Endura

FM810

Product Manual

www.radisys.com

World Headquarters
5445 NE Dawson Creek Drive ● Hillsboro, OR 97124 USA
Phone: 503-615-1100 ● Fax: 503-615-1121
Toll-Free: 800-950-0044

International Headquarters
Gebouw Flevopoort ● Televisieweg 1A
NL-1322 AC ● Almere, The Netherlands
Phone: 31 36 5365595 ● Fax: 31 36 5365620

97-7836-00
February 2002

Revision History

Revision	Revision History	Date
1.0	First Release	February 2002

Notational Conventions

This manual uses the following conventions:

- Screen text and syntax strings appear in this font.
- All numbers are decimal unless otherwise stated ('h' indicates a hexadecimal number).
- Bit 0 is the least-significant bit. If a bit is set to 1, the associated description is true unless otherwise stated.

Warnings indicate situations that may result in physical harm to you or the hardware.

Cautions indicate situations that may result in damage to data or the hardware.

Notes indicate important information about the product.

The globe indicates a World Wide Web address.

Safety & Approvals Notices

Battery

This product contains a lithium cell.

When removing or replacing the lithium cell, do not use a conductive instrument as a short-circuit may cause the cell to explode. Always replace the cell with one of the same type. This product uses a CR2032 cell. Dispose of a spent cell promptly – do not recharge, disassemble or incinerate. Keep cells away from children.

CAUTION! Danger of explosion if battery is incorrectly replaced. Replace only with the same or equivalent type recommended by the manufacturer. Dispose of batteries according to the manufacturer's instructions.

LAN (Local Area Network) Connector

This product may include an RJ45 LAN connector (see installation guide). Do not connect to anything other than an Ethernet LAN.

Thermal Interface Material

This product may contain thermal interface material between devices and heatsinks. This can cause irritation and can stain clothing. Avoid prolonged or repeated contact with the skin and wash thoroughly with soap and water after handling. Avoid contact with eyes and inhalation of fumes. Do not ingest.

Anti-static Precautions

This product contains static-sensitive components and should be handled with care. It is recommended that the product be handled in a Special Handling Area (SHA) as defined in EN100015-1:1992. Such an area has working surfaces, floor coverings and chairs connected to a common earth reference point. An earthed wrist strap should be worn whilst handling. Other examples of static-sensitive devices are the memory modules and the processor. Failure to employ adequate anti-static measures can cause irreparable damage to components on the motherboard.

Safety

This product complies with the American Safety Standard UL1950 when installed in a suitable chassis.

Electromagnetic Compatibility

This product is designed to meet the following EMC standards when installed in a suitable chassis.

FCC Class B (Title 47 of Code of Federal Regulations, parts 2 & 15, subpart B)
EN55022:1998 Class B
EN55024:1998

FCC Compliance Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures.

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and the receiver
- Connect the equipment into an outlet on a different circuit to that of the receiver
- Consult the dealer or an experienced radio/TV technician for help.

Any change or modification to this product not expressly approved by RadiSys could void the approvals held by this product.

Legal Directives

This product complies with the relevant clauses of the following European Directives.

Low Voltage Directive	73/23/EEC
EMC Directive	89/336/EEC

Contents

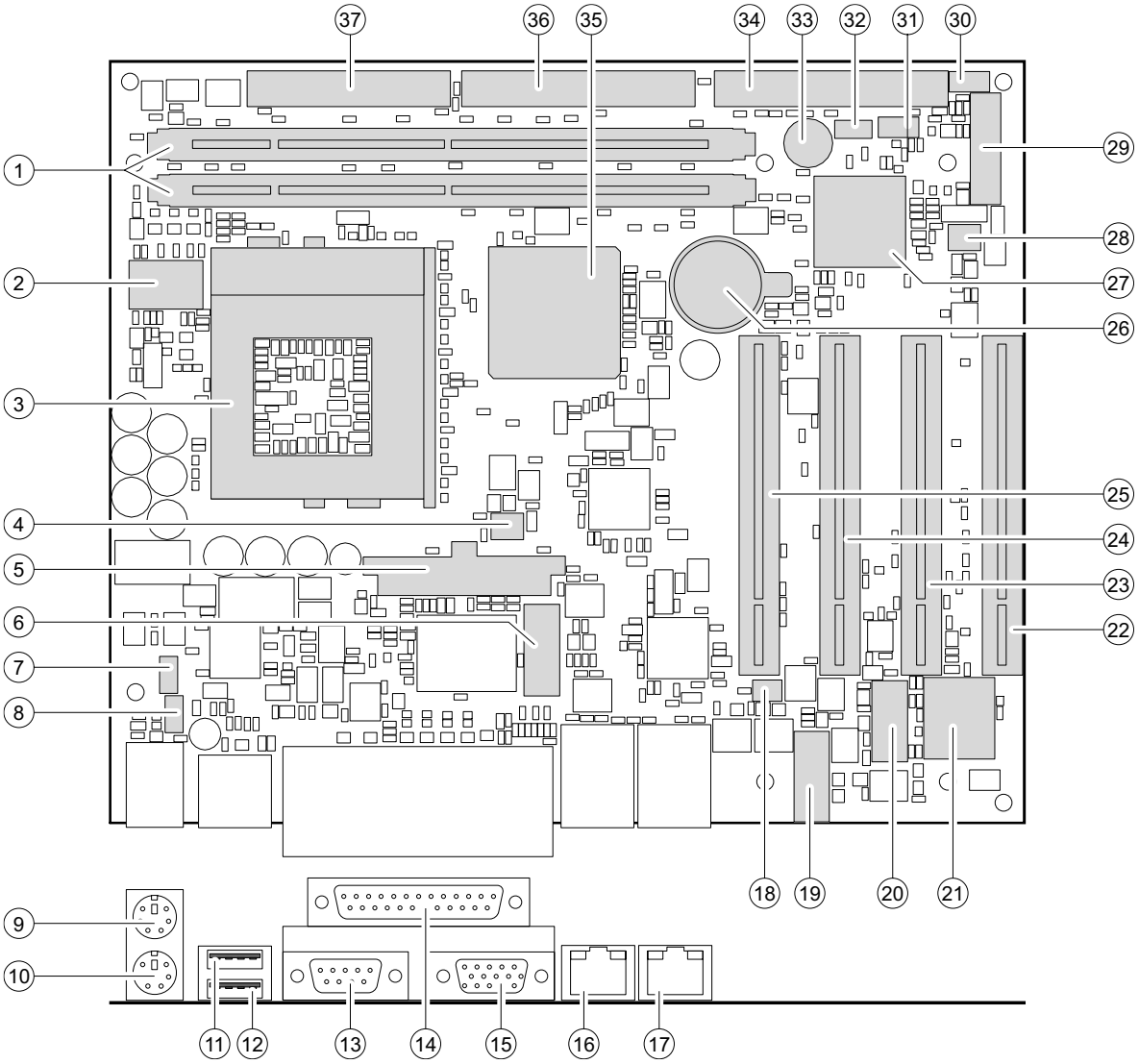
1 Overview

The FM810 is a microATX form factor motherboard based around an Intel Celeron or Pentium III processor and an Intel 810 family chipset. It integrates video, system monitoring and dual Ethernet controllers on a 9.0 x 7.5-inch board and is targeted at the enterprise appliance market. Its small size also enables it to be used in a FlexATX chassis.

Form Factor	microATX/FlexATX, 9.0 x 7.5 inches
Processor	370 pin PGA socket for Intel Celeron and Pentium III processors with 66 or 100MHz processor bus speed in PPGA or FC-PGA packages
Chipset	Intel 810
Memory	Two DIMM sockets for PC100 SDRAM modules without ECC or parity Maximum 512MB, minimum 16MB memory
Video	3D graphics controller integrated within chipset
Audio	On-board mini-speaker
Power Management	APM, ACPI, PCI PME
System Management	Voltage, temperature and fan monitoring for 2 fans Lithium cell voltage monitoring Fan speed control for 2 fans Watchdog timer
BIOS	Based on PhoenixBIOS™ 4.0 release 6.0 4Mbit device Includes POST, Setup, ACPI, APM, PnP, video BIOS Customizable startup logo
I/O	Dual rear USB 1.1 Two serial ports (one on header) Bi-directional/EPP/ECP parallel port PS/2 keyboard and mouse (duplicated on internal headers) IrDA General Purpose I/O Lines (8)
Network	Two Intel 82559ER-based 10/100Mbps Ethernet ports LAN indicator functions duplicated on internal header
Disks	Dual UltraDMA/66 interfaces with ATAPI CD, LS120 and ZIP drive support 3-mode floppy interface with on-board connector
Expansion	Four PCI 2.2 slots (3 usable with standard FlexATX chassis) Support for 3-slot riser via slot 2

1.1 Motherboard Layout

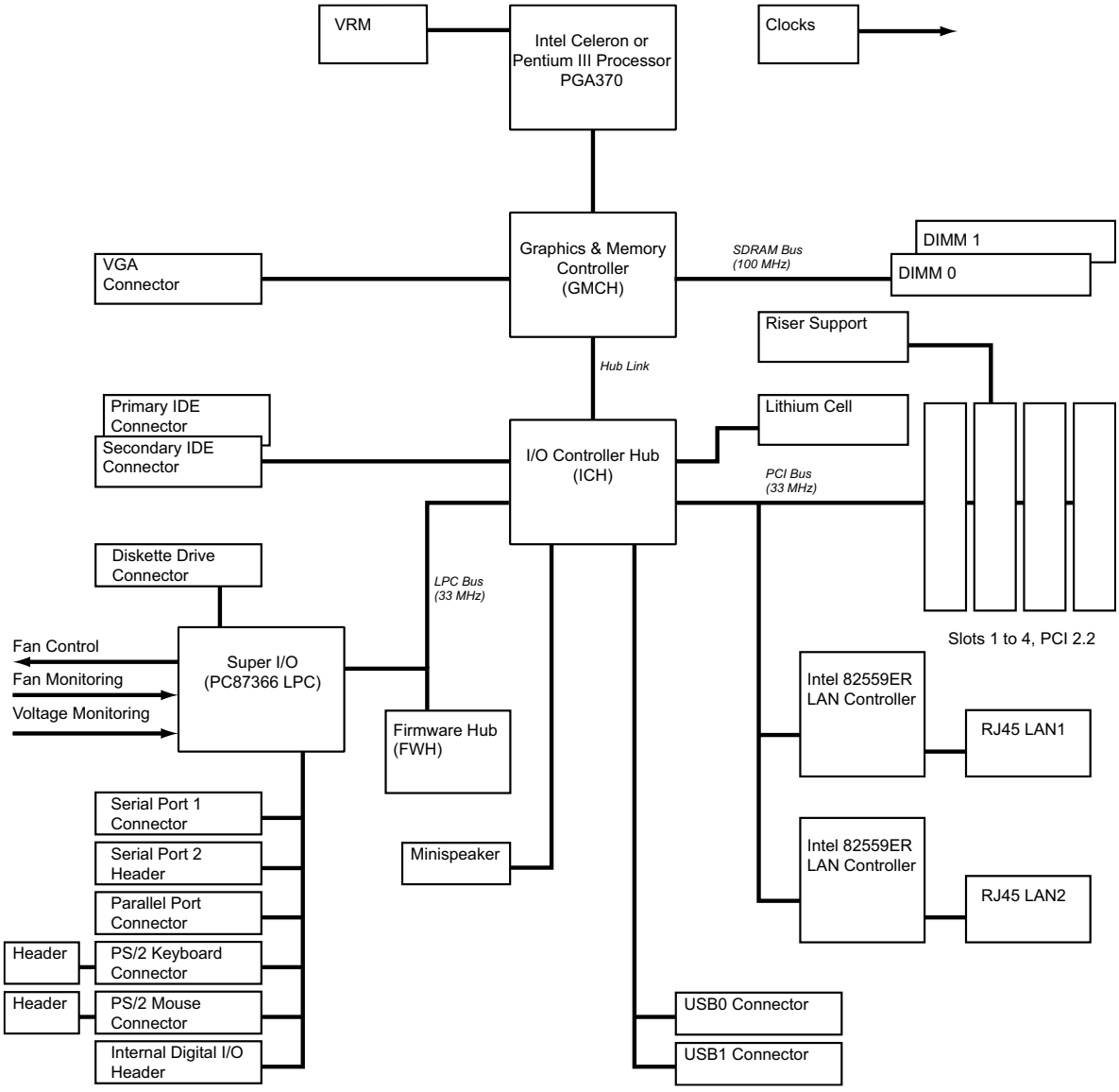
The figure below shows the layout of the FM810 motherboard with the major components identified.



