Developer Note

Enhanced Macintosh PowerBook 1400 Computer

Developer Note

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About This Developer Note

This developer note describes the latest model of the PowerBook 1400 computer. The note describes only the changes that make the new model different from its earlier counterparts. For information about the original PowerBook 1400 computer, see "Supplemental Reference Documents," later in this preface.

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 more 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/dnotes3.shtml

- on the Reference Library Edition of the Developer CD Series, which is mailed to registered developers and also available through the *Apple Developer Catalog*.

Contents of This Note

This note has only one chapter: a delta guide describing the differences between the latest PowerBook 1400 model and the original PowerBook 1400 computer. Because the note is so short, it has no index.

Supplemental Reference Documents

For information about the original PowerBook 1400 computer, developers should have the developer note for that computer. Adobe Acrobat PDF (portable document file) versions of all developer notes are available on the Developer CD and on the World Wide Web at

http://dev.info.apple.com/reference.html

For a description of the version of the Mac OS that comes with the new model, developers should refer to Technote 1090, "System 7.6." The technote is available on the Technote Web site at

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

Printed copies of the technote are available from Field Copy and Printing, telephone 1-415-323-3155. The technotes are also available on the reference library issues of the Developer CD.

For information about the latest version of the PC Card Manager, developers should refer to the PC Card Manager v3.0 SDK. The SDK is available on the March 1997 Reference Library edition of the Developer CD; the SDK is also available on the ftp site:

ftp://ftp.apple.com/devworld/Development_Kits/PC_Card_Manager/

Developers should also have copies of the relevant books of the *Inside Macintosh* series, available in technical bookstores and through the *Apple Developer Catalog*.

The *Apple Developer Catalog*

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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:

GB	gigabytes	nS	nanoseconds
KB	kilobytes	Ω	ohms
MB	megabytes	pF	picofarads
MHz	megahertz	V	volts

Other abbreviations used in this note include:

CD-ROM	compact disc read-only memory
DRAM	dynamic RAM
PDF	portable document file
RAM	random-access memory
RAS	row address strobe
RC	resistor-capacitor
ROM	read-only memory

CHAPTER 1

Delta Guide

Apple Computer has introduced a faster version of the Macintosh PowerBook 1400 computer. This chapter is a delta guide—it compares the new model with its earlier counterparts, describing only the changes and new features. For descriptions of previous models, see the *PowerBook 1400 Computer Developer Note.* For information about obtaining the developer note, see "Supplemental Reference Documents" on page v.

New Features

The latest PowerBook 1400 model includes the following changes from the features described in the original developer note:

- higher processor speed: 166 MHz
- a built-in second-level (L2) cache
- larger size internal hard disk: 2.0 GB
- a faster built-in CD-ROM drive: 8X-speed
- an upgraded system ROM to support the 166 MHz clock speed
- version 7.6.1 of the Mac OS

The new features are described in the following sections.

Processor Clock Speed

The latest PowerBook 1400 model has a microprocessor clock speed of 166 MHz. The microprocessor is the PowerPC™ 603ev, a faster version of the PowerPC 603e with a core power supply voltage of 2.5 V.

Second-Level Cache

The latest PowerBook 1400 model includes a second-level (L2) cache with 128 KB of fast static RAM. The L2 cache provides up to 40% better performance over similar computers without a cache.

The L2 cache subsystem is a single integrated circuit containing the cache controller and interface, along with the tag RAM and data RAM. The cache is a look-aside, write-through cache.

Note
Other recent models of the PowerBook 1400 also have a built-in L2 cache. All the recent models are listed in Table 1-1. ◆

Hard Disk Size

The built-in hard disk in the latest PowerBook 1400 model has a storage capacity of 2.0 GB. The list of configurations (Table 1-1) shows the sizes of the hard disks in all the recent PowerBook 1400 models.

IMPORTANT

In the developer note for the PowerBook 1400 Computer, Figure 3-1 on page 17 shows a maximum height of 19.25 mm for the internal hard disk drive. That is not correct. The hard disk drive must be no more than 12.50 mm in height, in both the original and the enhanced PowerBook 1400 computers. ▲

8X-Speed CD-ROM Drive

All the recent PowerBook 1400 models include an 8X-speed CD-ROM drive in the media bay. 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 an 8X-speed mechanism that supports sustained data transfer rates of 1200 KB per second and a data buffer that further enhances performance.

Note

Technote DV 22, "CD-ROM Driver Calls, " has recently been updated with information about the latest version of the CD-ROM driver. To find out how to obtain Apple Computer's technotes, see "Supplemental Reference Documents" on page v. ◆

System Software

The Mac OS included with the latest PowerBook 1400 model is version 7.6.1. Mac OS 7.6.1 is based on Mac OS 7.6. For a list of the features of Mac OS 7.6, see Technote 1090, "System 7.6." To find out how to obtain Apple Computer's technotes, see "Supplemental Reference Documents" on page v.

