

CHAPTER 3

Basic PC 97

This chapter presents the PC 97 requirements and recommendations for basic PC design under the Microsoft Windows family of operating systems.

Version 1.1

Includes changes to items 4, 5, 8a, 22, 25, 49, Port Replicator Requirements, References for Basic PC 97, and Checklist for Basic PC 97, as previously published in the PC 97 FAQ on <http://www.microsoft.com/hwdev/pc97.htm> and the PC 97 OnNow Requirements on <http://www.microsoft.com/hwdev/desguid/onnowpc97.htm>.

See also: System FAQs for WHQL Testing on http://www.microsoft.com/hwtest/faqs/faq_system.stm **Contents**

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Overview for Basic PC 97

Basic PC 97 defines a standard PC (both desktop and mobile) with no particular market category or customer application. This PC is designed to support typical Windows-based applications running under either the Microsoft Windows 95 or Windows NT Workstation operating system.

The new critical design requirements for PC 97 are the following:

- Support for Advanced Configuration and Power Interface (ACPI), the OnNow design initiative, and Plug and Play for essentially all system components
- Compliance with specified industry standards for all buses and devices
- Compliance with guidelines for ease of use for installation, configuration, and daily use of the PC system and peripherals

The Basic PC 97 requirements serve as the basis for all system requirements for the “Designed for Microsoft Windows” logo, with the requirements for Workstation PC 97 and Entertainment PC 97 defined as differences from these basic requirements.

For PC 97, the following definitions are used to distinguish the types of devices present in a PC system:

- System devices (or system board device) are those 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), IDE ports, serial and parallel ports, PCI bridges, and so on. In today’s PCs, these devices are typically integrated in the supporting chip set.
- Add-on devices are those devices traditionally added to the base PC system to add functionality, such as audio, networking, graphics, SCSI controller, dedicated tape backup, uninterruptible power supply (UPS), and so on. Add-on devices fall into two categories: devices built onto the system board, or devices on expansion cards added to the system through a system board connector such as ISA or PCI.

Important The system requirements defined in *PC 97 Hardware Design Guide* provide guidelines for designing PC systems that best run Windows 95 and Windows NT. These design requirements are not the basic system requirements for running the Windows operating system.

Hardware features are described as *Required*, *Recommended*, or *Optional* for the “Designed for Microsoft Windows” logo program:

- **Required:** These basic hardware features must be implemented to qualify for the “Designed for Microsoft Windows” logo.
- **Recommended:** These features add functionality supported by the Windows operating systems. For “Designed for Microsoft Windows” logo testing, if a recommended feature is implemented, it must meet the standards for that feature as defined in this guide. Some recommended features might become requirements under the logo program in the future.
- **Optional:** These features are neither required nor recommended, but if the feature is implemented in a PC 97 system, it must meet the specified requirements. These features will not become requirements under the logo program in the future.

General System Requirements for Basic PC 97

This section summarizes the requirements and recommendations for the basic components of desktop and mobile systems.

1. Minimum CPU: Pentium-class 120 MHz or equivalent

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>120 MHz Required</i>	<i>166 MHz Required</i>	<i>166 MHz Required</i>

This minimum computational capability is required to support the demands of Windows-based applications.

The requirement for RISC-based systems is one of the following:

- MIPS R4x00 or equivalent
- Digital Alpha 21064 (EV4) or higher processors
- IBM PowerPC Architecture for RISC-based systems

Notice that all requirements and recommendations for RISC-based PCs are for the Windows NT operating system only. There are no plans to enable Windows 95 to run on RISC-based PCs.

Note If multiprocessor support is provided in any PC 97 system with x86-based processors, such support must comply with MultiProcessor Specification v. 1.4 or higher (available from Intel).

2. L2 cache with 256K minimum, for Pentium-class processor

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Recommended</i>	<i>Required</i>	<i>Required</i>

This minimum Level 2 cache is recommended for performance on an x86-based Basic PC 97 system that uses a Pentium-class processor. This requirement does not apply for a system that uses a Pentium Pro-class processor with a built-in L2 cache.

3. Minimum system memory: 16 MB

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>32 MB Required</i>	<i>Required</i>

Recommended: 32 MB (64 MB for Workstation PC 97).

For Basic PC 97, at least 12 MB of system memory must be completely available for the system to use at boot time and cannot be locked from use by the operating system. For Workstation PC 97, 28 MB of system memory must be available to the system.

Note This minimum requirement for memory available to the operating system does not preclude applications that use dynamically allocated memory for audio or video playback or other temporary uses of system memory.

4. Advanced Configuration and Power Interface (ACPI) support

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

The system board must support the Advanced Configuration and Power Interface (ACPI) Specification v. 1.0 or higher. This requirement ensures that the system correctly supports the Plug and Play and power management functionality described in Part 1 of this guide. ACPI support includes the following:

- Power management timer.
- Power button—must comply with the ACPI definition. A separate reset switch is an acceptable alternative to the ACPI-specified override mechanism.
- Real-Time Clock alarm—wake-up due to a scheduled time and day of month.
- The S4 “soft off” state, as required in the ACPI specification, plus at least one of the sleep states: S1, S2, or S3. (At least one additional sleep state is required for PC 97, although these states are only recommended in the ACPI specification.)
- System control interrupt and Status and Enable (STS/EN) bits for the first three features in this list.
- Description table for system board devices— complete hierarchy including all non-Plug and Play devices to be enumerated and all other devices for which power management or removal capabilities have been added by the system board design.

- Each bus and device enumerated using ACPI must include the ACPI control methods necessary to configure these devices as described in the requirement, “Each bus and device complies with current Plug and Play specifications,” later in this chapter.
- The USB host controller must be able to wake the system using ACPI mechanisms (required for PC 97, although this support is only recommended in the ACPI specification).

Recommended: The following additional recommendations from the ACPI specification are also recommended for PC 97:

- Thermal model and fan control. This is recommended as a means of running the PC quietly while working and turning the fan off while sleeping.
- Support the interface defined in the Intel/Duracell Smart Battery System Specification for reporting battery information. Although other battery interfaces will also be supported, Windows 95 and Windows NT will optimize driver and user interface support to exploit the capabilities of this interface.

Note Any other system board power management or Plug and Play features must be implemented compliant with ACPI, even if a particular feature is not a specific PC 97 requirement or recommendation.

Version 1.1 Changes:

ACPI support includes the following:

- Real-Time Clock Alarm—wake up due to a scheduled time of day. A day-of-month alarm is no longer required for PC 97, but it is strongly recommended because it will be a requirement for PC 98 starting **July 1, 1998**. (Change date: August 7, 1997)
- The soft-off (S5) state, as required in the ACPI specification, plus at least one of the sleep states: S1, S2, or S3. (Notice that the S4 and S4BIOS sleeping states are **NOT** sufficient to meet this requirement.) (Change date: February 28, 1997)
- The USB host controller must be able to wake the system from at least one sleeping state (S1, S2 or S3) using ACPI mechanisms. (This is required for PC 97, although it is only recommended in the ACPI specification). (Change date: August 7, 1997)
- Thermal model and fan control. This is recommended as a means of running the PC quietly while working, and turning the fan off while sleeping. Notice that open-loop thermal control (hardware only) is an acceptable implementation for system cooling as long as it meets audible noise requirements. However, closed-loop

control using the PC's processor and/or an embedded controller is recommended. If a closed-loop implementation is used, it must be compliant with the ACPI specification and Hardware Compatibility Tests (HCT). (Change date: August 7, 1997)

Important: The processor throttling implementation in the Intel PIIX4 (B0 stepping) is not compliant with the ACPI specification. Systems that implement ACPI processor throttling will fail the ACPI HCT with the following two errors:

- System Hardware Error: Processor Throttling Backwards from spec.
- System Hardware Error: Processor Throttling is ineffective.

However, the Microsoft ACPI-aware operating systems have implemented software workarounds for these non-compliant issues with the Intel PIIX4 B0. Because of this, the above two errors will not be considered as compliance failures for WHQL testing on PIIX4 B0 systems until **July 1, 1998**. After that date, new systems will be required to use compliant hardware.

These errors do not occur on and do not affect systems that do not implement ACPI processor throttling. (Change date: August 7, 1997)

Note The Intel PIIX4 "RI" GPE pin is not compliant with the ACPI specification because it does not generate an SCI interrupt. Because of this, significant delays (on the order of 3 to 5 seconds) will be experienced in responding to events signaled on this pin while the system is awake. Examples of events are telephone ring, PC Card insertion/removal, PCI #PME event, and so on. This design is strongly discouraged, and after July 1, 1998, system designs that use the Intel PIIX4 RI pin for ACPI events will fail PC 97 compliance testing. (Change date: September 12, 1997)

5. Hardware support for OnNow initiative

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

Elements of the OnNow design initiative ensure that the operating system and device drivers control the state of individual devices and the system board. The following support is required for PC 97 hardware:

- The user experiences the PC as “off” when it is in Sleeping state.

