powers on.

NVRAM Updates

System configuration data is stored in the onboard NVRAM. When the system configuration changes, this information must be updated. If an update is necessary, it will happen at the end of POST (the BIOS will display an "Updating NVRAM..." message). The NVRAM update takes a few seconds and increases the boot time. Once the NVRAM is updated, boot times will return to normal.

NVRAM updates only happen when the system configuration changes. They do not happen spuriously. They are usually triggered by adding or removing a PCI device from a stack. Updates can also be triggered by altering the Plug-n-Play configuration of the BIOS.

Boot Device Order

The BIOS contains a list of devices to try booting from. If you wish to boot to a particular device (for example, a hard drive), make sure that it is first in the boot order. This will speed up boot times.

System Recovery

Loading Default BIOS Settings

The default BIOS can be restored either by using the "Load Defaults" option in the BIOS, or by installing jumper **JP5** (see Figure on page 99). In most cases, the easiest way to load default settings is by setting them in the BIOS. For other unique cases, jumper **JP5** provides an alternative method of restoring the BIOS settings.

To restore the default BIOS settings with jumper **JP5**, follow the procedure below.

1. Remove power from the system.
2. Install **JP5**.
3. Apply power to the system. The cpuModule will then load its default settings. Note that the multi-color LED will be magenta (purple) if power is applied while **JP5** is installed.
4. Reboot and press **Delete** to enter BIOS Setup.
5. Save the BIOS settings and exit, allowing the system to boot to the FSBR.
6. The next time the system is powered, the BIOS Setup will be configured to use the default settings.

Booting to the Fail Safe Boot ROM (FSBR)

If your system is in configuration that will not allow it to boot, the Fail Safe Boot ROM is a minimal build of ROM-DOS which can be booted to for system debugging. To boot to the FSBR, follow the instructions below.

1. Reboot the system and press **Delete** to enter BIOS Setup.
2. In the **Boot** menu, select **Bootup Settings Configuration**, and change **RTD Fail Safe Boot** to **Enabled**.
3. Save the BIOS settings and exit.

If you are unable to enter the BIOS Setup, an alternate method is to use **JP5** as described below:

1. Remove power from the system.
2. Install **JP5**. This will force the cpuModule to boot using the default BIOS configuration.
3. Apply power to the system. The cpuModule will then boot to the Fail Safe Boot ROM image. Note that the multi-color LED will be red if power is applied while **JP5** is installed.
4. Press the **Delete** key to enter Setup, or allow the cpuModule to boot to Failsafe

Basic Interrupt Information for Programmers

An interrupt is a subroutine called asynchronously by external hardware (usually an I/O device) during the execution of another application. The CPU halts execution of its current process by saving the system state and next instruction, and then jumps to the interrupt service routine, executes it, loads the saved system state and saved next instruction, and continues execution. Interrupts are good for handling infrequent events such as keyboard activity. Interrupts on this cpuModule are controlled by two Intel 8259-equivalent interrupt controllers containing 13 available interrupt request lines.

What happens when an interrupt occurs?

An IRQx pin on the PC/104 bus makes a low to high transition while the corresponding interrupt mask bit is unmasked and the PIC determines that the IRQ has priority, that is, the PIC interrupts the processor. The current code segment (CS), instruction pointer (IP), and flags are pushed onto the stack. The CPU then reads the 8-bit vector number from the PIC, and a new CS and IP are loaded from a vector—indicated by the vector number—from the interrupt vector table that typically exists in the lowest 1024 bytes of memory. The processor then begins executing instructions located at CS:IP. When the interrupt service routine is completed the CS, IP, and flags that were pushed onto the stack are popped from the stack into their appropriate registers and execution resumes from the point where it was interrupted.

How long does it take to respond to an interrupt?

A DOS system can respond to an interrupt between 6 and 15 µs. A Windows system can take a much longer time when a service routine has been installed by a device driver implemented as a DLL—from 250 to 1500 µs or longer. The time the CPU spends in the interrupt depends on the efficiency of the code in the ISR. These numbers are general guidelines and will fluctuate depending on operating system and version. Minimum time between two IRQ requests is 125 ns per ISA specification.

Hardware Interrupt Request Lines

To allow different peripheral devices to generate interrupts on the same computer, the ISA bus has eight different interrupt request (IRQ) lines. On the ISA bus, a transition from low to high on one of these lines generates an interrupt request, which is handled by the PC's interrupt controller. On the PCI bus, an interrupt request is level-triggered.

