



Developer Note

Power Macintosh G3



10/12/97
Technical Publications
© Apple Computer, Inc. 1997

🍏 Apple Computer, Inc.
© 1997 Apple Computer, Inc.
All rights reserved.

No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, mechanical, electronic, photocopying, recording, or otherwise, without prior written permission of Apple Computer, Inc., except to make a backup copy of any documentation provided on CD-ROM. Printed in the United States of America.

The Apple logo is a trademark of Apple Computer, Inc. Use of the "keyboard" Apple logo (Option-Shift-K) for commercial purposes without the prior written consent of Apple may constitute trademark infringement and unfair competition in violation of federal and state laws.

No licenses, express or implied, are granted with respect to any of the technology described in this book. Apple retains all intellectual property rights associated with the technology described in this book. This book is intended to assist application developers to develop applications only for Apple-labeled or Apple-licensed computers.

Every effort has been made to ensure that the information in this manual is accurate. Apple is not responsible for printing or clerical errors.

Apple Computer, Inc.
1 Infinite Loop
Cupertino, CA 95014
408-996-1010

Apple, the Apple logo, AppleLink, Apple SuperDrive, GeoPort, LaserWriter, LocalTalk, Macintosh, Macintosh Quadra, Performa, PlainTalk, and Power Macintosh are trademarks of Apple Computer, Inc., registered in the United States and other countries.

3D RAGE is a trademark of ATI Technologies, Inc.

QuickDraw and QuickDraw 3D are trademarks of Apple Computer, Inc. Adobe Illustrator and PostScript are trademarks of Adobe Systems Incorporated, which may be registered in certain jurisdictions.

Helvetica and Palatino are registered trademarks of Linotype Company.

ITC Zapf Dingbats is a registered trademark of International Typeface Corporation.

PowerPC is a trademark of International Business Machines Corporation, used under license therefrom.

Samsung is a trademark of Samsung Electronics Co., Ltd.

Simultaneously published in the United States and Canada.

ALL IMPLIED WARRANTIES ON THIS MANUAL, INCLUDING IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE LIMITED IN DURATION TO NINETY (90) DAYS FROM THE DATE OF THE ORIGINAL RETAIL PURCHASE OF THIS PRODUCT.

Even though Apple has reviewed this manual, APPLE MAKES NO WARRANTY OR REPRESENTATION, EITHER EXPRESS OR IMPLIED, WITH RESPECT TO THIS MANUAL, ITS QUALITY, ACCURACY, MERCHANTABILITY, OR FITNESS FOR A PARTICULAR PURPOSE. AS A RESULT, THIS MANUAL IS SOLD "AS IS," AND YOU, THE PURCHASER, ARE ASSUMING THE ENTIRE RISK AS TO ITS QUALITY AND ACCURACY.

IN NO EVENT WILL APPLE BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECT OR INACCURACY IN THIS MANUAL, even if advised of the possibility of such damages.

THE WARRANTY AND REMEDIES SET FORTH ABOVE ARE EXCLUSIVE AND IN LIEU OF ALL OTHERS, ORAL OR WRITTEN, EXPRESS OR IMPLIED. No Apple dealer, agent, or employee is authorized to make any modification, extension, or addition to this warranty.

Some states do not allow the exclusion or limitation of implied warranties or liability for incidental or consequential damages, so the above limitation or exclusion may not apply to you. This warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Contents

Figures and Tables vii

Preface **About This Note** ix

Contents of This Note ix
Supplemental Reference Documents x
Apple Developer World Web Site x
Conventions and Abbreviations xi
 Typographical Conventions xi
 Abbreviations xi

Chapter 1 **Introduction** 15

Summary of Features 16
External Features 17
 Front View of the Modular Desktop Enclosure 18
 Back View of the Modular Desktop Enclosure 19
 Access to the Logic Board in the Modular Desktop Enclosure 19
 Front View of the Tower Enclosure 20
 Back View of the Tower Enclosure 21
Optional Features 21
 Video Input 22
 Video Output 22
 Audio Input and Output 22
 Communications 23
 Internal Device Expansion Bays 23
Compatibility Issues 23
 Machine Identification 23
 Modem Slot 23
 Expansion Slots 24
 RAM Expansion 24
 RAM DIMM Height Dimensions 24
 L2 Cache Expansion 24
 CD-ROM Drive 24
 Power Supply 24
 Video RAM Expansion 25
Built-in Video and Graphics Features 25

Block Diagrams and Main ICs	28
PowerPC Microprocessor	30
Memory Subsystem	31
ROM	31
Second-Level Cache	31
System RAM	31
Custom ICs	31
Grackle IC	32
Heathrow IC	32
Screamer Sound IC	33
Cuda IC	33
ATI 3D RAGE II+DVD Graphics Controller	33
Display RAM	34

Serial I/O Ports	36
ADB Port	36
Disk Drives	36
Floppy Disk Drive	36
ATA Hard Disk	37
ATAPI CD-ROM Drive	37
SCSI Bus	37
SCSI Connectors	37
SCSI Bus Termination	37
Sound	38
Sound Output	38
Sound Input	38
Sound Input Specifications	39
Digitizing Sound	39
Sound Modes	39
Video Input and Output	40
S-Video Connectors	40
Composite Video Connectors	40
Built-in Display Video	40
External Video Connector	40
External Video Monitors	41
Video Input and Graphics Acceleration Display Modes	42

RAM DIMMs	44	
DRAM DIMM Presence Detect EEPROM		45
RAM DIMM Connectors	45	
RAM Address Multiplexing	45	
RAM Devices	46	
RAM Refresh	46	
Compatible SDRAM DIMMs		47
PCI Expansion Slot	47	
The DAV Connector	48	
The Modem Slot	48	
Auxiliary Cooling Fans	48	

Index	51	
--------------	----	--

Figures and Tables

Chapter 1	Introduction	15
	Figure 1-1	Front view of the modular desktop enclosure 18
	Figure 1-2	Back view of the modular desktop enclosure 19
	Figure 1-3	Accessing the main logic board in modular desktop enclosure 20
	Figure 1-4	Front view of the tower enclosure 20
	Figure 1-5	Back view of tower enclosure 21
Chapter 2	Architecture	27
	Figure 2-1	Main logic board block diagram 28
	Figure 2-2	Whisper Personality card block diagram 29
	Figure 2-3	Wings Personality card block diagram 30
Chapter 3	I/O Features	35
	Table 3-1	Maximum pixel depths for video monitors (not verified) 41
	Table 3-2	Video input and graphics acceleration display modes 42
Chapter 4	Expansion Features	43
	Figure 4-1	Location for auxiliary cooling fans 49
	Table 4-1	Memory configurations and sizes for DRAM DIMMS 44
	Table 4-2	Address multiplexing modes for SDRAM devices 46
	Table 4-3	Compatible SDRAM DIMMs for the Power Macintosh G3 computer 47

About This Note

This developer note describes the architecture of the logic board and enclosures for the new Power Macintosh G3 family of computers and emphasizes features that are new or different from previous Macintosh models. If you are unfamiliar with Macintosh computers or would simply like more technical information, you may wish to read the related technical manuals listed in the section “Supplemental Reference Documents.”

This developer note is intended to help hardware and software developers design products that are compatible with the Macintosh products described here. If you are not already familiar with Macintosh computers or if you would simply like additional technical information, you may wish to read the supplementary reference documents described in this preface.

This note is published only in electronic form, as an Adobe[™] Acrobat[™] PDF (portable document file). The file is available from two sources:

- on the World Wide Web at <<http://devworld.apple.com/dev/devnotes/dntable1.html>>
- on the Reference Library Edition of the Developer CD Series, which is distributed as part of the monthly mailing to registered developers

Contents of This Note

The information is arranged in four chapters and an index:

- Chapter 1, “Introduction,” gives a summary of the features of the logic board in the Power Macintosh G3 computers, describes the physical appearance of the supported enclosures, and lists the available configurations and options. This chapter also includes a section that describes the compatibility issues that hardware and software developers need to be aware of to take advantage of the features available with the Power Macintosh G3 computers.
- Chapter 2, “Architecture,” describes the internal organization of the computer. It includes a functional block diagram and descriptions of the main components of the logic board.
- Chapter 3, “I/O Features,” describes the built-in input/output (I/O) devices and the external I/O ports. It also describes the built-in support for external video monitors that can be used with the computer.
- Chapter 4, “Expansion Features,” describes the expansion slots on the Gazelle logic board. This chapter provides guidelines for designing cards for the I/O expansion slot and brief descriptions of the expansion modules for the other slots.

Supplemental Reference Documents

Developers should have copies of the appropriate Motorola reference documentation for the PowerPC™ G3 microprocessor. Information about Motorola microprocessors can be found at

<<http://www.mot.com/SPS/PowerPC/library/library.html>>.

For a description of the version of the Mac OS that comes with the new models, developers should refer to Technote 1102, “Mac OS 8” on the Developer CD Series and on the Technote web site at

<<http://devworld.apple.com/dev/technotes.shtml>>

For additional information about the digital data format used in the video input module, refer to *Power Macintosh DAV Interface for PCI Expansion Cards*. For information about the digital video interface, refer to the *SAA7140 Philips Desktop Video Handbook*.

For information about PCI expansion cards, refer to *Designing PCI Cards and Drivers for Power Macintosh Computers*.

Developers should also have copies of the relevant books of the *Inside Macintosh* series, available in technical bookstores and on the World Wide Web at

<<http://gemma.apple.com/dev/insidemac.shtml>>

Developers interested in taking advantage of the 3D graphics acceleration features built into the Gazelle logic board should have *3D Graphics Programming With QuickDraw 3D*.

Apple Developer World Web Site

The Apple Developer World Web site is the one-stop source for finding technical and marketing information specifically for developing successful Macintosh-compatible software and hardware products. Developer World is dedicated to providing developers with up-to-date Apple documentation for existing and emerging Macintosh technologies. Developer World can be reached at

<http://www.devworld.apple.com>

Conventions and Abbreviations

This developer note uses the following typographical conventions and abbreviations.

Typographical Conventions

Note

A note like this contains information that is of interest but is not essential for an understanding of the text. ◆

IMPORTANT

A note like this contains important information that you should read before proceeding. ▲

Abbreviations

When unusual abbreviations appear in this developer note, the corresponding terms are also spelled out. Standard units of measure and other widely used abbreviations are not spelled out.