At a minimum, the hard disks, CD drives, display, sound, input devices, and fans must be perceived as off while the system is in a Sleeping state (for example, no noise and no lights other than the status indicator). However, it is recognized that some CPUs have integrated fans that use CPU power and, hence, the fan cannot be controlled while the CPU is powered. Such CPU fans are exempt from this requirement, as long as the system Sleeping noise requirement is met.

- The user can easily see whether the PC is Working or Sleeping.

This can be implemented as LED status indicators on the front panel, or another solution can be used. At a minimum, the PC 97 system must provide one or more indicators to show whether the system is in the Working or Sleeping state. If telephone answering-machine capabilities are built into the system, then a Message Waiting indicator must also be included on desktop systems. However, the Message Waiting indicator is only a recommendation for mobile systems.

- The user can easily control power through switches and software.

The system must provide an easily accessible power switch that can be controlled by software and that supports the functionality required in the ACPI specification.

If the power switch is provided on the keyboard, the hot keys must be labeled clearly and must consist of a single key for turning on the PC. (Two keystrokes are permissible for turning the PC off.) The single keystroke ensures accessibility for persons with disabilities.

This requirement does not preclude power-control capabilities related to actions such as closing the lid on a mobile PC.

The following shows the scan code for the keyboard power switch:

```
VK_POWER = 5E
Set1-Make: E0, 5E   Set1-Break: E0, DE
Set2-Make: E0, 37   Set2-Break: F0, 37
```

- Power management is supported for all of these buses present on the system: PCI, USB, IEEE 1394, and PC Card.

Any of these buses present in the system must support power management requirements in the related bus standard, as defined in Part 3 of this guide.

- Each device supports the power management specifications for its class.

Each device on the system board or included with the system as an add-on device (either internally or externally) must support the power management reference specification for its device class and be controllable through either ACPI or its bus.

The device functionality expected in each OnNow power state and the possible Wakeup event definitions for the class are defined in power management specifications for each device class. For more information about these requirements, see the power management sections in the related device class chapters in Part 4 of this guide.

Version_1.1_Clarifications:

Requirement: “The user can easily see whether the PC is working or sleeping.”

A slowly blinking LED (less than 1 Hz) is an acceptable implementation of the sleep-state indicator. A non-flashing indicator (that is, one of a different color) is preferred. Notice that the non-volatile sleep state (S4 or S4BIOS) should appear to the user (that is, should have the same indication) as the off state. (Change date: July 2, 1997)

Recommendation: “If telephone answering machine capabilities are built into the system, then a Message Waiting indicator must also be included on desktop systems.”

This was originally presented as a requirement for desktop PCs in the PC 97 guidelines, but it is only a recommendation for all system types. It applies to PCs that include the telephone answering capabilities as a feature of the PC as shipped; meaning the shipped configuration includes telephone answering software and hardware.

Requirement: “The system must provide an easily accessible power switch that can be controlled by software and that supports the functionality required in the ACPI specification.”

To meet this requirement, an OnNow-enabled PC can have either an ACPI-defined power button or sleep button. The recommended implementation for both desktop PCs and mobile PCs is to have both. If both buttons are implemented, the sleep button should be easily distinguishable from the power button, preferably by hiding the power button.

The user must have a single, primary switch interface to start and finish working interactions with the PC. If both a power button and a sleep button are implemented, the primary switch should be the sleep button, because the power button should be hidden in such a configuration. (This recommendation does not contradict the ACPI specification, which suggests but does not require that for a single-button implementation the button should be a power button.)

6. BIOS support for OnNow initiative for x86-based systems

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

This requirement applies only for x86-based systems. For PC 97, the OnNow initiative requires the following additional BIOS support:

- **Fast power-on self test (POST).** The system must be available to the user quickly. Although a specific time is not required, the basic recommendation is that power-on to bootstrap loader occurs within five seconds plus hard disk ready-time. The following are recommendations for ways to reduce processing overhead to make system boot time as fast as possible:
 - No video memory test and limited test for DRAM size.
 - No tests for serial or parallel port.

- No floppy disk test or media check (boot from hard disk only).
- No tests for hard disk controller or drive type (if the system does not include swappable drives).
- Test execution controlled using a Windows-based control panel or application that can be scheduled to run periodically at off hours.
- Fast POST mode for BIOS can be disabled by user for troubleshooting.
- **Minimal time for Resume from Sleeping state.** Resume from Sleeping state to operating system handoff must occur within 500 milliseconds.
- **Minimal startup display.** System startup draws the end user’s attention only in case of errors or when there is a need for user action.

The default configuration must allow a beep during the boot process only in case of an error, and the only screen display allowed is the OEM splash screen, which can include information such as copyright notices. By default, the system must be configured so that the screen display does not display memory counts, device status, and so on, but present a “clean” BIOS startup so that the end user is not presented with cryptic and unnecessary information. However, this requirement does not preclude the following:

- Presenting a blank startup screen
- Providing a “hot key” override to display screen messages for troubleshooting or user-definable CMOS settings.
- Presenting text-based end-user action messages—for example, messages to display the setup hot key, system help hot key, password entry, network login for remote booting, and so on.
- Presenting manufacturer branding messages.
- Providing a CMOS option to turn the “clean startup screen” off and on.

The intention for this requirement is to ensure that the end user is not presented with confusing information and unnecessary visual display, but that access to error information is still available using a hot key.

7. System BIOS support for boot devices, for x86-based systems

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

For any x86-based system that includes CD-ROM as a bootable device, the system BIOS must support the No Emulation mode in “El Torito—Bootable CD-ROM Format Specification Version 1.0,” by IBM and Phoenix or an equivalent method that supports the Windows NT CD-ROM installation process.

For any x86-based system that includes a network adapter as a boot device, the system BIOS must comply with the requirements defined in section 3 and 4 (as they apply to Plug and Play devices) of the Compaq, Phoenix, Intel BIOS Boot Specification v. 1.01 or higher, which describes the requirements for Initial Program Load (IPL) devices.

8. BIOS boot support for USB keyboard, if USB is the only keyboard

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

For any x86-based system with a USB keyboard as the only keyboard in the system, the system BIOS must provide boot support for USB keyboards. The specification for this support is defined in “Universal Serial Bus PC Legacy Compatibility Specification,” v. 1.0 or higher, available from:

http://www.teleport.com/~usb/data/usb_le9.pdf.

Version 1.1 Addition:**8a. BIOS takes advantage of Windows NT Loader special-memory capabilities**

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Recommended</i>	<i>Recommended</i>	<i>Recommended</i>

If the BIOS uses the E820 memory-reporting interface and reports memory in this (fc0 - fff) region, Windows NT operating system support ensures that all the memory will be used except one page on the 16-MB boundary. A PC 97 system should use the E820 interface to report memory (and test it), which also allows the memory to be reclaimed. Information about this interface can be found in Paragraph 2 of Section 9.3.2, “BIOS Initialization of Memory,” in the ACPI 1.0 specification, which states that the E820 specification has been updated and lists the new memory range types. This recommendation will be required for 1998-99. (Change date: October 13, 1997)

Industrial Design Requirements for Basic PC 97

This section summarizes physical design requirements and recommendations for PC 97 systems. These requirements are in addition to those related to the OnNow initiative for power-state indicators and easily accessible power switches.

9. All expansion slots in the system are accessible for users to insert cards

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

The expansion slots cannot be physically blocked by components or devices provided with the system. This requirement does not exclude configurations that allow space for only half-height cards for some slots or passive back planes used for connectors, and so on.

10. Audible noise meets PC 97 standards

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Recommended</i>	<i>Recommended</i>	<i>Required</i>

A PC 97 system should be “silent” in the Sleeping state, and an Entertainment PC 97 system must also be quiet during active operations, including hard-disk seek activities. Recommended test procedures and measurements will be documented by Microsoft.

The need to limit audible noise comes from the OnNow design initiative. A PC that uses OnNow technologies will be active even when not under direct operation by the user. For example, OnNow PCs will perform scheduled and background tasks such as receiving faxes and voice mail, checking e-mail, and downloading Internet information using a modem. These operations must happen silently so as not to interfere with other activities in the home or at work.

11. System and component design practices follow accessibility guidelines

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Recommended</i>	<i>Recommended</i>	<i>Recommended</i>

Accessibility design guidelines are provided in Appendix C, “Accessibility,” in this guide. These guidelines were developed in consultation with the Trace Research and Development Center at the University of Wisconsin. This recommendation will not become a requirement.

