

RaQ XTR System Specification

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Preface

About This Document

This document describes the architecture, operation, and components of the RaQ XTR server appliance platform. Please also refer to the following related documentation:

- Monterey System Engineering Specification
- Monterey Software Specification
- Intel Pentium III Specification
- ADM 9240 System Hardware Monitor Datasheet
- National DP83815 Dual Ethernet Controller Datasheet
- AMD 29F080B FLASH Memory Datasheet
- ServerWorks ServerSet III LE 3.0 NB6635 Northbridge Device Datasheet
- ServerWorks ServerSet III LE 3.0 IB6566 Northbridge Device Datasheet
- National Super I/O PC97317 Datasheet
- HighPoint HP370 IDE Controller Datasheet

Audience

This document assumes that you have some familiarity with server technology, Internet and intranet services, and Intel Pentium III (or compatible) processors and associated support devices. The people who benefit from this document are:

- Engineers and managers who are evaluating the RaQ XTR hardware platform for possible use in a server environment.
- Engineers who are designing the RaQ XTR hardware platform into a server environment.
- Field sales engineers for familiarization with the product
- Sales staff for familiarization with the product

Organization

This document is organized into the following chapters:

- Chapter 1, “Overview,” is a basic system description of the RaQ XTR platform.
- Chapter 2, “Functional Description,” is a detailed functional description of the platform.
- Chapter 3, “Mechanical Description,” describes the mechanical design and packaging of the platform.
- Chapter 4, “Specifications,” describes the environmental, mechanical, electrical, vibration, and regulatory specifications of the RaQ XTR hardware platform.
- Appendix A, “System Power Analysis,” contains a detailed power analysis of the RaQ XTR.

Conventions

The first time a word or phrase is defined in this manual, it is *italicized*.

The word *assert* means to drive a signal true or active. The word *deassert* means to drive a signal false or inactive.

Hexadecimal numbers are indicated by the prefix “0x” —for example, 0x32CF. Binary numbers are indicated by the prefix “0b” —for example, 0b0011.0010.1100.1111.

Overview

1.1 Introduction

The RaQ XTR hardware platform is a highly extensible, high-performance server appliance platform built into a rack-mountable one rack unit (1RU) enclosure. The RaQ XTR platform is optimized for Internet and intranet services, and is specifically designed to seamlessly operate with Cobalt's operating system and applications. The RaQ XTR platform is designed for ease of use, extensibility, high-performance, and high reliability and availability. The platform is shown in Figure 1-1.



Figure 1-1 RaQ XTR Hardware Platform (Front View)

The RaQ XTR platform is packaged in a 1.75 in. x 17.75 in. x 22.75 in. (H x W x D) sheet metal enclosure with front to rear cooling. The enclosure is designed to be easy to mount either from the front or the middle of the enclosure. The front of the enclosure houses a plastic decorative bezel that contains an array of server status indicator lights, a power-on switch, a backlit LCD panel, and six push button switches for easy network set-up and server administration. The bezel can be extended approximately 3 in. by pulling it forward. The bezel can then be rotated so the LCD panel can be easily viewed and operated from above or below in a rack-mount environment. When the bezel is extended, it reveals the four removable drive bays. A drive bay can be removed by rotating the bezel down, inserting your finger into the recessed slot provided at the front of the bay, and firmly pulling forward.

1.2 What's Included

Included with the RaQ XTR platform are the following in-box items:

- AC power cord
- Two custom designed heavy-duty tabs and screws for rack mounting
- User manual
- Quick Start Guide
- Warranty/Registration card
- Packing list

The included items are shown in Figure 1-2.

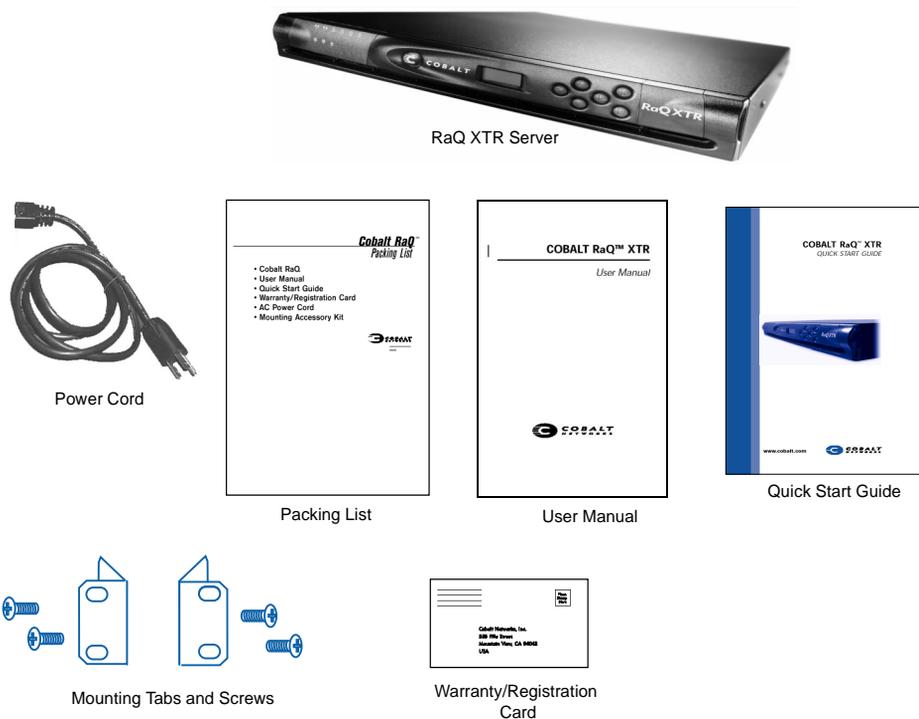


Figure 1-2 Included Items

1.3 Architecture

The system architecture centers around a main logic board supporting a single Intel Pentium III (or compatible) processor and up to 2 GB of registered ECC SDRAM. The main logic board has one 64-bit/33-MHz PCI slot, two serial ports, a USB port, and two 10/100BASE-T Ethernet controllers. The main logic board is supported by an I/O subsystem capable of running up to four removable IDE hard disk drives. The system is powered from a single 180W power supply.

A simplified block diagram of the RaQ XTR platform is shown in Figure 1-3.