Here are the standard units of measure used in this developer note:

A	amperes	mA	milliamperes
dB	decibels	μA	microamperes
GB	gigabytes	MB	megabytes
Hz	hertz	MHz	megahertz
in.	inches	mm	millimeters
k	1000	ms	milliseconds
K	1024	μs	microseconds
KB	kilobytes	ns	nanoseconds
kg	kilograms	Ω	ohms
kHz	kilohertz	sec.	seconds
kΩ	kilohms	V	volts
lb.	pounds	W	watts

P R E F A C E

Other abbreviations used in this note include:

$\$n$	hexadecimal value n
ADB	Apple Desktop Bus
ATA	advanced technology attachment
ATAPI	advanced technology attachment packet interface
ATX	
AV	audiovisual
AWACS	audio waveform amplifier and converter for sound
CAS	column address strobe
CD-ROM	compact disc read-only memory
CLUT	color lookup table
DAC	digital to analog converter
DAV	digital audio video
DDC	display data channel
DIMM	dual inline memory module
DIN	Deutsche Industrie Norm
DMA	dynamic memory access
DRAM	dynamic random-access memory
EDO	extended data out DRAM device type
EMI	electromagnetic interference
GCR	group code recording
IC	integrated circuit
IDE	integrated device electronics
IIC	inter-integrated circuit (an internal control bus)
I/O	input/output
IR	infrared
JEDEC	Joint Electronics Devices Engineering Council
L2	level 2, used in reference to level of cache
MESH	Macintosh enhanced SCSI hardware
MMU	memory management unit
MPEG	Motion Picture Experts Group
NTSC	National Television Standards Committee (the standard system used for broadcast TV in North America and Japan)
PAL	Phase Alternating Line system (the standard for broadcast TV in most of Europe, Africa, South America, and southern Asia)
PCI	Peripheral Component Interconnect
PGA	pin grid array
PIO	parallel input output

P R E F A C E

RAM	random-access memory
RAS	row address strobe
RAVE	Rendering Acceleration Virtual Engine
RGB	a video signal format with separate red, green, and blue components
RISC	reduced instruction set computing
ROM	read-only memory
SCSI	Small Computer System Interface
SCC	serial communications controller
SDRAM	synchronous dynamic random access memory
SECAM	the standard system used for broadcast TV in France and the former Soviet countries
SIMM	single inline memory module
SGRAM	synchronous graphics random access memory
SO-DIMM	small outline dual inline memory module
SRAM	static random access memory
S-video	a type of video connector that keeps luminance and chrominance separate; also called a Y/C connector
SWIM	Super Woz Integrated Machine, a custom IC that controls the floppy disk interface
VRAM	video RAM; used for display buffers
Y/C	a type of video connector that keeps luminance and chrominance separate; also called an S-video connector
YUV	a video signal format with separate luminance and chrominance components

Introduction

Introduction

The main logic board for the Power Macintosh G3 computers has a mini-ATX form factor that supports a PowerPC™ G3 microprocessor module via a PGA processor socket, a back-side second-level (L2) cache on the microprocessor module, three Peripheral Component Interconnect (PCI) card expansion slots, and a PERCH slot for two configurations of Apple Macintosh Personality cards which provide enhanced AV features (audio and video input and output) or connectivity. Multiple Macintosh enclosures will support the logic board. This note provides a brief description of the modular desktop and tower enclosure for the Power Macintosh G3 computer.

Summary of Features

Here is a summary of the hardware features of the Power Macintosh G3 computers. Each feature is described more fully later in this note.

- Microprocessor: PowerPC G3 microprocessor running at 233 MHz and 266 MHz.
- System bus speed: 66 MHz Apple Risc system bus
- RAM: 0 MB soldered on the main logic board; expandable to 384 MB using 64-bit (non-parity) 168-pin JEDEC-standard 3.3-volt unbuffered SDRAM (synchronous dynamic access memory) DIMM (dual inline memory module) cards. Three DIMM card slots are provided for DRAM expansion. 32 MB of RAM are installed in one of the DIMM card slots.
- ROM: 4 MB on 160-pin DIMM; 64-bit ROM data bus width.
- Cache: 512 KB back-side second-level(L2) cache on processor module. The cache runs at one half the speed of the microprocessor.
- Video display modes supported on built-in monitor port: 640 by 480, 800 by 600, and 832 by 624 at 32 bits per pixel; 1024 by 768, 1152 by 870, 1280 by 1024, and 1600 by 1200 at 16 bits per pixel; 2 MB synchronous graphics RAM (SGRAM) frame buffer on the main logic board. Video memory can be expanded to 4 MB or 6 MB with an optional 2 MB or 4 MB SGRAM graphics memory module. 67 MHz local graphics memory bus.
- Built-in 2D and 3D hardware graphics acceleration using the ATI 3D RAGE II+DVD graphics controller. Software support through Macintosh QuickDraw 3D and QuickDraw 3D RAVE (rendering acceleration virtual engine) APIs. This graphics controller is similar to the graphics controller used in the Power Macintosh 6500 computer.
- Built-in YUV and MPEG scaler.
- PERCH slot: supports Apple Wings and Whisper Personality cards.
- Video input/output: video input and output feature on Wings Personality card configurations allows video input and output through RCA or S-Video connectors.
- Sound: Wings and Whisper Personality card configurations support 16 bits/channel stereo input and output, external jack for sound in, optional front jack for headphones, rear jack for stereophonic speakers, one built-in speaker in tower and modular desktop enclosures, stereo speakers on all-in-one enclosure.

Introduction

- Hard disks: one internal ATA hard disk with 4 GB or larger capacity. A SCSI bus for additional internal SCSI devices and an external SCSI port for additional SCSI devices. PIO, singleword DMA, and multiword DMA data transfers are supported.
- Expansion bay (enclosure dependent): no device expansion in all-in-one enclosures, the modular desktop enclosure has two bays which allow adding internal 3.5-inch SCSI devices. Tower enclosures support the addition of either 5.25 or 3.5-inch SCSI devices. Some models may include an optional SCSI Iomega Zip drive.
- Floppy disk: one internal 1.4 MB GCR SuperDrive.
- CD-ROM drive: internal 24X-speed ATAPI CD-ROM drive.
- Zip drive: optional 100 MB SCSI Zip drive.
- Processor bus: 64-bit wide, 66 MHz, supporting split address and data tenures.
- Standard Macintosh I/O ports: two serial ports, 10BaseT RJ-45 Ethernet port, a SCSI port, and an ADB port.
- GeoPort: supported on both the modem and printer ports.
- Modem slot: 112-pin connector accepts an optional modem interface. The interface is a superset of the type of communications slot found in the Power Macintosh 4400, 5500, and 6500 computers. It is strictly a modem interface and does not carry the PCI signals like the comm-slot II does.
- PCI card expansion slots: accepts three 12-inch PCI cards; three 15-watt cards or two 25-watt cards.
- Power switch: soft power controlled from keyboard and infrared remote control.
- Voltage switch on desktop enclosures: allows selection of either 115 for voltages of 100–130 V or 230 for voltages of 200–230 V depending on the voltage which you will be connecting to. The voltage selection must be set manually.
- Fan speed control: The speed of the fan is thermally controlled and is automatically set to the lowest possible speed to minimize noise. The fan speed varies according to the temperature inside the enclosure.
- Energy saving: sleep, startup, and shutdown scheduling can be controlled with an Energy Saver control panel.

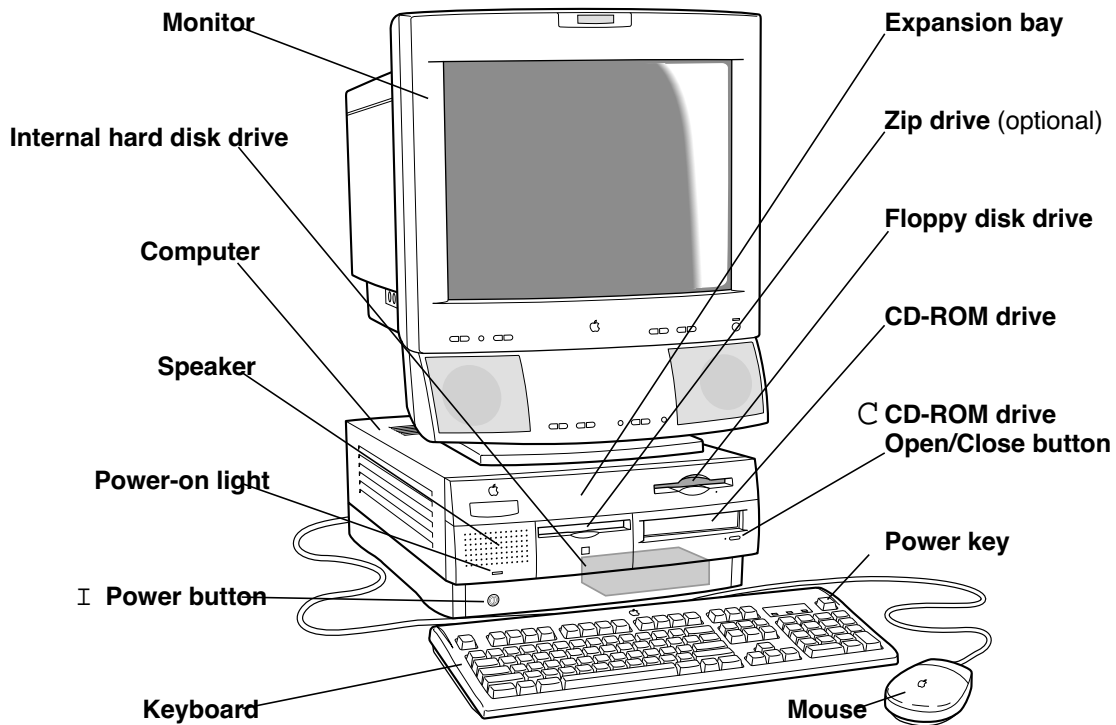
External Features

The Power Macintosh G3 computer is available in a modular desktop enclosure similar to the Power Macintosh 7600 enclosure and a tower enclosure similar to, but smaller than the Power Macintosh 9600 enclosure. This section describes the features of the two enclosures.

Front View of the Modular Desktop Enclosure

Figure 1-1 is a front view of the Power Macintosh G3 modular desktop enclosure. The front view shows the location of the expansion bay, the openings for the CD-ROM drive and floppy disk, the IR sensor for the optional remote control, the volume control push-buttons, the power-on light, and the headphone jack.