1	PC100 DIMM sockets	**14**	Parallel port	**27**	I/O controller hub (ICH)
2	Clock generator	**15**	VGA monitor	**28**	System fan connector
3	PGA370 socket for processor	**16**	10/100 Ethernet port 1 (RJ45)	**29**	Front panel connector
4	Processor fan power connector	**17**	10/100 Ethernet port 2 (RJ45)	**30**	Alternate Power LED header
5	Power supply connector	**18**	Riser enable jumper	**31**	Operating mode jumper
6	GPIO header	**19**	Ethernet ports LED header	**32**	ISA bridge support connector
7	Mouse header	**20**	Serial port 2 header	**33**	On-board speaker
8	Keyboard header	**21**	Firmware hub (FWH)	**34**	Primary IDE connector
9	PS/2 mouse (green)	**22**	Slot 4 – PCI 2.2	**35**	Graphics & memory controller (GMCH)
10	PS/2 keyboard (purple)	**23**	Slot 3 – PCI 2.2	**36**	Secondary IDE connector
11	USB 1.1 channel 1	**24**	Slot 2 – PCI 2.2	**37**	Diskette header
12	USB 1.1 channel 0	**25**	Slot 1 – PCI 2.2		
13	Serial port 1	**26**	3V Lithium cell – use CR2032		

1.2 Block Diagram

The figure below shows a block diagram of the FM810 motherboard.



1.3 Product Options

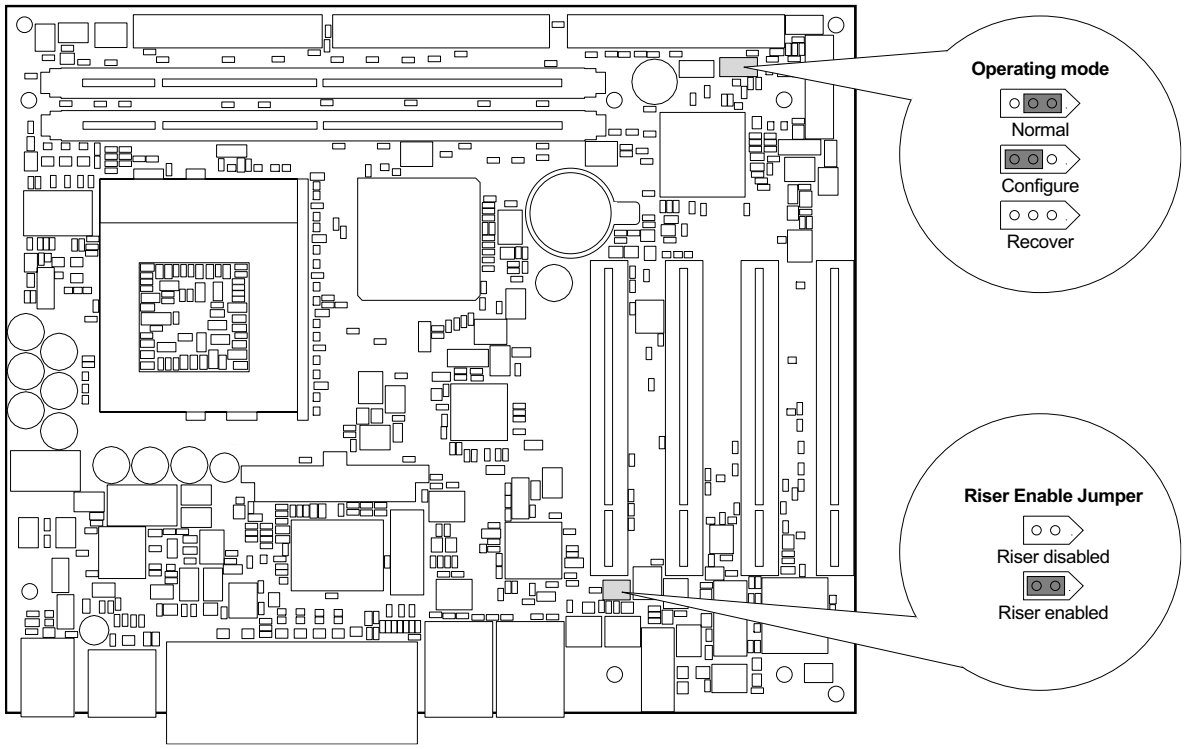
The table below lists the product options available.

Functions	FM810-2L
Video	Yes
USB	Dual USB 1.1
On-board speaker	Yes
Riser support	Yes
LAN	Dual 10/100

Each of the products is available with a choice of CPU speed. Consult the latest price list for the available options. Other product options are available to special order for high volume customers.

1.4 Configuration

The majority of the configuration of the motherboard is done through the Setup utility built into the BIOS – discussed later in this document. There are, however, two jumpers - one to control the operation of the motherboard and a second jumper to enable a riser fitted to slot 2.



1.4.1 Operating Mode Selection Jumper

This jumper selects one of three operating modes for the motherboard – Normal, Configure and Recovery modes. The factory default position for this jumper selects 'Normal' mode.

Normal Mode	This is the position the jumper should be in for normal operation of the motherboard. If the motherboard detects corruption in the BIOS ROM, then recovery mode will be entered regardless of the state of the jumper.
Recovery Mode	If the jumper is in the recovery mode position or if the motherboard detects a corrupted BIOS ROM then recovery mode is entered. The motherboard will not boot and will wait until a valid recovery diskette is detected and will then copy a new BIOS into the ROM. The motherboard must be powered down and then re-powered with the jumper in the normal position before normal operation can resume.
Configure Mode	With the jumper in this position the motherboard will automatically run the BIOS Setup utility regardless of the state of the Setup disable flag that can be set in the BIOS defaults. Additional BIOS settings are also available within Setup in this mode.

1.4.2 Riser Enable jumper

Install this jumper to enable the additional riser support signals to be routed to the normally unused pins of the slot 2 PCI connector. Remove this jumper when fitting a PCI card directly into slot 2.

Do not fit the riser enable jumper when a PCI adapter card is fitted directly into slot 2.

1.4.3 Front Panel Connections

The primary controls and indicators for the motherboard are connected via the front panel connector using either a single ribbon cable to a 'front panel' assembly, or using a number of small PC-standard connectors. The functions are described below. See appendix B for the connector pin-out information.

Power LED
This can be used to connect either a single-color LED (usually green) or a two-terminal bi-color LED (usually green/yellow) to indicate the powered status of the motherboard. In both cases, the 'green' anode should be attached to pin 2 of the front panel connector. See the Indicators section later in this document for further information.

Power Switch
A momentary switch should be connected between pins 6 and 8 of the power connector if the motherboard is used with a soft-switch power supply. If the switch is closed for greater than approximately 4 seconds, the motherboard will power off immediately, regardless of the state of the operating system, losing any system context information. This switch is redundant when using a hard-switch power supply.

Reset Switch
If used, a momentary switch connected between pins 5 and 7 will cause the motherboard to restart when closed.

Hard Disk LED
A single color LED should be connected between pins 1 (anode) and 3 to indicate hard disk activity on either of the two ATA channels.

Speaker
Connect an external speaker between pins 10 and 11 or 10 and 16. This is used only for the PC 'beep' functions - it cannot be used as an output of the audio CODEC. The speaker should typically be 8Ω.

Tamper Switch
Connect a momentary switch between pins 18 and 20 to make use of the tamper detection logic of the motherboard. The switch should be open when the chassis is closed.

Infra-red port
Pins 9, 11, 13 and 15 provide an interface to an infra-red receiver/transmitter module. Pins 9 and 13 provide the +5V module power and signal ground return.

1.4.4 Alternate Power LED

The power LED function on the front panel connector is duplicated on the Alternate Power LED connector for use LEDs cabled to a 3-pin connector. Do not use both the primary (front panel) and alternate connectors simultaneously.

2 Motherboard Description

2.1 Processor

The FM810 motherboard supports Intel Celeron and Pentium III processors in a PGA370 package (either PPGA or FC-PGA). The table below lists the supported processors. An on-board voltage regulator generates the voltage for the CPU. Both the processor voltage and the operating frequency are automatically adjusted by the motherboard to suit the installed processor.

Processor Type	Processor Speed	CPU bus speed	Cache size	Package
Intel Celeron	300 MHz	66 MHz	128kB	PPGA
Intel Celeron	366 MHz	66 MHz	128kB	PPGA
Intel Celeron	433 MHz	66 MHz	128kB	PPGA
Intel Celeron	566 MHz	66 MHz	128kB	FC-PGA
Intel Celeron	733 MHz	66 MHz	128kB	FC-PGA
Intel Celeron	850 MHz	100 MHz	128kB	FC-PGA
Intel Celeron	1.0 GHz	100 MHz	128kB	FC-PGA
Intel Pentium III	600 MHz	100 MHz	256kB	FC-PGA
Intel Pentium III	700 MHz	100 MHz	256kB	FC-PGA
Intel Pentium III	850 MHz	100 MHz	256kB	FC-PGA
Intel Pentium III	1.0 GHz	100 MHz	256kB	FC-PGA

2.2 System Memory

The FM810 motherboard has two DIMM sockets to accept PC100 or PC133 modules although PC133 parts offer no performance advantage over PC100. The product does not accept PC66 modules. The sockets may be populated in any order and each can accept either single or double-sided modules. The minimum total memory size is 16MB and the maximum is 512MB. The BIOS automatically configures the motherboard for the correct size, speed and type. See the Manuals, Drivers & BIOS section on the RadiSys web site at www.radisys.com for a list of memory modules that have been tested with this product.

When using the on-board video controller, the frame buffer is held within system memory and thus less memory is available to the operating system.

Each memory module should meet the following requirements

- Compliance with the Intel PC100 or PC133 specification
- Inclusion of a serial presence detect (SPD) ROM
- The module type is 3.3V 168-pin unbuffered synchronous DRAM (SDRAM)
- Based on 16Mb, 64Mb or 128Mb devices
- Capacity of between 16MB and 256MB
- 64 bits wide. ECC or parity is not supported

2.3 Chipset

The FM810 motherboard is based around an Intel 810 chipset comprising two parts -

- Graphics and memory controller hub (GMCH). This includes the processor interface, a high-performance 3D graphics controller and the system memory controller.
- I/O controller hub (ICH). This provides all the PCAT-compatible devices and the PCI bus interface. In addition, it integrates USB and SMBus controllers, a dual UltraATA/66 disk controller and power management functions.

In addition a firmware hub flash ROM contains the system BIOS, setup utility and video BIOS.

2.4 Video

The video controller is integrated within the 810 chipset GMCH and provides the features listed below. The monitor connection is via a standard 15-pin D-sub analog VGA connector on the rear I/O. The BIOS supports multiple independent displays via PCI (or ISA via external bridge) video adapter cards.

