Welcome

This guide is for engineers who build personal computers, expansion cards, and peripheral devices that will be used with the Microsoft® Windows® 98 and Windows NT® version 5.0 operating systems. The goal of this document is to provide hardware design guidelines that will result in the optimal user experience, particularly when the hardware is used with the Windows family of operating systems.

This guide is co-authored by Intel Corporation and Microsoft Corporation, with contributions by Compaq Computer Corporation. The requirements and recommendations in this guide outline features that the hardware industry should consider in designing PCs and peripherals for various price levels and performance levels.

The clarifications, changes, and additional requirements in this guide define the PC 98 requirements for 1998–99 in the way that *PC 97 Hardware Design Guide* (Microsoft Press, 1996; ISDN 1-57231-381-1) defined the PC 97 requirements for 1997–98.

This guide includes PC 98 requirements for basic consumer and office implementations, such as desktop, mobile, and workstation systems, and for Entertainment PCs. In this guide, the following requirements are defined:

- Design requirements for specific types of systems that will run either Windows 98 or Windows NT operating systems
- Design requirements related to the OnNow design initiative, including requirements related to the Advanced Configuration and Power Interface (ACPI) specification, Plug and Play device configuration, and power management in PC systems
- New manageability requirements that focus on improving Windows 98 and Windows NT, with the end goal of reducing total cost of ownership (TCO) by providing support for maximum automation of administrative tasks using centralized control and maximum flexibility
- Clarifications and additional design requirements for devices supported under Windows 98 and Windows NT, including new graphics and video device capabilities, DVD, scanners and digital cameras, and other devices

This book does not address PC systems designed to act as servers in networked environments. It also does not address non-PC handheld computers running on the Microsoft Windows CE operating system.

Important: The system requirements defined in this document provide guidelines for designing PC systems that deliver an enhanced user experience when implemented with Windows 98 and Windows NT operating systems. These design requirements are not related to the minimum, most-optimal, or best system requirements for running the Windows family of operating systems. For information about minimum system requirements, see the web site at http://www.microsoft.com/windows/.

How to Use This Guide

The PC 98 requirements are defined by system type and for individual bus classes and device classes. This guide is divided into five parts, with each part addressing a particular element of PC 98 design.

Part 1: System Design Issues. Introduces the important design issues for PC 98. Study this part first to understand the key design issues being addressed in the PC 98 requirements.

Part 2: PC 98 Systems. Presents system-type definitions and PC 98 requirements for each system type. Study this part for an understanding of the overall system requirements.

Part 3: Bus Design Guidelines. Presents requirements for each bus type and I/O host controller supported under Windows 98 and Windows NT. Study this part for a detailed understanding of how buses and controllers are to be implemented on PC 98 systems.

Part 4: Device Design Guidelines. Defines design requirements for each particular device type, whether the device is an integral part of a PC system or designed as an add-on device. Study this part for a detailed understanding of the design requirements for each device type.

References. Includes the PC 98 checklist, which summarizes all the requirements defined in this guide, plus other technical appendixes, a comprehensive hardware glossary with a list of acronyms and abbreviations used in this guide, and an index.

Updates to this guide, technical clarifications, and answers to frequently asked questions are available on the following web sites:

http://www.microsoft.com/hwdev/desguid/
http://developer.intel.com/design/pc98/

Required vs. Recommended PC 98 Features

In this guide, hardware features are described as *Required*, *Recommended*, or *Optional.* For PC 98, these terms are used to mean the following:

- **Required:** These basic features must be implemented in order for hardware to comply with PC 98 requirements.
- **Recommended:** These features add capabilities that are supported by the Windows family of operating systems. Recommended features take advantage of the native capabilities of the device drivers included with the operating system, usually without imposing major cost increases.

  Notice that for compliance testing, if a recommended feature is implemented, it must meet the requirements for that feature as defined in this guide.

  Some recommended features might become requirements in the future.
- **Optional:** These features are neither required nor recommended, but if the feature is implemented in a PC 98 system, it must meet the specified requirements. Optional features will not become requirements in the future.