Figure 1-1 Front view of the modular desktop enclosure

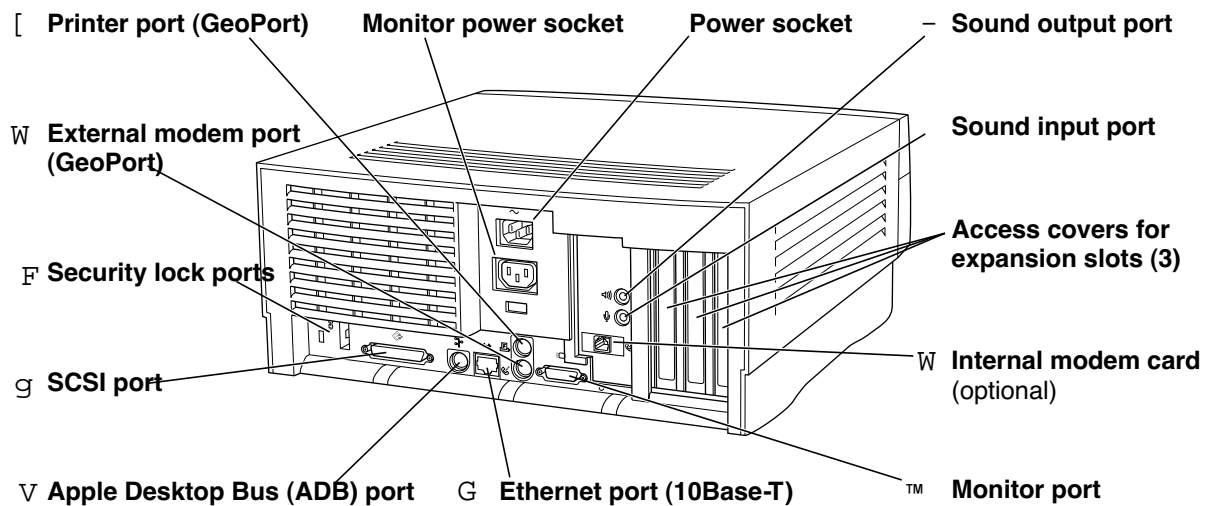


Back View of the Modular Desktop Enclosure

The back panel includes the power socket, the monitor power socket, the reset button, the I/O ports, the openings for PCI cards, and the opening for I/O access to the expansion features of the Personality cards in the PERCH slot.

Figure 1-2 shows the back view of the modular desktop enclosure for the Power Macintosh G3 computer.

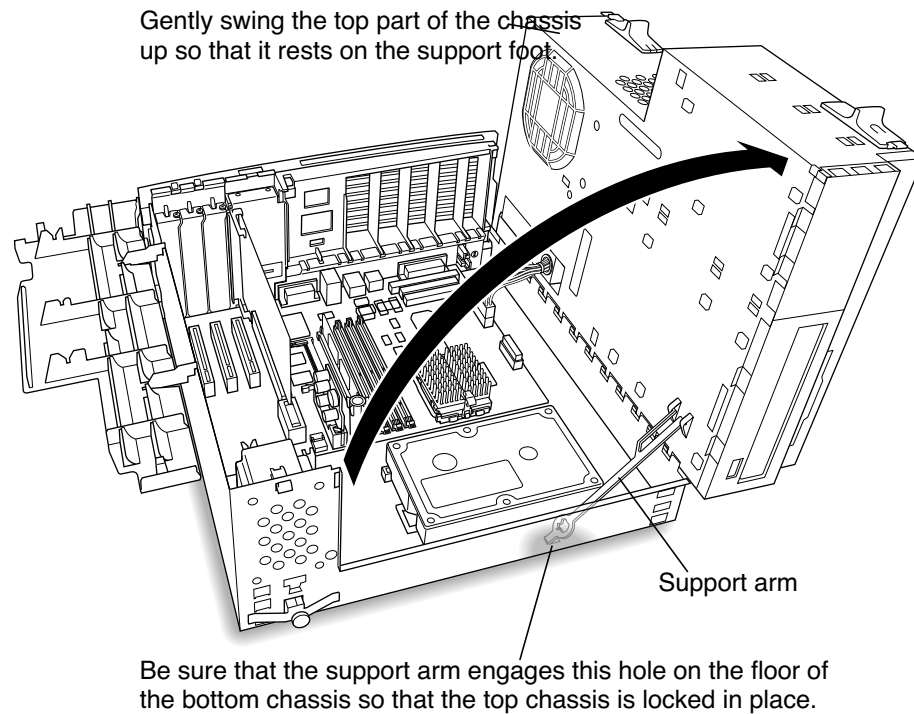
Figure 1-2 Back view of the modular desktop enclosure



Access to the Logic Board in the Modular Desktop Enclosure

You can access the logic board to add expansion DRAM, expansion graphics memory, or PCI expansion cards by removing the top of the case and swinging the sub chassis up, as shown in Figure 1-3.

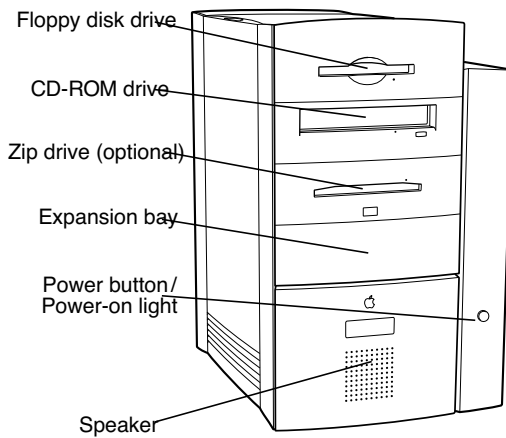
Figure 1-3 Accessing the main logic board in modular desktop enclosure



Front View of the Tower Enclosure

Figure 1-4 is a front view of the Power Macintosh G3 tower enclosure. The front view shows the location of the expansion bay, the openings for the CD-ROM drive, floppy disk and Zip drive, and the power-on light.

Figure 1-4 Front view of the tower enclosure

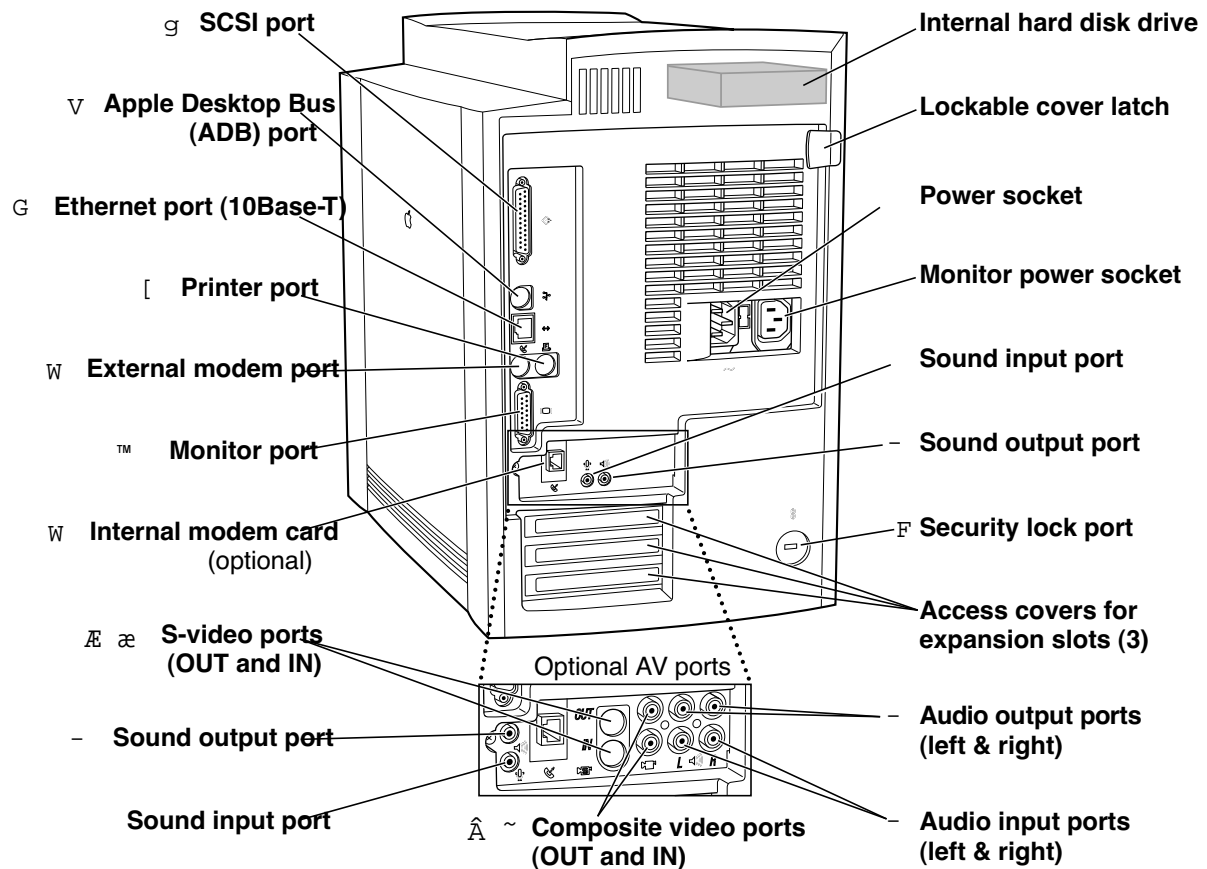


Back View of the Tower Enclosure

The back panel includes the power socket, the monitor power socket, the I/O ports, the openings for PCI cards, and the opening for I/O access to the AV expansion features of the Personality cards in the PERCH slot.

Figure 1-5 shows the back view of the tower enclosure for the Power Macintosh G3 computer.

Figure 1-5 Back view of tower enclosure



Optional Features

Several features of the logic board are implemented as plug-in modules available either as a configuration option at the time of purchase or as a later upgrade. The modules are designed so that they can be installed by the user.