- 2D graphics with full 2D acceleration
- 3D graphics with extensive rendering capabilities
- Hardware motion compensation for software MPEG2 decode
- System memory is used as frame buffer storage
- 15-way D-type for analog RGB output with VESA DDC2B capability

The Intel 810 chipset supports a wide variety of video modes. The drivers for specific operating systems support a subset of these modes. The table below lists the video modes supported by the Windows and Linux drivers.

Resolution	Color Depth (bpp) *	Windows 2D Refresh Rates (Hz)	Windows 3D Refresh Rates (Hz)	Linux 2D Refresh Rates (Hz)
640 x 480	8, 24	60, 70, 72, 75, 85		60, 75, 85
	16	60, 70, 72, 75, 85	60, 70, 72, 75, 85	60, 75, 85
720 x 480	8, 24	75, 85		
	16	75, 85	75, 85	
720 x 576	8, 24	60, 75, 85		
	16	60, 75, 85	75, 85	
800 x 600	8, 24	60, 70, 72, 75, 85		60, 75, 85
	16	60, 70, 72, 75, 85	60, 70, 72, 75, 85	60, 75, 85
1024 x 768	8, 24	60, 70, 72, 75, 85		60, 75, 85
	16	60, 70, 72, 75, 85	60, 70, 75, 85	60, 75, 85
1152 x 864	8, 16, 24	60, 70, 72, 75, 85		60, 75, 85
1280 x 960	8, 16	60, 75, 85		
1280 x 1024	8, 16	60, 70, 72, 75, 85		60, 75, 85
	24	60, 70, 75, 85		60, 75, 85

* Bits per pixel. 8bpp=256 colors, 16bpp=64k colors, 24bpp=16M colors

2.4.1 System Memory Allocation

The video controller does not have dedicated frame buffer memory but instead makes use of system memory for all its needs. This must be taken into account when the amount of system memory is chosen. When the on-board video controller is not used, it should be disabled completely via BIOS Setup to prevent system memory being allocated to the controller.

The motherboard BIOS allocates 1MB of system memory to the video controller to support legacy VGA graphics. The amount of system memory reported by the BIOS will reflect this reduction when the on-board video controller is enabled. Once the operating system loads, the video drivers allocate further system memory dependant on availability as described in the table below for Intel PV 4.x video drivers. Systems using Windows NT 4.0, Windows 2000 or those that require 16M colors at a resolution greater than 1024 x 768 must have at least 64MB of system memory.

Total Allocation of System Memory for On-board Video (including 1MB legacy support)			
	Total System Memory Size		
Operating System	**32MB**	**64MB**	**128MB or greater**
Windows 98	7MB	11MB	11MB
Windows NT 4.0	Not valid	10MB	10MB
Windows 2000	Not valid	10MB	11MB

2.5 Audio

The motherboard includes a mini-speaker that provides PC speaker functions (error 'beep' etc.).

2.6 Network

The FM810 provides two 10/100 Ethernet controllers based around the Intel GD82559ER. Each channel has an RJ45 connector located on the rear panel with two integrated LED indicators to provide link status information. The list below describes the features provided.

- IEEE 802.3 10Base-T and 100Base-TX compatible
- 32-bit bus-mastering PCI device with jumper-less configuration
- RJ45 with two integral LEDs showing line activity, link integrity and line speed

The operation of the two indicators is described in the table below. The motherboard also supports cabling to alternate Ethernet status indicators (to a front panel assembly, for example). See the Indicators section of this document for a description of this header.

LED color	**LED state**	**Indicates**
Green	Off	10Mbps link speed
	On	100Mbps link speed
Yellow	Off	No link is established
	Steady on	Link is established but there is no communication activity
	Blinking	Link is established and communication activity is detected

2.7 Diskette Drives

The diskette drive interface supports a maximum of two drives. The drives should be 2- or 3-mode 3.5-inch devices supporting 720kB, 1.2MB or 1.44MB formats. The controller is located at I/O addresses 3F0-3F7h and uses IRQ6.

2.8 IDE Drives

Two independent bus-mastering IDE interfaces are provided, each supporting ATA modes up to UltraATA/66. The following drive types are supported.

- ATA hard disks up to UltraATA/66 speeds
- ATAPI devices such as CD-ROMs
- LS120 drives

The BIOS supports logical block addressing (LBA) and extended CHS translation modes for hard disks. When booting from LS120 drives, the correct mode (floppy or hard disk) must be chosen in Setup. The BIOS supports both automatic and manual determination of ATA cable type (80 - or 40-pin) to support UltraATA/66 drives.

2.9 Standard PC I/O

The standard PC I/O functions serial ports, parallel ports, keyboard and mouse ports and diskette drive controller are provided via a National Semiconductor PC87366 Super I/O (SIO) device attached to the low pin count (LPC) bus from the chipset ICH. In addition, this device provides system monitoring and fan control functions and general-purpose I/O lines.

2.9.1 Serial Ports

The FM810 motherboard supports two 16C550-compatible serial ports that can operate at speeds of up to 115.2kbps. Serial port 1 is located on the rear panel whilst serial port 2 is via a header. Each port can be assigned as COM1 through COM4 via the BIOS Setup utility:-

- I/O address 3F8-3FFh, IRQ4
- I/O address 2F8-2FFh, IRQ3
- I/O address 3E8-3EFh, IRQ4
- I/O address 2E8-2EFh, IRQ3

2.9.2 Parallel Port

The FM810 has a 25 way female D-sub parallel port connector located on the rear panel. It supports the following operating modes, configured via the BIOS Setup utility.

- Standard PC-compatible parallel port
- Bi-directional parallel port
- EPP mode
- ECP mode

The I/O locations can be assigned as follows.

- I/O address 378-37Fh & 778-77Fh, IRQ5 or IRQ7
- I/O address 278-27Fh & 678-67Fh, IRQ5 or IRQ7

2.9.3 Infra-red Support

The FM810 motherboard supports an IrDA compliant infra-red interface via the front panel header. An IR transceiver must be added such as the Hewlett Packard HSDL-3201 or the HSDL-3610 device. The IR port shares the serial port 2 channel and thus the two ports cannot be used simultaneously. A transfer rate of up to 115kbps is supported.

2.9.4 Keyboard and Mouse Ports

Two PS/2 style keyboard and mouse ports are provided on the rear panel. Both ports provide a resettable fuse protected +5V supply to the peripheral. In addition, both the keyboard and mouse ports are accessible internally via 4-way headers.

The keyboard controller is functionally equivalent to the 8042 standard and is located at I/O addresses 60-64h and uses IRQ1. The mouse shares the same controller and uses IRQ12.

2.10 USB Ports

Two USB 1.1 compliant ports are provided on the rear panel with a resettable fuse protected +5V supply to the peripheral.

The BIOS supports the use of a USB keyboard and/or mouse in lieu of a PS/2 device via the BIOS customization tools (the feature is disabled by default). This USB legacy support provides emulation of standard keyboards and/or mice and since it causes performance degradation should be enabled only when the operating system being used also supports USB (the emulation is automatically disabled once the operating system is running).

2.11 General Purpose I/O Lines

In order to support products that require a small number of internal input or output lines (such as switches or LED indicators), the FM810 provides access to 8 general-purpose lines via a 12-pin header. Each line can be programmed independently as an input or an output. The signals are provided by the National Semiconductor PC87366 Super I/O device GPIO port 2. It is the responsibility of the customer to provide suitable software to control these lines.

2.12 CMOS RAM & RTC

The chipset integrates a Motorola MC146818A compatible real-time clock (RTC) and 256 bytes of CMOS RAM that is used by the BIOS to store configuration information. A replaceable primary lithium coin cell backs up both the RTC and the CMOS RAM and provides for approximately 5 years of unpowered backup. The RTC includes a century byte and is supported by the BIOS to provide year 2000 compliance.

The lithium coin cell is a CR2032 device.

When the +5V standby power is applied to the motherboard, the RTC and the CMOS RAM are powered from that rather than the lithium cell.

2.13 Expansion Cards

The motherboard provides 4 bus-master PCI 2.2 compliant slots. The motherboard generates the 3.3Vaux supply to these slots using the 5V standby input from the power supply. Always ensure that the 5V standby rail can support the required current when using a PCI card that makes use of the 3.3Vaux supply. The FM810 is designed to support a maximum total power consumption of 60W for all four slots (15W each, on average).

Slot 2 supports a 3-slot PCI riser with the additional signals provided via reserved or unused pins on the standard PCI connector. The riser enable jumper must be fitted to enable these additional signals. Do not fit the riser enable jumper when an adapter card is fitted directly into slot 2. Contact RadiSys for further information.

Do not fit the riser enable jumper when a PCI adapter card is fitted directly into slot 2.

2.14 System management

The FM810 motherboard includes hardware system management functions integrated into the National Semiconductor PC87366 Super I/O (SIO) device. They monitor system voltages, motherboard and CPU temperatures, fan speed and control system fans. The following sections describe this in more detail. The BIOS Setup utility can be used to display the status of the system monitors.

2.14.1 Voltage Monitoring

The table below details the motherboard voltage rails monitored and their usage.

Voltage Rail	Usage on Motherboard
+12V	Serial ports, processor voltage generation, audio headphone amplifier, fans.
+5.0V	Processor voltage generation, internal logic, keyboard, mouse, USB and video ports.
+3.3V	Chipset ICH, firmware hub, audio CODEC, SIO, clock generator, flat panel controller.
+2.5V	Processor signaling (PPGA processors).
+1.8V	Chipset GMCH, chipset ICH.
+1.5V	Processor bus termination, processor signaling (FC-PGA processors).
-12V	Serial ports.
VCPU	Processor core voltage.
+3.3V Standby	Primary standby voltage to systems that control motherboard wake-up, System memory DIMMs, Ethernet controllers.
VBAT*	This rail is used to power the RTC and the CMOS RAM.

* The system monitor device directly reads the lithium cell voltage when it is below 2.9V. A lithium cell with a higher voltage will result in a typical system monitor reading of 2.9V.

A regulator on the motherboard generates the processor operating voltage with each processor selecting the correct voltage automatically. The table below indicates the correct operating voltage for the different processors.

Processor Type	Processor Speed	Operating Voltage
Intel Celeron	300 MHz	2.00V
Intel Celeron	366 MHz	2.00V
Intel Celeron	433 MHz	2.00V
Intel Celeron	566 MHz	1.50V, 1.70V or 1.75V
Intel Celeron	733 MHz	1.65V, 1.70V or 1.75V
Intel Celeron	850 MHz	1.70V or 1.75V
Intel Celeron	1.0 GHz	1.75V
Intel Pentium III	600 MHz	1.65V, 1.70V or 1.75V
Intel Pentium III	700 MHz	1.65V, 1.70V or 1.75V
Intel Pentium III	850 MHz	1.65V, 1.70V or 1.75V
Intel Pentium III	1.0 GHz	1.75V

2.14.2 Temperature Monitoring

There are two temperature sensors on the motherboard. The first measures the motherboard temperature. Since the sensor is contained within the SIO, this will be a localized reading dominated by the motherboard surface temperature around the SIO component.

The second temperature sensor is located on the processor die and thus accurately measures the local die temperature. Since the local die temperature fluctuates rapidly with activity, the controller within the SIO filters the signal to produce an average temperature.

2.14.3 Fan Monitoring

The motherboard includes two fan monitors that check the fan tachometer signal to determine the rotation speed. Fan speed limits can be set to cause an alarm in the event that the fan rotates more slowly than the limit. Using this method, early warning of a failing fan can be generated.

Note that when a fan is temperature controlled, the fan monitoring alarms for that fan should not be used since the speed is determined by the temperature control mechanism and the fan will sometimes be intentionally slowed or stopped.

The two fan tachometer monitors are assigned to fans as follows.

Monitor	Usage by motherboard
Fan monitor 0	System fan (see motherboard layout section)
Fan monitor 1	Processor fansink (see motherboard layout section)

2.14.4 Fan Control

The motherboard supports individual variable speed controls for both the processor fansink and the system fan by pulse-width modulation of the fan drive output voltage.