The interrupt controller checks to see if interrupts are to be acknowledged from that IRQ and, if another interrupt is already in progress, it decides if the new request should supersede the one in progress or if it has to wait until the one in progress is done. This prioritizing allows an interrupt to be interrupted if the second request has a higher priority. The priority level is based on the number of the IRQ; IRQ0 has the highest priority, IRQ1 is second-highest, and so on through IRQ7, which has the lowest. Many of the IRQs are used by the standard system resources. Therefore, it is important to know which IRQ lines are available in your system for use by the cpuModule.

The CME137686LX cpuModule supports the standard PC Interrupt Request Lines (IRQs) listed below. This table represents a default (or near default) cpuModule configuration. IRQs not in use by hardware on the cpuModule itself are available for use.

WARNING *Installing a peripheral that conflicts with the IRQs of the onboard hardware may prevent the system from functioning!*

Depending on your cpuModule configuration, the list of used IRQs may change. In particular, devices indicated by an asterisk (*) are user-configurable, and may be enabled/disabled/modified from the BIOS setup.

Table 55 Hardware Interrupts on the CME137686LX cpuModule

IRQ	Description
0	System Timer
1	Keyboard
2	Cascade of IRQ 8-15
3	Serial Port (COM2) *
4	Serial Port (COM1) *
5	(*Available*)
6	Floppy Controller *
7	Parallel Port (LPT1) *
8	Real Time Clock
9	(*Available*)[1]
10	(*Available*)
11	(*Available*)
12	PS/2 Mouse *
13	x87 Math Coprocessor
14	IDE Controller (Primary Channel) *
15	(*Available*)[2]

1. May be reserved by the operating system for ACPI. Do not use this IRQ if you are using an ACPI-aware operating system (e.g. Windows XP).
2. If the onboard IDE controller is enabled, this IRQ may not be available. IRQ15 is typically used by the Secondary IDE channel. Some operating systems assume that the onboard IDE controller is dual-channel, and will automatically reserve both IRQ14 and 15.

The cpuModule has onboard PCI devices (e.g. USB, Ethernet) that will claim one or more of the IRQs listed above. The BIOS automatically assigns IRQs to PCI devices at boot time. Since PCI devices are dynamically configured, their IRQs can change from boot to boot.

Note *In some instances, a PCI device will claim an IRQ line that is required by legacy ISA device. A PCI device and an ISA device cannot share the same IRQ. To reserve an IRQ for a legacy device, refer to the PnPPCI configuration screen in the BIOS.*

WARNING *There must be at least one IRQ line free for PCI devices. Using every available IRQ for ISA devices will prevent the system from functioning properly!*

Intel 8259 Programmable Interrupt Controller

The chip responsible for handling interrupt requests in the PC is the Intel 8259 Programmable Interrupt Controller. To use interrupts, you need to know how to read and set the Intel 8259's interrupt mask register (IMR) and how to send the end-of-interrupt (EOI) command to the Intel 8259.

Each bit in the IMR contains the mask status of an IRQ line; bit 0 is for IRQ0, bit 1 is for IRQ1, and so on. If a bit is set (1), then the corresponding IRQ is masked and will not generate an interrupt. If a bit is clear (0), then the corresponding IRQ is unmasked and can generate interrupts. The IMR is programmed through port 21h.

PCI Interrupts

PCI devices can share interrupts. The BIOS or operating system may assign multiple PCI devices to the same IRQ line. Any interrupt service routine (ISR) written for PCI devices must be able to handle shared interrupts. Refer to *Interrupt-Driven PC System Design* (ISBN: 0-929392-50-7) for more information on PCI interrupts.

Writing an Interrupt Service Routine (ISR)

The first step in adding interrupts to your software is to write the ISR. This is the routine that will automatically be executed each time an interrupt request occurs on the specified IRQ. An ISR is different than standard routines that you write. First, on entrance, the processor registers should be pushed onto the stack BEFORE you do anything else. Second, just before exiting your ISR, you must clear the interrupt status flag and write an end-of-interrupt command to the Intel 8259 controller. Finally, when exiting the ISR, in addition to popping all the registers you pushed on entrance, you must use the IRET instruction and not a plain RET. The IRET automatically pops the flags, CS, and IP that were pushed when the interrupt was called.

Most C compilers allow you to identify a procedure (function) as an interrupt type and will automatically add these instructions to your ISR, with one important exception: most compilers do not automatically add the end-of-interrupt command to the procedure; you must do this yourself. Other than this and the few exceptions discussed below, you can write your ISR just like any other routine. It can call other functions and procedures in your program and it can access global data. If you are writing your first ISR, RTD recommends focusing on the basics, such as incrementing a global variable.

Most operating systems have restrictions on what instructions can be called in your ISR. Consult your OS documentation for details on writing your ISR.