Video Input

The Wings Personality card accepts video from an external source and displays it in a window on the computer's display. The features of the video portion of the AV Personality card are

- acceptance of video input in NTSC, PAL, or SECAM format
- connectors for stereo sound, composite video, and S-video (Y/C)
- video display in a 320-by-240 pixel window
- pixel expansion for 640-by-480 pixel maximum display
- video overlay capability
- YUV format for digital video input
- a bi-directional digital audio video (DAV) connector for adding a video processor on a PCI expansion card

The Wings Personality card provides AV features similar to those of the Power Macintosh 6500 computer. The card can accept video input from an external device, such as a VCR or camcorder. The external device can be connected to the Wings card through either the composite video connector or the S-video connector.

The default window size for the Apple Video Player software is 320 by 240 pixels; the user can resize the window up to 640 by 480 pixels—the full screen on a 14-inch monitor.

The video input circuitry is part of the Wings Personality card which plugs into a dedicated PERCH slot on the main logic board. The PERCH slot connector is a 182-pin microchannel connector. The PERCH slot is a superset of the PCI specification, but does not except PCI cards.

Video Output

The Wings Personality card provides video output features similar to those available in the Power Macintosh 8500 computer. The video output features are

- output of NTSC, PAL, and SECAM video formats
- connectors for composite and S-video output

Audio Input and Output

The audio I/O features for Power Macintosh G3 computers are provided on both the Wings and Whisper Personality cards when plugged into the PERCH slot on the main logic board. These cards include a line-level audio input port and an audio output port for use of headphones or amplified speakers. Connection to the optional front panel infrared and sound push buttons provides for control of the sound output volume through an infrared remote control or by pushing the volume control buttons on the front panel.

Introduction

The sound specifications for the sound ports on AV configurations of the Power Macintosh G3 computers are

- 16-bit stereo output
- sample rates of 11.025, 22.05, and 44.1 kHz
- input line level: 2 V_{pp} maximum into 10 kilohms impedance; nominal signal to noise ratio 80 dB, 85 dB typical (A-weighted, 2 V_{pp} output, 1 kHz, digital record and playback, sound input port to sound output port)
- frequency response: 20 Hz–18 kHz (+–3 dB relative to 1 kHz)

Communications

The Wings Personality card has a modem slot that allows the computer to support an internal modem communications module without occupying the PCI expansion slot. A modem card can be installed by either the user or the dealer.

Internal Device Expansion Bays

The expansion bays in the modular desktop and tower enclosures include data and power connectors for adding additional SCSI devices. The three expansion bays in the tower enclosure are configured to support 1-inch-high 3.5-inch or 5.25-inch devices. The three expansion bays in the modular desktop enclosure support 1-inch-high 3.5-inch devices. Some configurations include an optional Zip drive in one of the expansion bays.

Compatibility Issues

The Power Macintosh G3 computers incorporate several changes from earlier desktop models. This section describes key issues you should be aware of to ensure that your hardware and software work properly.

Machine Identification

The Power Macintosh G3 computers have a machine ID value of 510 (hexadecimal 1FE). Applications can find out which computer they are running on by using the Gestalt Manager routines. *Inside Macintosh: Overview* describes the Gestalt Manager and tells how to use the `gestaltMachineType` value to obtain the machine name string.

Modem Slot

The modem slot in the Power Macintosh G3 computers is not a PCI bus compatible communications slot (comm slot II) like the comm slot in the Power Macintosh 5500 and 6500 computers. The modem slot is strictly for modem cards that do not require the use of the PCI signals. The modem slot is located on the Wings and Whisper Personality

Introduction

cards rather than on the main logic board, as it is on previous Macintosh models that include a comm slot.

Expansion Slots

The I/O expansion slots are PCI expansion slots that conform to the PCI V2.1 specification.

RAM Expansion

The logic board uses JEDEC-standard 64-bit (non-parity) 168-pin 3.3-volt unbuffered SDRAM DIMM cards. For information about DRAM DIMM configurations supported on the Power Macintosh G3 logic board, see “RAM DIMMs” beginning on page 44.

RAM DIMM Height Dimensions

The maximum supported height of RAM DIMM cards depends on the enclosure. The maximum height of RAM DIMMs in the Power Macintosh G3 modular desktop enclosures is 1.15 inches. The maximum height of RAM DIMMs in the Power Macintosh G3 tower enclosure is 1.5 inches.

L2 Cache Expansion

The Power Macintosh G3 back-side L2 cache is integrated into the design of the microprocessor module. No cache expansion is possible.

CD-ROM Drive

The CD-ROM drive is an ATAPI CD-ROM drive, rather than a SCSI drive. The system software release includes version 4.0 of the ATA Manager and supports PIO, singleword DMA, and multiword DMA data transfers.

Power Supply

The power supply in modular and tower enclosures is not self-configuring for different input voltages. The voltage switch is delivered preconfigured for the input voltage of the region in which the unit is originally purchased. If the computer is moved to another location where the input voltage is different, a voltage switch must be adjusted to accommodate the voltage change. The switch has two positions that support voltage ranges of 100 to 130 V or 220 to 270 V.

Video RAM Expansion

The Power Macintosh G3 computers include 2 MB of SGRAM on the main logic board. The video RAM can be expanded to 4 MB or 6 MB with an additional 2 MB or 4 MB of SGRAM on a 144-pin SO-DIMM (small outline dual inline memory module). The difference between supported display modes when using 4 MB or 6 MB of video memory is minimal, see Table 3-1 on page 41. However, 6 MB of SGRAM provides additional memory for storing 3D textures and increases in 3D graphics performance over a 4 MB SGRAM configuration.

The mechanical characteristics of the SGRAM expansion DIMM are given in the JEDEC specification for the 144-pin 8-byte graphics SO-DIMM. The devices on the DIMM must be 3.3 V, 83 MHz/12ns or faster, SGRAM devices. Additional information about memory devices and 144-pin SO-DIMMs can be found at

<<http://www.eia.org/jedec/download/freestd/pub21/>>

Built-in Video and Graphics Features

The Power Macintosh G3 computers have the following built-in video and graphics capabilities:

- ATI 3D RAGE II+DVD 64-bit graphics and multimedia accelerator
- 2 MB of synchronous graphic RAM (SGRAM)
- Hardware acceleration of 2D QuickDraw graphics and video to speed up scrolling text and graphics and screen redraw operations
- Hardware acceleration of video for full screen, full motion, TV-quality playback of Cinepak and MPEG1 QuickTime movies
- Bilinear hardware interpolation and scaling
- Accelerates 3D QuickDraw rendering up to 6 times that of software-only rendering
- Real-time 3D shaded object manipulation, animation, and virtual world navigation
- Includes 16-bit Z buffer for hidden texture surface removal
- Provides six perspective correct texture mapping functions
- Alpha blending, transparency, and fog effects
- Flat and Gouraud shading
- Video textures and video lighting

The graphics acceleration features enhance the realism of 3D interactive software titles and games.

For information about the supported display modes for video input and QuickDraw 2D and QuickDraw 3D acceleration capabilities, see “Video Input and Graphics Acceleration Display Modes” beginning on page 42.

Architecture

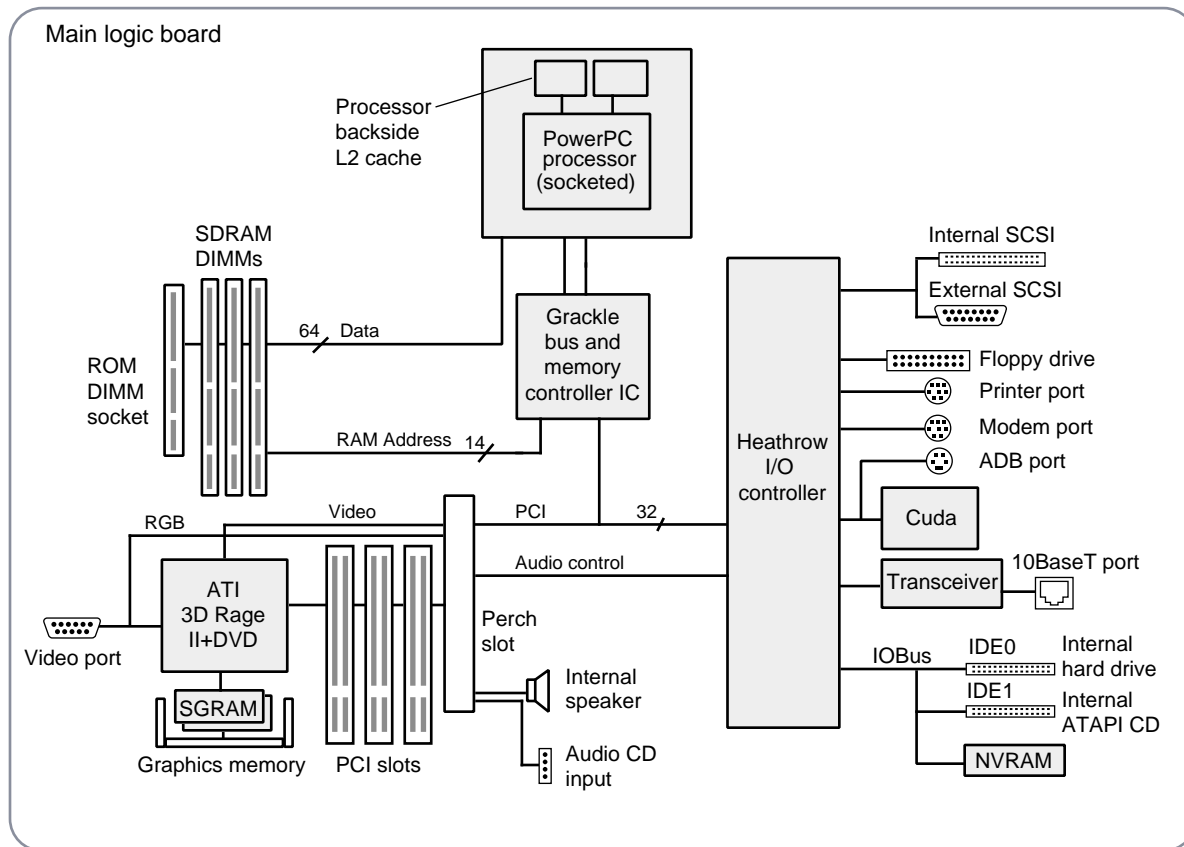
Architecture

This chapter describes the architecture of the Power Macintosh G3 computers, which consists of a main logic board and one of two Personality cards installed in the Perch connector. It describes the major components of the main logic board: the microprocessor, the custom ICs, and the display RAM. Input and output connectors are discussed in Chapter 3, "I/O Features."