2.14.5 Tamper Detection

The motherboard supports tamper detection security that operates via a chassis tamper switch connected to the front panel connector. When the motherboard detects this signal low the BIOS can be configured to display a warning message or to require a password at the next boot. Since the lithium cell powers the logic, the tamper detection continues to operate even if the board is unpowered.

2.15 Power management

The FM810 motherboard implements a number of power management features with software support for APM and ACPI. Where an operating system does not support ACPI, the motherboard defaults to using APM. An APM driver is required by the operating system in order to take advantage of the APM power management features.

2.15.1 ACPI Power States

An ACPI-aware operating system directs the power management of the motherboard – causing the various devices within the system to change power state as appropriate. The table below describes the ACPI power states available using the FM810 motherboard.

Global State	Sleep State	Device State	Description
G0	S0	C0, D0	Fully operational, all devices powered.
G1 Sleeping	S1 CPU stopped	C1, D1, D2, D3	Sleep state. CPU is stopped but all devices are powered.
G1 Sleeping	S4 Suspend to disk	D3	All devices are unpowered except wake-up logic. Memory and system context saved to disk.
G2/S5	S5 Soft Off	D3	All devices are unpowered. Memory contents and context are lost. No wake-up possible.
G3 Mechanical Off	No power	No power	System is unpowered with no standby rails. No wake-up is possible

2.15.2 ACPI Wake-up Support

The table below indicates which events can cause an ACPI wake-up and from which sleep states.

Event	Sleep State	Comment
Power switch	S1, S4, S5	
RTC alarm	S1, S4	
PS/2 keyboard or mouse	S1	Ports are unpowered in S4, S5
USB device (any port)	S1	Ports are unpowered in S4, S5
On-board LAN	S1	
IR device	S1	
PCI PME signal	S1, S4	

2.16 Indicators

The motherboard supports a single dual-color LED indicator that is used to show both power and message waiting status. It is possible to use a single-color LED although some functionality is lost. The table below describes how the indicator is driven when operating with both single and dual-color devices. The indicator can be connected via the front panel header or the alternate power LED header, but not both.

LED	LED state	Indicates
Single color	Off	The motherboard is powered down or in one of the ACPI sleep states (including S1).
	On	The motherboard is fully powered up (S0).
	Blinking	The motherboard is fully powered up (S0) with a message waiting (as determined by ACPI TAPI).
Dual color (green/yellow)	Off	The motherboard is powered down or in ACPI sleep states S4 or S5 (no +5V supply available).
	Green	The motherboard is fully powered up (S0).
	Yellow	The motherboard is in sleep state S1.
	Blinking Green	The motherboard is fully powered up (S0) with a message waiting (as determined by ACPI TAPI).
	Blinking Yellow	The motherboard is in sleep state S1 with a message waiting (as determined by ACPI TAPI).

To support off-board network status indicators, a header is provided that allows the functions of the LEDs integrated into the RJ45 connectors to be duplicated. The table below shows how this connector is used.

LED color	LED state	Indicates	Channel 1 Pins	Channel 2 Pins
Green	Off	10Mbps link speed	11: Anode (+)	5: Anode (+)
	On	100Mbps link speed	12: Cathode	6: Cathode
Yellow	Off	No link is established	8: Anode (+)	2: Anode (+)
	Steady on	Link is established but there is no communication activity	10: Cathode	4: Cathode
	Blinking	Link is established and communication activity is detected		

2.17 BIOS

The system BIOS is held within a flash ROM device called the firmware hub (FWH). The device is a 4Mbit part that contains the following code.

- System BIOS, POST and configuration (Setup) utility
- Video BIOS
- Product configuration information including boot logo and CMOS defaults
- Processor microcode updates
- Customizations

The code is built from a number of software and data modules that can be customized and assembled with a software tool that can be provided by RadiSys. Software to support BIOS updates and crisis recovery is also available - see the Manuals, Drivers & BIOS section on www.radisys.com for BIOS updates and support software.

The configuration of the motherboard is generally automatic with intervention possible via the built-in BIOS Setup utility. The operation and feature set are described in the BIOS chapter of this document.

2.18 Operating Systems Support

The following operating systems are validated by RadiSys with the FM810 motherboard. Contact RadiSys for information on the support of other operating systems. See the Manuals, Drivers & BIOS section on www.radisys.com for device drivers.

- Microsoft MS-DOS 6.2
- Microsoft Windows 98, NT 4.0, 2000
- Wind River Systems VxWorks

3 Specifications

3.1 Regulatory EMC Compliance

The table below lists the EMC regulations the FM810 motherboard is designed to meet when correctly installed in a suitable chassis.

Regulation
FCC Class B (Title 47 of Code of Federal Regulations, parts 2 & 15, subpart B)
EN55022:1998 Class B
EN55024:1998

3.2 Regulatory Safety Compliance

The table below lists the safety regulations the FM810 motherboard complies with when correctly installed in a suitable chassis.

Regulation
UL1950/07.95
CAN/CSA-C22.2 No. 950-95
IEC60950, 1991 2nd edition with amendments 1, 2, 3, 4

3.3 Environmental

Parameter	State	Specification
Temperature (ambient)	Operating	0°C to 55°C
	Storage	–40 to 85 °C
Humidity		5% to 95% non-condensing
Shock	Packaged	0 to 20lbs: 36 inches free fall, 167 inches/s velocity change 21 to 40lbs: 30 inches free fall, 152 inches/s velocity change 41 to 80lbs: 24 inches free fall, 136 inches/s velocity change 81 to100lbs: 18 inches free fall, 118 inches/s velocity change
	Unpackaged	30 g trapezoidal waveform,170 inches/s velocity change
Vibration	Packaged	10Hz to 40Hz: 0.015g^2Hz 40Hz to 500Hz: 0.015g^2Hz sloping down to 0.00015g^2Hz
	Unpackaged	5Hz to 20Hz: 0.01g^2Hz sloping up to 0.02g^2Hz 20Hz to 500Hz: 0.02g^2Hz
Altitude	Operating	To 15000 ft. (4500m)
	Storage	To 40000 ft. (12000m)
ESD	Operating	4kV direct contact, 8kV air

3.4 Thermal

The ambient operating temperature range for the motherboard is 0 - 55°C but the selection of processor and heatsink (or fansink) can reduce the system operating range. Intel Celeron processors have a minimum operating temperature of 5°C. The processor and fansink combinations normally supplied as standard with the motherboards are tested by RadiSys to the full operating range using software designed to cause maximum power dissipation in the processor. This testing is done in an environmental test chamber with forced-air cooling.

Always test the final system configuration to determine if the operating temperature range limits for the motherboard and processor are being met. Failure to do so can lead to motherboard or processor damage and/or shortened life.

Intel Celeron processors have a minimum operating temperature of 5°C. Refer to the relevant Intel processor datasheet for the maximum operating temperature.

3.5 Industry Compliance

The FM810 motherboard implements the following industry specifications.

Specification	Description	Revision
ACPI	Advanced Configuration and Power Interface Specification	1.0b
APM	Advanced Power Management BIOS Specification	1.2
ATAPI	ATA Packet Interface for CD-ROMs	2.5
ATX	ATX Motherboard Form Factor Specification	2.03
microATX	MicroATX Motherboard Interface Specification	1.0
FlexATX	FlexATX Addendum to the microATX Specification 1.0	1.0
PCI	Peripheral Component Interconnect Local Bus Specification	2.2
	PCI Power Management Interface Specification	1.1
USB	Universal Serial Bus Specification	1.1

3.6 Miscellaneous

Parameter	Conditions	Specification
RTC Clock accuracy	25°C, 3.3V	+/- 25 ppm max.
CPU and system fan drive capability	12.0V	300mA max.

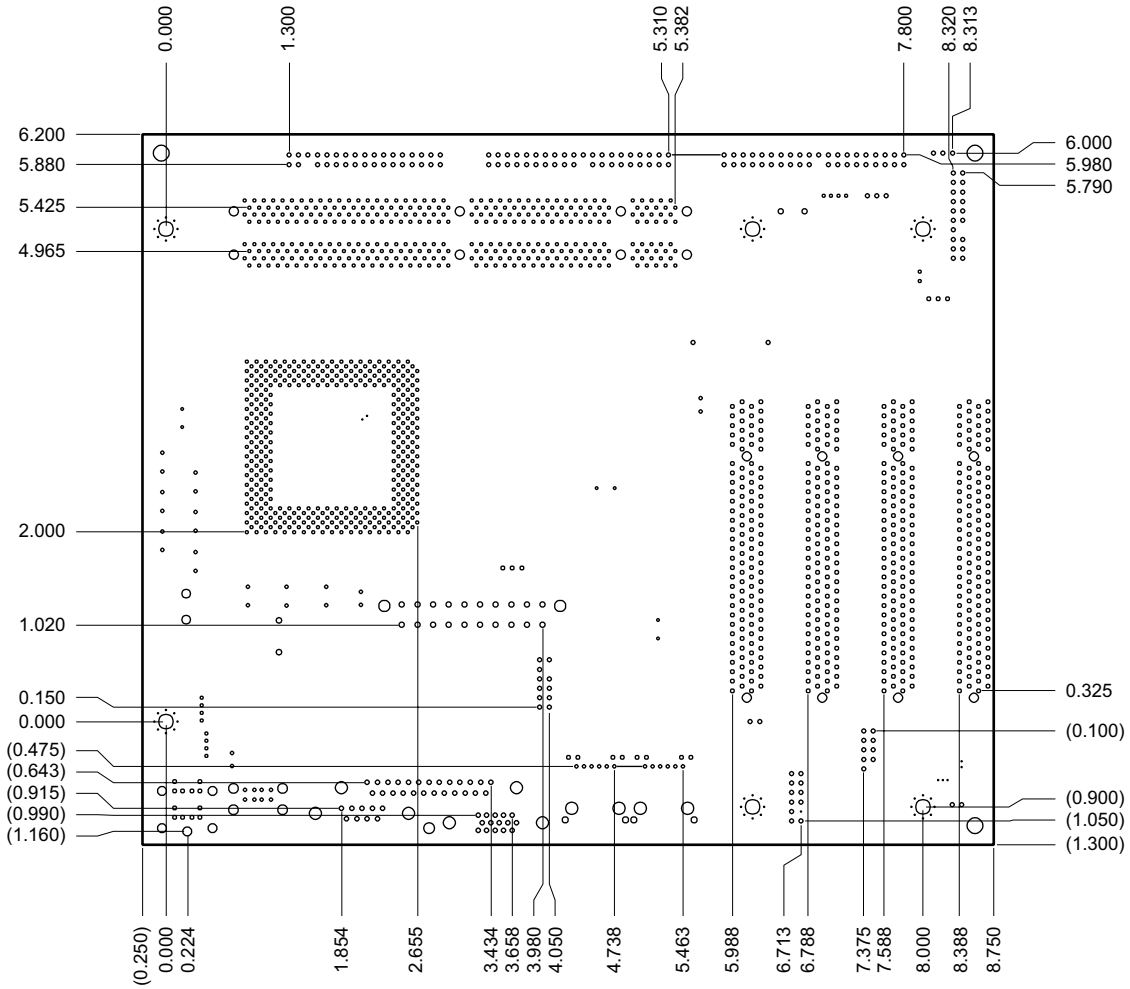
3.7 Mechanical

3.7.1 Motherboard

The FM810 motherboard meets the microATX Motherboard Interface Specification, version 1.0 and its FlexATX addendum, version 1.0. It measures 9.0 x 7.5 inches and is manufactured using a 4-layer PCB with components on the topside only. The screen-printing includes the following.