General Device Requirements for Basic PC 97

The requirements in this section apply for every device, whether it is present on the system board or as an expansion device provided by the OEM in a default system configuration. Most general device requirements are related to Plug and Play capabilities.

12. Each device and driver meets PC 97 device requirements

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

Each device, whether provided in the PC system, as an expansion card, or as an external device, must comply with all PC 97 requirements for the related device class and must have supporting device drivers that work for both Windows 95 and Windows NT, as tested by Microsoft WHQL. This includes support for power management IRPs (for WDM drivers) or messages (for VxD drivers) if power management hardware is nonstandard.

In addition to the device requirements in this section, see also the requirements for specific device classes in Part 4 of this guide.

13. Each bus complies with written specifications and PC 97 requirements

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

In the past, some bus designs did not fully implement all of the bus requirements on every expansion card connector. Each bus used in the system must meet all the requirements for that bus, as defined in Part 3 of this guide.

14. Each bus and device complies with current Plug and Play specifications

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

Each bus and device provided in a PC 97 system must meet the current Plug and Play specifications related to its class, including requirements defined in the ACPI specification and clarifications published for some Plug and Play specifications. This includes requirements for automatic device configuration, resource allocation, and dynamic disable capabilities.

There is only one change to Plug and Play specifications from those defined in 1995: the addition of SCANNER and DIGCAM as new CLASS key values for Plug and Play parallel devices.

The following shows current version numbers for all Plug and Play specifications:

- Plug and Play BIOS Specification v. 1.0a
- Clarification to Plug and Play BIOS Specification v. 1.0a
- Plug and Play ISA Specification v. 1.0a
- Clarification to Plug and Play ISA Specification v. 1.0a
- Plug and Play SCSI Specification v. 1.0
- Plug and Play Parallel Port Device Specification v. 1.0b
- Plug and Play External COM Device Specification v. 1.0

The following specification provides an optional format for non-volatile storage of configuration information for PCs where form factors limit available non-volatile storage. This specification is not a PC 97 requirement:

- Extended System Configuration Data Specification v. 1.02a or higher

Note Standard system devices are excluded from the Plug and Play requirement. The system can reserve static resources for standard devices such as interrupt controllers 1 and 2, timer (8254-2), keyboard controller (8042), real-time clock, DMA page registers, DMA controllers 1 and 2, and math coprocessor (if present). For an x86-based system, these fixed resources are located at I/O addresses under 100h and can also include an NMI mask. For more information, see Appendix D, “Legacy I/O Assignments.”

15. Unique Plug and Play device ID for each system device and add-on device

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

Each device connected to an expansion bus must be able to supply its own unique identifier. Each type of bus contains different information for uniquely identifying devices on expansion cards. For more information, see the chapters for particular bus designs in Part 3 of this guide.

- Each separate function or device on the system board must be enumerated separately, so each must provide a device identifier in the manner required for the bus it uses.
- If a device on an expansion card is enumerated by the BIOS, it must have a unique identifier and its own resources according to the PC 97 device-ID requirements for the bus to which the card is connected. This includes devices that are separately enumerated on multifunction cards or multifunction chips.
 CardBus devices must meet the requirements defined in the “PC Card” chapter in Part 3 of this guide.

The following are exceptions to this requirement:

- Legacy devices attached to the ISA bus on the system board do not have unique Plug and Play identifiers (for example, serial ports, parallel ports, or PS/2-compatible port devices). The method for device identification is defined in the Plug and Play ISA Specification v. 1.0a.
- Some multifunction devices (such as SuperI/O) might include devices that do not each have unique Plug and Play IDs or unique PCI subsystem IDs, but that are supported by standard drivers under the Windows operating system.
- A device such as a multifunction PCI device that supports a number of functions but uses only a single set of relocatable resources does not have to provide separate identifiers for each function included on the device.

16. Option ROMs meet Plug and Play requirements (for x86-based systems)

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

This requirement applies only for x86-based systems for any devices that might use option ROM, whether the device is present on the system board or provided through an expansion card. Related option ROM requirements are also defined for specific bus classes and specific devices, such as SCSI and graphics adapters, respectively.

For x86-based systems, option ROMs are usually located on cards used as system boot devices. During the boot process, option ROMs initialize the boot devices, which provide the primary input, primary output, and IPL device to boot the system. However, Plug and Play option ROMs can be used to supply the Plug and Play expansion header to devices other than boot devices, enabling them to initialize both devices when the system boots.

To design an option ROM with Plug and Play capabilities, follow the requirements described in the Plug and Play BIOS Specification, which discusses the Plug and Play expansion header and the interaction between the system BIOS and the option ROM. In particular, note the following points from the specification:

- The header contains information that identifies the type of boot device connected to the expansion card and allows the system BIOS to prioritize the boot devices. Shadowed copies of the option ROM must also contain the Plug and Play expansion headers.
- A Plug and Play option ROM must be able to determine whether the system BIOS complies with Plug and Play. If the system ROM is not Plug and Play compliant, the option ROM should immediately initialize the card and hook the proper interrupt as though it were a non-Plug and Play option ROM. This allows the expansion card to be used in non-Plug and Play systems.
- Option ROMs can use the system BIOS run-time functions, but these functions are not available until after the POST process has completed and Int 19 has been called. In particular, an option ROM must not hook the following interrupts until the system BIOS calls the boot connection vector contained in the Plug and Play expansion header: Int 9h, Int 10h, Int 13h, Int 18h, or Int 19h. Option ROM routines must not try to use these run-time functions until that time, because the results can be unpredictable.

Option ROM requirements for specific devices are defined in the “ATA and ATAPI” and “SCSI” chapters in Part 3, and also in the “Graphics Adapters” chapter in Part 4 of this guide.

17. “PNP” vendor code used only to define a legacy device’s CompatibleID

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
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<i>Required</i>	<i>Required</i>	<i>Required</i>
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All ISA and other legacy devices not enumerated by the system board interface must not use “PNP” in their Vendor and Device codes. The “PNP” vendor code is reserved for Microsoft and the vendors whose hardware is specifically assigned a particular ID. Other hardware can only use a “PNP” code when defining a device’s CompatibleID after first indicating the device’s HardwareID in the Plug and Play header.

For non-BIOS enumerated ISA devices, rather than using “PNP” in the vendor ID code, vendors must register any new vendor IDs by sending e-mail to pnpid@microsoft.com. For information about using “PNP” CompatibleIDs, see Appendix B, “Device Identifiers.”

Use of CompatibleIDs is strongly recommended for devices that use device drivers provided with the Windows operating system, such as a “Standard PC COM Port” (PNP0500) or “Sound Blaster 16 Sound Device” (PNPB003).

18. All devices support correct 16-bit decoding for I/O port addresses

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

Each device must support a unique I/O port address in the 16-bit address range. This requirement means, at a minimum, the upper address lines A10 – A15 can be used as device enable, so the device does not respond to addresses outside of the 10-bit address range. CardBus controllers and cards must meet the requirements defined in the “PC Card” chapter in Part 3 of this guide.

Devices that use less than 16-bit I/O decode create conflicts that cannot be resolved by a Plug and Play operating system. Phantom (alias) addressing is not supported by the Windows operating system and cannot be used to meet the PC 97 requirements.

Notice, however, that this requirement does not apply for the three ISA auto-configuration registers used during device enumeration and configuration. The ADDRESS, WRITE_DATA, and READ_DATA registers will continue to use 12-bit decoding as described in the ISA Plug and Play specification.

19. Devices and buses support hot plugging if using USB, 1394, or PC Card

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

Any bus or device designed to use USB, IEEE 1394, or PC Card (which all support hot plugging) must support being added or removed while the system is fully powered.

20. The user is protected from incorrectly connecting devices

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

This requirement is to help ensure that the end user can correctly make the physical connections required for adding a device in the system. This requirement includes the following:

- Wherever possible, keyed or shrouded connectors or other configurations should be used to prevent misconnection.

The physical design of the connector must ensure that the user cannot mistakenly insert the connector in the wrong port. For specific requirements related to keying connectors and cables for I/O controllers and peripherals, see the “ATA and ATAPI” chapter and “SCSI” chapter in Part 3 of this guide.

- Icons are provided for all external connectors.

The icons can be molded, printed, or added as permanent stickers (which can include text). Icons can be based on existing vendor designs or on suggestions listed in the “Icons” appendix.

For mobile PC designs with small-height considerations, connector icons might not fit on the back of the case. In such cases, it is acceptable to wrap the icons to the bottom of the unit or on the inside of an access door.

Note It is recognized that the design for legacy ports such as the PS/2-compatible mouse and keyboard ports, analog audio and video jacks, and the microphone and speaker jacks will not change, and therefore cannot fully meet this requirement. However, icons and labels must be provided wherever possible to assist the user in making correct connections.