Block Diagrams and Main ICs

The architecture of the main logic board is based on the PowerPC G3 microprocessor and two buses: the processor bus and the PCI bus. The processor bus connects the microprocessor, video, cache, and memory; the PCI bus connect the expansion slots and the I/O devices. The PCI interface on the Power Macintosh G3 computers conforms to PCI specification revision 2.1. Figure 2-1 shows the main logic board block diagram.

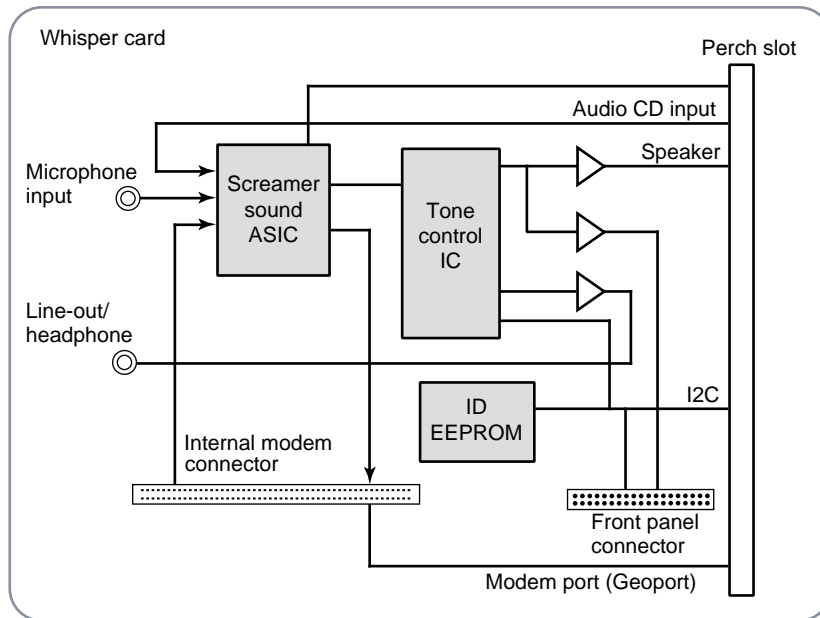
Figure 2-1 Main logic board block diagram



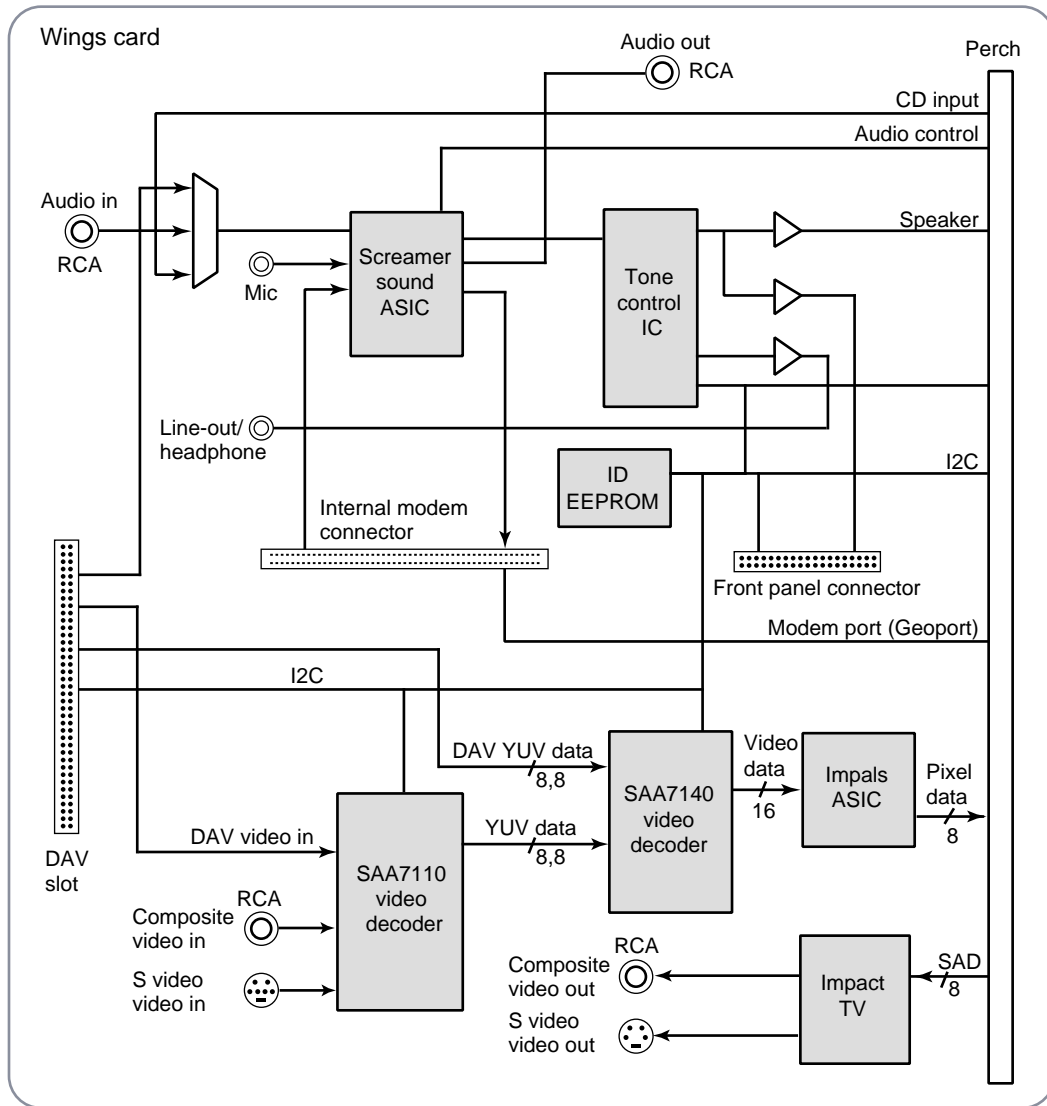
Architecture

The Whisper Personality card, which is installed in the Perch slot on the main logic board, provides sound input and output features for the Power Macintosh G3 computers. Figure 2-2 shows the Whisper Personality card block diagram.

Figure 2-2 Whisper Personality card block diagram



The Wings Personality card, which is installed in the Perch slot on the main logic board in AV configurations of the Power Macintosh G3 computers, provides the necessary circuitry for the audio and video input and output features. Figure 2-3 shows the Wings Personality card block diagram.

Figure 2-3 Wings Personality card block diagram

PowerPC Microprocessor

The main logic board supports the PowerPC G3 series of microprocessors running at 233 MHz and 266 MHz.

The principal features of the PowerPC G3 microprocessor include

- full RISC processing architecture
- parallel processing units: load-store unit, two integer units, one complex integer unit, and one floating-point unit

Architecture

- a branch manager that can usually implement branches by reloading the incoming instruction queue without using any processing time
- integrated L2 cache controller and Tag RAMs for high performance memory access
- an internal memory management unit (MMU)
- 64 KB of on-chip cache memory (32 KB each for data and instructions)

For complete technical details, see the Motorola PowerPC Library web page at <http://www.mot.com/SPS/PowerPC/library/library.html>.

Memory Subsystem

The memory subsystem of the main logic board consists of RAM, ROM, and back-side second-level (L2) cache, in addition to the PowerPC microprocessor cache. The Grackle custom IC provides burst mode control to the ROM.

ROM

The ROM consists of 4 MB of ROM installed in a DIMM socket.

Second-Level Cache

The back-side second-level (L2) cache consists of 512 KB of SRAM. The cache is on the microprocessor card module. This cache runs at one half the speed of the microprocessor, a ratio of 2:1.

System RAM

The Power Macintosh G3 computers have 0 MB of DRAM memory soldered on the main logic board. All RAM expansion is provided by SDRAM devices on 64-bit 168-pin JEDEC-standard 3.3-volt unbuffered SDRAM DIMMs. Three DIMM sockets are used for memory expansion. Supported DIMM sizes are 8, 16, 32, 64, and 128 MB. The DIMM sockets support both one- and two-bank DRAM modules with no more than 16 memory devices on a DIMM. The Grackle custom IC provides memory control for the system RAM.

Custom ICs

The architecture of the main logic board is designed around five large custom integrated circuits:

- the Grackle memory controller and PCI bridge
- the Heathrow I/O subsystem and DMA controller
- the Screamer sound processor (on Wings and Whisper Personality cards, not on the main logic board)

Architecture

- the Cuda soft-power controller
- the ATI 3D RAGE II+DVD video subsystem

The computer also uses several standard ICs that are used in other Macintosh computers. This section describes only the custom ICs.

Grackle IC

The Grackle IC functions as the bridge between the PowerPC microprocessor bus and the I/O and graphics devices on the PCI bus. It provides buffering and address translation from one bus to the other.

The Grackle IC also provides the control and timing signals for ROM and RAM. The memory control logic supports byte, word, longword, and burst accesses to the system memory. If an access is not aligned to the appropriate address boundary, Grackle generates multiple data transfers on the bus.

Memory Control

The Grackle IC controls the system RAM and ROM and provides address multiplexing and refresh signals for the DRAM devices. For information about the address multiplexing, see “RAM Address Multiplexing” on page 45.

PCI Bus Bridge

The Grackle IC acts as a bridge between the processor bus and the PCI expansion bus, converting signals on one bus to the equivalent signals on the other bus. The PCI bridge functions are performed by two converters. One accepts requests from the processor bus and presents them to the PCI bus. The other converter accepts requests from the PCI bus and provides access to the RAM and ROM on the processor bus.

The PCI bus bridge in the Grackle IC runs synchronously. The processor bus operates at a clock rate of 66 MHz, and the PCI bus operates at 30 or 33 MHz.

The PCI bus bridge generates PCI parity as required by the PCI bus specification, but it does not check parity or respond to the parity error signal.

Heathrow IC

The Heathrow IC is an I/O controller and DMA engine for Power Macintosh computers using the PCI bus architecture.

Heathrow also provides power-management control functions for energy saving features included on Power Macintosh computers. The Heathrow IC is connected to the PCI bus and uses the 30–33 MHz PCI bus clock.