In this guide, these words can be understood as follows with regard to PC 98 requirements:

- **Must:** Required
- **Should:** Recommended

Important: The requirements and recommendations in this guide are often provided in the form of references to industry specifications. These specifications might contain intellectual property of Intel, Microsoft, or other third parties. Each of these industry specifications might have different intellectual property licensing arrangements. It is the original equipment manufacturer's (OEM's) responsibility to consult these industry specifications or their issuance bodies for licensing specifics or details.

Conventions Used in This Guide

The following conventional terms are used throughout this guide. In addition, see the Hardware Glossary in the References part of this guide.

Convention	Meaning
Add-on device	Refers to devices that are traditionally added to the basic PC system to increase functionality. Examples include audio, networking, graphics, small computer system interface (SCSI) controller, and so on. Add-on devices fall into two categories: devices built on to the system board and devices on expansion cards added to the system through a system-board connector, such as Peripheral Component Interconnect (PCI).
Intel Architecture	Refers to computers based on 32-bit microprocessors that use the Intel Architecture instruction set, such as Intel® 80486, Intel Pentium®, Intel Pentium with MMX™ technology, Pentium Pro, Pentium II, or compatible processors. MMX technology refers to Intel's media-enhancement technology that includes new instructions to the Intel Architecture instruction set.
PC 97	Collection of requirements and recommendations for PC system design defined in the *PC 97 Hardware Design Guide*.
PC 98	Collection of requirements and recommendations defined in this guide that make up the 1998–99 requirements for PC system design. **Note:** The term "PC 98" as used in this guide should not be confused with NEC PC98, a Japanese-specific product.
RISC-based	Refers to computers based on reduced instruction set computing (RISC) architecture. Notice that all requirements and recommendations for RISC-based PCs are for the Windows NT operating system only.
System device	Also *on-board device*. Refers to devices on the system board such as interrupt controllers, keyboard controller, real-time clock, direct memory access (DMA) page registers, DMA controllers, memory controllers, floppy disk controller (FDC), Integrated Device Electronics (IDE) ports, serial and parallel ports, PCI bridges, and so on. In today's PCs, these devices are typically integrated with the supporting chip set.
Windows	For PC 98, refers to the Microsoft Windows 98 operating system, including any add-on capabilities and any later versions of the operating system.
Windows NT	For PC 98, refers to the Microsoft Windows NT Workstation version 5.0 operating system, including any add-on capabilities and any later versions of the operating system.

PC 98 and the “Designed for Microsoft Windows” Logo Program

Microsoft will use the requirements and recommendations in this guide as the basis of requirements for the 1998–99 “Designed for Microsoft Windows” hardware logo program.

The “Designed for Microsoft Windows” logo program—represented in 1997 by the “Designed for Microsoft Windows NT and Windows 95” logo program—was developed by Microsoft to help end users easily identify hardware and software products designed specifically for the Windows and Windows NT operating systems. Users can mix and match hardware and software products designated with these logos and can be assured that the products will take advantage of the new technologies integrated into the Microsoft Windows family of 32-bit operating systems. The goal is to ensure that end users will have an optimal experience using the software and hardware products that carry this logo.

The logo program provides customers with the assurance that their hardware works with the Windows and Windows NT family of products, with an emphasis on how the system performs when running commercially marketed desktop applications. The end result Microsoft is seeking is lower cost of support for both vendors and users.

Licensing the logo enables vendors to use the logo on web sites, product packaging, advertising, collateral, and other marketing materials. The logo indicates to customers that the product is designed to meet a specific set of standards and to provide an optimal experience when run on either a Windows or Windows NT operating system.

Logo Compliance Dates. In general, the PC 98 requirements go into effect on July 1, 1998, for the “Designed for Microsoft Windows” logo. Compliance testing for some requirements will begin later because of the time required for silicon changes to become widely available. For information about actual compliance testing dates for specific requirements, see the web site at http://www.microsoft.com/hwdev/desguid/.