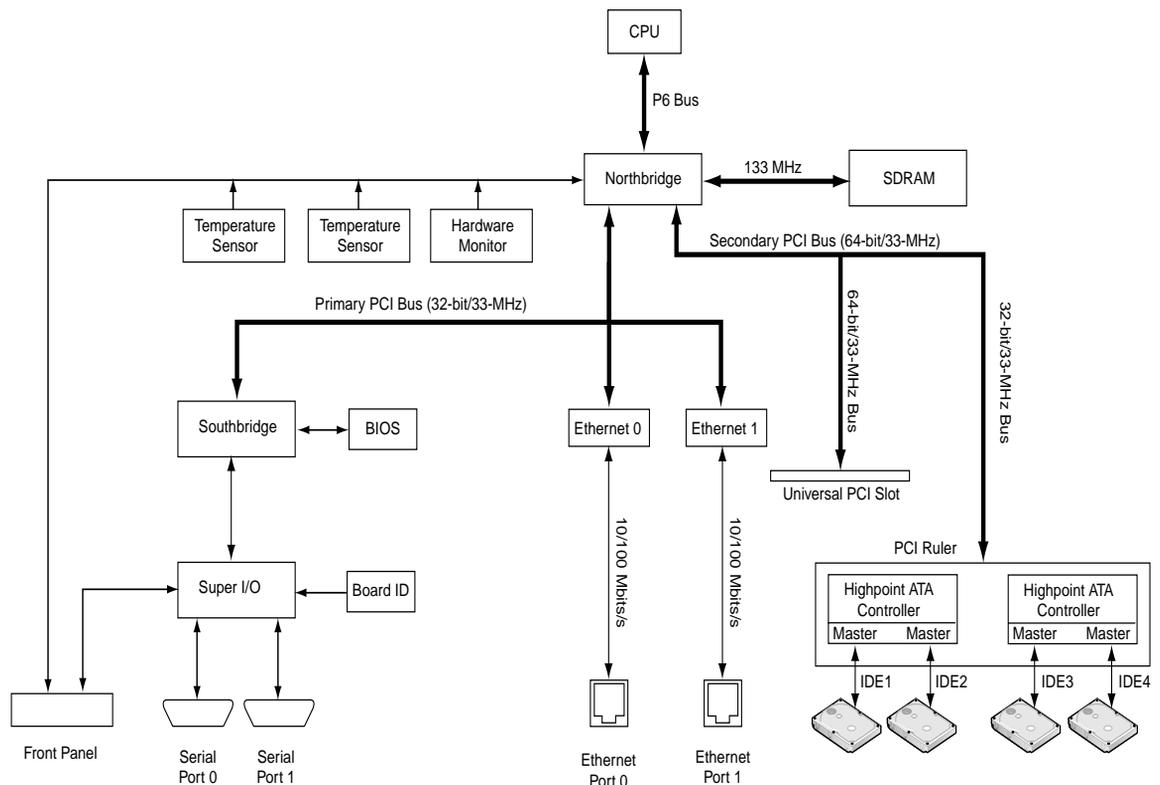


Figure 1-3 RaQ XTR Simplified Block Diagram

1.4 External Interfaces

The RaQ XTR platform interfaces to the external world through the front and rear panels, as explained in the sections that follow.

1.4.1 Front Panel

The front panel has the following features and interfaces:

- Logo badge. This acts as the power on button, power LED, and fault indicator LED (when flashing).
- LCD screen. The 16 x 2 backlit screen displays setup options and status messages.
- Pushbuttons. Six pushbuttons are used for setup and configuration.
- Indicator LEDs. There is one drive activity LED for each installed hard disk drive, Ethernet link active and Ethernet activity LEDs for each of the two Ethernet ports, and an LED indicating accesses to the Web.

1.4.2 Rear Panel

The rear panel contains the following features and interfaces:

- Two RJ-45 Ethernet port connectors with built-in LEDs that indicate link active status and Ethernet activity.
- Two DB-9 Serial port connectors
- One USB connector
- One 64-bit/33-MHz PCI expansion slot
- One AC power socket for connecting an external AC power cord

1.5 Product Configurations

The product configuration for the RaQ XTR platform is summarized in Table 1-1.

Table 1-1 *RaQ XTR Product Configuration*

Component	Description
Chassis	1RU basic chassis; 1.75 in x 17.75 in x 22.75.
Front Bezel	Bezel extends and rotates up and down, with detents every 30°.
Drive Bays	Up to four removable drive shuttles, each containing IDE hard disk drives.
Cooling Fans/Ducting	Six high-speed 40 mm x 20 mm fans.
Power Supply	Single 180W (continuous) power supply.
Motherboard	
CPU	Single Pentium III processor (733 or 933 MHz).
Cache	On-Die 256KB L2.
System Bus Speed	133 MHz.
Northbridge/ Southbridge Chipset	ServerWorks ServerSet III LE 3.0.
Memory	Four DIMMs (up to 2 GB).
External PCI slot	One half-length 64-bit/33-MHz slot.
Ethernet connectors	Dual 10/100 Mb/s with built-in link status and activity LEDs.
RAID	Software RAID 0/1/5. HighPoint IDE controller enables drive removal.

1.6 Features

The RaQ XTR platform features are:

- Single Intel PGA 370 Pentium III processor.
- 32 MB to 1 GB SDRAM DIMMs (per slot), with a maximum size of 2 GB. The memory bus runs at 133 MHz.
- Two HighPoint Technologies dual-master channel IDE controllers on the PCI ruler.
- ServerWorks ServerSet III LE 3.0 chipset (Northbridge and Southbridge).
- National Semiconductor PC97317 Super I/O chip.
- National Semiconductor DP83815 Ethernet network interface (RJ-45).
- 64 bit wide/33-MHz PCI slot, half-length, fully compliant to PCI specification.
- Sheetmetal enclosure with black vinyl decorative top cover; shipped with two rack-mounting brackets.
- Extensible, rotating front control panel with backlit LCD display, menu navigation buttons, disk status indicators, and power-on switch.
- Front mounted removable drive bays.
- Up to six 40 mm x 20 mm fans, operating from 12V.
- Storage capacity options (factory installed):
 - Up to four removable IDE hard drives (built-in software RAID 0/1/5 supported by IDE hardware controllers)
- Single 180 W power supply capable of remote sense, remote inhibit, and 5V trickle.

1.7 Benefits

The benefits of the RaQ XTR platform are:

- Extensibility
 - Can be configured with mid-range functionality (733-MHz processor) or high-end functionality (933-MHz processor).
 - Can be configured with from one to four removable drives.
 - 64-bit/33 MHz PCI expansion for newer high-performance peripherals.
- Ease of Use
 - Cobalt user interface.
 - Easy to operate front panel with backlit LCD indicator, indicator LEDs, and pushbuttons.
 - Easily removable/replaceable drive bays.
- High Performance
 - FC-PGA Pentium III processor.
 - 133-MHz front side bus at 1.06 GB/s.
 - ServerWorks ServerSet III LE 3.0 chipset.
 - Disk I/O subsystem on 64-bit/33 MHz PCI bus with each IDE drive controlled from a dedicated master channel.
 - Network I/O isolated on 32-bit PCI bus.
 - Up to 2 GB ECC PC133 SDRAM.
 - IDE software RAID 0/1/5.
 - Support for 7,200-RPM ATA66 drives.
- High Reliability/Availability and Serviceability
 - Front-removable RAID 0/1/5 IDE hard disk drives.
 - ECC memory.
 - Monitoring of CPU temperature and fan RPM.
 - Front panel with indicators for disk activity, network status, network activity, and server fault warning LED (built into the power button).
 - Protected soft power off switch (linked to proper O/S shutdown).
 - Password protectable front panel controls.
 - 1RU, low chassis depth for easy handling and mounting.
 - Front- and mid-mountable.
 - Virtually cable-less design.

Functional Description

This chapter is a detailed functional description of the RaQ XTR hardware platform. It is organized on a block-by-block basis and contains the following sections:

- “Introduction” on page 2
- “Block Diagram” on page 3
- “Main Board” on page 3
- “Disk Storage” on page 7
- “External PCI Expansion” on page 7
- “Front Panel” on page 7
- “Rear Panel” on page 10
- “Power” on page 10

2.1 Introduction

The main architectural systems and components on the RaQ XTR platform are:

- Main Board
- Disk Storage
- External PCI Expansion
- Front Panel
- Jumpers and Options
- Power

Each of these are explained in some detail in the following sections.

2.3.1 Processor

The RaQ XTR architecture primarily supports Intel's Pentium III processor (other value-priced processors may also be compatible). The processor fits in a 370-pin pin grid array (PGA) socket on the main board.

The Intel Pentium III (PIII) for PGA 370 is latest version of the Intel P6 family in the IA-32 processor line. It uses the industry standard x86 instruction set and, at the time of this writing, is offered at internal clock frequencies from 550 to 933 MHz. The PIII is packaged in a 370-pin Flip Chip Pin Grid Array (FC-PGA) for improved handling protection and ZIF socketability. The PIII is manufactured using Intel's 0.18 micron process technology, known as Coppermine. The PIII is available in versions that support either a 100-MHz or a 133-MHz front side bus, and integrates high performance 16 KB instruction and 16 KB data, nonblocking, level-one cache. It is also fabricated with 256 KB of Advanced Transfer Cache (on-die, full speed level-2 cache with error correction code). The PIII is designed to enable systems which are scalable for up to two processors.

2.3.2 Memory

2.3.2.1 SDRAM

The SDRAM DIMM memory is either single or double-banked 64, 128, and 256-Mbit (depending on the size of the memory module) registered ECC PC133 SDRAM high-density modules. The system board supports up to four 168-pin slots and will support from 32 MB to 1 GB of memory per slot. A maximum of 2 GB of memory may be installed. The maximum height of the module is 1.75". The DIMMs are mounted using angled DIMM sockets.