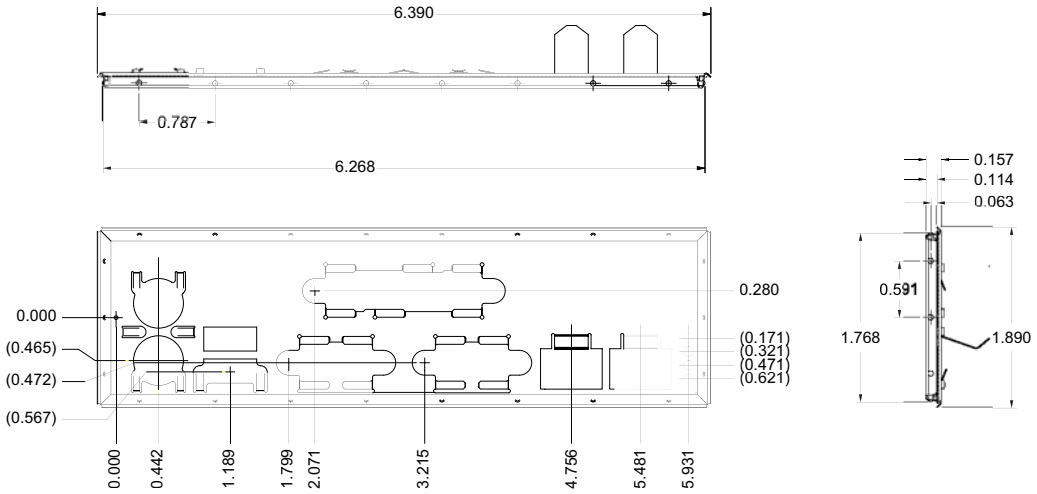
- Product Name, RadiSys part number and RadiSys branding.
- Location for serial number label
- Selected component reference designators

The figure below shows the dimensions of the motherboard and the location of the rear panel connectors and the location of the processor, memory sockets and expansion slots.



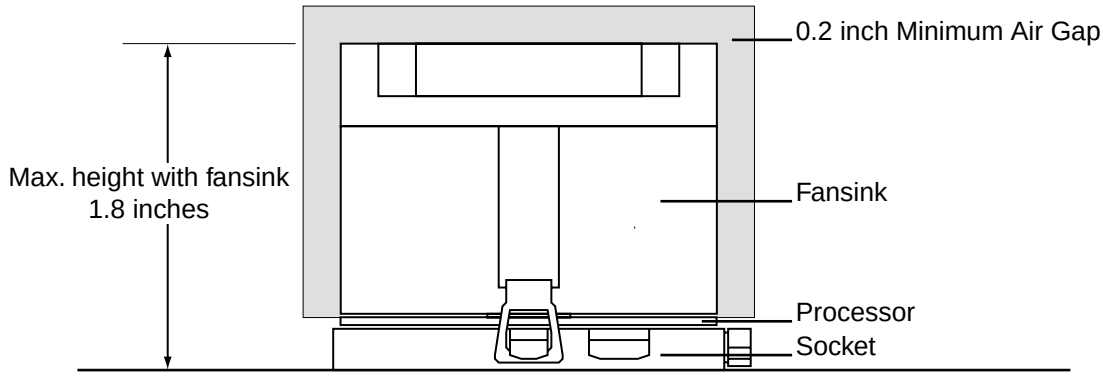
3.7.2 I/O Shield

An I/O shield is available for the FM810 when used in a standard ATX, microATX or FlexATX chassis and is illustrated below. The shield press-fits into the chassis shield aperture.



3.7.3 Fansink

The motherboard can be optionally shipped with a processor fansink, which must have a minimum air space of 0.2 inches around it to function correctly. This is shown in the drawing below.



3.8 Electrical

3.8.1 Motherboard Power Consumption

The motherboard power consumption is highly dependent on the processors, memory and devices attached and also on the software that is running and the power state that the board is in. The figures given in the table below are designed to give the user a guide to the power requirements that should be expected under selected conditions. They should not be interpreted as maximum requirements.

The figures are based on measurements of a real system configured in the following manner.

Processor	Intel Pentium III at 1.0GHz and 100MHz bus
Memory	256MB using two 128MB modules
Drives	Western Digital 205AA 20.5GB HDD, Aopen CD-948E 48X CD-ROM, Sony MPF920-F diskette drive (all powered independently)
Video	On-board
Network	On-board

	Motherboard Current				
Mode	**+3.3V**	**+5V**	**+12V**	**-12V**	**+5Vsby**
MS-DOS Prompt without power management	2.9A	3.4A	0.2A	50mA	10mA
Windows 2000 desktop idle	2.3A	0.5A	0.1A	50mA	10mA
Windows 2000 standby	2.1A	0.5A	0.1A	50mA	10mA
Off with AC connected and LANs	0	0	0	0	750mA
Stress test maximums*	3.4A	6.1A	0.3A	50mA	10mA

* These results are from a suite of stress tests designed to maximize the power dissipation of the above configuration. Each figure is the worst case seen from any test – they are not maximums that can be measured together.

3.8.2 Power Delivery to Expansion Slots

The table below indicates the maximum current that should be drawn from each PCI expansion slot - do not exceed these ratings. In the case of the main +5.0V and +3.3V supplies, each PCI card is limited to a maximum of 25W in total, all of which can be drawn from either voltage rail. The maximum combined power consumption of all 4 slots should not exceed 60W.

Maximum Expansion Slot Current				
+3.3V	**+5V**	**+12V**	**-12V**	**+5Vsby**
7.6A (25W)*	5.0A (25W)*	500mA (6W)	100mA (1.2W)	375mA/20mA** (1.8W/0.1W)

*The combined power consumption via the +3.3V and +5.0V supplies is a maximum of 25W
**One wake-enabled card at 375mA and the remainder at 20mA

Do not exceed the limit of 60W for the combined power consumption of all expansion slots or 25W for any slot.

3.8.3 Power Supply Selection

The FM810 motherboard is designed to operate in conjunction with an ATX compatible power supply, as defined in section 4.2 of the ATX 2.03 specification. The provision of a 5V standby power rail is optional but, if not provided, the soft-switched power supply control features of the motherboard cannot be used. Where the standby rail is provided, ensure it is capable of providing sufficient current for the motherboard, particularly when the optional motherboard LAN controllers are fitted or a PCI adapter card that draws current from the auxiliary 3.3V supply is used.

The tolerances on the voltage rails are described in the ATX specification 2.03 section 4.2.3 and reproduced below. The -5.0V rail is not used by the FM810 motherboard.

Voltage Rail	Tolerance
+5.0V DC	± 5%
+12.0V DC	± 5%
-12.0V DC	± 10%
+3.3V DC	± 4%
+5.0V DC standby	± 5%

It is very important that the power supply used can support the required load current on all rails – failure to meet this can cause damage to the power supply or the motherboard. Pay particular attention to the 5V Standby power requirement – the LAN controllers (when fitted) are powered from this rail.

The power supply must be properly approved by a third party agency for use in IEC/EN/UL/CSA 1950/60950 applications.

3.8.4 Power Budget

The table below gives an example power budget for the motherboard with processor, memory and expansions cards fitted. The figures are based on maximum figures (motherboard consumption measured under stress testing) and they should not be interpreted as typical values. Before choosing a power supply, always create a power budget for your system. These figures yield a total power requirement of 156W.

	Motherboard Current					Power
	+3.3V	+5V	+12V	-12V	+5Vsby	
Motherboard	3.4A	6.1A	0.3A	0.05A	0.75A	49.7W
Keyboard		0.3A				1.5W
Mouse		0.1A				0.5W
Two USB ports		1.0A				5.0W
Slots (total)	18.2A*	12.0A*	2.0A	0.4A	0.45A	91.1W
Fans			0.6A			7.2W
Front panel		0.1A				0.5W
Video DDC channel		0.05A				0.3W
Total	21.6A	19.7A	2.9A	0.5A	1.2A	156W

*These cannot be drawn simultaneously - total combined for all slots and both rails power is 60W

3.8.5 General Purpose I/O Lines

Symbol	Parameter	Conditions	Min	Max	Unit
V_{IH}	Input High Voltage		2.0	5.5	V
V_{IL}	Input Low Voltage		-0.5	0.8	V
I_{IL}	Input Leakage Current	$V_{IN} = V_{3.3V}$		10	µA
		$V_{IN} = V_{GND}$		10	µA
V_H	Input Hysteresis		250		mV
V_{OH}	Output High Voltage	I_{OH} = -3mA	2.4		V
V_{OL}	Output Low Voltage	I_{OL} = 6mA		0.4	V

4 Motherboard BIOS

4.1 Configuration

The motherboard BIOS includes a setup utility that can be used to both view and modify the board's configuration. The settings are stored in CMOS RAM with the default settings held in the flash ROM. To start the utility, press the F2 key when prompted. If 'silent-boot' is on (logo displayed) then press the ESC key to show the start-up messages.

The display is divided into four areas.

- The top bar shows the six main menus
- The large left area shows the options
- The large right area displays help text specific to the highlighted option or menu
- The bottom bar shows the action of the active keys

The primary menus are briefly described in the table below. The help text describes each option more fully. Many options have sub-menus.

Menu	Options
Main	Product description including processor and memory fitted.
	Date and time.
	IDE disks found and sub-menus for extra configuration.
Advanced	Start-up display mode (silent-boot etc.).
	Operating system type (ACPI etc.).
	Advanced chipset configuration.
	Processor cache control.
	PCI space configuration.
	I/O devices configuration.
	Advanced hard disk drive options.
Security	Passwords and permissions.
Power	Action after AC-reconnect.
	Power savings modes and timers.
Boot	Selects device boot order.
Exit	Save with or without changes.
	Load/save default settings (from flash ROM).

4.2 Update and Recovery

This section describes how to update the code and data held in the BIOS ROM. The process should be undertaken with care and must not be interrupted. A recovery mechanism is also described that enables a corrupted BIOS ROM (as a result of an interrupted update, for example) to be repaired.

Updates are available online from the RadiSys site in the form of a compressed image (ZIP) of a number of files. Using the software contained in the ZIP file, you must first create a flash diskette that is then used for the update or recovery process. Included in the ZIP file is a 'Readme.txt' file that contains information on the update and instructions on how to use it. Always read this document before proceeding as it may contain updates to the descriptions below.

The update process assumes you have a PC that can be used to create an update diskette and that the system to be updated or recovered has a diskette drive attached.

Updating the BIOS is a process that should be undertaken with caution. Always complete the process before powering-down or restarting the motherboard – failure to do this may result in a corrupted BIOS that will require recovery.

4.2.1 Creating a BIOS Update Diskette

Follow the steps below. You need a PC with Microsoft MS-DOS, Windows 95 or Windows 98 and a blank diskette.

1. Obtain the update ZIP file from the Manuals, Drivers & BIOS section on the RadiSys web site, www.radisys.com.
2. Unzip the contents to an empty directory on your hard drive.
3. Insert a blank diskette into the floppy drive.
4. Run CRISDISK from the directory created in step 2 to create the update diskette
5. Follow the steps as directed. A copy of MS-DOS 'Format.com' must be available for CRISDISK to complete successfully.

4.2.2 Updating the System BIOS

The system BIOS can be updated from MS-DOS without changing jumpers as described below. It is recommended that you create a recovery diskette (described later) before updating the BIOS. This operation does not affect the customization area in the BIOS. If you use the BIOS Setup utility CMOS Save and Restore functions to save a set of defaults, you will need to recreate and re-save these once the update is complete.