Note *A complete explanation of interrupt programming is beyond the scope of this manual. For more information on interrupts, refer to the Appendix.*

Sample Code

RTD's drivers provide examples of ISR's and interrupt handling. Refer to them as working examples. These drivers were shipped with your cpuModule, but they can also be downloaded from RTD's website (www.rtd.com).

Appendix A Hardware Reference

This appendix provides information on CME137686LX cpuModule hardware, including:

Jumper Settings and Locations — page 98

Onboard PCI Devices — page 100

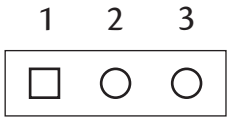
Physical Dimensions — page 101

Jumper Settings and Locations

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

Some jumpers have three pins, allowing three settings:

- Pins 1 and 2 connected (indicated as “1–2”)
- Pins 2 and 3 connected (indicated as “2–3”)
- No pins connected



Some jumpers have two pins, allowing two settings:

- Pins 1 and 2 connected (indicated as “closed”)
- Pins 1 and 2 unconnected (indicated as “open”)

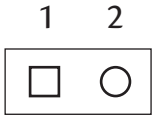
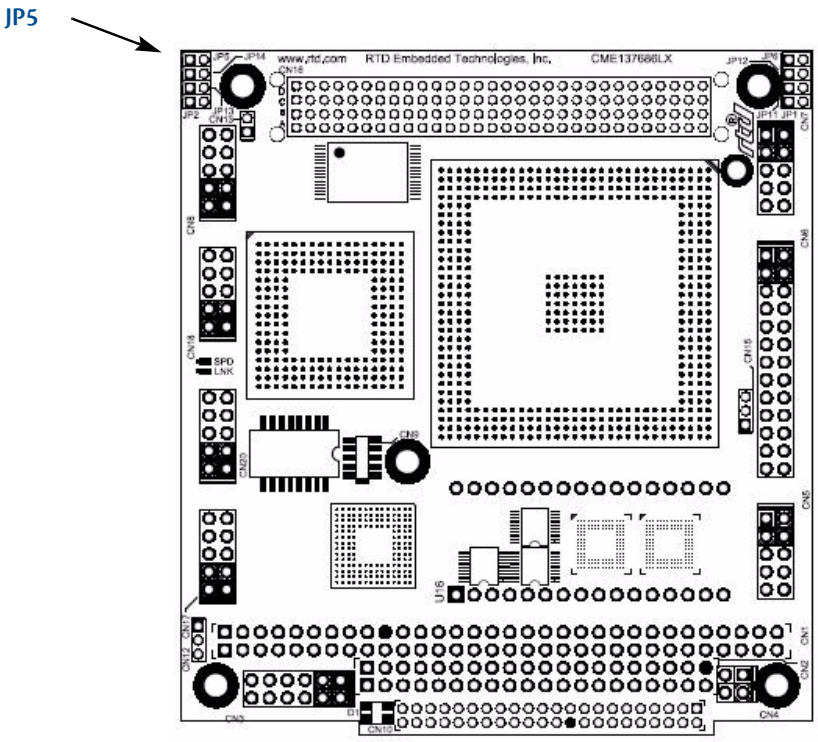


Figure shows the jumper locations that are used to configure the cpuModule. Table 57 lists the jumpers and their settings.



CME137686LX Jumper Locations (top side)

Table 56 CME137686LX Jumpers

Jumper	Pins	Function	Default
JP1	2	Reserved	open
JP2	2	Reserved	open
JP5	2	Install to load the default BIOS settings and boot to Fail Safe (for more information, refer to *System Recovery* — page 92). Note that the multi-color LED will be magenta (purple) if **JP5** is installed.	open
JP6	2	Reserved	open
JP11	2	Reserved	open
JP12	2	Reserved	open
JP13	2	Reserved	open
JP14	2	Reserved	open

Onboard PCI Devices

The CME137686LX cpuModule has several onboard PCI devices, all of which are listed in the table below.

Table 57 Onboard PCI Devices

Device ID	Vendor ID	Bus	Device	Function	Description
1229h	8086h	00h	0Dh	00h	PCI 82551QM Fast Ethernet Controller
2080h	1022h	00h	01h	00h	PCI to Host Bridge
2081h	1022h	00h	01h	01h	PCI VGA Display Controller
2090h	1022h	00h	0Fh	00h	PCI to ISA bridge (CS5536 LPC)
2094h	1022h	00h	0Fh	04h	PCI USB OHCI Controller
2095h	1022h	00h	0Fh	05h	PCI USB EHCI Controller
209Ah	1022h	00h	0Fh	02h	PCI IDE Controller
8888h	1283h	00h	0Ch	00h	PCI to ISA Bridge
-	-				PCI Slot 1
-	-				PCI Slot 2
-	-				PCI Slot 3
-	-				PCI Slot 4

Physical Dimensions

Figure 7 shows the mechanical dimensions of the CME137686LX cpuModule.