2.3.2.2 FLASH

The FLASH memory (AMD AM29F080B) is 8 Mbit, 70–150 ns, and 5.0 V only, organized as 1024 KB of data and divided into 16 uniform sectors of 64 KB each. The system FLASH memory contains the system bootstrap and system diagnostics.

2.3.3 Northbridge

Northbridge is a generic term for the single integrated circuit that connects the CPU to the system memory, PCI, and I²C busses. Other functions are provided by the Southbridge chip.

The Northbridge chip in the RaQ XTR platform is the NB6635 IC from the ServerWorks ServerSet III LE 3.0 chipset and is contained in a 576-pin BGA package. The NorthBridge IC serves as the interface between the memory bus, CPU bus, and I/O busses.

The Northbridge features are:

- Supports multiple processors
- 100- and 133-MHz front side bus capable
- Supports ECC, PC133 SDRAM
- Supports 32- and 64-bit PCI technology
- Advance I/O caching technology

2.3.4 Southbridge

Southbridge is a generic term for the integrated circuit that controls the IDE bus, USB, plug-n-play support, the PCI-ISA bridge, keyboard/mouse controller, power management, and various other features. Other functions are provided by the Northbridge chip.

The Southbridge chip is the IB6566 IC from the ServerSet III LE 3.0 chipset, and is contained in a 352-pin BGA package. The Southbridge IC serves as the bridge between the PCI bus and the ISA bus and IDE controllers.

2.3.5 Super I/O Controller

The Super I/O IC (National PC97317) provides legacy I/O functionality not available in the LE 3.0 South Bridge. On the RaQ XTR platform, the Super I/O provides Real Time Clock (RTC) timekeeping, Advanced Power Control (APC), Watchdog functionality, two enhanced serial ports (UARTs), and 24 General-Purpose Input/Output (GPIO) signals.

2.3.6 Ethernet

Each network I/O port is controlled by a National Semiconductor DP83815 dual Ethernet controller. The DP83815 is a single-chip 10/100 Mbit/s Ethernet Controller for the PCI bus. Each controller is tied to the 32-bit/33-MHz PCI bus to isolate the 64-bit/33-MHz bus for storage I/O.

The DP83815 fully implements the V2.2 33-MHz PCI bus interface for host communications with power management support. Packet descriptors and data are transferred via bus-mastering, reducing the burden on the host CPU. The DP83815 can support full duplex 10/100 Mbits/s transmission and reception, with minimum interframe gap.

2.3.7 Hardware Monitoring and System Management

In addition to the hardware reporting functions discussed in the previous section, the system also incorporates other system management functions and hardware monitoring for high reliability. These functions are listed below:

- **Watchdog Timer**—As part of the Super I/O, the watchdog timer resets the system in the event of a system lockup.
- **CPU Thermal Sensor**—A thermal sensor is used to measure the CPU temperature.
- **Fan Speed Monitoring**—Each chassis fan is monitored for RPM drop. An alarm is triggered when a fan drops below a predetermined speed.
- **Serial Ports**—One serial port is available for console mode access to the server. A second serial port can be used with an uninterruptible power source (UPS).
- **5V Trickle**—Always-on power is maintained on the Super I/O to support soft power features.
- **Removable Drives Monitoring**—Removal of each drive is monitored through a hardware switch.

2.4 Disk Storage

The RaQ XTR server can be equipped with up to four removable 7,200 rpm IDE drives. Each drive is mounted on a removable shuttle that contains two LED indicators, a limit switch, and a decorative shuttle bezel. The drive is removed by rotating the front bezel down, then pulling the drive shuttle using a finger hole in the shuttle bezel. The drive is replaced using the reverse process.

IDE drives can be removed and replaced under control of two HighPoint 370 IDE controllers, which enable graceful shutdown of the IDE drive. The HighPoint controllers also support RAID 0/1/5 through software drivers. The controllers are specified to handle up to the ATA-100 standard. The IDE controllers reside on the 64-bit, 33-MHz bus and are located on a T-shaped signal distribution backplane (the PCI ruler) that contains the supporting hardware and the SCA blindmate connectors.

To minimize power consumption at startup, the power supplied to the drives is staggered through the use of additional circuitry on the IDE bus.

2.5 External PCI Expansion

The RaQ XTR platform supports a single, standard half-length (6.875") PCI v2.2 card on the 64-bit PCI slot on the main logic board. This PCI slot is on the 33-MHz PCI bus. The PCI slot supports half-length 64-bit, 33-MHz PCI cards.

2.6 Front Panel

The front panel is shown in Figure 2-2.

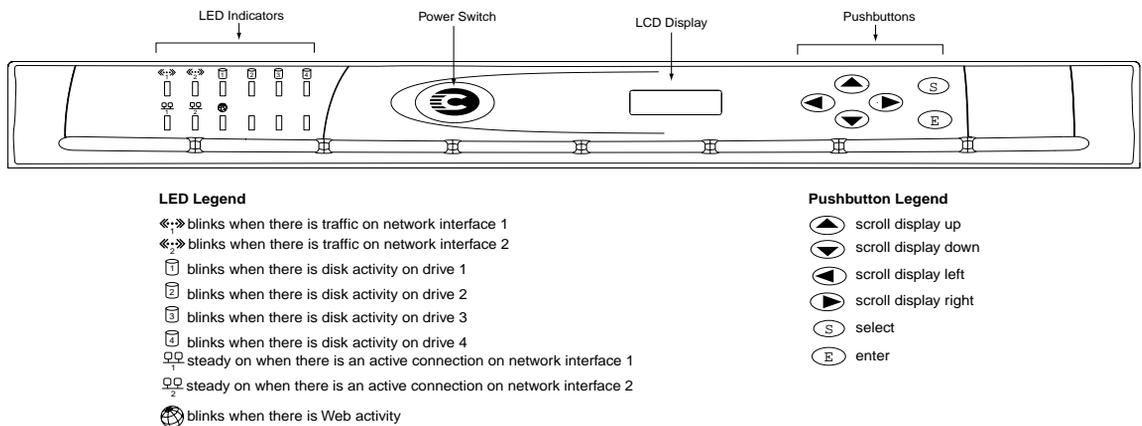


Figure 2-2 Front Panel Components and Indicators

2.6.1 Command Interface

The front panel accepts commands over the I²C bus, for controlling and monitoring the LCD panel and pushbuttons.

Power-on is controlled with soft power-on functions in the Super I/O module. Using trickle power from the power supply, the Super I/O allows power on/off control of the module (through the power supply remote power on/off) to always be active.

2.6.2 Server Status LEDs

The server status LEDs indicate network connection type, connection status, and hard disk activity (see Table 2-1).

Table 2-1 Server Status LEDs

LED Icon	Meaning (when illuminated)	LED Color
 1	Ethernet 1 Tx/Rx Traffic Activity	Green
 2	Ethernet 2 Tx/Rx Traffic Activity	Green
 1	Disk 1 Activity	Green
 2	Disk 2 Activity	Green
 3	Disk 3 Activity	Green
 4	Disk 4 Activity	Green
 1	Network Link 1 Active Connection	Green
 2	Network Link 2 Active Connection	Green
	Web Activity	Green
	Spare ¹	Green
	Spare ¹	Green
	Spare ¹	Green

1. Spare LEDs are not connected

2.6.3 Power-on Pushbutton

The pushbutton “C” logo is illuminated by an LED that is lit when an AC power cord is connected to the server and is supplying power from a wall outlet. This LED is on as long as AC power is being supplied to the server, even if the server is not powered up.

A power-on button located behind the “C” logo in the center of the front bezel is a non-latching momentary pushbutton. The pushbutton is directly tied to a control line on the Super I/O module that controls remote power on/off of the power supply. This button, when depressed, powers on the server (if the server power is off). If the server is already on, the signal from the button causes the server shutdown menu to appear on the LCD display. Following the instructions on the LCD allows execution of the proper server shutdown sequence.

Note: If the power on button is held depressed for more than five seconds when the server is powered up, the server is forced to power down. This may cause OS damage.

2.6.4 Server Fault Warning Light

In the event of a system fault such as a disk or fan failure, the server warning light behind the “C” logo flashes.