1. Create an update diskette as described above.
2. Boot the system to be updated into MS-DOS without memory managers or boot from the update diskette.
3. If you did not boot from the update diskette, do the following.
   A. Insert the update diskette into the floppy drive.
   B. Change the MS-DOS directory to match the floppy drive's directory.
   C. Type UPDATE and press Enter.
4. Follow the instructions to initiate the update. When it is finished, the following message appears:

   Flash memory has been successfully programmed
   PRESS ANY KEY TO RESTART THE SYSTEM
   If the system does not restart
   TURN THE POWER OFF, THEN ON

5. Turn off the system power and re-boot. The motherboard will boot using RadiSys defaults.

If the update operation fails for any reason (if it was interrupted, for example), and the motherboard will no longer operate, then the BIOS must be recovered.

4.2.3 Creating a BIOS Recovery Diskette

Follow the steps below. You need a PC with Microsoft MS-DOS, Windows 95, Windows 98 or Windows NT and a blank diskette.

1. Obtain the update ZIP file from the Manuals, Drivers & BIOS section on the RadiSys web site, www.radisys.com.
2. Unzip the contents to an empty directory on your hard drive.
3. Insert a blank diskette into the floppy drive.
4. Run CRISDISK /R from the directory created in step 2 and follow the steps as directed to create the recovery diskette. A copy of MS-DOS 'Format.com' must be available for CRISDISK to complete successfully.

4.2.4 Recovering the System BIOS

The recovery diskette should be used to recover a system BIOS when the motherboard no longer operates after a failed BIOS update operation. The process is described below.

1. Remove the operating mode selection jumper to place the board into the recover mode (see Configuration section of this document).
   A. Turn off the power.
   B. Remove any covers to gain access to the jumper.
   C. Remove the jumper from the operating mode selection block
2. Insert the recovery diskette into the floppy drive.
3. Power up the motherboard. You will hear the following audio signals if you have a speaker connected. If you do not have a speaker, wait for approximately 1 minute after all activity has stopped to ensure the operation has completed.

Beep code	Definition
One short beep	BIOS update begins.
One long beep	BIOS update is finished.
Three beeps	This indicates an error.

4. Power down the motherboard.
5. If you removed the operating mode jumper,
   A. Refit the jumper into the normal operating position.
   B. Replace the system cover(s).
6. Power up the motherboard. The recovery process is now complete and the product should boot normally.

4.2.5 Updating the Flash Bootblock

There is an area of the BIOS ROM, the bootblock, which is normally not updated. It contains code to perform the recovery process and data that identifies the motherboard. Occasionally, a BIOS release may require this bootblock area to be updated and the update disk will do this automatically. However, exercise caution when attempting such an update as a damaged bootblock area means that the motherboard may need to be returned to RadiSys for repair.

Exercise caution when updating BIOS that includes a bootblock update. If this process is interrupted, the motherboard cannot be recovered and must be returned to RadiSys for repair.

4.3 Customization

There are a number of features of the BIOS that can be customized and the software to accomplish this is contained within the BIOS OEM kit ZIP file that can be obtained from the Manuals, Drivers & BIOS section on the RadiSys web site, www.radisys.com. The 'Readme.txt' file also contained in this ZIP provides updated customization information and should be read before proceeding.

The process involves creating a new update disk that contains the customized BIOS. The steps below will guide you through the process.

1. Obtain both the update and OEMKIT ZIP files from the Manuals, Drivers & BIOS section on the RadiSys web site, www.radisys.com.
2. Unzip the contents of the update ZIP to an empty directory on your hard drive.
3. Unzip the contents of the OEMKIT ZIP to the same directory as step 2. This may replace some files.
4. Replace the 'Logo.bmp' file with a customized logo if required (see description below).
5. Replace the 'P6upd.bin' file with a customized version if required (see description below).
6. Run MAKEBIOS to create the customized binary.
7. Create the update diskette by running CRISDISK /O with a blank diskette in the floppy drive and following the instructions.
8. Using a reference or 'gold' board, update its BIOS with the diskette created in step 6 above using the standard update procedure.
9. Re-boot the board and run the BIOS setup utility.
10. Configure the board as required.
11. From the Exit menu, save the new settings to flash and re-boot the board with the update disk still in the floppy drive.
12. There should be no reported difference between disk and ROM BIOS versions at this point and you will be prompted to read-back the BIOS. Select this to extract the motherboard ROM image and save it to the update disk, replacing the BIOS binary in the file BIOS.ROM.
13. The diskette is now a fully customized update disk. Save the BIOS.ROM file back to the directory on your hard disk used in step 2, replacing the previous version.
14. Create a new version of the update disk by running CRISDISK (with no switches) with a blank diskette in the floppy drive and following the instructions.

The customized 'Logo.bmp' file must be a 16-colour standard BMP format file. The palette can be chosen at will but note that three colors are used by the BIOS for the start-up progress indicator, text and background - palette entries 8, 7 and 0 respectively. The total size of the BMP file must not exceed 40960 bytes which represents approximately 80k pixels. The BIOS will center the image on the screen.

Intel microprocessors allow for their microcode to be updated by the BIOS to workaround some outstanding errata. Each processor type and revision has a unique update image and the BIOS supports a maximum of four contained in the 'P6upd.bin' file. To customize the processor microcode update selections, create a new version of this file by concatenating four microcode updates in binary form - these can be obtained from Intel.

4.4 BIOS Error Indications

Once the motherboard powers-up the BIOS code runs Power-On-Self-Test software to check that the motherboard is operating correctly. During this process, the code writes an 8-bit value to an error port at various code checkpoints. If a fatal error is determined, then the error code indicates the last successful checkpoint reached. The BIOS will attempt to write this code to the display. The error port (I/O location 80h) can be read via “off-the-shelf” Debug cards. The table below lists the checkpoint codes.

There are a number of checkpoints that also generate an audible ‘beep’ code on failure using the standard PC speaker (also routed though the motherboard audio system). The beep codes are made up of up to 4 groups of short beeps and are also listed below.

Once the video is enabled further errors generated during and after POST are sent to the video display as text messages. These messages are always displayed unless the motherboard is configured for silent boot or headless (no keyboard, mouse or display) operation.

BIOS POST Checkpoint Codes			
02h	Verify Real Mode	6Ch	Display shadow message
03h	Disable NMI	6Eh	Display non-disposable segments
04h	Get CPU type	70h	Display error messages
06h	Initialize system hardware	72h	Check for configuration errors
08h	Initialize chipset registers with initial POST values	74h	Test real-time clock
09h	Set in POST flag	76h	Check for keyboard errors
0Ah	Initialize CPU registers	7Ah	Test for key lock on
0Bh	Enable CPU cache	7Ch	Set up hardware interrupts vectors
0Ch	Initialize cache to initial POST values	7Eh	Test coprocessor if present
0Eh	Initialize I/O	80h	Disable onboard I/O ports
0Fh	Initialize local bus IDE	81h	Late device initialization
10h	Initialize Power Management	82h	Detect and install external RS232 ports
11h	Load alternate registers with initial POST values	83h	Configure IDE controller
12h	Restore CR0	84h	Detect and install external parallel ports
13h	Reset PCI BM	85h	Initialize PCI PCC devices
14h	Initialize keyboard controller	86h	Re-initialize onboard I/O ports
16h	BIOS ROM checksum	87h	Configure MCD devices
17h	Pre-size DRAM	88h	Initialize BIOS Data Area
18h	8254 timer initialization	89h	Enable NMI
1Ah	8237 DMA controller initialization	8Ah	Initialize Extended BIOS Data Area
1Ch	Reset Programmable Interrupt Controller	8Bh	Initialize mouse
20h	Test DRAM refresh	8Ch	Initialize floppy controller
22h	Test 8742 Keyboard Controller	8Eh	Execute auto-typing
24h	Set ES segment to register to 4GB	8Fh	Hard disk controller fast pre-initialization

BIOS POST Checkpoint Codes			
26h	Enable A20	90h	Initialize hard disk controller
28h	Autosize DRAM	91h	Initialize local bus hard disk controller
29h	Initialize PMM	92h	Disable unused PCI clocks
2Ah	Clear 512KB base RAM	93h	Build MPTABLE for multiprocessor boards
2Ch	Test 512KB base address lines	95h	Install CDROM for boot
2Eh	Test low byte of 512KB base memory	96h	Clear huge ES segment register
2Fh	Pre-System Shadow	97h	Fix up MP table
30h	Test high byte of 512KB base memory	98h	Search for option ROMs (beep for bad checksum)
32h	Test CPU bus-clock frequency	99h	Check for SMART HDD
33h	Initialize PDM	9Ah	Shadow option ROMs
34h	Test CMOS RAM	9Ch	Set up Power Management
35h	Initialize alternate chipset registers	9Dh	Initialize security
36h	Warm start shutdown entry point	9Eh	Enable hardware interrupts
37h	Reinitialize the chipset	9Fh	(Second) HDD fast initialization
38h	Shadow system BIOS ROM	A0h	Set time of day
39h	Reinitialize the cache	A2h	Check keylock
3Ah	Auto-size cache	A4h	Initialize typematic rate
3Ch	Configure advanced chipset registers	A8h	Erase F2 prompt
3Dh	Load alternate registers with CMOS values	AAh	Scan for F2 keystroke
3Eh	Read HW	ACh	Enter SETUP
40h	Set Initial CPU speed	AEh	Clear in-POST flag
42h	Initialize interrupt vectors	B0h	Check for errors
44h	Initialize BIOS interrupts	B2h	POST done--prepare to boot operating system
45h	Core Device Init	B4h	One beep before boot
46h	Check ROM copyright notice	B5h	Quiet boot end/Display MultiBoot menu
48h	Check video configuration against CMOS	B6h	Check password (optional)
49h	Initialize PCI bus and devices	B8h	Clear global descriptor table
4Ah	Initialize all video adapters in system	B9h	Prepare to boot
4Bh	Display QuietBoot™ screen	BAh	DMI
4Ch	Shadow video BIOS ROM	BBh	Initialize BCVS
4Eh	Display copyright notice	BCh	Clear parity checkers
50h	Display CPU type and speed	BDh	Boot Menu
51h	Initialize EISA board	BEh	Clear screen (optional)
52h	Test keyboard	BFh	Check virus and backup reminders
54h	Set key click if enabled	C0h	Try to boot with INT19

BIOS POST Checkpoint Codes			
56h	Enable keyboard	C1h	Initialize PEM
58h	Test for unexpected interrupts	C2h	PEM log
59h	Initialize PDS	C3h	PEM Display
5Ah	Display prompt "Press F2 to enter SETUP"	C4h	PEM sys error initialization
5Bh	CPU cache off	C5h	Dual CMOS
5Ch	Test RAM between 512KB and 640KB	C6h	Docking initialization (not used)
5Eh	Base Address	C7h	Late docking initialization (not used)
60h	Test extended memory	D0h	Interrupt handler error
62h	Test extended memory address lines	D2h	Unknown interrupt error
64h	Jump to UserPatch1	D4h	Pending interrupt error
66h	Configure advanced cache registers	D6h	Initialize option ROM error
68h	Enable external and CPU caches	D8h	Shutdown error
69h	PM set up SMM	DAh	Extended Block Move
6Ah	Display external cache size	DCh	Shutdown 10 error
6Bh	Load custom defaults	DFh	A20 Error

Checkpoint Code		Beep Code
16h	BIOS ROM checksum	1-2-2-3
20h	Test DRAM refresh	1-3-1-1
22h	Test 8742 Keyboard Controller	1-3-1-3
28h	Autosize DRAM	1-3-3-1
29h	Initialize PMM	1-3-3-2
2Ch	Test 512KB base address lines	1-3-4-1
2Eh	Test low byte of 512KB base memory	1-3-4-3
34h	Test CMOS RAM	1-4-3-1
3Ah	Auto-size cache	1-4-3-3
46h	Check ROM copyright notice	2-1-2-3
58h	Test for unexpected interrupts	2-2-3-1
90h	Initialize hard disk controller	3-2-1-1
98h	Search for option ROMs (beep for bad checksum)	1-2
B4h	One beep before boot	1
DFh	A20 Error	4-2-4-4

5 Customer Support

RadiSys Online Support can be found at www.radisys.com and includes device drivers, BIOS updates, support software and documentation. See the Manuals, Drivers & BIOS section.