21. Minimal user interaction needed to install and configure devices

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

After physically installing the device, the user must not be required to perform any action other than to insert disks that contain drivers and other files. The user should have to restart the system only for devices that do not support hot plugging. As specified earlier in this section, devices that use USB, IEEE 1394, or PC Card must support hot plugging. For devices that use other buses, detection occurs when the system is powered on after the device is inserted.

- The device is functional immediately without restarting the system.

It is acceptable to require rebooting for primary system devices such as the primary graphics adapter, the primary hard-disk controller, and any ISA boot device.

In all cases, however, changing configuration settings still must not require jumper changes.

- Software settings are available for configuring all resources.
 All buses and devices on both the system board and all expansion cards must be capable of being configured by the operating system and by software such as Device Manager in Windows 95, so the user does not need to open the PC case to change the configuration. DIP switches on boot devices can be used for an initial power-on default state or for non-Plug and Play system compatibility, but must be able to be overridden by software configuration after power-up.
Note This does not exclude jumper settings that the OEM configures to define CPU speed, select a keyboard, or make other system-related settings. This requirement excludes only jumper settings that the end user must make to configure the hardware.
- Dynamic disable capabilities are supported for all devices.
 All devices must be capable of being disabled automatically by the system. Also, disabling the device must result in freeing all its resources for use by other devices.
 The following devices are exempt from the requirement for dynamic disable capabilities: all legacy devices using the I/O range under 100h, keyboard controller, floppy disk controller, hard disk controller, VGA memory and I/O addresses, and any BIOS memory ranges required for legacy boot support.

22. Device driver and installation meet Windows and Windows NT standards

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

Each device must have drivers for both Windows 95 and Windows NT to ensure correct support under both operating systems. For some device classes, this support can be provided using a WDM driver, as defined in the specific requirements for devices in Part 4 of this guide.

The manufacturer does not need to supply a driver if a standard driver provided with the operating system can be used. If the manufacturer supplies drivers, the requirements for device drivers and installation include the following:

- All devices and drivers must pass testing by Microsoft WHQL.
 Each device included in a PC 97 system must comply with the “Designed for Microsoft Windows” logo requirements and must have supporting 32-bit device drivers for the CPU platform and the operating system.
- All configuration settings are stored in the registry.
 The driver must not use INI files for configuration settings.

- The correct minidriver, VxD, or any other manufacturer-supplied files specified in the device's INF must be installed in the correct locations.
For manufacturer-provided files, the vendor must not be identified as Microsoft, and all other copyright and version information must be correct for the manufacturer.
- Driver installation and removal use Windows-based methods.
Drivers must be installed using Windows-based methodology only as defined in the Windows 95 and Windows NT DDKs. The device driver must be able to be removed using Windows-based software, which can be managed using either the Windows Control Panel option for removing devices or using its own remove utility. For information, see these topics in the DDKs:
 - “Windows 95 Class Installers and Network Driver Installers” in the Windows 95 DDK
 - “Driver Installation” in the Win32 DDKHowever, any software applications included with the device can be installed using an alternate Windows-based installation method as defined in the Win32 SDK.
- Driver files provided by the vendor must not use the same file names as used by files included in Microsoft operating systems and provided as either retail or OEM products, unless specifically agreed with Microsoft.
- Only 32-bit, protected-mode components are installed. No real-mode or 16-bit protected-mode components can be provided in order to operate under Windows. (An exception for Windows 95 graphics drivers is noted in the “Graphics Adapters” chapter in Part 4 of this guide.)
Any real-mode components provided for backward compatibility should use a separate installation procedure. Although installation of Windows-based components must not make entries in Autoexec.bat or Config.sys, the separate real-mode installation program can make such entries, but must not modify the registry, Win.ini, or System.ini.
- Driver supports Plug and Play IRPs (for WDM drivers) or messages (for VxDs).
- For device classes where support using WDM drivers is provided in the operating system, the driver supplied by the manufacturer must be a WDM minidriver.

Version 1.1 Clarifications:

The “PC 97 Driver Clarifications” article on www.microsoft.com/hwdev/desguid/drv97faq.htm provides information about testing requirements for drivers. (April 7, 1997)

The manufacturer does not need to supply a driver if a PC 97-compliant driver that is provided with the operating system can be used. Not all

drivers supplied with the Windows or Windows NT operating systems meet the requirements for a particular device class, including requirements that might be defined for power management capabilities. (Change date: August 6, 1997)

23. Multifunction add-on devices meet general device requirements for each device

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

Multifunction add-on devices can contain more than one device. Multifunction add-on devices must meet the standards defined earlier in this section for automated software-only settings for device configuration, standard device drivers, and Windows-based installation. In addition, the following requirements must be met:

- Each function or device on the multifunction add-on device that is individually enumerated by the BIOS must provide a device identifier for the bus it uses.
- The system must be able to access separately each logical device that is individually enumerated by the BIOS, configure the device resources independently, and disable individual devices in the event of a conflict.
- For each individually enumerated device, resource configuration requirements are the same as for an equivalent device on a separate expansion card. This requirement means that registers cannot be shared between individually enumerated devices on a multifunction add-on device, but does not supersede device requirements among different bus classes.

The exception to this requirement is a device such as a multifunction PCI device that supports several functions but uses only a single set of relocatable resources. When each device is not individually enumerated, there is no requirement to provide separate identifiers and separate resources for each function on the device.

24. Standard system board devices use ISA-compatible addresses

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

For x86-based systems, this includes devices with I/O port addresses within the reserved range 0h through 0ffh. For information about legacy system I/O addresses, see Appendix D, “Legacy I/O Assignments.”

Basic PC 97 Buses and Devices

This section defines specific requirements for buses and devices provided in a PC 97 system, in addition to the basic requirement for supporting the Advanced Configuration and Power Interface specification, as defined earlier in this chapter.

System Buses for Basic PC 97

This section defines the general requirements for system buses. Additional requirements are defined in Part 3 of this guide for particular buses.

25. Universal Serial Bus with one USB port, minimum

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required, with 2 USB ports</i>

Recommended: 2 ports. Universal Serial Bus (USB) provides a bidirectional, isochronous, dynamically attachable serial interface for adding peripheral devices such as game controllers, communications devices, and input devices on a single bus.

The USB implementation in the system must meet the requirements defined in USB specifications, plus any additional requirements for PC 97 defined in the “USB” chapter in Part 3 of this guide.

Version 1.1 Clarification:

The USB controller must be capable of waking the system as part of ACPI compliance. (Change date: March 19, 1997)

Compliance testing for the USB port requirement for mobile PCs began **January 1, 1998**. This date does NOT apply for desktop PCs. (Change date: June 25, 1997)

26. Support for other high-speed expansion capabilities

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Recommended</i>	<i>Recommended</i>	<i>IEEE 1394 Required</i>
<i>CardBus Required for mobile</i>		

Additional support for expansion capabilities can be provided using PCI v. 2.1, IEEE 1394, CardBus, or other high-speed buses. For a mobile PC, one CardBus slot is required, and two slots are recommended. Any expansion bus implemented in the system must meet the requirements defined in the related chapter in Part 3 of this guide.

27. If present, PCI bus meets PCI v. 2.1 and higher, plus PC 97 requirements

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

If PCI is used in a PC system, the PCI bus must meet the requirements defined in PCI v. 2.1 or higher, plus any additional requirements for PC 97 defined in the

“PCI” chapter in Part 3 of this guide. Exceptions for particular devices are noted in Part 3 and Part 4.

For example, add-on PCI IDE devices must comply with PCI 2.1 requirements and also provide Subsystem IDs and Subsystem Vendor IDs, but PCI-to-PCI bridges and core chip sets do not have to provide Subsystem IDs and Vendor Subsystem IDs.

28. ISA expansion bus

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Optional</i>	<i>Optional</i>	<i>Optional</i>

It is recommended that system designers consider not providing expansion capabilities using the ISA bus in PC 97 systems and that all hardware vendors plan for migration away from ISA in their product lines. However, the PC system designer might choose to include the ISA expansion bus to support customers who want to “recycle” legacy add-on hardware.

If ISA is implemented in a PC 97 system, the following is required:

- Complete Plug and Play support must be implemented as defined in Plug and Play ISA Specification v. 1.0a. For x86-based systems, this includes support in the system BIOS and support for ISA option ROMs. These requirements include a means for identifying the Plug and Play capabilities of the option ROM and enabling the option ROM to determine whether the system BIOS is compatible with Plug and Play.
- Resource configuration requirements are specified for each physical port or device on the system and cannot be split among devices of the same type. This ensures true Plug and Play resource assignment and conflict resolution in the system. These minimum resource requirements are defined in the chapters for specific device classes in Part 4 of this guide.
- If the device cannot meet the resource requirements defined for PC 97, ISA IRQ sharing must be supported in the hardware and driver for an ISA device by using the operating system support first provided in 1996 for Windows 95.
- As specified in the Plug and Play ISA specification, a card must have both an industry-unique Vendor ID and a company-unique Product Identifier. This means that each different product and model from the same manufacturer must have a different product identifier to ensure that the operating system can isolate and identify these different cards.