2.6.5 LCD Panel and Pushbutton Cluster

The LCD panel and pushbutton cluster provides easy server setup and administration. The backlit LCD panel displays two lines of 16 characters each. The pushbutton cluster contains six buttons. LCD operation can be optionally secured with a user-defined password entered from the pushbuttons.

2.6.5.1 LCD Panel

The LCD Panel allows you to:

- Change the network configuration information, which is useful if the location of the RaQ XTR is changed
- Configure the uninterruptible power supply (UPS)
- Reboot, which restarts the entire RaQ XTR
- Reset and change the RaQ XTR Administrator password
- Exit from the LCD commands without making any changes
- Select boot options (hold the Select button depressed during power up)
- View boot messages
- Reset the server (password protected)

2.6.5.2 Pushbutton Cluster Assignments

- Left
- Right
- Up
- Down
- Select
- Enter

2.7 Rear Panel

The rear panel is shown in Figure 2-3.

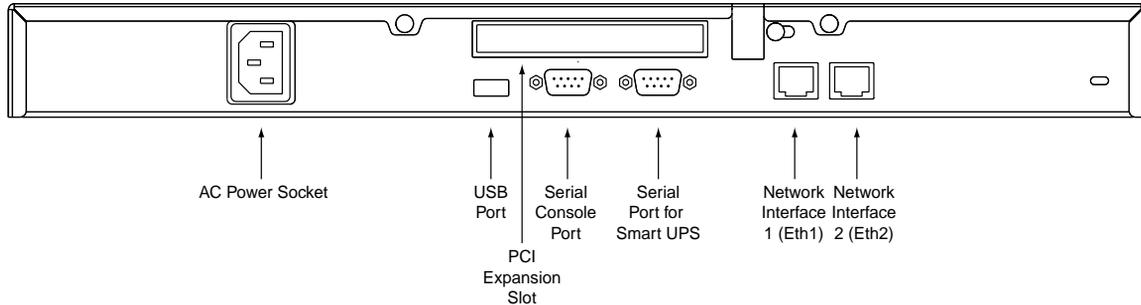


Figure 2-3 Rear Panel Components

2.8 Power

The RaQ XTR operates from a single 180W power supply. The power supply supports ATX functionality (remote sense, remote inhibit, and trickle power).



Caution: The power connector pin assignments on the motherboard are not ATX-compatible. An ATX power supply should never be plugged into this connector.

Mechanical Description

This chapter describes the mechanical aspects of the RaQ XTR hardware platform and contains the following sections:

- “Introduction” on page 1
- “Mechanical Design Description” on page 2
- “Printed Circuit Board” on page 4
- “Packaging” on page 6

3.1 Introduction

Figure 3-1 and Figure 3-2 show the front and rear perspective views of the RaQ XTR platform.

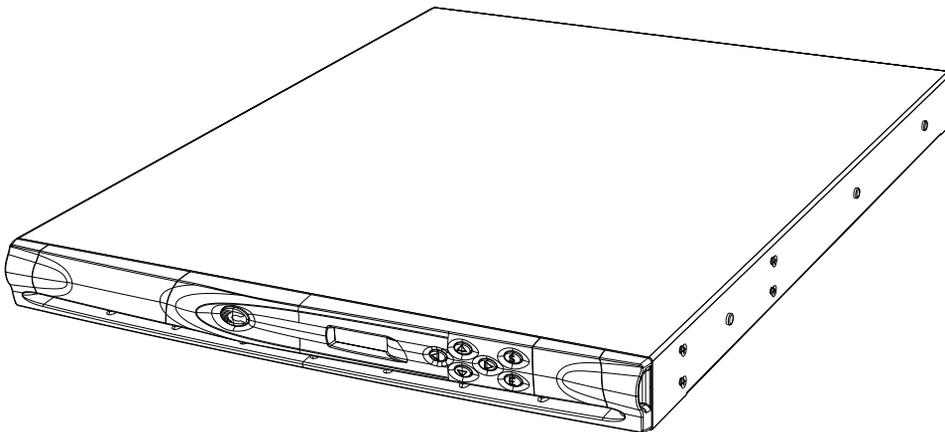


Figure 3-1 Front View

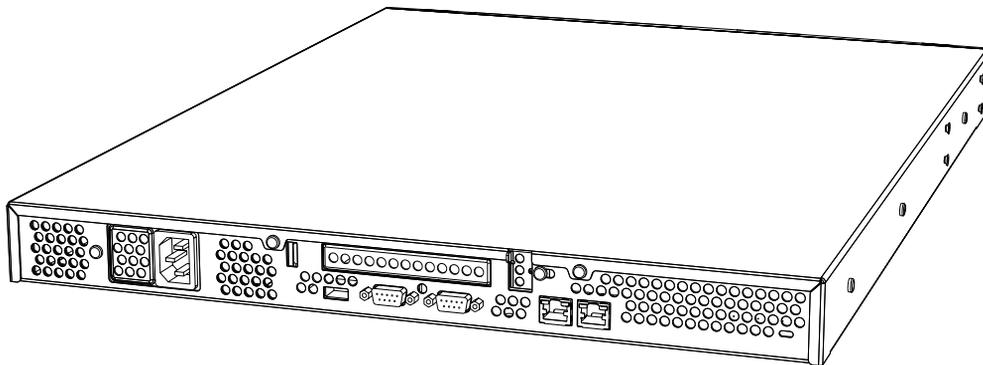


Figure 3-2 Rear View

3.2 Mechanical Design Description

The RaQ XTR mechanical design is based on the following:

- High density rack mounting
- Efficient thermal design
- Extensible design to accommodate all functionality required by target customers
- Ease of use and industrial design

3.2.1 High Density Rack Mounting

The RaQ XTR enclosure is designed to occupy a 1U height space (1.75”) in a standard 19” equipment rack. At approximately 1.75 in x 17.75 in x 22.5 in. and approximately 28 lbs (with four drives), the enclosure is designed to allow high-density mounting of 42 units in a 42U server rack. The enclosure is also designed for desktop use.

3.2.2 Efficient Thermal Design

The enclosure has front-to-back cooling to bring in cool air from the outside, convection cool the internal components, and exhaust the heated air through the rear. To minimize choking at the intake, the front bezel and drive shuttle bezels are purposely designed to have oversized air intakes to allow large volumes of air to enter the chassis. The drive shuttles are also designed for minimum top and bottom air blockage to prevent choking. Conversely, to minimize backpressure at the exhaust, the rear panel is perforated with exhaust venting. In addition, the overall mechanical design is virtually cable free to minimize air blocking due to wide cabling.

Six 40 mm x 40 mm x 20 mm high cubic feet per minute (CFM) axial fans are mounted in the middle section (halfway down the depth) of the chassis with the four drive bays near their intake, and the main logic board and power supply subsystem at their exhaust. The fans are divided into two banks of fans—one set that cools the main logic board, and one that cools the power supply. To optimize the thermal design, the main logic board is purposely designed to have the processor as close as possible to the high-pressure exhaust side of the fans. By keeping the processors within 1.5 inch from the fan exhaust, the heat sinks receive maximum convection cooling. To allow room for growth, the area around the processors is designed to accommodate oversized custom-built heat sinks. The relatively short depth of the box allows for a low pressure drop from the exhaust of the fans to the rear exit of the chassis.

3.2.3 Extensible Design

The following features allow for extensibility:

- One to four hard disk drive capacity
- 64-bit PCI bus
- Four DIMM memory slots

3.2.4 Front Panel and Server Controls

The front plastic decorative bezel contains server status indicator LEDs, a power-on button, and a backlit LCD panel with a cluster of six pushbuttons. The front panel is extendible and rotates down to allow access to the removable drives. The front panel LCD display and pushbuttons are visible and operable from the extended and rotated position.

3.3 Printed Circuit Board

The main PCB component layout is shown in Figure 3-3. The main PCB components are shown in Figure 3-4.