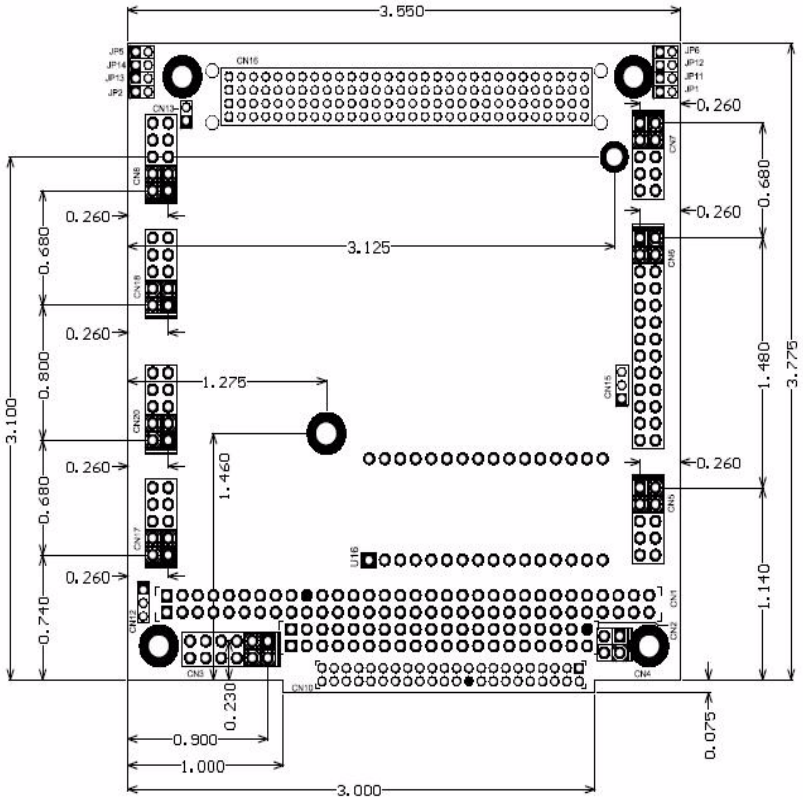


Figure 7 CME137686LX Physical Dimensions (±0.005 inches)

Appendix B Troubleshooting

Many problems you may encounter with operation of your CME137686LX cpuModule are due to common errors. This appendix includes the following sections to help you get your system operating properly.

Common Problems and Solutions — page 104

Troubleshooting a PC/104-Plus System — page 105

How to Obtain Technical Support — page 106

Common Problems and Solutions

Table 58 lists some of the common problems you may encounter while using your CME137686LX cpuModule, and suggests possible solutions.

If you are having problems with your cpuModule, review this table before contacting RTD Technical Support.

Table 58 Troubleshooting

Problem	Cause	Solution
cpuModule "will not boot"	no power or wrong polarity	• check for correct power on the PC/104-*Plus* (PCI) bus connector
	incorrect Setup	• reboot and press **Delete** to run Setup
	defective or misconnected 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
cpuModule keeps rebooting	problem with power supply	• check for correct power on the PC/104-*Plus* (PCI) bus connector
	reset switch is on	• check that the reset button is not pushed in
	watchdog timer is not being serviced quickly enough	• verify that the watchdog timer is being refreshed before it times out
cpuModule will not boot from particular drive or device	device not bootable	• use sys command on drive or reformat 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
erratic operation	excessive bus loading	• reduce number of 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 4.75 VDC will trigger a reset • add bypass caps
	power supply limiting	• examine power supply output with oscilloscope • check for voltage drop below 4.75 VDC when hard drive or floppy drive starts • add bypass caps
	insufficient cabling through power connector	• increase wire gauge to connector • power through bus connectors
	temperature too high	• add fan, processor heatsink, or other cooling device(s) • See *Thermal Management* on page 85
	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

Table 58 Troubleshooting (cont'd)

Problem	Cause	Solution
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
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 side)
will not boot when video card is removed	illegal calls to video controller	• look for software trying to access nonexistent video controller for video, sound, or beep commands
abnormal video	flat panel is enabled	• disable the flat panel in the BIOS
can only use 640 x 480 resolution in Windows	flat panel is enabled	• disable the flat panel in the BIOS
	video drivers not installed	• install the video drivers
will not 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 RS-422 or RS-485 modes	not configured for RS-422/485	• correctly configure serial port in Setup program
COM port will not transmit in RS-422 or RS-485 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 multi-function connector

Troubleshooting a PC/104-*Plus* System

If you have reviewed the preceding table and still cannot isolate the problem with your CME137686LX 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 need to contact technical support.