The use of a unique serial number is strongly recommended. To avoid problems that can occur when a user installs two of the same cards in a PC system, the Plug and Play ISA specification defines a unique serial number field that can be added to the Vendor and Product IDs to make the card completely unique. If unique serial numbers are not supported, the Serial Number field must contain 0xFFFFFFFF, as required in the Plug and Play ISA specification.

- The system BIOS must properly configure all Plug and Play ISA cards in the PC system if a non-Plug and Play operating system is loaded.

Notice that including ISA in the system will probably require support for traditional keyboard, parallel, and serial ports. For related requirements, see the “Serial, Parallel, and Wireless Support” and “Input Components” chapters in Part 4 of this guide. For a complete list of ISA requirements for PC 97, see the “ISA” chapter in Part 3 of this guide.

I/O Devices for Basic PC 97

This section defines the general requirements for I/O devices. Additional requirements are defined in the sections titled “Graphics Adapter and Monitor for Basic PC 97” and “Storage and Related Peripherals for Basic PC 97” later in this chapter.

29. Keyboard connection and keyboard

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>USB or Wireless Required</i>

Recommended: USB. The external connection requirements on any PC can also be met using a PS/2-style or AT-style port or wireless capabilities in the system. A mobile or all-in-one system that has a built-in keyboard must also provide the capability for an external keyboard connection, which can be implemented using a port replicator or a single PS/2-style port with special cabling for both external keyboard and mouse. For complete requirements for keyboard ports and peripherals, see the “Input Components” chapter in Part 4 of this guide.

30. Pointing device connection and pointing device

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>USB or Wireless Required</i>

Recommended: USB or other external bus. The external connection requirements on any PC can also be met using a PS/2-style port or wireless capabilities in the system. A mobile or all-in-one system that has a built-in pointing device must also provide the capability for an external mouse connection, which can be implemented using a port replicator or a single PS/2-style port with special cabling for both external keyboard and mouse. A second serial port is not recommended as the external connection for a pointing device. For complete requirements for mouse ports and peripherals, see the “Input Components” chapter in Part 4 of this guide.

31. Connection for external parallel devices

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

Recommended: USB or other external bus. This can also be provided as a parallel port with ECP mode capabilities. For complete requirements for parallel ports, see the “Serial, Parallel, and Wireless Support” chapter in Part 4 of this guide.

32. Connection for external serial devices

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

Recommended: USB or PC Card. This can also be provided as a 16550A serial port. For complete requirements for serial ports, see the “Serial, Parallel, and Wireless Support” chapter in Part 4 of this guide.

33. Wireless capabilities in PC system

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Recommended</i>	<i>Recommended</i>	<i>Required</i>

If wireless capabilities are included in the system, PC 97 requirements must be met, as defined in the “Serial, Parallel, and Wireless Support” chapter in Part 4 of this guide.

34. Support for installing the operating system

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

The PC 97 system must include I/O device support (and system BIOS support for boot devices, as described earlier in this chapter) to allow the user to install (or reinstall) the operating system. This support can be included as one of the following types of devices, depending on specific customer requirements:

- CD-ROM drive

If this device is present, the host controller must meet requirements defined in the related chapter in Part 3 of this guide, and the device must meet the requirements defined in the “Storage and Related Peripherals” chapter in Part 4 of this guide.
- Network adapter

If the network interface is implemented in the PC system (either on the system board or through an expansion card), the network adapter must meet the requirements defined in the “Network Communications” chapter in Part 4 of this guide.
- Floppy disk drive: 3.5", 1.44 MB minimum capacity

Support for a floppy disk drive can be provided using PC Card or USB or a legacy FDC device, as defined in the “Storage and Related Peripherals for Basic PC 97” section later in this chapter.

For the Windows NT operating system, either a CD-ROM drive or network adapter must be included in the system, because Windows NT does not support installing the operating system from a floppy disk drive.

Note It is recognized that OEMs supply PC systems to corporations with specific feature requirements. For example, a customer might want to insert network adapters at the end-user site and might require no local storage devices for remote-boot, diskless workstations. PC systems designed for specific corporate customer features are exempt from this PC 97 requirement.

35. Audio support in PC system meets PC 97 requirements

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Recommended</i>	<i>Recommended</i>	<i>Advanced audio Required</i>

Recommended: PC 97 Advanced audio. Audio in a PC 97 system—whether it is implemented as baseline audio built into the PC system or PC 97 Advanced audio—must meet the minimum requirements defined in the “Audio Components” chapter in Part 4 of this guide.

36. Communications device provided with PC system

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Recommended</i>	<i>Required</i>	<i>Required</i>

If a modem or networking adapter is implemented in the PC system, the device must meet the requirements defined in the “Modems” chapter or “Network Communications” chapter in Part 4 of this guide.

Graphics Adapter and Monitor for Basic PC 97

This section summarizes the PC 97 requirements for the graphics adapter and monitor. For complete details related to basic graphics adapter requirements, including recommendations for hardware acceleration, see the “Graphics Adapters” chapter in Part 4 of this guide.

37. Display adapter meets PC 97 minimum requirements

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>800x600x16 bpp 640x480x8 bpp, small LCD</i>	<i>1024x768x16 bpp</i>	<i>1024x768x16 bpp</i>

A Basic PC 97 system must contain a graphics adapter that permits a color depth of 16 bpp, minimum.

- Minimum resolution:
 - Basic PC 97: 800x600x16 bpp for Windows desktop and 640x480x16 bpp double buffered for DirectDraw-based full-screen applications.
The minimum required resolution for a 7"–10" LCD internal display is 640x480x8 bpp.
 - Workstation PC 97: 1024x768x16 bpp.
 - Entertainment PC 97: 1024x768x16 bpp.

Display RAM requirements are tied directly to the minimum graphics resolution supported by the adapter. The requirement to support double buffering implies 1.5 MB of display RAM. However, PC 97 requirements do not specify minimum display RAM support; rather, the adapter designer can implement any solutions for supporting the minimum resolution requirements.

- Primary graphics adapter does not use legacy bus
 For the primary graphics adapter, the video bus must not use ISA. A higher-performance solution is required to optimize performance of the packed-pixel frame buffer. Possible implementations that meet this requirement can include PCI v. 2.1 for all system types or the Intel Accelerated Graphics Port 1.0 (AGP) interface for systems that have Pentium Pro-class processors. If the graphics adapter uses the PCI bus, it must comply with PCI v. 2.1 and additional requirements defined in the “PCI” chapter and the “Graphics Adapters” chapter in this guide.
- System operates normally with default VGA mode driver
 The default VGA driver is required for installing the operating system. The adapter must support 4-bit planar VGA mode as described in the Windows 95 DDK.
- Support for multiple adapters and multiple monitors
 This support ensures that the end user has guaranteed, automatic support for installing and using another graphics adapter, and support for simultaneous display on two or more monitors. The requirement is related to new capabilities in the Windows operating system. This requirement ensures baseline support in the hardware to allow the operating system to correctly configure use of multiple monitors or multiple graphics adapters. For complete information, refer to the “Graphics Adapters” chapter in Part 4 of this guide.

38. Support for NTSC or PAL TV output, if no large-screen monitor

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Recommended</i>	<i>Recommended</i>	<i>Required</i>

This recommendation will not become a requirement for the Basic PC system in the future. For complete information, refer to the “Graphics Adapters” chapter in Part 4 of this guide.

39. Color monitor supports DDC 2.0 Level B, EDID, and 800x600, minimum

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

A monitor designed for or included with a PC 97 system must be compliant with Display Data Channel Standard v. 2.0, Level B (DDC2B), which defines the communication channel between the display and host system. In addition, the monitor must transmit an Extended Display Identification Data (EDID) structure containing unique ID Manufacturer Name and ID Product Code identifiers, and all required fields as described in Section 3 of Extended Display Identification Data Standard 2.0 (or higher).

For complete PC 97 requirements for monitors, including requirements for image color matching (ICC), ergonomic timing standards, and DDC support, see the “Video Components” chapter in Part 4 of this guide.

40. System supports MPEG-1 playback

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

Microsoft provides operating system support through Microsoft ActiveMovie. For information about performance and graphics hardware requirements to support video playback, see the “Video Components” chapter in Part 4 of this guide.