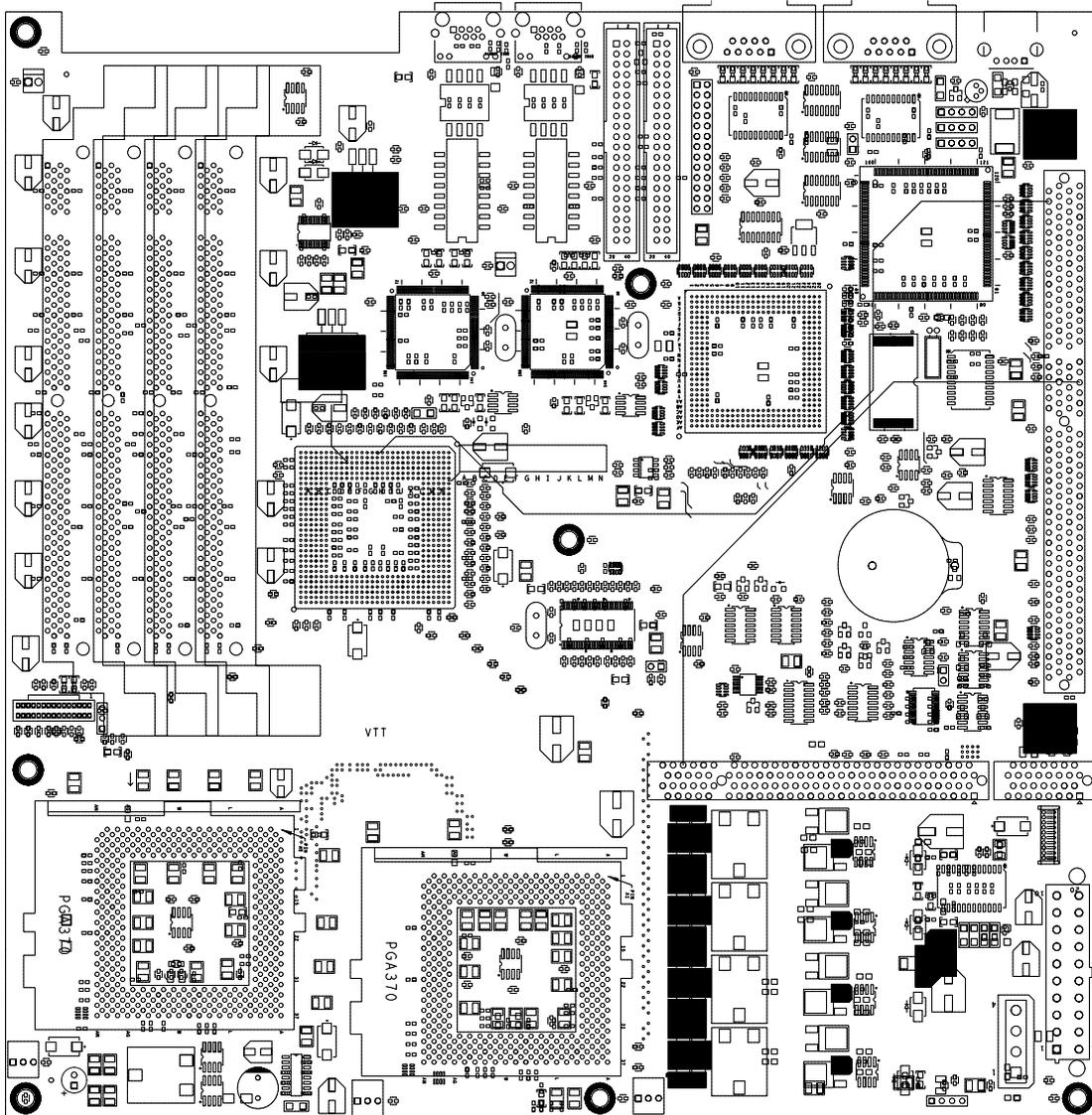


Figure 3-3 Main Logic Board PCB Component Layout

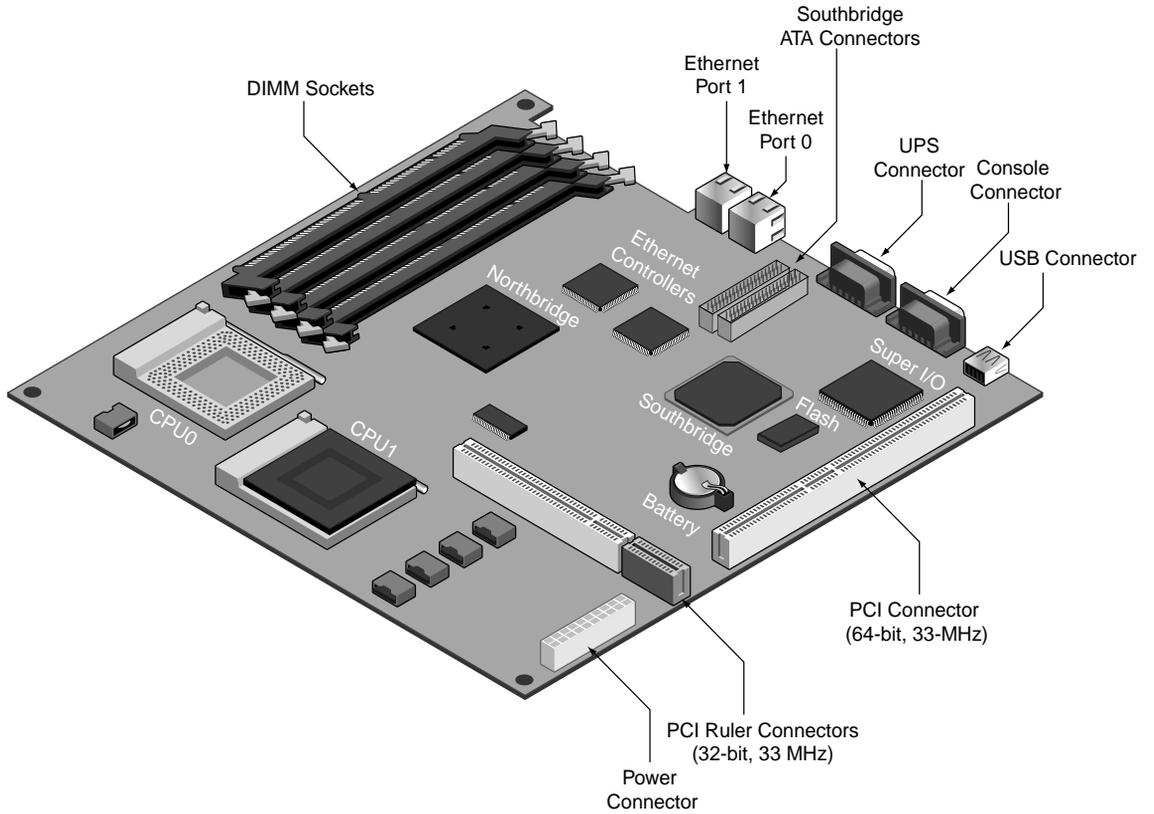


Figure 3-4 Main Components

3.4 Packaging

The product packaging provides protection of the contents against the mechanical and environmental hazards. The packaging consists of the following:

- Product unit package
- Shock cushions
- Accessory box
- Dust protective plastic wrap

Package testing complies with the ISTA-2A testing protocol. The ISTA-2A protocol consists of:

- Random vibration test: 1-200Hz, intensity of 1.15G rms, 1 hour, per ASTM D4728
- Compression test: 240 lb. load on top surface, 1 hour, per ASTM D642
- Drop test: 10 drops at 38 inches, per ASTM D5276

Specifications

This chapter describes the environmental, mechanical, electrical, vibration, and regulatory specifications of the RaQ XTR hardware platform and contains the following sections:

- “Environmental Specifications” on page 2
- “Mechanical Specifications” on page 2
- “Power Specifications” on page 2
- “Shock and Vibration” on page 3
- “Regulatory Approvals” on page 3

4.1 Environmental Specifications

Table 4-1 summarizes the environmental specifications of the RaQ XTR platform.

