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 Windows2000 operating systems. The goal of this document is to provide guidelines for hardware design 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. 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 extensions to the requirements defined in *PC 98 System Design Guide* (Microsoft Press®, 1997; ISBN 1-57231-716-7) for 1998–99.

This guide includes PC 99 requirements for basic consumer and office implementations, such as desktop, mobile, and workstation systems, and for Entertainment PCs .It also includes updates from the PC 99 Addendum that are highlighted in yellow onscreen (see “Conventions Used in This Guide” later in this section). In this guide, the following requirements are defined:

- Design requirements for specific types of systems that will run either Windows 98 or Windows 2000 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
- Manageability requirements that focus on improving Windows 98 and Windows 2000, with the end goal of reducing total cost of ownership (TCO)
- Clarifications and additional design requirements for devices supported under Windows 98 and Windows 2000, including new graphics and video device capabilities, DVD, scanners and digital cameras, and other devices

This guide 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 2000 operating systems. These design requirements are not related to the minimum or optimal system requirements for running the Windows family of operating systems. For information about minimum system requirements for both operating systems, see the web site at http://www.microsoft.com/windows/.

How to Use This Guide

The PC 99 requirements are defined by system type and for individual bus classes and device classes. This guide is divided into four parts, plus appendixes, with each chapter addressing a particular element of PC 99 design.

Part 1: System Design Issues. Introduces the important design issues for PC 99. Study this part first to understand the key design issues being addressed in the PC 99 requirements.

Part 2: PC 99 Systems. Presents system-type definitions and PC 99 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 2000. Study this part for a detailed understanding of how buses and controllers are to be implemented on PC 99 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.

Appendixes. Includes the PC 99 checklist, which summarizes all the requirements defined in this guide, plus other technical appendixes.

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

http://www.microsoft.com/hwdev/pc99.htm
http://developer.intel.com/design/desguide/

Required vs. Recommended PC 99 Features

In this guide, hardware features are described as *Required*, *Recommended*, or *Optional*. For PC 99, these terms are used to mean the following:

- **Required:** These basic features must be implemented in order for hardware to comply with PC 99 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.

  Note: If it is planned that a specific recommended feature will become a requirement in future versions of these guidelines, it is specifically noted in the text.
- **Optional:** These features are neither required nor recommended, but if the feature is implemented in a PC 99 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 99 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 responsibility of the original equipment manufacturer (OEM) 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 Glossary in the Appendixes 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®, Pentium Pro, Pentium II, or compatible processors.
PC 99	Collection of the additional requirements and recommendations defined in this guide that make up the 1999–2000 requirements for PC system design.
PC 99A Clarifications and Corrections	Presents technical clarifications and corrections, highlighted in yellow onscreen, to the original requirements and recommendations defined in *PC 99 System Design Guide*.
RISC-based or DEC Alpha	Refers to Windows NT-compatible computers based on reduced instruction set computing (RISC) architecture. Notice that all requirements and recommendations for DEC Alpha 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), hard disk controller (HDC), 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 99, refers to the entire family of Microsoft Windows operating systems, including any add-on capabilities and any later versions of the operating system.
Windows NT	Refers to Microsoft Windows NT 4.0 and earlier.
Windows 2000	For PC 99, refers to the Microsoft Windows client and server products based on Windows NT technologies, including any add-on capabilities and any later versions of the operating system.
Windows 2000 Professional	Refers to the client version for the Microsoft Windows 2000.

PC 99 and the “Designed for Microsoft Windows” Logo Program

Microsoft will refer to the requirements and recommendations in this guide when defining requirements for the 1999–2000 “Designed for Microsoft Windows” hardware logo program. The “Designed for Microsoft Windows” logo program was developed by Microsoft to help end users easily identify hardware and software products designed specifically for the Windows 98 and Windows 2000 Professional operating systems.

The logo program provides customers with the assurance that their hardware works with the Windows family of products, with an emphasis on how the system performs when running commercially marketed desktop applications. The end result Microsoft is seeking is a good user experience and 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 98 or Windows 2000 operating system.

Logo Compliance Dates. In general, the PC 99 requirements go into effect on July 1, 1999, for the “Designed for Microsoft Windows” logo. Compliance testing for some requirements will begin later because of the time required for supporting parts 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 98 and Windows 2000 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 on the Windows Update web site.

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 list shows basic information resources available from Intel and Microsoft to help build hardware that is compliant with the PC 99 requirements. Each chapter in this guide also 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 98 and Windows 2000 Device Driver Kits (DDKs)	http://www.microsoft.com/ddk/ 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/
Hardware testing tools	http://www.microsoft.com/hwtest/

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3Com Corporation
3Dfx Interactive, Inc.
3Dlabs, Inc.
3M Company
Acer Lab, Inc.
Adaptec, Inc.

Advanced Micro Devices
Alcor Micro Inc.
APC
ATI Technologies, Inc.
Aureal Semiconductor
Award Software
Brooktree/Rockwell
Cadence Design Systems, Inc.
Chips & Technologies, Inc.
Chromatic Research, Inc.
Cirrus Logic, Inc.
COCOM A/S
Compaq Computer Corporation
Creative Computer Corporation
Creative Technology, Ltd.
Crucial Technology, Inc.
Cyrix Corporation
Dell Computer Corporation
Digital Equipment Corporation
Dolby Laboratories, Inc.
Ectiva/Creative, Inc.
Efficient Networks, Inc.
Equator Technologies Inc.
Ericsson Mobile Communications
ESS Technology, Inc.
First Int Comp of America, Inc.
Fujitsu
Gateway 2000, Inc.
Hewlett-Packard Company
Hitachi, Ltd.
IBM Corporation
Imation Corporation
Integrated Device Technology Inc.
JAE Electronics
Lucent Technologies, Inc.
Matsushita Electric Industrial Co., Ltd.
Micron Electronics, Inc.
Micron Semiconductor Products, Inc.
Micronas Semiconductors
Mitsubishi Electric Corporation
Motorola, Inc.
Nanao Corporation
National Semiconductor
NEC Corporation
NEC Technologies, Inc.
NeoMagic Corporation

Nokia Display Products
NVIDIA Corporation
Olicom
Panasonic Industrial Company
Pericom Semiconductor Corporation
Philips Semiconductors
Phoenix Technologies Ltd.
Portable Systems, IBM Japan
Quantum Corporation
Raychem Corporation
Real 3D, Inc.
Ricoh Company, Ltd.
Rockwell Semiconductor Systems
S3, Inc.
Samsung Electronics
Samsung Information Systems America Inc.
Schlumberger Well Services
Seagate Technology
SGS Thomson
Shure Brother, Inc.
Siemens Nixdorf
Silicon Graphics
Silicon Integrated Systems
Silicon Motion, Inc.
SMSC - Standard Microsystems Corporation
Sonnetech, Ltd.
STB Systems, Inc.
Symbios, Inc.
Synaptics, Inc.
SystemSoft Corporation
Texas Instruments, Inc.
Toshiba
Transmeta Group
Trident Microsystems, Inc.
Tulip Computers International
Universal Access AB
ViewSonic Corporation
Vobis Microcomputer AG
Xircom, Inc.
Yamaha Systems Technology