41. PC 97 DVD playback requirements, if PC system includes DVD-Video

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required with DVD-Video</i>	<i>Required with DVD-Video</i>	<i>Required</i>

All PC 97 systems that include DVD-Video support must provide PC 97 playback support for DVD content, as defined in the “Video Components” chapter in Part 4 of this guide. For other requirements related to DVD if it is implemented in a PC system, see the “Storage and Related Peripherals” chapter in Part 4 of this guide.

Storage and Related Peripherals for Basic PC 97

This section summarizes the requirements for storage devices for PC 97. For system requirements related to CD-ROM and floppy disk drives, see the “System Buses and I/O Devices for Basic PC 97” section earlier in this chapter.

42. Support Int 13h Extensions in system and option ROMs

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

This requirement applies only for x86-based systems. The Int 13h Extensions ensure correct support for high-capacity drives. Support for the “fixed disk access” subset of Int 13h Extensions must be provided in the system BIOS and in any option ROMs for storage devices that include BIOS support. The Int 13h Extensions are defined in “Int 13h Extension APIs” in the Layered Block Device Drivers section of the Windows 95 DDK.

43. Host controller for storage device meets PC 97 requirements, if present

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

If present in the PC 97 system, the host controller must meet requirements defined for the bus it uses; for SCSI or IDE controllers, it must also meet the requirements in the “ATA and ATAPI” or “SCSI” chapter in Part 3 of this guide.

44. Primary host controller supports bus mastering

<i>Basic PC 97</i>	<i>Workstation PvC 97</i>	<i>Entertainment PC 97</i>
<i>Recommended</i>	<i>Required</i>	<i>Required</i>

The primary host controller should support bus mastering, whether using IDE, SCSI, or IEEE 1394. Bus mastering support should also be enabled for IDE devices, including hard disks, CD-ROM, and tape drives.

Bus master capabilities, if implemented, must meet the related specification for the particular controller. For example, the programming register set for PCI IDE bus master DMA is defined in Small Form Factor (SFF) 8038i.

Note This recommendation will become a requirement in 1998. This recommendation does not apply to legacy floppy disk controllers, and will not become a requirement for the floppy disk controller.

45. Hard drive meets PC 97 requirements, if present

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

If present in the PC 97 system, the hard disk drive must meet the requirements defined in the “Storage and Related Peripherals” chapter in Part 4 of this guide; for SCSI or IDE peripherals, it must also meet the requirements in the “ATA and ATAPI” or “SCSI” chapter in Part 3 of this guide.

46. Media status notification support for removable media

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

IDE and ATAPI removable devices must follow the Microsoft specification named Media Status Notification v. 1.03 or higher (included in SFF 8020i v. 2.6 in 1996). SCSI devices must follow the Media Status Notification Support Specification for SCSI and ATAPI Devices v. 1.0 or higher.

47. Legacy floppy disk controller built into system

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Optional</i>	<i>Optional</i>	<i>Optional</i>

Recommended: floppy disk capabilities provided through expansion card or external bus. To support migration away from legacy devices for PC 97, it is recommended that support for floppy disk drives be provided by using a solution based on an external bus such as USB, IEEE 1394, PC Card, or a peripheral device that uses SCSI or IDE. If a legacy FDC is included on a PC 97 system, it must meet the requirements defined in the “Storage and Related Devices” chapter in Part 4 of this guide.

Mobile PC and Form-Factor Related Requirements

This section summarizes exceptions and additional requirements for mobile PCs and provides requirements for docking stations and port replicators.

Note PC 97 Hardware Design Guidelines do not apply for so-called personal digital assistants (PDAs) or other sub-PC form factor designs.

The following is a specific requirement for mobile PCs.

48. CardBus for high-speed expansion capabilities on mobile PCs

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>Required</i>

One CardBus slot is required; two slots are recommended. For more information about the PC 97 requirements for implementing CardBus, see the “PC Card” chapter in Part 3 of this guide.

Mobile PC Design Exceptions and Clarifications

A few design exceptions are called out in the Basic PC 97 requirements in regards to capabilities that cannot be met on mobile PCs because of form factors issues or limitations in chip designs for mobile units. Exceptions and clarifications for general system design and general device requirements for mobile PCs are the following:

- **All expansion slots are accessible:** It is recognized that the fan and heat sink on the CPU or Overdrive processor might block full-sized add-on devices from being installed in some slots in mobile PCs or other small form factor system boards. However, notice that it is acceptable to allow space for only half-height cards for some slots or passive back planes used for connectors, and so on.
- **Hardware support for OnNow initiative:**
 - The power switch control requirements do not preclude power-control capabilities related to closing the lid on the mobile unit.
 - The Message Waiting indicator is only a recommendation for mobile PCs.
- **General device requirements:** The battery in a mobile unit is a device that must meet the requirements defined in “General Device Requirements for Basic PC 97” in this chapter.
- **User cannot physically connect devices incorrectly:** Connector icons can wrap to the bottom of the mobile unit or inside an access door when they don’t fit on the back of the case.

Exceptions and clarifications for system buses on mobile PCs are the following:

- **Universal Serial Bus:** The refinements to the USB specifications for power and timing for mobile PCs are PC 97 requirements for power management. For mobile units, USB must be built into the PC, not provided solely by port replications or docking stations, although these units can provide extra USB connectors.

For Entertainment PC 97, it is recognized that there might be no room for two USB connectors on a mobile PC unit. However, for a docking pair, a second USB connector can be provided on the docking station.

- **Other high-speed expansion bus:** A mobile PC design can include an expansion bus for connecting a docking station or port replicator.

Exceptions and clarifications for I/O devices on mobile PCs are the following:

- **Connections for external keyboard and pointing device:** The requirement for external connections for the keyboard and pointing device can be met by implementing a single PS/2 port and providing a special cable that allows both the external keyboard and the mouse to use the single port.

The external connection can also be implemented on the port replicator for a mobile unit that includes such a device.

A second serial port is not a recommended design solution for an external mouse connection on a mobile PC.

- **Connection for external parallel and serial devices:** These capabilities can be provided on a port replicator or on the docking station for a docking pair.
- **Audio meets PC 97 requirements:** It is recognized that baseline audio is built into the mobile unit on the system board. For mobile PCs, the signal-to-noise requirement is 75 dB from 20 Hz to 15 kHz, A-weighted, as noted in the “Audio Components” chapter in Part 4 of this guide.

Exceptions and clarifications for graphics on mobile PCs are the following:

- **Display adapter resolution minimum:** Minimum resolution is specified as 640x480x8 bpp for small LCD displays such as those used for the internal display on mobile PCs. The display adapter for external displays must meet the resolution requirements and all other minimum requirements as defined in the “Graphics Adapters” chapter in Part 4 of this guide.
- **Hardware support for video playback.** Hardware arithmetic stretching and YUV off-screen surfaces for color space conversion are recommended but not required for the internal display on mobile PCs.
- **ICC color matching for monitors.** This is a recommendation for LCD, color plasma displays, or other flat panel devices. This will become a requirement.

Docking Station Requirements

Docking systems for mobile PCs allow docking of a PC with additional hardware capabilities. A docking station adds capability to a mobile PC that allows the end user to add other devices to the system—for example, sound, network adapter, hard disks, CD-ROM, different display adapter, SCSI, modems, and so on.

Resource conflicts can occur with a mobile PC that is paired with a docking station if the docking station contains an expansion bus that allows users to add non-proprietary expansion cards to the system. For a mobile PC-and-docking station pair, the system designer must ensure that the docking system is capable of arbitrating resources for conflicts that might occur if an expansion card is added to the docking station. However, the system designer does not need to add to the mobile PC unit all of the Basic PC 97 resource-arbitration capabilities.

49. Mobile unit and docking station meet PC 97 requirements as a pair

Required

Manufacturers who submit a mobile PC unit that has a docking station companion for “Designed for Microsoft Windows” logo testing must submit the combined docking station and mobile PC for testing, and this combination must pass WHQL testing.

Version 1.1 Addition:

Warm docking is required for docking stations for PC 97. Docking or undocking a mobile unit from a docking station must not require powering off the system and must not require a system reboot. (Change date: January 24, 1997)

Expansion devices that support removable IDE devices do not have to meet this requirement for warm docking. (Change date: April 24, 1997)

50. Docking station meets ACPI requirements

Required

The Advanced Configuration and Power Interface (ACPI) specification, as discussed in Part 1 of this guide, ensures support for recognizing and managing docking and undocking events and the related power states and resource requirements.

51. Docking station meets all Basic PC 97 requirements for general devices, expansion cards, system bus, and system board

Required

This is required if the docking station allows addition of non-proprietary devices, but is not a requirement if the docking station does not allow addition of non-proprietary devices. These requirements are defined earlier in this chapter.