Table 4-1 Environmental Specifications

Parameter	Operating	Non-Operating
Temperature	32° F to 95° F (0° C to 35° C)	14° F to 122° F (-10° C to 50° C)
Humidity (non-condensing)	10% to 90%	5% to 93%

4.2 Mechanical Specifications

The RaQ XTR platform has the following mechanical characteristics:

Height:	1.75 in. (1 rack unit)
Width:	17.75 in.
Depth:	22.75 in.
Platform Weight:	28 lb. (with four drives)
Drive Weight:	2 lb. (drive and drive sled)

4.3 Power Specifications

The power supply autosenses the input voltage and automatically switches to accommodate the supplied voltage. The parameters are as follows:

- Starting Voltage: 85 VAC
- Working Voltages: 90 to 260 VAC
- Switchover Voltage: 150±10 VAC

Table 4-2 lists the power supply output parameters.

Table 4-2 Power Supply Output Parameters

Normal Output Voltage	Load Current	
	Maximum	Minimum
+5V	16.0	1.6
+12V	7.0	1.0
-5V	0.2	0.0
-12V	0.7	0.1
+3.3V	10	1.0
+5VSB	1.5	0.15

4.4 Shock and Vibration

Table 4-3 shows the RaQ XTR shock and vibration test parameters.

Table 4-3 Shock and Vibration Parameters

Parameter	Value
Operating Vibration	
z axis (vertical)	0.001 G ² /Hz (0.7 GRMS)
bandwidth	Random 5–500Hz
x and y axes (in plane)	0.004 G ² /Hz (1.08 G RMS)/0.0006G ² /Hz (0.3 GRMS)
bandwidth	Random 10–300Hz/300–450Hz
Non-Operating Vibration	0.0098 G ² /Hz (2.2 G RMS)
bandwidth	Random 10–300Hz/300–450Hz
Operating Shock	6 G, 11 ms
Non-Op Shock	30 G, 11 ms

4.5 Regulatory Approvals

4.5.1 Safety

UL 1950/CSA C22.2 No.950, EN 60950, IEC 950

4.5.2 Emissions and Immunity

EN55022 Class A, AS/NZS 3548 Class A, VCCI Class A, FCC Class A, EN 55024, AS/NZS 4252.1, EN 61000-3-2 Class A, and EN 61000-3-3

4.5.3 Certifications

Safety: TUV (US and Canada), CE Mark

EMC: CE Mark, FCC Class A, VCCI Class A, Austel

4.5.4 Statement of EMI Compliance

A statement of EMI compliance is shown in Figure 4-1.



ELECTRO MAGNETIC TEST, INC.
1547 Plymouth Street, Mountain View, CA 94043 Tel: (650) 965-4000 Fax: (650) 965-3000

Statement of Compliance

Presented to

COBALT NETWORKS, INC.

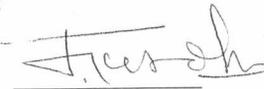
The following model was tested and found to be fully compliant with EN 55022 Class A, AS/NZS 3548 Class A, VCCI Class A, FCC Class A, EN 55024, AS/NZS 4252.1, EN 61000-3-2 Class A, and EN 61000-3-3.

NETWORK SERVER APPLIANCE
M/N: RAQ XTR

Tested at Electro Magnetic Test, Inc. on November 3, 7, 8, 9, 15,
December 5, and 6, 2000.

Certificate Number: 15745


Kevin Bothmann
Lab Manager


Jay Gandhi
President

RP-1

Figure 4-1 Statement of Compliance

System Power Analysis

This appendix contains a detailed power analysis of the RaQ XTR and includes the following sections:

- “Background” on page 1
- “Steady State Power States” on page 1
- “Transient Maximum Power States” on page 3
- “Power Consumption Results” on page 7
- “Dominant Power Consuming Elements” on page 7
- “Effect of Active Power Factor Supplies” on page 10

A.1 Background

General and detailed power input tests were performed on the RaQ XTR. The test results are published in this appendix.

Power that can be sustained for more than 5 seconds is known as steady state. Power states lasting less than 3 seconds are known as transient. The states are discussed in the following section.

A.2 Steady State Power States

A.2.1 Idle

The Idle power state represents the system power after the OS has booted and is idling with CPU usage at a minimum (1 to 2 percent). By inference, the rest of the system (memory, disk and the network) is also in a relatively idle state.

A.2.2 Active

The Active power state is when the system is moderately loaded (delivering 50% of the rated Specweb96¹ capacity). The power depends on the RaQ XTR servicing typical traffic. 50% of the rated capacity is approximately 50 simultaneous connections (200 Specweb96 operations), which indicates a very busy website.

A.2.3 Maximum Usage

The Maximum Usage power state is when the system is delivering 100% of the rated Specweb96 web hits.

Note that custom programs such as “burnP6” can have much worse system power requirements than just the maximum web hits requirements. This is because these programs tend to exercise the CPU to 100% of its capacity. This overload can be caused by any inadvertent spin loop of any script, program, or application.

Table A-1 indicates the power consumption of the RaQ XTR as a function of SPECweb96 operations.

Table A-1 Power Consumption vs. SPECweb96 Operations

SPECweb96 Operations	Power Consumption
100	97.8 W
200	97.8
300	99.8
400	104.2
500	103.1
600	105.3
700	106.5
777	109.8

1. SPECweb96 is a standardized benchmark for measuring basic Web Server performance.

A.3.2 Soft Power Up AC Current

Soft power up AC current occurs immediately after the main board and disk receive power. This current can be 3 times the normal current in certain power supplies. The soft power up current usually lasts for 30 to 40 ms. Because the soft power sequence allows units to individually power on, this is less of a problem.

A.3.3 Disk Spin Up

Disk spin up consumes 2A @ 12V or 26 W (including 2.5 W @ 5V) per disk drive. Current after spin up drops to a quiescent current of 400mA. The overload duration lasts for approximately 3 seconds. As shown in the RaQ XTR power measurements, staggered power is a very useful feature that reduces the overall power requirement. Figure A-2 shows the benefits of staggered power up.

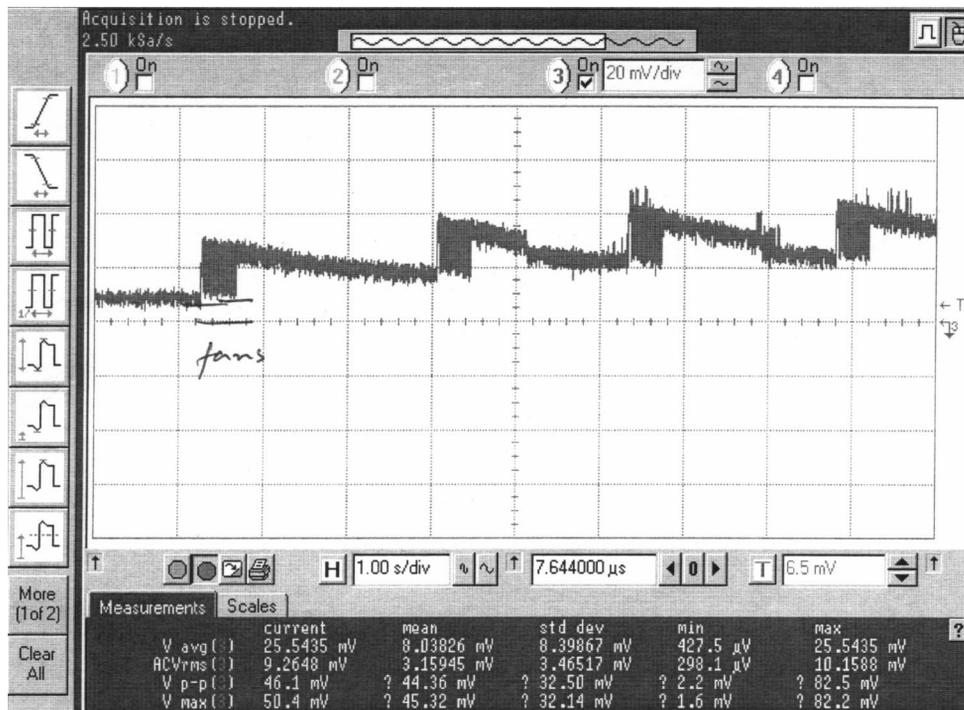


Figure A-2 12V Current At Power Up With 4 Drives and 6 Fans in RaQ XTR Showing the Benefit of Staggered Power Up. Vertical = 2A/division; Horizontal = 1s/division

A.3.4 High CPU Usage

CPU utilization causes a linear increase in the power consumption. CPU usage of 2% causes a power consumption of 5W. CPU usage of 100% causes a power consumption of 12W to 35W, depending upon the processor. Thus a sudden increase in CPU usage (beyond 50% utilization) can cause a transient load state. Figure A-3 shows the CPU core current at maximum CPU usage and Figure A-4 shows the CPU core current at system idle.