1. **Simplify the system**. Remove items one at a time and see if one particular item seems to cause the problem.
2. **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 CME137686LX cpuModule, please gather 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 RTD Technical Support:

Phone: 814-234-8087

Fax: 814-234-5218

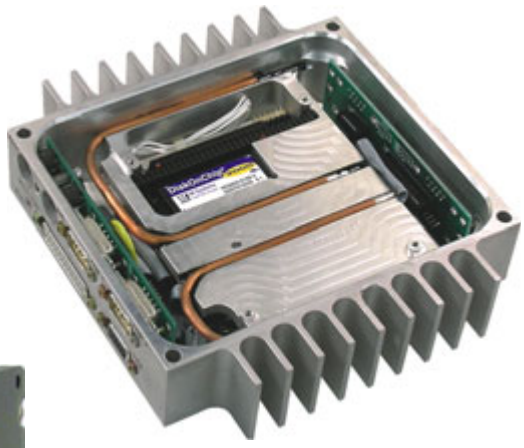
E-mail: techsupport@rtd.com

Appendix C IDAN™ Dimensions and Pinout

cpuModules, like all other RTD PC/PCI-104 modules, can be packaged in Intelligent Data Acquisition Node (IDAN) frames, which are milled aluminum frames with integrated heat sinks and heat pipes for fanless operation. RTD modules installed in IDAN frames are called building blocks. IDAN building blocks maintain the simple but rugged stacking concept of PC/104 and PC/104-*Plus*. Each RTD module is mounted in its own IDAN frame and all I/O connections are brought to the walls of each frame using standard PC connectors. No connections are made from module to module internal to the system other than through the PC/104 and PC/104-*Plus* buses, enabling quick interchangeability and system expansion without hours of rewiring and board redesign.

The CME137686LX cpuModule can also be purchased as part of a custom-built RTD HiDAN™ or HiDAN*plus*™ High Reliability Intelligent Data Acquisition Node. This appendix provides the dimensions and pinouts of the CME137686LX installed in an IDAN frame. Contact RTD for more information on high reliability IDAN, HiDAN, and HiDAN*plus* PC/PCI-104 systems.

IDAN—Adhering to the PC/104 stacking concept, IDAN allows you to build a customized system with any combination of RTD modules.



IDAN Heat Pipes—Advanced heat pipe technology maximizes heat transfer to heat sink fins.

HiDAN*plus*—Integrating the modularity of IDAN with the ruggedization of HiDAN, HiDAN*plus* enables connectors on all system frames, with signals running between frames through a dedicated stack-through raceway.