RadiSys hotline numbers for the US and Canada are

Support: (800) 438-4769
Service: (800) 256-5917

Online specifications and reference material:

Specification	Description	Location
ACPI	Advanced Configuration and Power Interface specification	www.acpi.info
APM	Advanced Power Management specification	www.microsoft.com/hwdev/archive/BUSBIOS/amp_12.asp
DDWG	Digital Display Working Group	www.ddwg.org
Intel 810 Chipset	Intel 810 chipset datasheet	http://developer.intel.com/design/chipsets/810/index.htm
Intel Celeron processor	Intel Celeron processor datasheet	http://developer.intel.com/design/celeron
Intel Pentium III processor	Intel Pentium III processor datasheet	http://developer.intel.com/design/pentiumiii
ATX, microATX, FlexATX	Form factor specifications	www.formfactors.org
PCI	PCI local bus specification	www.pcisig.com
SDRAM DIMMs	PC SDRAM module specification	http://developer.intel.com/technology/memory/
SMBus	System management bus	www.smbus.org
USB	Universal Serial Bus specification	www.usb.org/developers
VESA	Video Electronics Standards Association	www.vesa.org

Appendix A Technical Reference

A.1. I/O Map

Address (hex)*	Description
0000 – 000F	DMA controller 1
0020 – 0021	Interrupt controller 1
0040 – 0043	Timer counter
0060 – 0064	Keyboard and mouse controller
0070 – 0071	RTC and CMOS RAM
0080 – 008F	DMA controller page registers (for channels 1 and 2)
0092	PC compatible Port 92 (fast A20 and PIC)
x094	VGA controller POS102 access control
00A0 – 00A1	Interrupt controller 2
00B2 – 00B3	Advanced power management (APM) control registers
00C0 – 00DF	DMA controller 2
00F0	Floating point error control
x102	VGA controller POS102 register
015C – 015D	SIO control registers
0170 – 0177	Secondary IDE controller
01F0 – 01F7	Primary IDE controller
0278 –027F	Parallel port, LPT2
02E8 – 02EF	COM4 serial port
02F8 – 02FF	COM2 serial port
0374 – 0376	Secondary IDE controller
0378 –037F	Parallel port, LPT1
x3B0 – x3BB	VGA controller
x3C0 – x3CF	EGA controller registers
x3D4 – x3DA	CGA controller registers
03F0 – 03F5	Flexible diskette controller
03F6 – 03F7	Primary IDE controller
03E8 – 03EF	COM3 serial port
03F8 – 03FF	COM1 serial port
04D0 – 04D1	Interrupt controller
0778 – 077A	ECP registers (for parallel port)
0CF8 – 0CFF	PCI configuration address and data registers
1000 – 105F	ACPI registers
1060 – 107F	TCO controller
1600 – 165F	SIO system management controller and GPIO

Address (hex)*	Description
FFA0 – FFA7	Primary IDE bus master registers
FFA8 – FFAF	Secondary IDE bus master registers
Dynamically assigned	USB controller (32 locations on 32-byte boundary)
Dynamically assigned	SMBus controller (16 locations on 16-byte boundary)
Dynamically assigned	PCI bridge (4096 locations on a 4096-byte boundary)
Dynamically assigned	LAN controller 1 (32 locations on a 32-byte boundary)
Dynamically assigned	LAN controller 2 (32 locations on a 32-byte boundary)

* An ‘x’ prefix for the address indicates that only the low-order 10 address bits are decoded.

A.2. PCI Interrupt Allocation

In order to share PCI interrupts efficiently, the routing of the PCI interrupts INTA - INTD to the motherboard interrupts PCIINT0 – PCIINT3 are rotated for each slot. Thus the PCI card INTA signal for PCI slots 1 to 4 are spread across all four motherboard inputs.

Device	PCIINT0	PCIINT1	PCIINT2	PCIINT3
Slot 1 (PCI 2.2)	INTA	INTB	INTC	INTD
Slot 2 (PCI 2.2)	INTD	INTA	INTB	INTC
Slot 3 (PCI 2.2)	INTC	INTD	INTA	INTB
Slot 4 (PCI 2.2)	INTB	INTC	INTD	INTA
VGA controller	INTA	-	-	
Ethernet controller 1	-	-	INTA	-
Ethernet controller 2	-	-	-	INTA
USB controller	-	-	-	INTD
SMBus controller	-	INTB	-	-

Example. From the table above, the INTA interrupt from a card plugged into slot 2 would be routed to the motherboard PCIINT1.

A.3. PCI Device Assignments

Device	IDSEL	Bus Number	Device Number	Function Number
Chipset host bridge	-	0	0	0
Graphics controller	-	0	1	0
PCI bridge	-	0	30	0
LPC bridge (Includes DMA, timers, PIC, APIC, RTC, power & system management, GPIO)	-	0	31	0
IDE controller	-	0	31	1
USB controller	-	0	31	2
SMBus controller	-	0	31	3

Device	IDSEL	Bus Number	Device Number	Function Number
Slot 1 (PCI 2.2)	AD31	1	15	-
Slot 2 (PCI 2.2)	AD29	1	13	-
Slot 3 (PCI 2.2)	AD27	1	11	-
Slot 4 (PCI 2.2)	AD25	1	9	-
Ethernet controller 1	AD19	1	3	0
Ethernet controller 2	AD20	1	4	0

Note that the PCI slots and the Ethernet controllers are behind a virtual bridge implemented by the chipset ICH. Each device therefore resides on PCI bus 1.

A.4. ISA Interrupt Allocation

Whilst the motherboard does not include an ISA bus, it includes an ISA-compatible interrupt controller (PIC) in order to be compatible with AT standard architecture. The interrupts are allocated as described in the table below.

Interrupt	Description
IRQ0	System Timer
IRQ1	Keyboard Controller
IRQ2	Cascade interrupt
IRQ3	COM2, COM1 or unassigned
IRQ4	COM1, COM2 or unassigned
IRQ5	Parallel port or unassigned
IRQ6	Floppy
IRQ7	Printer port or unassigned
IRQ8	Real time clock/CMOS RAM
IRQ9	Unassigned
IRQ10	Unassigned
IRQ11	Unassigned
IRQ12	PS/2 mouse or unassigned
IRQ13	Floating point unit
IRQ14	Primary IDE or unassigned
IRQ15	Secondary IDE or unassigned
NMI	PCI PERR and SERR signals (and IOCHCHK when using ISA bridge)

A.5. ISA DMA Channel Allocation

Whilst the motherboard does not support an ISA bus, it includes an ISA-compatible DMA controller in order to be compatible with AT standard architecture. The DMA channels are allocated as described in the table below.

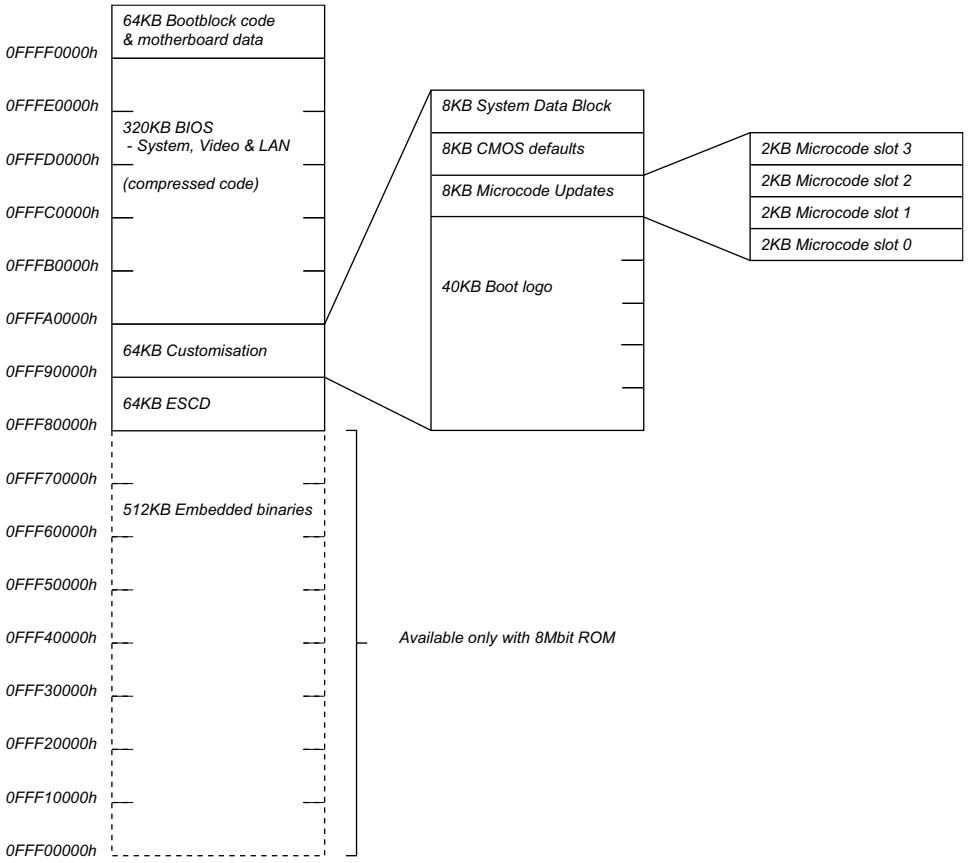
DMA Channel	Description
Channel 0	Unassigned 8-bit channel
Channel 1	Unassigned 8-bit channel
Channel 2	Floppy controller or unassigned 8-bit channel
Channel 3	ECP parallel port or unassigned 8-bit channel
Channel 4	Cascade channel
Channel 5	Unassigned 16-bit channel
Channel 6	Unassigned 16-bit channel
Channel 7	Unassigned 16-bit channel

A.6. SMBus Resource Allocation

Address	Description
1010 000X	Memory module 1
1010 001X	Memory module 2
1101 001X	Clock synthesizer

A.7. BIOS Organization

The BIOS ROM is a 4Mbit device containing eight symmetrical 64KB blocks. The diagram below shows how the ROM is used to store code and control information. The addresses shown refer to the ROM image at the top of the 4GB-address space. Note that the system BIOS segment is compressed in this image. When the BIOS runs, the code is uncompressed in real-time and the resulting code and data image is found at physical address 0E0000h through 0FFFFFh. The diagram includes the map for products that contain an 8Mbit ROM where fitted although this is not fitted as standard.



Appendix B Connector Descriptions

B.1. Connector Part Numbers

The various motherboard connectors are listed in the table below along with the part number of one of the approved vendors. The list is intended to assist in the selection of mating connectors.