The Heathrow IC includes circuitry equivalent to the Ethernet, IDE, SCC, SCSI, SWIM3, and VIA controller ICs. The functional blocks in the Heathrow IC include the following:

- gated clocks PCI bus arbiter
- systemwide interrupt handling

Architecture

- a SWIM3 floppy drive controller
- a MESH-based (Macintosh enhanced SCSI hardware) SCSI controller
- SCC serial I/O controller
- IDE hard disk interface controller
- sound control logic and buffers
- 10Base-T Ethernet controller

The Heathrow IC provides bus interfaces for the following I/O devices:

- ADB device controller
- VIA system interface to the Cuda IC
- Screamer sound input and output IC
- 8 KB nonvolatile RAM control

The SCSI controller cell in the Heathrow IC is an 8-bit MESH controller. The MESH cell supports data transfer rates of 5 MB per second.

The Heathrow IC also contains a serial interface and sound control logic for the Screamer sound IC on the Wings and Whisper Personality cards.

The 85C30 SCC cell in the Heathrow IC is an 8-bit device. The SCC circuitry supports GeoPort and LocalTalk protocols.

Screamer Sound IC

The Screamer custom IC combines a waveform amplifier with a 16-bit digital sound encoder and decoder (codec). The Screamer IC supports all of the audio input and output features on the Wings and Whisper Personality cards. The Screamer IC provides improved audio performance over the AWACS IC used in previous Macintosh computers. For additional information about the audio features of the Wings and Whisper Personality cards, see “Sound” on page 38.

Cuda IC

The Cuda IC provides several system functions, including

- management of soft system resets; warm reset is controlled by the ADB cell in the Heathrow IC
- management of the real-time clock
- software control of the power supply

ATI 3D RAGE II+DVD Graphics Controller

The ATI 3D RAGE II+DVD graphics controller contains the logic for the video display. It includes the following functions:

- architecture optimized for 83 MHz SGRAM video memory

Architecture

- display memory controller, built-in drawing coprocessor, video scaler, color space converter, clock generator, and true color palette video DAC (digital-to-analog converter)
- video CLUT (color lookup table)
- hardware graphics acceleration with a 16-bit Z-buffer
- accelerates QuickDraw 3D rendering up to 6 times that of software-only acceleration
- true color palette DAC supporting pixel clock rates to 200 MHz for 1600 by 1200 resolution at 75 Hz
- graphics and video line buffer for superior video scaling and playback quality
- hardware cursor up to 64 x 64 x 2
- DDC1 and DDC2B+ for plug-and-play monitor support
- supports synchronous graphics RAM (SGRAM) at up to 83 MHz memory clock, providing a bandwidth up to 536 MB per second
- graphics control accessible through the QuickDraw , QuickDraw 3D, QuickDraw 3D RAVE, and QuickTime components APIs

A separate data bus handles data transfers between the ATI 3D RAGE II+DVD IC and the display memory. The display memory data bus is 64 bits wide, and all data transfers consist of 32 bits at a time. The ATI 3D RAGE II+DVD IC breaks each 64-bit data transfer into several pixels of the appropriate size for the current display mode—4, 8, 16, 24, or 32 bits per pixel.

The ATI 3D RAGE II+DVD IC uses several clocks. Its transactions are synchronized with the PCI bus. Data transfers from the frame-buffer RAM are clocked by the MEM_CLK signal, which runs at 83 MHz. Data transfers to the CLUT and the video output are clocked by the dot clock, which has a different rate for different display monitors.

The 2D graphics accelerator is a fixed-function accelerator for rectangle fill, line draw, polygon fill, panning/scrolling, bit masking, monochrome expansion, and scissoring.

Display RAM

The display memory on the main logic board is separate from the main memory. The display memory consists of 2 MB of 83 MHz SGRAM devices configured to make a 64-bit data bus. The display memory can be expanded to 4 MB or 6 MB with a 2 MB or 4 MB SGRAM SO-DIMM card.

With the 2 MB of built-in video memory the display data generated by the computer can have pixel depths of 8, 16, or 32 bits for monitors up to 832 by 624 pixels, 8 or 16 bits for larger monitors up to 1152 by 870 pixels, and 8 bits for monitors supporting 1280 by 1024 pixels. Data from the video input module is always stored and transferred at 16 bits per pixel. The video frame buffers support live video in a 320-by-240 pixel frame at 30 frames per second. For a complete listing of the supported monitors and display resolutions, see “Video Input and Output” beginning on page 40.

I/O Features

I/O Features

This chapter describes both the built-in I/O devices and the interfaces for external I/O devices. It also describes the types of external video monitors that can be used with the Power Macintosh G3 computers.

Serial I/O Ports

The main logic board has two standard Macintosh 9-pin mini-DIN serial ports, one for a printer and one for a modem. Both serial ports accept either 8-pin or 9-pin mini-DIN plugs. Both serial ports support the AppleTalk and GeoPort serial protocols.

ADB Port

The Apple Desktop Bus (ADB) port on the logic board is functionally the same as on other Macintosh computers.

The ADB is a single-master, multiple-slave serial communications bus that uses an asynchronous protocol and connects keyboards, graphics tablets, mouse devices, and other devices to the computer. The custom ADB microcontroller drives the bus and reads status from the selected external device. A 4-pin mini-DIN connector connects the ADB to the external devices. For more information about the ADB, see *Guide to the Macintosh Family Hardware*, second edition.

Note

The total current available for all devices connected to the +5 V pins on the ADB and the modem port is 500 mA. Each device should use no more than 100 mA. ♦

Disk Drives

The Power Macintosh G3 computers have a connector for one GCR (group code recording) internal high-density floppy disk drive, an ATA hard disk drive, an internal ATAPI CD-ROM drive, and internal and external SCSI devices. The modular desktop and tower enclosures also provide expansion bays with power and data connectors for the addition of other SCSI devices.

Floppy Disk Drive

The logic board supports one high-density floppy disk drive (Apple SuperDrive). The drive is connected to a 20-pin connector on a cable that is connected to the main logic board.

ATA Hard Disk

The logic board supports an internal hard disk that uses the standard ATA-2 interface. The implementation of the ATA interface on the Power Macintosh G3 computers is a subset of the ATA interface specification, ANSI proposal X3T9.2/90-143, Revision 3.1.

The internal hard disk has a standard 40-pin ATA connector and a separate 4-pin power connector. The 40-pin connector cable is attached to the main logic board. The power cable is attached directly to the power supply.

ATAPI CD-ROM Drive

The Power Macintosh G3 computers have a 24X-speed internal ATAPI CD-ROM drive. The CD-ROM drive supports the worldwide standards and specifications for CD-ROM and CD-digital audio discs described in the Sony/Philips Yellow Book and Red Book. The drive can read CD-ROM, CD-ROM XA, CD-I, and PhotoCD discs as well as play standard audio discs.

The CD-ROM drive has a sliding tray to hold the disc. The drive features a mechanism that supports 4X, 8X, 12X, and 24X data transfer rates and a data buffer that further enhances performance.

SCSI Bus

The Power Macintosh G3 computers have a SCSI bus for an additional internal SCSI devices, and one or more external SCSI devices. Additional internal SCSI devices receive power directly from the power supply.

SCSI Connectors

The SCSI connector for the internal SCSI devices is a 50-pin connector with the standard SCSI pin assignments. It attaches to a cable that is connected to the main logic board by the internal chassis connector. The external SCSI connector is a 25-pin D-type connector with the same pin assignments as other Apple SCSI devices.

SCSI Bus Termination

The internal end of the SCSI bus is terminated by an active terminator. The terminator is located on the main logic board.

Sound

The sound system for the Power Macintosh G3 computers is implemented entirely on the Whisper and Wings Personality cards. Each supports 16-bit stereo sound output and input, available simultaneously.

Like other AV class Macintosh computers, the sound circuitry on the Whisper and Wings Personality cards and system software can create sounds digitally and either play the sounds through speakers inside the enclosure or send the sound signals out through the sound output jacks. The Power Macintosh G3 computers also record sound from several sources: a microphone connected to the line-level sound input jack, the sound in ports on the video input module, analog sound from an optional modem card connected to the internal modem connector, a compact disc in the CD-ROM player, or analog sound from a cross-platform card in a PCI slot. With each sound input source, sound playthrough can be enabled or disabled.

Sound Output

All the sound output features for the Power Macintosh G3 computers are provided by either a Whisper or a Wings Personality card. The Whisper Personality card provides one mini jack for sound output on the back of the enclosure. The Wings Personality card provides three sound output connectors, two RCA jacks for right and left sound out, and one 1/8-inch mini jack for a stereophonic phone plug. The output jacks are connected to the sound amplifier; the mini jack is intended for connecting a pair of headphones or amplified external speakers. Inserting a plug into the sound output mini jack disconnects the internal speaker. (Options in the Monitors & Sound control panel can be used to determine the interaction between the sound input and output devices.) The modular desktop and tower enclosures have one built-in speaker. All-in-one enclosures have a pair of front-firing stereo speakers and sound output jacks at the front and rear. In the all-in-one enclosure, the internal speakers are turned off when the rear jack is used for external speakers.

An optional front headphone jack is available for the modular desktop enclosure. A Wings or Whisper Personality card is required to connect the headphone jack to the sound system.

The Screamer IC provides the stereo sound output to both the internal speakers and the sound output jacks.

Sound Input

Both the Wings and Whisper Personality cards provide a stereo sound input jack on the back of the enclosure for connecting an external PlainTalk microphone or other sound source. The sound input jack accepts a standard 1/8-inch stereophonic phone plug (two signals plus ground). The Wings Personality card provides an additional pair of RCA jacks for right and left sound input for an external source, such as a TV, VCR, or VTR.

I/O Features

The 1/8-inch sound input jack accepts either the Apple PlainTalk line-level microphone or a pair of line-level signals.

Note

The Apple PlainTalk microphone requires power from the main computer, which it obtains by way of an extra-long, 4-conductor plug that makes contact with a 5-volt pin inside the sound input jack. ♦

IMPORTANT

The microphone for the Macintosh LC and LC II does not work with the Whisper or Wings Personality cards; the cards require the line-level signal provided by the Apple PlainTalk microphone. ▲

Sound Input Specifications

The sound input jack has the following electrical characteristics:

- input impedance: 10 k Ω
- maximum input level: 2 V peak to peak (V_{pp}) maximum

Digitizing Sound

The sound circuitry digitizes and records sound as 16-bit samples. The computer can use any one of three sampling rates: 11.025K samples per second, 22.050K samples per second, or 44.100K samples per second.

The sound system plays samples at the sampling rate specified in the control panel for sound.