52. Automatic resource assignment and dynamic disable capabilities for mobile/docking station pair

Required

The mobile PC unit that is part of a docking system does not require all of the resource-arbitration capabilities required for expandable PC systems. However, the system as a whole must be capable of dynamically disabling add-on devices completely and freeing all the resources used by that device when the mobile unit is docked. (This requirement excludes fixed-resource devices, such as the DMA controller, interrupt controller, and so on.)

With this capability, individual devices in the mobile PC will be disabled when it is docked, allowing the appropriate devices in the docking station to be enabled.

The system could fail if an add-on card requires resources that conflict with a device on either the mobile PC or the docking station. The mobile/docking station combination must be able to resolve resource conflicts between all the devices in the docking system.

This means that docking-station devices must be available to replace disabled devices in the mobile PC, and these devices must meet the basic resource arbitration requirements for PC 97, as described earlier in this chapter. However, it is up to the design engineer of a mobile/docking station combination to determine which component (mobile or docking station) will resolve the conflict when the mobile unit is docked.

53. Fail-safe docking

Required

The system must provide a fail-safe system for docking and undocking the mobile unit. Working in conjunction with the operating system and ACPI, the mechanism for fail-safe docking must ensure the following:

- The undock button signals the user's intent to the system.
- Docking can occur only when the mobile unit is in the correct power state. (The power state depends on whether the system is designed to support cold, warm, or hot docking.)
- The user can initiate undocking through Windows-based software choices. Notice, however, that a hardware "button" must also be provided, because experience shows that users often do not find the software option and remove mobile units without operating-system notification.
- The undock button or software choice sends signal to the operating system, so that the user is warned if resources in use are in danger of being lost.
- A safe undock indicator is provided so that user can identify when it is safe to remove the mobile unit. This can be an LED light or any other mechanism chosen by the vendor. If a physical mechanism automatically undocks the mobile PC or if hot docking is supported, then the "safe undock" indicator is not required.

There is no requirement for mechanical lockout to block the user from removing the mobile unit without operating system notification.

Port Replicator Requirements

A port replicator duplicates externally and extends features that are already available in a mobile PC—for example, providing an extra PC Card slot.

A port replicator with dedicated features allows the end user to add a specific feature to the original mobile PC — for example, providing a CD-ROM drive when the mobile unit does not have such a drive.

A mobile PC with a port replicator does not need to meet the expansion card requirements defined for Basic PC 97, and also does not need to meet all the resource requirements of a mobile/docking station combination. A port replicator is not required to provide an undock or eject button.

However, some mobile PC system designs include a port replicator that has dedicated features for networking, additional PC Card slots, CD-ROM, and so on. This means that the system could have additional resource requirements so that all available IRQs in the system are already allocated; and therefore the PC Card slots (for example) would not have any IRQs available, rendering them useless. In such cases, the port replicator must contain devices that replace any devices in the mobile PC that do not meet the resource requirements for a PC 97 computer.

Version 1.1 Addition:

Warm docking is required for port replicators for PC 97, with compliance testing for this requirement beginning **January 1, 1998**. Docking or undocking a mobile unit from a docking station or port replicator must not require powering off the system and must not require a system reboot. (Change date: January 24, 1997)

Expansion devices that support removable IDE devices do not have to meet this requirement for warm docking. (Change date: April 24, 1997)

54. Automatic resource assignment and dynamic disable capabilities for replacement devices

Required

A port replicator that can accept expansion cards must contain devices that replace any devices in the mobile PC that do not meet Basic PC 97 requirements for IRQ, DMA, I/O port, and memory resources. This allows the operating system to disable the device on the mobile PC, enable the corresponding device on the port replicator, and then arbitrate resources among the remaining devices in the mobile unit and the devices on the port replicator.

Devices in the system must be capable of being disabled dynamically, so that the user can choose to free resources in order to allow other devices in the system to function. For ISA devices included with the PC system that do not otherwise meet the resource requirements defined for PC 97, the system designer must implement IRQ sharing for ISA, as described in the “ISA” chapter in Part 3 of this guide.

Multimedia PC Guidelines for PC 97

Entertainment PC 97 defines a system that is optimized for home recreation applications such as game playing, Internet browsing, personal communications, and educational multimedia CD-ROMs. Many features of Entertainment PC 97 are designed to ensure quick adoption of the advanced technologies required for new forms of digital entertainment and to provide the very best multimedia capabilities in every category when compared to all other competing platforms for game playing, education and entertainment, and Internet browsing.

However, it is recognized that there is a market category for lower-end PCs that support good quality output for entertainment and educational software applications that are graphics- and audio-intensive. Such systems have been commonly known as “multimedia PCs.” This section summarizes the subsystem features of a Basic PC 97 system that is designed for this market.

55. “Multimedia PC” meets PC 97 minimum requirements

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<i>Required</i>	<i>Required</i>	<i>N/A</i>

The following table summarizes the minimum requirements and recommendations for each subsystem.

Notice that for a multimedia PC that implements a recommended feature, the PC 97 requirements for that particular feature must be met. However, the system designer can implement recommended items on a feature-by-feature basis. That is, not all recommended features need to be implemented if one or more features are selected for a multimedia PC.

Multimedia PC Requirements and Recommendations

Required	Recommended	PC 97 reference
System requirements:		
Basic PC 97 minimum	Pentium-class 166 MHz MMX instruction set, or equivalent	“Basic PC 97”
System buses:		
Basic PC 97 minimum	IEEE 1397 No ISA add-on devices provided with PC	“USB”; “IEEE 1394”
I/O devices:		
Basic PC 97 minimum	USB game pad Devices use USB or IEEE 1394 bus Remote control	“Input Components”
Graphics components:		
Basic PC 97 minimum	64-bit accelerator	“Graphics Adapters”;
MPEG-1 graphics support	Low resolution modes PC 97 recommendations or 2-D and 3-D acceleration 20" or larger monitor or NTSC/PAL TV output PC 97 DVD playback, if video discs are supported	“Video Components”
Audio components:		
Basic PC 97 audio	Advanced PC 97 audio Devices use USB bus Support music synthesis	“Audio Components”
Communications:		
Internal 28.8 Kbps V.34 data/fax/voice modem	ISDN	“Modems”
Storage capabilities:		
6x CD-ROM	Bus mastering	“Storage and Related Peripherals”
1 GB hard disk	DVD-ROM	
	Larger capacity hard disk	

References for Basic PC 97

The following presents some of the references, services, and tools available to help build hardware that is optimized to work with Windows operating systems.

Plug and Play specifications

<http://www.microsoft.com/hwdev/pnpspecs.htm>

Vendor ID registration: pnpid@microsoft.com

Microsoft Device Driver Kits (DDKs) for Windows operating systems

Microsoft Developer Network (MSDN) Professional membership

Advanced Configuration and Power Interface (ACPI) specification

<http://www.teleport.com/~acpi/>

Power management specifications for device and bus classes

Guidelines for audible noise and other OnNow technologies

<http://www.microsoft.com/hwdev/onnow.htm>

MultiProcessor Specification Version 1.4

Intel part number 242016-002

Phone: (800) 879-4683

El Torito—Bootable CD-ROM Format Specification Version 1.0

Compaq, Intel, Phoenix BIOS Boot Specification v. 1.01

<http://www.ptltd.com/techs/specs.html>

Intel/Duracell Smart Battery System Specification

<http://www.intel.com/ial/powermgm/sbovr.htm>

Version 1.1 References Update:

Advanced Configuration and Power Interface Specification, Revision 1.0

<http://www.teleport.com/~acpi/>

Device Bay Interface Specification, Version 1.0

<http://www.device-bay.org>

Display Data Channel Standard, Version 2.0

Extended Display Identification Data Standard, Version 2.0

<http://www.vesa.org>

El Torito—Bootable CD-ROM Format Specification, Version 1.0

Compaq, Intel, Phoenix BIOS Boot Specification, Version 1.01

<http://www.ptltd.com/techs/specs.html>

Hot-plugging support under Windows operating systems

<http://www.microsoft.com/hwdev/devdes/>

Intel/Duracell Smart Battery System Specification

<http://www.sbs-forum.org>

Intel hardware developer site

<http://developer.intel.com>

Interoperability Specification for ICCs and Personal Computer Systems
<http://www.smartcardsys.com>

Media Status Notification Support Specification, Version 1.03

Plug and Play specifications

<http://www.microsoft.com/hwdev/respec/>

Vendor ID registration: pnpid@microsoft.com

MultiProcessor Specification, Version 1.4

Intel part number 242016-002

<http://developer.intel.com>

PCI Local Bus Specification, Revision 2.1 (PCI 2.1)