The system software has been modified to support the new hardware features of the PowerBook 1400 and other recent Macintosh computer models.

Changes in the ROM

The ROM software has been modified to support the higher processor clock speeds.

Changes in the Disk Software

The following changes have been made in the system software on the hard disk:

- The CD Setup application now supports the Macintosh 8X-speed CD-ROM drive.
- The Drive Setup application now supports the 2.0 GB hard disk drives.

Configurations

Table 1-1 shows the configurations of all the PowerBook 1400 models introduced since the original PowerBook 1400 developer note was written.

Table 1-1 Configurations of recent PowerBook 1400 models

Model	Processor clock speed	Amount of DRAM	Size of hard disk	Type of display
PowerBook 1400 cs	117 MHz	12 MB	1.0 GB	DualScan color
PowerBook 1400 cs	117 MHz	16 MB	1.0 GB	DualScan color
PowerBook 1400 cs	133 MHz	16 MB	1.3 GB	DualScan color
PowerBook 1400 c	133 MHz	16 MB	1.3 GB	Active-matrix color
PowerBook 1400 c	166 MHz	16 MB	2.0 GB	Active-matrix color

Note
All these PowerBook 1400 models have a built-in second-level (L2) cache of 128 KB and include an 8X CD-ROM drive. ◆

Compatibility Issues

Except for the changes described in this developer note, the features of the latest PowerBook 1400 model are the same as those of its earlier counterparts. There should be no compatibility problems with applications and peripherals that operate correctly with the earlier models.

Machine Identification

All models of the PowerBook 1400 computer return the same `gestaltMachineType` value: 311 (hexadecimal $137). *Inside Macintosh: Overview* describes the Gestalt Manager and tells how to use the `gestaltMachineType` value to obtain the machine name string.

RAM Expansion Guidelines

Developers must take special care when designing RAM expansion cards for the PowerBook 1400 computers. Excessive capacitive loading on the memory address bus can cause a problem with the timing margins. When this problem occurs, the computer displays a dialog box at startup time warning the user that the memory test has failed, and the computer does not recognize a portion of the newly-installed expansion RAM.

This section describes simple, inexpensive ways to modify the design of the RAM expansion card to improve the timing margins.

IMPORTANT
The information in this section applies to all models of the PowerBook 1400 computer. ▲

Address Signal Timing

For proper operation of the expansion RAM, the signals on the memory address bus must be stable before the assertion (falling edge) of the RAS (row address strobe) signals. Because each address line is connected to every DRAM device, whereas each RAS line is connected to only one bank of devices, the difference in loading can cause the address signals to change more slowly than the RAS signals. The resulting decrease in the timing margins is greater on expansion cards that have many DRAM devices.

Note
The interface to the RAM expansion slot uses buffers to provide adequate fan-outs. Signals RMA(0–11), /RCAS(0–3), /RRAS(2–7), and /RRAMWE are buffered by 74FCT245 devices and 22 Ω damping resistors. ◆

The timing margin between the address signals and the assertion of the RAS signals is small. Additional loading of the address bus signals will further decrease the timing margins and, under worst-case conditions, will force negative timing margins on the RAM expansion card.

To maintain adequate timing margins in the worst case—using DRAM devices from different manufacturers and considering the timing delay caused by circuit loading—requires an additional delay of 7 to 10 nS in the assertion of the RAS signals. The next section describes two ways of obtaining this additional delay.

Suggested Modifications

The simplest approach is to use resistors of an appropriate value (typically 22 to 47 Ω) in series with the RAS control lines on the DRAM expansion card, before the signals are fanned out to the individual DRAM devices. This creates a distributed RC lowpass delay circuit whose capacitive component is provided by the parasitic input capacitances of the

RAS inputs of the DRAM devices. The resistor value should be carefully selected to provide the minimum delay required. The resistor selection process should include testing of the card and measurement of the timing margins using samples of memory devices from several manufacturers.

A more robust approach is to use a combination of a discrete RC delay network in cascade with a gate delay to provide the needed final delay. You can do this by using a very fast two-input OR gate—one with a typical maximum propagation time of 4nS. You connect the RAS signal to both inputs of the gate and add a discrete RC section in one input path to differentially skew the RAS signal between the two inputs. This approach delays the assertion (falling edge) timing while retaining most of the original deassertion (rising edge) timing, except for the gate delay. In other words, this approach slightly shortens the active (low) period of the RAS signal by delaying the assertion.

As with the previous approach, careful selection of the RC skewing network is required. A suggested starting point uses RC values of 33 Ω and 68 pF.

IMPORTANT

Developers of RAM expansion cards should measure and characterize the memory timing on their cards to ensure that it conforms to the timing requirements specified for the DRAM devices used in the card. Because this timing depends in part on the input characteristics of the DRAM devices, you can improve the likelihood that your card will operate properly in worst-case situations by testing it with devices from many different DRAM manufacturers. ▲

Delta Guide