IDAN Dimensions

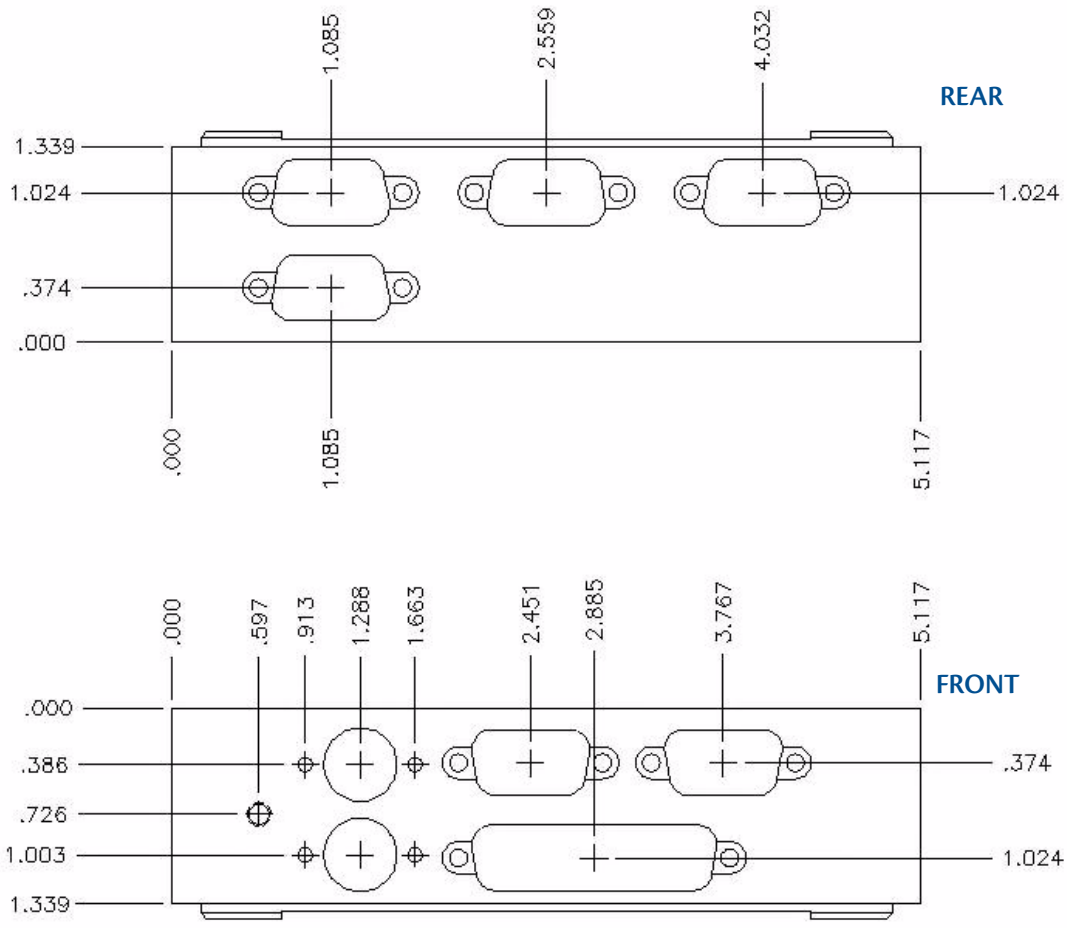


Figure 8 IDAN-CME137686LX Dimensions

IDAN Connectors

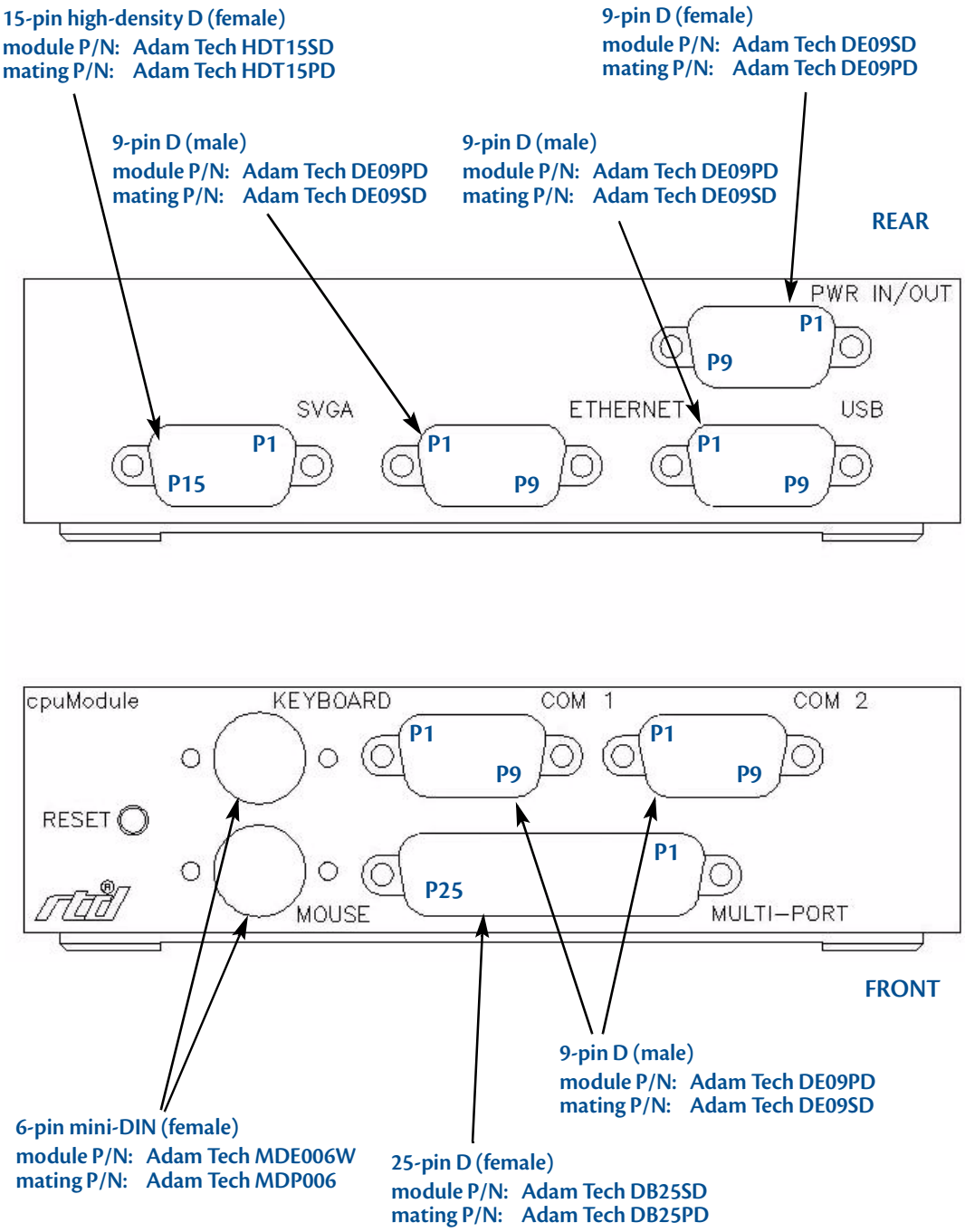


Figure 9 IDAN-CME137686LX Connectors

Table 59 PS/2 Mouse — 6-Pin mini-DIN Connector (female)

IDAN Pin #	Signal	Function
1	MDAT	Mouse Data
2	Reserved	—
3	GND	Ground
4	+5 V	+5 Volts
5	MCLK	Mouse Clock
6	Reserved	—

Table 60 Keyboard — 6-Pin mini-DIN Connector (female)

IDAN Pin #	Signal	Function
1	KDAT	Keyboard Data
2	Reserved	—
3	GND	Ground
4	+5 V	+5 V
5	KCLK	Keyboard Clock
6	Reserved	—

Table 61 COM1/COM2 (RS-232) — 9-Pin D Connector (male)

IDAN Pin #	Signal	Function	Mode
1	DCD	Data Carrier Detect	Input
2	RXD	Receive Data	Input
3	TXD	Transmit Data	Output
4	DTR	Data Terminal Ready	Output
5	GND	Ground	—
6	DSR	Data Set Ready	Input
7	RTS	Request To Send	Output
8	CTS	Clear To Send	Input
9	RI	Ring Indicator	Input

Table 62 COM1/COM2 (RS-422/485) — 9-Pin D Connector (male)

IDAN Pin #	Signal	Function	Mode
1	Reserved	—	—
2	RXD–	Receive Data –	Input
3	TXD–	Transmit Data –	Output
4	Reserved	—	—
5	GND	Ground	—
6	Reserved	—	—
7	TXD+	Transmit Data +	Output
8	RXD+	Receive Data +	Input
9	Reserved	—	—

Table 63 COM A (RS-232) and COM B(RS-232)

IDAN Pin #	Signal	Function	In/Out	CPU Pin #
1	DCD1	COM A- Data Carrier Detect	Input	1