Connector	Part Number	Type
Dual rear USB	Foxconn UB1112C-81	Dual vertically stacked USB
Rear RJ45	Bel Fuse 0810-1XX1-03	RJ45 with LEDs and transformer
Rear PS/2 keyboard and mouse	Foxconn MH11061-PD2	Stacked 6-way mini-DIN
Rear VGA monitor	Foxconn DZ11A31-P9	15-way high-density female D-sub
Rear parallel port	Foxconn DM11351-PR3	25-way female D-sub
Rear serial port	Foxconn DT10121-P5T	9-way male D-sub
Serial port 2 header	Foxconn HL09051-P5	2 by 5-way shrouded header
CPU and system fan	Foxconn HF06031	3-way with locking ramp
GPIO header	Foxconn HL09061-P9	2 by 6-way shrouded header
Ethernet LED header	Foxconn HL07061-P7	2 by 6-way shrouded header
DIMM sockets	Foxconn AT08413-K8	168-pin, 3V SDRAM
Processor socket	Foxconn PZ37047-S01-S	370-pin ZIF PGA
Primary and secondary IDE	Foxconn HL07207-D2	40-pin shrouded header
Diskette drive	Foxconn HL07171-P4	34-pin shrouded header
Keyboard and mouse headers	Foxconn HF55040	4-pin 2mm headers
PCI connector	Foxconn EH06001-GU-V	5V signaling
Front panel header	Foxconn HC19101-L6	2 by 10-way keyed header
Alternate power LED header	Foxconn HB1103G	3-pin header
External ISA bridge support	Foxconn HF55040	4-pin 2mm header

B.2. PCI Expansion Slot

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
A1	TRST#[1]	B1	-12V	A32	AD16	B32	AD17
A2	+12V	B2	TCK[1]	A33	+3.3V	B33	C/BE2#
A3	TMS[2]	B3	GND	A34	FRAME#	B34	GND
A4	TDI[2]	B4	TDO[3]	A35	GND	B35	IRDY#
A5	+5V	B5	+5V	A36	TRDY#	B36	+3.3V
A6	INTA#	B6	+5V	A37	GND	B37	DEVSEL#
A7	INTC#	B7	INTB#	A38	STOP#	B38	GND
A8	+5V	B8	INTD#	A39	+3.3V	B39	LOCK#
A9	CLKRUN#[3]	B9	PRSNT1#	A40	*Not Used*	B40	PERR#
A10	+5V	B10	RESERVED	A41	*Not Used*	B41	+3.3V
A11	RESERVED	B11	PRSNT2#	A42	GND	B42	SERR#
A12	GND	B12	GND	A43	PAR	B43	+3.3V
A13	GND	B13	GND	A44	AD15	B44	C/BE1#
A14	+3.3V AUX	B14	RESERVED	A45	+3.3V	B45	AD14
A15	RST#	B15	GND	A46	AD13	B46	GND
A16	+5V	B16	CLK	A47	AD11	B47	AD12
A17	GNT#	B17	GND	A48	GND	B48	AD10
A18	GND	B18	REQ#	A49	AD9	B49	GND
A19	PME#	B19	+5V	A50	KEY	B50	KEY
A20	AD30	B20	AD31	A51	KEY	B51	KEY
A21	+3.3V	B21	AD29	A52	C/BE0#	B52	AD8
A22	AD28	B22	GND	A53	+3.3V	B53	AD7
A23	AD26	B23	AD27	A54	AD6	B54	+3.3V
A24	GND	B24	AD25	A55	AD4	B55	AD5
A25	AD24	B25	+3.3V	A56	GND	B56	AD3
A26	IDSEL	B26	C/BE3#	A57	AD2	B57	GND
A27	+3.3V	B27	AD23	A58	AD0	B58	AD1
A28	AD22	B28	GND	A59	+5V	B59	+5V
A29	AD20	B29	AD21	A60	REQ64#	B60	ACK64#
A30	GND	B30	AD19	A61	+5V	B61	+5V
A31	AD18	B31	+3.3V	A62	+5V	B62	+5V

PCI connector pin-out deviations when riser support is enabled

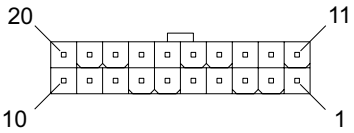
A1	LPCAD0	A40	REQ1#	B2	LPCAD1	B11	CLKL
A3	LPCAD2	A41	GNT1#	B9	LPCFRAME#	B14	CLK3
A4	LPCAD3	A60	REQ3#	B10	CLK1	B60	GNT3#

[1] Not used but pulled low

[2] Not used but pulled high to +5V

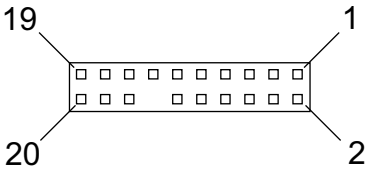
[3] Not connected

B.3. ATX Power Supply



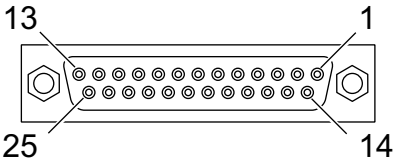
Pin	Signal	Pin	Signal
11	+3.3V	1	+3.3V
12	-12.0V	2	+3.3V
13	GND	3	GND
14	PS_ON#	4	+5.0V
15	GND	5	GND
16	GND	6	+5.0V
17	GND	7	GND
18	*Not Used*	8	PWR_OK
19	+5.0V	9	+5.0VSBY
20	+5.0V	10	+12.0V

B.4. Front Panel Header



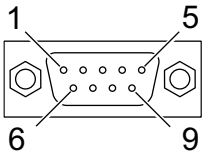
Pin	Signal	Pin	Signal
1	HDLED+	2	GREENLED+
3	HDLED-	4	GREENLED-
5	RESETSW-	6	PWRSW+
7	RESETSW+	8	PWRSW-
9	IR +5V	10	SPKR+
11	IRRXDAT	12	SPKR-
13	IR GND	14	KEY
15	IRTXDAT	16	SPKR-
17	*Not Used*	18	TMPSW+
19	*Not Used*	20	TMPSW-

B.5. Parallel Port



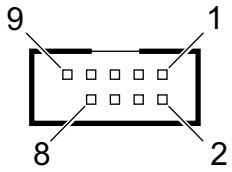
Pin	Signal	Pin	Signal
1	STB#	14	AFD#
2	DB0	15	ERR#
3	DB1	16	INIT#
4	DB2	17	SLIN#
5	DB3	18	GND
6	DB4	19	GND
7	DB5	20	GND
8	DB6	21	GND
9	DB7	22	GND
10	ACK#	23	GND
11	BUSY	24	GND
12	PE	25	GND
13	SLCT		

B.6. Serial Port 1



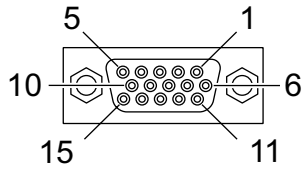
Pin	Signal	Pin	Signal
1	DCD	6	DSR
2	RxD	7	RTS
3	TxD	8	CTS
4	DTR	9	RING
5	GND		

B.7. Serial Port 2



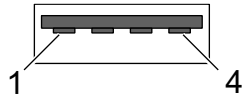
Pin	Signal	Pin	Signal
1	DCD	2	DSR
3	RxD	4	RTS
5	TxD	6	CTS
7	DTR	8	RING
9	GND	10	KEY

B.8. VGA Monitor



Pin	Signal	Pin	Signal
1	RED	9	+5V
2	GREEN	10	GND
3	BLUE	11	RESERVED[4]
4	RESERVED[4]	12	SDA
5	GND	13	HSYNC
6	RED RTN	14	VSYNC
7	GREEN RTN	15	SCL
8	BLUE RTN		

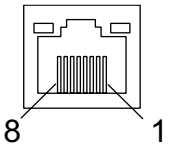
B.9. USB Ports



Pin	Signal
1	+5V
2	DATA-
3	DATA+
4	GND

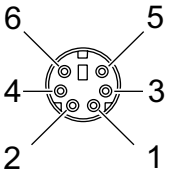
[4] Pulled high to +5V

B.10. RJ45 Ethernet Ports



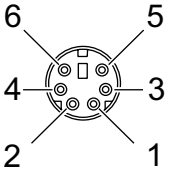
Pin	Signal
1	TxD+
2	TxD-
3	RxD+
4	75Ω to GND
5	75Ω to GND
6	RxD-
7	75Ω to GND
8	75Ω to GND

B.11. PS/2 Keyboard



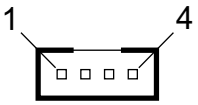
Pin	Signal	Pin	Signal
1	DATA	4	+5V
2	Not Used	5	CLOCK
3	GND	6	Not Used

B.12. PS/2 Mouse



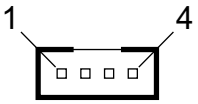
Pin	Signal	Pin	Signal
1	DATA	4	+5V
2	Not Used	5	CLOCK
3	GND	6	Not Used

B.13. Keyboard Header



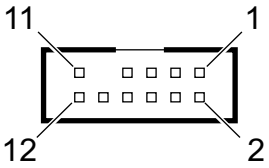
Pin	Signal
1	+5V
2	DATA
3	GND
4	CLOCK

B.14. Mouse Header



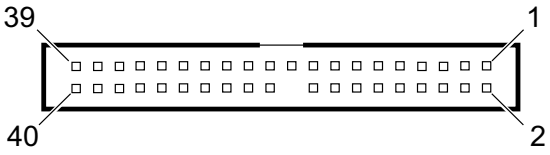
Pin	Signal
1	+5V
2	DATA
3	GND
4	CLOCK

B.15. General Purpose I/O



Pin	Signal	Pin	Signal
1	GPIO20	2	GPIO21
3	GPIO22	4	GPIO23
5	GPIO24	6	GPIO25
7	GPIO26	8	GPIO27
9	KEY	10	GND
11	+5V	12	+3.3V

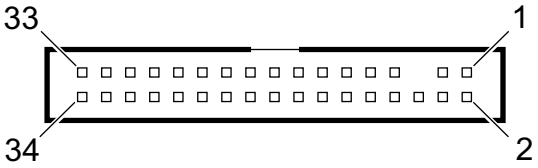
B.16. IDE Drive Headers



Pin	Signal	Pin	Signal
1	RST#	2	GND
3	D7	4	D8
5	D6	6	D9
7	D5	8	D10
9	D4	10	D11
11	D3	12	D12
13	D2	14	D13
15	D1	16	D14
17	D0	18	D15
19	GND	20	KEY
21	DRQ	22	GND
23	IOW#	24	GND
25	IOR#	26	GND
27	IORDY	28	CSEL
29	DAK#	30	GND
31	IRQ[5]	32	*Not Used*
33	DA1	34	CBLID#
35	DA0	36	DA2
37	CS1#	38	CS3#
39	HDACT#	40	GND

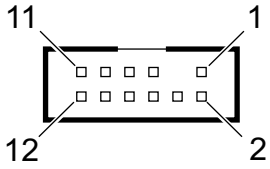
[5] IRQ14 for Primary, IRQ15 for Secondary

B.17. Diskette Drive Header



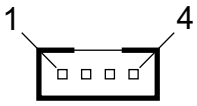
Pin	Signal	Pin	Signal
1	GND	2	DENSEL
3	GND	4	*Not Used*
5	KEY	6	DRATE0
7	GND	8	INDEX#
9	GND	10	MTR0#
11	GND	12	DS1#
13	GND	14	DS0#
15	GND	16	MTR1#
17	GND	18	DIR#
19	GND	20	STEP#
21	GND	22	WDATA#
23	GND	24	WGATE#
25	GND	26	TRK0#
27	GND	28	WP#
29	GND	30	RDATA#
31	GND	32	HDSEL#
33	GND	34	DSKCHG#

B.18. Ethernet LED Header



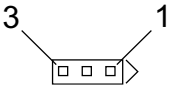
Pin	Signal	Pin	Signal
1	150R Pullup	2	ACTIVITY2#
3	KEY	4	LINK2#
5	150R Pullup	6	100MB2#
7	150R Pullup	8	ACTIVITY1#
9	NC	10	LINK1#
11	150R Pullup	12	100MB1#

B.19. ISA Bridge Support



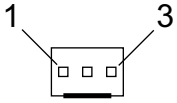
Pin	Signal
1	NOGO
2	REQ#
3	GNT#
4	SERIRQ

B.20. Alternate Power LED



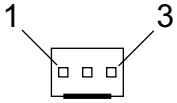
Pin	Signal
1	GREENLED+
2	KEY
3	YELLOWLED+

B.21. Processor Fan



Pin	Signal
1	GND
2	POWER
3	TACH#

B.22. System Fan



Pin	Signal
1	GND
2	POWER
3	TACH#