Logo Testing. Both hardware and software are tested before rights to use the "Designed for Microsoft Windows" logo are granted. The testing organization for the logo program is the Windows Hardware Quality Labs (WHQL), which provides compatibility testing services for Windows and Windows NT hardware and drivers.

Hardware developers whose products pass the WHQL testing program also receive a detailed test report, inclusion of tested hardware on the Windows Hardware Compatibility List (HCL), and free distribution of drivers in the Windows Driver Library (WDL).

If you have questions about the program, contact WHQL:

Windows Hardware Quality Labs
Microsoft Corporation
One Microsoft Way
Redmond, WA 98052-6399 USA

http://www.microsoft.com/hwtest/
E-mail: whqlinfo@microsoft.com
Fax: (425) 703-3872

References

The following table lists some of the information resources, services, and tools available from Intel and Microsoft to help build hardware that is compliant with the PC 98 requirements. In addition, each chapter in this guide contains a reference section.

Resource	Address
Intel information for developers	http://developer.intel.com
Microsoft information for hardware manufacturers	http://www.microsoft.com/hwdev/ E-mail: ihv@microsoft.com
Windows and Windows NT DDKs	Provided with Microsoft Developer Network (MSDN) Professional membership. To subscribe: Fax: (425) 936-7329, Attn: Developer Network E-mail: msdn@microsoft.com http://www.microsoft.com/msdn/subscribe/
Plug and Play and Microsoft-provided specifications	http://www.microsoft.com/hwdev/specs/
Hardware testing tools	http://www.microsoft.com/hwtest/

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Adaptec, Inc.
Advanced Micro Devices
Alpine Software Technologies
Association for Computing Machinery
AST Research
ATI Instruments
AVM Berlin
Azfin Semiconductors Pte, Limited
Aztech Systems, Limited
Brooktree Corporation
Canon, Inc.
Chips and Technologies, Inc.
Cirrus Logic, Inc.
Compaq Computer Corporation
Creative Labs
Chromatic Research, Inc.
Crystal Semiconductor
Cyrix Corporation
Dell Computer Corporation
Digital Equipment Corporation
Digital Infotainment
Efficient Networks, Inc.
ELSA, Inc.
Epson
ESS Technology, Inc.
Evans & Sutherland Computer Corporation
Fujitsu, Limited
Gamry Instruments, Inc.
Gateway 2000, Inc.

Hewlett-Packard Company
Hirin Information Technology Co., Limited
Hitachi, Limited
Integrated Device Technology, Inc.
International Business Machines Corporation
Information Technology and Telecommunications Equipment (ITTE) Intercommittee Working Group on Acoustics, including:

- Information Technology Industries Council, TC-6, Product Acoustics
- Institute of Noise Control Engineering, Technical Committee on Information Technology and Telecommunications Equipment
- ISO Technical Committee 43/SC1/WG23 Noise from Information Technology and Telecommunications Equipment
- ANSI S12-3, Noise from ITTE
- ECMA, TC 26, Noise

Iomega Corporation
Iterated Systems
ITT Semiconductors
Kasan Electronics
Keesler AFB
Madge Networks
Matrox Graphics, Inc.
Matsushita Electric Industrial Co., Limited
Melco, Inc.
Micron Electronics, Inc.
Mitsubishi Electric Corporation
NEC Corporation
NeoMagic Corporation
Nihon Unisys, Limited
Nissei Electric Company, Limited
Norpak Corporation
NVidia
Oak Leaf Systems, Inc.
Packard Bell NEC, Inc.
Phoenix Technologies
Pioneer Electronic Corporation
Quantum Corporation
Real3D/Realsoft International
Rockwell Semiconductor Systems
Roger Jennings, consultant

SBC Communications
Schlumberger, Limited
Seagate Technology
Sharp Electronics Corporation
Silent Systems, Inc.
Sonnetech, Limited
S3, Inc.
SystemSoft Corporation
Toshiba Corporation
Trace Research and Development Center
Unisys Corporation
US Robotics
VideoLogic Limited
Vsis, Inc.
Western Digital Corporation
Yamaha Corporation
Ye Data, Inc.