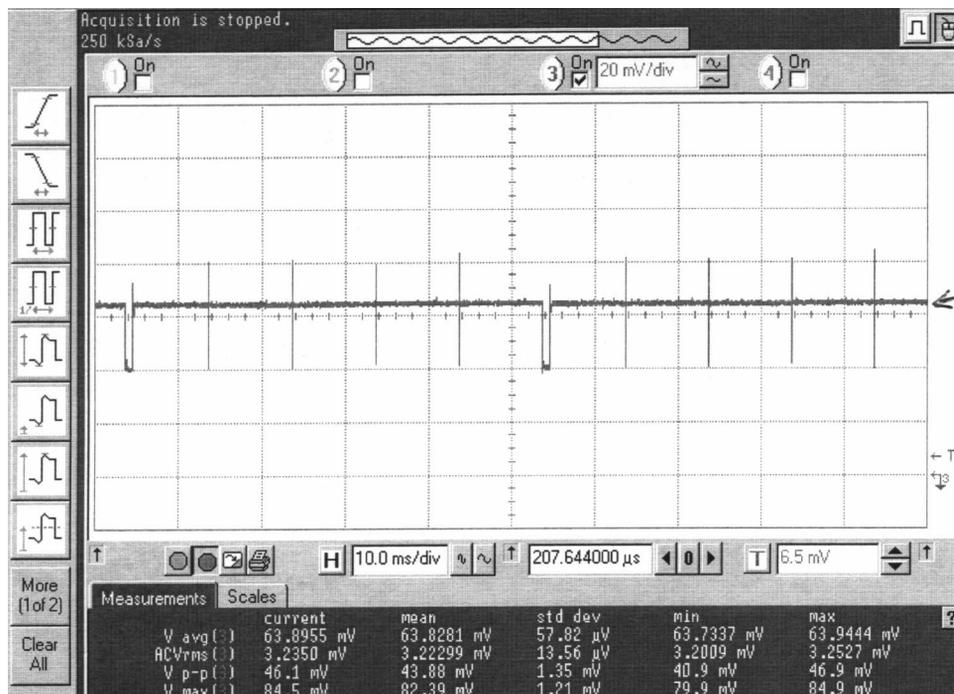


Figure A-3 CPU Core Input Current @ 5V at Maximum CPU Utilization
Vertical = 1A/division; Horizontal = 10ms/division

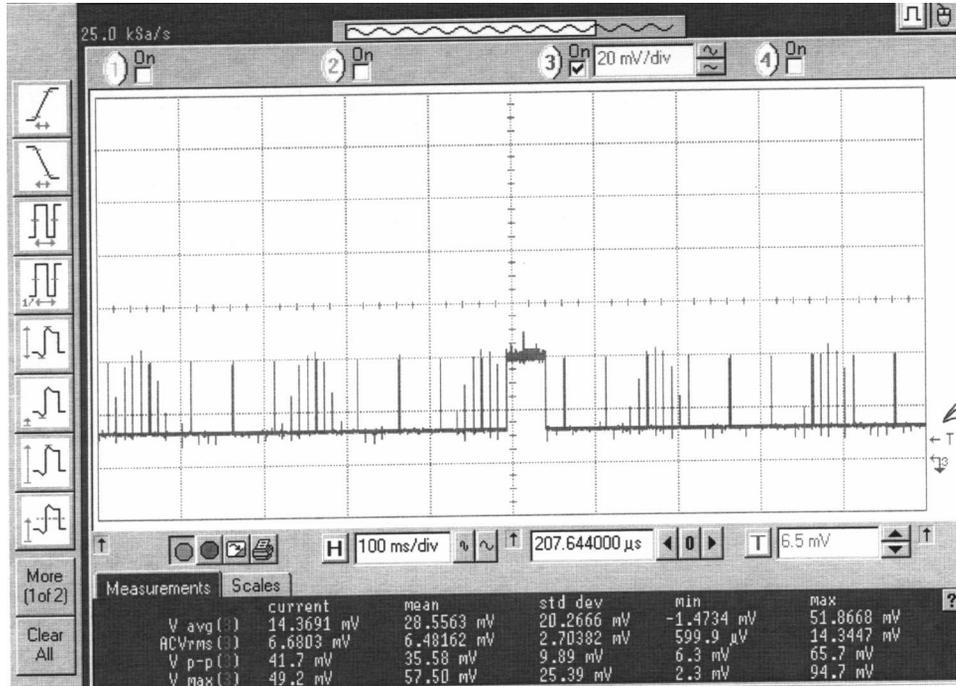


Figure A-4 CPU Core Input Current @ 5V at System Idle
Vertical = 1A/division; Horizontal = 10ms/division

A.4 Power Consumption Results

Testing shows that the RaQ XTR consumes power in various states as outlined in the following list:

- Power Up—127W
- Booting—90W
- Idle—82.5W
- Active—104W
- Maximum—109.5
- Maximum Theoretical—120W

Note: The measurements were made with a power meter, with the RaQ XTR system configured with a 1 GHz Pentium III processor, 1 GB of RAM, four Seagate hard disk drives, and no PCI, USB, or SCSI utilization.

A.5 Dominant Power Consuming Elements

A.5.1 Power Supply Losses

There are currently power conversion losses of up to 34%. Hence, one-third of the loss is in the power supply. A 90% percent efficient power supply would save 20W from the total budget in this design.

A.5.2 CPU (1Ghz)

The CPU consumes from 5W to 40W. Core voltage converters have an efficiency of approximately 78%. Actual CPU usage can be calculated using this efficiency rating. For example, a 78% efficiency results in 4W to 32W of real power consumed.

A.5.3 Hard Disk

Each hard disk consumes between 8W and 24W.

A.5.4 Fans

The steady state fan power consumption is 7.2W for all 6 Fans. A more efficient circuit design would require less extraction of heat, resulting in less fan power needed.

A.5.5 Memory

The SDRAM subsystem operates from a 3.3V supply. The base average current for the 3.3V supply results in less than 8W. Increased memory activity lifts this to approximately 12W. Increased memory size does not appreciably increase the maximum current; however, it affects the average standby current.

A.5.6 Miscellaneous 5V Power

1.3A of 5A current is drawn for various elements, which accounts for approximately 8W of power.

A.5.7 System Load

The chart shown in Figure A-5 shows the system power loading of a RaQ XTR system with the standard (66% efficient) power supply, a single 1-GHz CPU, and four hard disk drives. The chart breaks down the power drawn by different system elements. As shown in the chart, power supply inefficiency and the hard disks account for most of the power consumption.

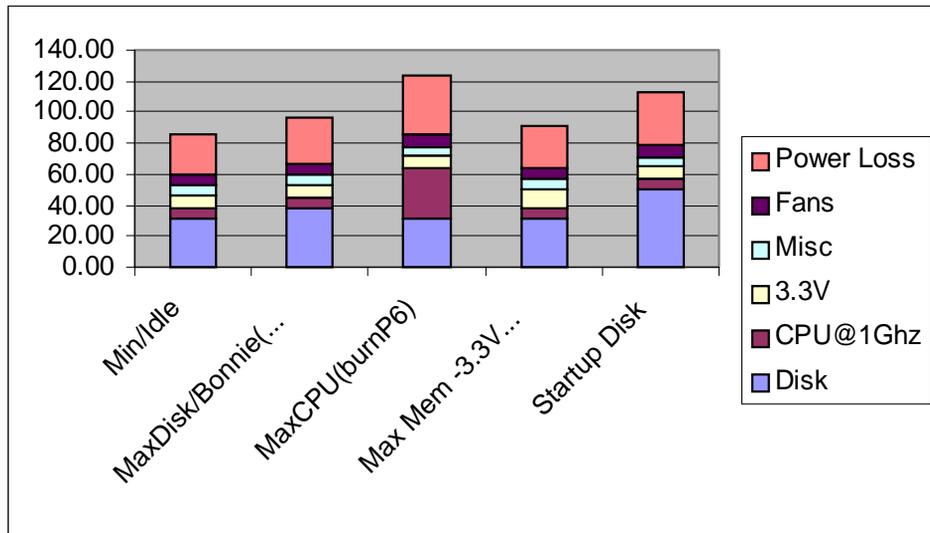


Figure A-5 System Load (60% Efficient Power Supply)

Figure A-6 shows the hypothetical system power loading using a 90% power supply, a single 1-GHz CPU, and four hard disk drives. In this case, power supply inefficiency has much less of an effect on the power consumption.