Sound Modes

The sound mode is selected by a call to the Sound Manager. The sound circuitry normally operates in one of three modes:

- Sound playback: computer-generated sound is sent to the speaker and the sound output jacks.
- Sound playback with playthrough: computer sound and sound input are mixed and sent to the speakers and the sound output jacks.
- Sound record with playthrough: input sound is recorded and also sent to the speakers and the sound output jacks.

When recording from a microphone, applications should reduce the playthrough volume to prevent possible feedback from the speakers to the microphone.

The Screamer IC provides separate sound buffers for input and for stereo output so that the computer can record and send digitized sound to the sound outputs simultaneously.

Video Input and Output

The Wings Personality card supports video input and output of composite and S-video signals. The card supports input and output of NTSC, PAL, and SECAM video formats.

S-Video Connectors

The Wings Personality card has two S-video (Y/C) connectors, a standard 4-pin S-video connector for video output, and a 7-pin S-video connector for video input. The signal assignments on the 7-pin connector are the same as those on the Power Macintosh 8500 S-video output connector.

Composite Video Connectors

Composite video input and output are available on a pair of RCA-type connectors. The video input or output is connected to the center pin, and the outer shell is connected to ground. The video output signal is the same as that on pin 5 of the S-video output connector.

Built-in Display Video

The built-in video circuitry supports pixel display sizes of 512 by 384, 640 by 480, 800 by 600, 832 by 624, 1024 by 768, 1152 by 870, 1280 by 960, 1280 by 1024, and 1600 by 1200. When power is applied, the monitor is initially set for a display size of 640 by 480 pixels. With a multisync monitor the user can switch the monitor resolution on the fly from the Monitor BitDepth and Monitor Resolution modules in the Control Strip or from the Monitors & Sound control panel.

External Video Connector

The cable from the external monitor plugs into a DB-15 video port located on the enclosure's rear panel. The pin assignments for the external video connector are the same as those for the Power Macintosh 5500 and 6500 computers.

External Video Monitors

The Power Macintosh G3 can drive several sizes of external video monitors. Table 3-1 shows the display resolution, vertical refresh, horizontal refresh, and maximum pixel depths supported by the Power Macintosh G3 display graphics subsystem.

Table 3-1 Maximum pixel depths for video monitors (not verified)

Display resolution	Vertical refresh	Horizontal refresh	Maximum pixel depth 2 MB	Maximum pixel depth 4 MB	Maximum pixel depth 6 MB
512 by 384	70 Hz	31.488 kHz	32	32	32
640 by 480	60 Hz	31.469 kHz	32	32	32
640 by 480	67 Hz	35.00 kHz	32	32	32
640 by 480	72 Hz	37.861 kHz	32	32	32
640 by 480	75 Hz	37.500 kHz	32	32	32
640 by 480	85 Hz	43.269 kHz	32	32	32
640 by 870	75 Hz	68.85 kHz	16	32	32
800 by 600	56 Hz	35.156 kHz	32	32	32
800 by 600	60 Hz	37.879 kHz	32	32	32
800 by 600	72 Hz	48.077 kHz	32	32	32
800 by 600	75 Hz	46.875 kHz	32	32	32
800 by 600	85 Hz	53.674 kHz	32	32	32
832 by 624	74.5 Hz	49.725 kHz	32	32	32
1024 by 768	60 Hz	48.363 kHz	16	32	32
1024 by 768	70 Hz	56.476 kHz	16	32	32
1024 by 768 (VESA)	75 Hz	60.023 kHz	16	32	32
1024 by 768 (19" RGB)	75 Hz	60.241 kHz	16	32	32
1024 by 768	85 Hz	68.677 kHz	16	32	32
1152 by 870	75 Hz	68.681 kHz	16	32	32
1280 by 960	75 Hz	75.000 kHz	8	16	16
1280 by 1024	60 Hz	63.981 kHz	8	16	32
1280 by 1024	75 Hz	79.976 kHz	8	16	16
1280 by 1024	85 Hz	91.146 kHz	8	16	16
1600 by 1200	60 Hz	75 Hz	8	16	16

continued

I/O Features

Table 3-1 Maximum pixel depths for video monitors (not verified) (continued)

Display resolution	Vertical refresh	Horizontal refresh	Maximum pixel depth 2 MB	Maximum pixel depth 4 MB	Maximum pixel depth 6 MB
1600 by 1200	65 Hz	81.250 Hz	8	16	16
1600 by 1200	70 Hz	87.500 Hz	8	16	16
1600 by 1200	75 Hz	93.750 Hz	8	16	16

Video Input and Graphics Acceleration Display Modes

Table 3-2 shows the display modes for video input and QuickDraw 2D and QuickDraw 3D acceleration.

Table 3-2 Video input and graphics acceleration display modes

Display resolution	Pixel depth	Vertical scan rate	Video input	QuickDraw 2D acceleration	QuickDraw 3D acceleration
512 by 384	8	70 Hz	Yes	Yes	No
512 by 384	16, 32	70 Hz	Yes	Yes	Yes
640 by 480	8	60 Hz, 67 Hz, 72 Hz, 75 Hz, 85 Hz	Yes	Yes	No
640 by 480	16	60 Hz, 67 Hz, 72 Hz, 75 Hz, 85 Hz	Yes	Yes	Yes
640 by 480	32	60 Hz, 67 Hz, 72 Hz, 75 Hz, 85 Hz	Yes	Yes	Depends on application window size
640 by 870	16	75 Hz	Yes	Yes	No
800 by 600	8, 32	56 Hz, 60 Hz, 72 Hz, 75 Hz, 85 Hz	Yes	Yes	No
800 by 600	16	56 Hz, 60 Hz, 72 Hz, 75 Hz, 85 Hz	Yes	Yes	Depends on application window size
832 by 624	8, 32	75 Hz	Yes	Yes	No
832 by 624	16	75 Hz	Yes	Yes	Depends on application window size
1024 by 768	8, 16	60 Hz, 70 Hz, 75 Hz	Yes	Yes	No
1152 by 870	16	75 Hz	Yes	Yes	No
1280 by 980	8	75 Hz	Yes	Yes	No
1280 by 1024	8	60 Hz, 75 Hz	Yes	Yes	No

Expansion Features

Expansion Features

This chapter describes the expansion features of the Power Macintosh G3 logic board: the RAM expansion slot, the PCI expansion slot, and the DAV connector and communications slot on the AV Personality card. This chapter also provides minimum specifications for adding auxiliary cooling fans in the tower enclosure.

Note

Apple does not support development of third-party Personality cards for the PERCH slot. ♦

RAM DIMMs

The logic board has three DRAM expansion slots. The DRAM expansion slots accept 3.3 volt unbuffered 8-byte (x64 non-parity) SDRAM DIMMs. The 8-byte 168-pin DIMM has a 64-bit-wide data bus per bank. One of the slots contains a factory installed DRAM DIMM.

The mechanical design of the DRAM DIMM is defined by the JEDEC MO-161 specification.

The JEDEC MO-161 specification can be found at

<<http://www.eia.org/jedec/download/freestd/pub95/#MO>>

The electrical characteristics of the DRAM DIMM are defined by the JEDEC standard 21-C section 4.5.4 release 7. The specification can be found at

<<http://www.eia.org/jedec/download/freestd/pub21/>>

The minimum bank size supported by the Grackle IC is 2 MB, and the largest is 64 MB; the largest DIMM supported is a 2-bank DIMM of 128 MB using 64 Mbit SDRAM devices. Table 4-1 shows the DIMM configurations and sizes for a range of DRAM device sizes that are supported on the Gossamer logic board.

Table 4-1 Memory configurations and sizes for DRAM DIMMS

Device size	Device configuration	Devices per bank	DIMM size per bank
16 Mbits	2 Mbits x 4 x 2	16	32 MB
16 Mbits	1 Mbits x 8 x 2	8	16 MB
16 Mbits	512K x 16 x 2	4	8 MB
16 Mbits	256K x 32 x 2	2	4 MB
64 Mbits	8 Mbits x 4 x 2	16	128 MB
64 Mbits	4 Mbits x 4 x 4	16	128 MB
64 Mbits	4 Mbit x 8 x 2	8	64 MB

continued

Expansion Features

Table 4-1 Memory configurations and sizes for DRAM DIMMS (continued)

Device size	Device configuration	Devices per bank	DIMM size per bank
64 Mbits	4 Mbits x 8 x 4	8	64 MB
64 Mbits	2 Mbits x 16 x 2	4	32 MB
64 Mbits	1 Mbits x 16 x 4	4	32 MB
64 Mbits	1 Mbits x 32 x 2	2	16 MB
64 Mbits	512K x 32 x 4	2	16 MB

The DRAM DIMMs can be installed one or more at a time. The Power Macintosh Gossamer logic board supports only linear memory organization; therefore no performance gains are seen when two DIMMs of the same size are installed. Any supported size DIMM can be installed in either DIMM slot, and the combined memory of all of the DIMMs installed will be configured as a contiguous array of memory.

IMPORTANT

The modular desktop enclosure accommodates RAM DIMMs of 1.15 inches in height. The tower enclosure accommodates RAM DIMMs of 1.5 inches in height. ▲

DRAM DIMM Presence Detect EEPROM

The presence detect serial EEPROM specified in the JEDEC standard is required and must be set properly. Details about the required values for each byte on presence detect EEPROM can be found in sections 4.5.4 and 4.1.2.5 of the JEDEC standard 21-C, release 7 specification.

RAM DIMM Connectors

The RAM DIMM connector accommodates 3.3 volt unbuffered 168-pin SDRAM DIMM cards as defined in the JEDEC specification.

RAM Address Multiplexing

Signals A[0–13] on each RAM DIMM make up a 14-bit multiplexed address bus that can support several different types of DRAM devices. Table 4-2 shows the address multiplexing modes used with SDRAM types of DRAM devices. The devices are

Expansion Features

characterized by their bit dimensions: for example, a 1 M by 16-bit device has 1 M addresses and stores 16 bits at a time.