6	RXD2	COM B- Receive Data	Input	2
2	RXD1	COM A - Receive Data	Input	3
7	RTS1	COM A - Request To Send	Output	4
3	TXD1	COM A - Transmit Data	Output	5
8	CTS1	COM A - Clear To Send	Input	6
4	TXD2	COM B - Transmit Data	Output	7
9	RI1	COM A - Ring Indicate	Input	8
5	GND	Signal Ground	—	9
—	GND	Signal Ground	—	10

Table 64 COM A (RS-422/485) and COM B (RS-232)

IDAN Pin #	Signal	Function	In/Out	CPU Pin #
1	DCD1	COM A - Data Carrier Detect	Input	1
6	RXD2	COM B - Receive Data	Input	2
2	RXD1-	COM A - Receive Data (–)	Input	3
7	TXD1+	COM A - Transmit Data (+)	Output	4
3	TXD1-	COM A - Transmit Data (–)	Output	5
8	RXD1+	COM A - Receive Data (+)	Input	6
4	TXD2	COM B - Transmit Data	Output	7
9	RI1	COM A - Ring Indicate	Input	8
5	GND	Signal Ground	—	9
—	GND	Signal Ground	—	10

Table 65 COM A (RS-422/485) and COM B (RS-422/485)

IDAN Pin #	Signal	Function	In/Out	CPU Pin #
1	RXD2+	COM B - Receive Data (+)	Input	1
6	RXD2-	COM B - Receive Data (–)	Input	2
2	RXD1-	COM A - Receive Data (–)	Input	3
7	TXD1+	COM A - Transmit Data (+)	Output	4
3	TXD1-	COM A - Transmit Data (–)	Output	5
8	RXD1+	COM A - Receive Data (+)	Input	6
4	TXD2-	COM B - Transmit Data (–)	Output	7
9	TXD2+	COM B - Transmit Data (+)	Output	8
5	GND	Signal Ground	—	9
—	GND	Signal Ground	—	10

Table 66 multiPort — 25-Pin D Connector (female)