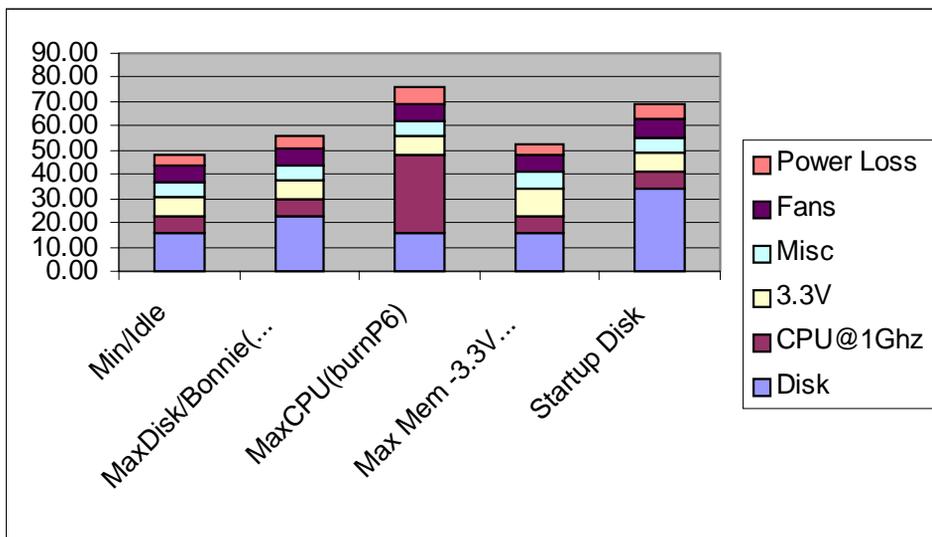


Figure A-6 System Load (90% Efficient Power Supply)

A.6 Effect of Active Power Factor Supplies

Active power factor supplies can decrease the crest factor (CF) of the input current, and improve the power factor (PF) from 70% to above 95%. The overload occurs for 2 to 3 ms. Table A-2 shows the differences between active and non-active power factor supplies.

Table A-2 Comparison of Active and Non-Active Power Factor Supplies

Power Supply Type	Power Factor	Crest Factor	Peak Current (CPU Load < 2%)
Non APC	0.7	2.8	2.8A
APC	> 0.95	1	1A

Even though the CF and PF increase, the efficiency of the unit deteriorates or stays the same for a Power Factor Correction (PFC) supply. Obviously, the price would be up to 20% higher because of an added conversion stage. Figure A-7 shows the AC current for a PFC power supply at system idle, and Figure A-8 shows the current for a non-PFC power supply.

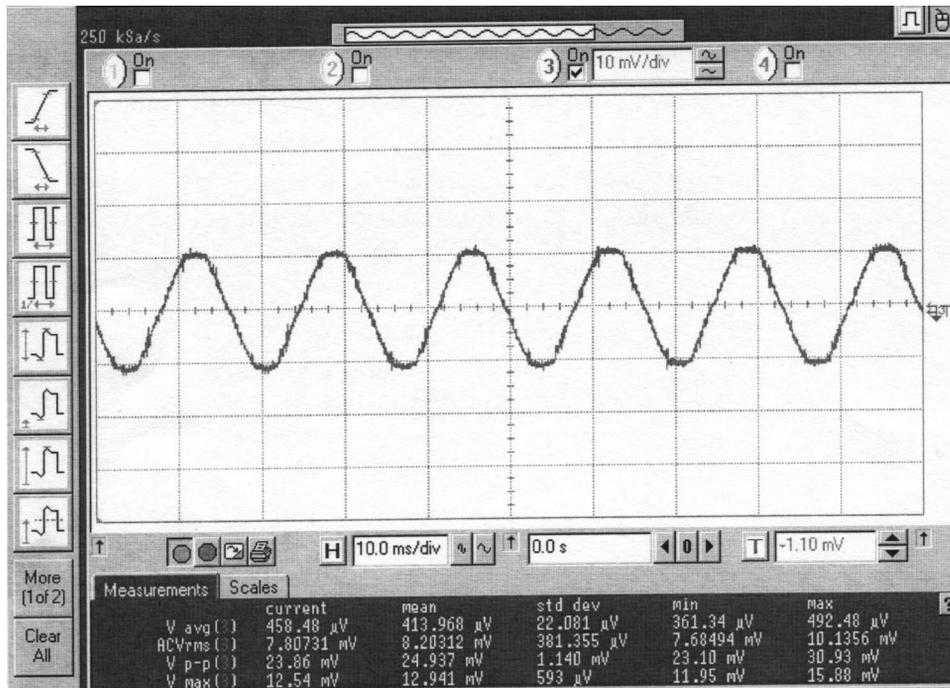


Figure A-7 PFC Power Supply AC Current at System Idle
Vertical = 1A/division; Horizontal = 10ms/division

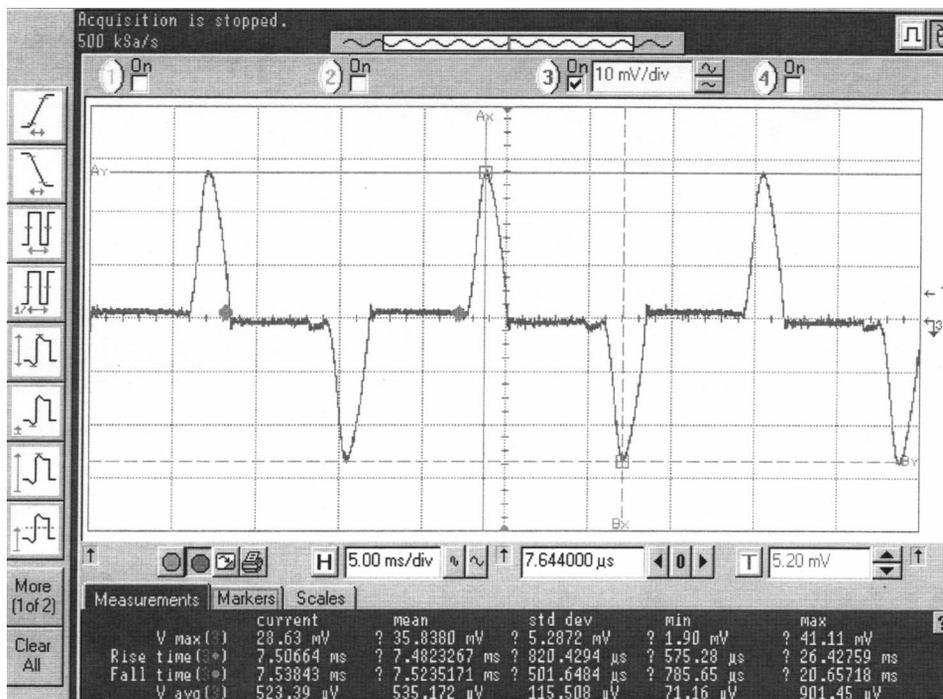


Figure A-8 Non PFC AC Current at System Idle
Vertical = 1A/division; Horizontal = 5 ms/division

Note how the peak in the ordinary (non-PFC) supply is 2.6X the Power Factor Corrected supply.