Table 4-2 Address multiplexing modes for SDRAM devices

Device size	Device configuration	Number of banks	Size of row address	Size of column address
16 Mbits	2 M x 4 x 2	2	11	10
16 Mbits	1 M x 8 x 2	2	11	9
16 Mbits	512K x 16 x 2	2	11	8
64 Mbits	8 M x 4 x 2	2	13	10
64 Mbits	4 M x 4 x 4	4	12	10
64 Mbits	4 M x 8 x 2	2	13	9
64 Mbits	2 M x 8 x 4	4	12	9
64 Mbits	2 M x 16 x 2	2	13	8
64 Mbits	1 M x 16 x 4	4	12	8
64 Mbits	1 M x 32 x 2	2	13	7
64 Mbits	512K x 32 x 4	4	12	7

RAM Devices

The memory controller in the Grackle IC supports 1 M, 4 M, 8 M, 16 M, and 64 M SDRAM devices. The speed of the SDRAM devices is 100 MHz or faster. The devices are programmed to run with a CAS latency of 3. The access time from clock at CAS latency of 3 should be 7 ns or faster. Burst length should be at least 4 and the minimum clock delay, back to back random column accesses should be a latency of 1 clock.

RAM Refresh

The Grackle IC provides a CAS-before-RAS refresh cycle every 15.6 μ s. DRAM devices must be compatible with this refresh cycle; for example, this cycle will refresh 2K-refresh parts within 32 milliseconds.

Compatible SDRAM DIMMs

Table 4-3 lists some vendors and part numbers for SDRAM DIMMs that have been qualified as compatible with the Power Macintosh G3 architecture.

Table 4-3 Compatible SDRAM DIMMs for the Power Macintosh G3 computer

Vendor name	SDRAM DIMM part number
Hyundai	HY57V168010A TC-10, HYM7V64400TFG-10
LG Semicon	GM72V1681BT 10K, GMM2642233BL TG-10K 7042S
Samsung	KMM366S104BTN, KMM366S403BT2

PCI Expansion Slot

The Power Macintosh Gossamer logic board uses the industry-standard peripheral component interconnect (PCI) bus for an I/O expansion bus. The PCI bus is a 32-bit multiplexed address and data bus. The PCI expansion slots have a 33.33 MHz system clock.

PCI I/O expansion cards are mounted vertically in PCI expansion slots on the main logic board.

A total of 15 watts of power is provided for each of the PCI expansion slots. Both 5 volts and 3.3 volts are supplied; the total power consumed by both voltages must not exceed the 15-watt maximum.

The Power Macintosh Gossamer logic board requires that PCI cards use the 5-volts signaling standard described in the *PCI Local Bus Specification*, Revision 2.1.

The Gossamer logic board accepts standard 6.88-inch and 12.283-inch PCI cards as defined by the *PCI Local Bus Specification*, Revision 2.1. The cards are required to use the standard ISA fence described in the specification.

The PCI slots support all the required PCI signals and certain optional PCI signals. The PCI slots on the Gossamer logic board do not support the optional 64-bit bus extension signals or cache support signals.

For more information about the PCI expansion slot, refer to *Designing PCI Cards and Drivers for Power Macintosh Computers*.

The DAV Connector

The Wings Personality card has a separate connector called the DAV (digital audio video) connector. The DAV connector provides access to the Wings card's 4:2:2 unscaled YUV video input data bus and associated control signals. By means of a 60-pin cable to the DAV connector, a PCI expansion card can gain access to the digital video bus on the Wings Personality card and use it to transfer real-time video data to the computer. Such a PCI expansion card can contain a hardware video compressor or other video processor.

The DAV connector accepts YUV video and analog sound from the PCI expansion card.

The DAV connector is a 60-pin flat-ribbon connector located at the top edge of the Wings Personality card. A PCI expansion card can be connected to the Wings card with a 7-inch 60-conductor flat-ribbon cable that the user can install between the DAV connector and the PCI card.

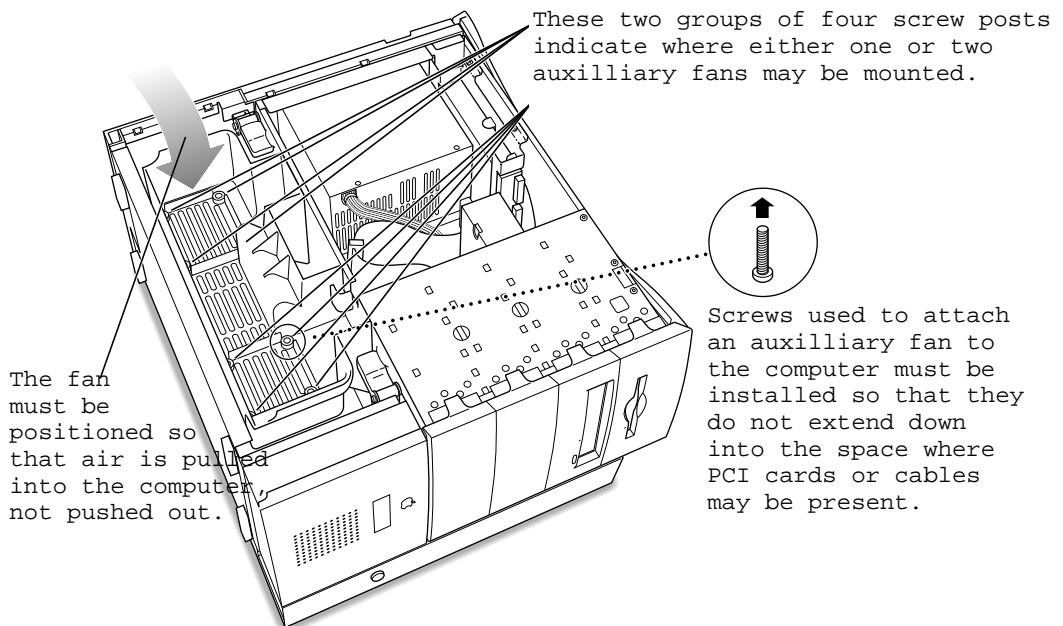
The Modem Slot

The Wings and Whisper Personality cards have a separate slot for an optional fax/modem card. The modem slot is not a PCI bus-based communications slot (comm slot II) like that in the Power Macintosh 5500 and 6500, and it does not accept comm slot II cards that use any of the PCI signals.

Auxiliary Cooling Fans

The Power Macintosh G3 tower enclosure includes a baffle above the PCI card slots for the addition of one or two cooling fans. This feature is provided for VARS or developers that plan to configure the tower enclosure with PCI cards that require additional cooling. Figure 4-1 shows the baffle where the fans can be installed.

Expansion Features

Figure 4-1 Location for auxiliary cooling fans

Power for the fans can be obtained from one of the peripheral power connectors, or a Y termination harness can be used if a connector is not available. The fan or fans power consumption must be figured in with the PCI expansion card power budget. The maximum allowable current per fan as +12 V is .2 amps (2.4 watts per fan). The Yellow wire on the peripheral connector provides +12 V and either of the Black wires provides power supply ground.

The baffle is designed to accommodate a 60mm square fan frame with a depth up to 25mm.

IMPORTANT

VARs and developers installing fans in the enclosure are responsible for routing and securing the wiring properly from the baffle to the power source. The VAR or developer is responsible for safety compliance within the country or countries where the fan configuration of the Power Macintosh G3 tower enclosure will be sold. This includes providing fingerguards, testing compliance and agency submittal. If the fan assembly is provided as a kit, the VAR or developer is responsible for the installation instructions and safety compliance. ▲

Index

A

abbreviations xi to xiii
ADB (Apple Desktop Bus) port 36
ADB controller 33
ATA (IDE) hard disk 24, 37
ATI RAGE II+DVD IC 33

B

block diagrams
 main logic board 28
 Whisper Personality card 29
 Wings Personality card 30

C

cache expansion 24
CD-ROM drive 37
comm slot II 48
communications modules 23
compatibility
 ATA (IDE) hard disk 24
 L2 cache 24
 modem slot 24
 power supply 24
connectors
 ADB 36
 DAV 48
 floppy disk 36
 SCSI 37
 sound input jack 39
 sound output jacks 38
 video input 22
Cuda IC 33
custom ICs 31
 ATI RAGE II+DVD 33
 Cuda 33
 Grackle 32
 Heathrow 32
 Screamer 33

D

DAV connector 48
display memory 34
display RAM 34
dual inline memory modules
 for RAM 44

E

expansion bus 47
expansion slots 24, 47

F

features summary 16
floppy disk connector 36

G

Grackle custom IC 32

H

hard disk 24, 37

I, J, K

input and output ports
 ADB 36
 ATA 37
 built-in video 40
 floppy disk drive 36
 SCSI 37
 sound 38
I/O control IC. *See* Heathrow custom IC

L

logic board access 19

M

memory
 sizes and configurations of 44
 memory control IC. *See* Grackle custom IC
 microphone 39
 modem slot 48
 modular desktop enclosure
 back view 19
 front view 18

N

nonvolatile RAM 33

O

optional modules
 communications 23
 video input 22

P, Q

PCI bus bridge 32
 PCI expansion bus 47
 PCI expansion slots 47
 power, to expansion slots 47
 power supply 24

R

RAM devices 46
 access time of 46
 refresh operation 46
 RAM DIMMs 44
 address multiplexing for 45
 compatibility 47
 connectors 45
 devices in 46
 dimensions of 24, 45
 installation of 45
 specifications 44
 ROM 31

S

Screamer custom IC 33
 screen buffers 34
 SCSI bus termination 37
 SCSI connectors 37
 SDRAM DIMM 44, 47
 sound 39
 sound IC 33
 sound input jack 39
 sound output jacks 38
 summary of features 16

T, U

terminator, for SCSI bus 37
 tower enclosure
 back view 21
 front view 20

V, W, X

video input module 22
 DAV connector on 48
 input connectors 22
 window size 22
 video monitors, colors displayed 41
 voltage switch 24

Y, Z

YUV digital video 48

This Apple manual was written, edited, and composed on a desktop publishing system using Apple Macintosh computers and FrameMaker software. Proof pages were created on an Apple LaserWriter Pro printer. Line art was created using Adobe™ Illustrator and Adobe Photoshop. PostScript™, the page-description language for the LaserWriter, was developed by Adobe Systems Incorporated.

Text type is Palatino® and display type is Helvetica®. Bullets are ITC Zapf Dingbats®. Some elements, such as program listings, are set in Apple Courier.

WRITER

Steve Schwander

EDITOR

Donna S. Lee

PRODUCTION EDITOR

Gerri Gray

ILLUSTRATORS

Tom Llewellyn and David Arrigoni

Special thanks to Peter Baum,
ChengHwee Chee, Meng Chi Lee,
and Bill Saperstein