IDAN Pin #	aDIO Port	Parallel Port	Floppy Port	CPU Pin #
1	strobe 0	STB	—	1
2	P1-0	PD0	INDEX#	3
3	P1-1	PD1	TRK0#	5
4	P1-2	PD2	WRTPRT#	7
5	P1-3	PD3	RDATA#	9
6	P1-4	PD4	DSKCHG	11
7	P1-5	PD5	—	13
8	P1-6	PD6	—	15
9	P1-7	PD7	—	17
10	P0-0	ACK	DS1#	19
11	P0-1	BSY	MTR#	21
12	P0-2	PE	WDATA#	23
13	P0-3	SLCT	WGATE#	25
14	P0-4	AFD	DR0#	2
15	P0-5	ERR	HDSEL#	4
16	P0-6	INIT	DIR#	6
17	P0-7	SLIN	STEP#	8
18	strobe 1	GND	GND	10
19	GND	GND	GND	12
20	GND	GND	GND	14
21	GND	GND	GND	16
22	GND	GND	GND	18
23	GND	GND	GND	20
24	GND	GND	GND	22
25	GND	GND	GND	24

Table 67 SVGA — 15-Pin High Density D Connector (female)

IDAN Pin #	Signal	Function	CPU Pin #
1	Red	Red Analog Output	4
2	Green	Green Analog Output	6
3	Blue	Blue Analog Output	8
4	Reserved	Reserved	—
5	GND	Ground	9
6	GND	Ground	9
7	GND	Ground	9
8	GND	Ground	10

Table 67 SVGA — 15-Pin High Density D Connector (female)

IDAN Pin #	Signal	Function	CPU Pin #
9	+5 V	+ 5 Volts	7
10	GND	Ground	10
11	Reserved	Reserved	—
12	DDC Data	Monitor data	5
13	HSYNC	Horizontal Sync	2
14	VSYNC	Vertical Sync	1
15	DDC CLK	Monitor Clock	3

Table 68 USB — 9-Pin D Connector (male)

IDAN Pin #	Signal	Function	Mode
1	VCC1	+5 V to USB1	output
2	Data USB1–	USB1 Data–	input/output
3	Data USB1+	USB1 Data+	input/output
4	GND	Ground	—
5	GND	Ground	—
6	VCC2	+5 V to USB2	output
7	Data USB2–	USB2 Data–	input/output
8	Data USB2+	USB2 Data+	input/output
9	GND	Ground	—

Table 69 Ethernet — 9-Pin D Connector (male)

IDAN Pin #	10Base-T Adapter Pin #	Signal	CPU Pin #
1	3	Receive +	1
2	4	Reserved	3
3	1	Transmit +	5
4	7	Reserved	7
5	—	Ground	9
6	6	Receive -	2
7	5	Reserved	4
8	2	Transmit -	6
9	8	Reserved	8

Table 70 Power — 9-Pin D Connector (female)

IDAN Pin #	Signal
1	+5 V

Table 70 Power — 9-Pin D Connector (female)

IDAN Pin #	Signal
2	Ground
3	+12 V
4	Ground
5	-12 V
6	+5 V
7	Ground
8	Reserved
9	Reserved

Appendix D Additional Information

Application Notes

RTD offers many application notes that provide assistance with the unique feature set of the CME137686LX cpuModule. For the latest application notes, refer to the RTD website.

Drivers and Example Programs

To obtain the latest versions of drivers and example programs for this cpuModule, refer to the RTD website.

Interrupt Programming

For more information about interrupts and writing interrupt service routines, refer to the following book:

Interrupt-Driven PC System Design
by Joseph McGivern
ISBN: 0929392507

Serial Port Programming

For more information about programming serial port UARTs, consult the following book:

Serial Communications Developer's Guide
by Mark Nielson
ISBN: 0764545701

PC/104 and PC/104-*Plus* Specifications

A copy of the latest PC/104 and PC/104-*Plus* specifications can be found on the webpage for the PC/104 Embedded Consortium:

http://www.pc104.org

Appendix E Limited Warranty

RTD Embedded Technologies, 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 RTD Embedded Technologies, Inc. This warranty is limited to the original purchaser of product and is not transferable.

During the one year warranty period, RTD Embedded Technologies 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 RTD Embedded Technologies. All replaced parts and products become the property of RTD Embedded Technologies. Before returning any product for repair, customers are required to contact the factory for a Return Material Authorization 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 RTD Embedded Technologies, “acts of god” or other contingencies beyond the control of RTD Embedded Technologies), or as a result of service or modification by anyone other than RTD Embedded Technologies. 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 RTD Embedded Technologies expressly disclaims all warranties not stated herein. All implied warranties, including implied warranties for merchantability 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 RTD Embedded Technologies 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.

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