PCI SIG

Phone: (800) 433-5177

<http://www.pcisig.com>

Power management specifications for device and bus classes

Guidelines for audible noise and other OnNow technologies

<http://www.microsoft.com/hwdev/onnow.htm>

SFF 8070i, SFF 8038i, SFF 8090 (Mt. Fuji specification), and other

SFF specifications

SFF Committee publications

FaxAccess: (408) 741-1600 (fax-back)

Fax: (408) 867-2115

<ftp://ftp.symbios.com/pub/standards/io/>

Universal Serial Bus PC Legacy Compatibility Specification, Version 0.9

http://www.teleport.com/~usb/data/usb_le9.pdf

USB Specification, Version 1.0

USB Device Class Definition for Human Interface Devices, Version 1.0

Other USB device class specifications

Phone: (503) 264-0590

Fax: (503) 693-7975

<http://www.usb.org>

Web-Based Enterprise Management (WBEM) information

<http://wbem.freerange.com>

<http://www.microsoft.com/management/wbem/>

<http://www.dmtf.org/work/cim.html>

Windows and Windows NT DDKs, including NDIS documentation

MSDN Professional membership

Windows Hardware Instrumentation Implementation Guidelines, Version 1.0

(WHIIG), Microsoft Corporation and Intel Corporation

<http://www.microsoft.com/hwdev/respec/>

(This specification is expected in the second half of 1997.)

Wired for Management Baseline Specification, Version 2.0

Intel Corporation.

<http://www.intel.com/managedpc/wired>

(This specification is expected in the second half of 1997.)

Checklist for Basic PC 97

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
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General System Requirements for Basic PC 97

1. <i>Minimum CPU: Pentium-class 120 MHz or equivalent</i> <i>120 MHz Required</i>	<i>166 MHz Required</i>	<i>166 MHz Required</i>
2. <i>L2 cache with 256K minimum, for Pentium-class processor</i> <i>Recommended</i>	<i>Required</i>	<i>Required</i>
3. <i>Minimum system memory: 16 MB</i> <i>Required</i>	<i>32 MB Required</i>	<i>Required</i>
4. <i>Advanced Configuration and Power Interface (ACPI) support</i> <i>Required</i>	<i>Required</i>	<i>Required</i>
5. <i>Hardware support for OnNow initiative</i> <i>Required</i>	<i>Required</i>	<i>Required</i>
6. <i>BIOS support for OnNow initiative for x86-based systems</i> <i>Required</i>	<i>Required</i>	<i>Required</i>
7. <i>System BIOS support for boot devices, for x86-based systems</i> <i>Required</i>	<i>Required</i>	<i>Required</i>
8. <i>BIOS boot support for USB keyboard, if USB is the only keyboard</i> <i>Required</i>	<i>Required</i>	<i>Required</i>
8a. <i>BIOS takes advantage of Windows NT Loader special-memory capabilities</i> <i>Recommended</i>	<i>Recommended</i>	<i>Recommended</i>

Industrial Design Requirements for Basic PC 97

9. <i>All expansion slots in the system are accessible for users to insert cards</i> <i>Required</i>	<i>Required</i>	<i>Required</i>
10. <i>Audible noise meets PC 97 standards</i> <i>Recommended</i>	<i>Recommended</i>	<i>Required</i>
11. <i>System and component design practices follow accessibility guidelines</i> <i>Recommended</i>	<i>Recommended</i>	<i>Recommended</i>

General Device Requirements for Basic PC 97

12. <i>Each device and driver meets PC 97 device requirements</i> <i>Required</i>	<i>Required</i>	<i>Required</i>
13. <i>Each bus complies with written specifications and PC 97 requirements</i> <i>Required</i>	<i>Required</i>	<i>Required</i>
14. <i>Each bus and device complies with current Plug and Play specifications</i> <i>Required</i>	<i>Required</i>	<i>Required</i>
15. <i>Unique Plug and Play device ID for each system device and add-on device</i> <i>Required</i>	<i>Required</i>	<i>Required</i>
16. <i>Option ROMs meet Plug and Play requirements (for x86-based systems)</i> <i>Required</i>	<i>Required</i>	<i>Required</i>
17. <i>"PNP" vendor code used only to define a legacy device's CompatibleID</i> <i>Required</i>	<i>Required</i>	<i>Required</i>
18. <i>All devices support correct 16-bit decoding for I/O port addresses</i> <i>Required</i>	<i>Required</i>	<i>Required</i>

*19. Devices and buses support hot plugging if using USB, 1394, or PC Card
Required Required Required*

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
20. The user is protected from incorrectly connecting devices <i>Required</i>	<i>Required</i>	<i>Required</i>
21. Minimal user interaction needed to install and configure devices <i>Required</i>	<i>Required</i>	<i>Required</i>
22. Device driver and installation meet Windows and Windows NT standards <i>Required</i>	<i>Required</i>	<i>Required</i>
23. Multifunction add-on devices meet general device requirements for each device <i>Required</i>	<i>Required</i>	<i>Required</i>
24. Standard system board devices use ISA-compatible addresses <i>Required</i>	<i>Required</i>	<i>Required</i>

Basic PC 97 Buses and Devices

System Buses for Basic PC 97

25. Universal Serial Bus with one USB port, minimum <i>Required</i>	<i>Required</i>	<i>Required, with 2 USB ports</i>
26. Support for other high-speed expansion capabilities <i>Recommended</i> CardBus <i>Required</i>	<i>Recommended</i> <i>for mobile</i>	<i>IEEE 1394 Required</i>
27. If present, PCI bus meets PCI v. 2.1 and higher, plus PC 97 requirements <i>Required</i>	<i>Required</i>	<i>Required</i>
28. ISA expansion bus <i>Optional</i>	<i>Optional</i>	<i>Optional</i>

I/O Devices for Basic PC 97

29. Keyboard connection and keyboard <i>Required</i>	<i>Required</i>	<i>USB or wireless Required</i>
30. Pointing device connection and pointing device <i>Required</i>	<i>Required</i>	<i>USB or wireless Required</i>
31. Connection for external parallel devices <i>Required</i>	<i>Required</i>	<i>Required</i>
32. Connection for external serial devices <i>Required</i>	<i>Required</i>	<i>Required</i>
33. Wireless capabilities in PC system <i>Recommended</i>	<i>Recommended</i>	<i>Required</i>
34. Support for installing the operating system <i>Required</i>	<i>Required</i>	<i>Required</i>
35. Audio support in PC system meets PC 97 requirements <i>Recommended</i>	<i>Recommended</i>	<i>Advanced audio Required</i>
36. Communications device provided with PC system <i>Recommended</i>	<i>Required</i>	<i>Required</i>

Graphics Adapter and Monitor for Basic PC 97

37. Display adapter meets PC 97 minimum requirements 800x600x16 bpp 640x480x8 bpp, small LCD	1024x768x16 bpp	1024x768x16 bpp
38. Support for NTSC or PAL TV output, if no large-screen monitor <i>Recommended</i>	<i>Recommended</i>	<i>Required</i>

<i>Basic PC 97</i>	<i>Workstation PC 97</i>	<i>Entertainment PC 97</i>
<hr/>		
39. Color monitor supports DDC 2.0 Level B, EDID, and 800x600, minimum <i>Required</i>	<i>Required</i>	<i>Required</i>
40. System supports MPEG-1 playback <i>Required</i>	<i>Required</i>	<i>Required</i>
41. PC 97 DVD playback requirements, if PC system includes DVD-Video <i>Required</i>	<i>with DVD-Video Required</i>	<i>with DVD-Video Required</i>
Storage and Related Peripherals for Basic PC 97 <hr/>		
42. Support Int 13h Extensions in system and option ROMs <i>Required</i>	<i>Required</i>	<i>Required</i>
43. Host controller for storage device meets PC 97 requirements, if present <i>Required</i>	<i>Required</i>	<i>Required</i>
44. Primary host controller supports bus mastering <i>Recommended</i>	<i>Required</i>	<i>Required</i>
45. Hard drive meets PC 97 requirements, if present <i>Required</i>	<i>Required</i>	<i>Required</i>
46. Media status notification support for removable media <i>Required</i>	<i>Required</i>	<i>Required</i>
47. Legacy floppy disk controller built into system <i>Optional</i>	<i>Optional</i>	<i>Optional</i>
Mobile PC and Form-Factor Related Requirements <hr/>		
48. CardBus for high-speed expansion capabilities on mobile PCs <i>Required</i>	<i>Required</i>	<i>Required</i>
Mobile PC Design Exceptions and Clarifications Docking Station Requirements <hr/>		
49. Mobile unit and docking station meet PC 97 requirements as a pair <i>Required</i>		
50. Docking station meets ACPI requirements <i>Required</i>		
51. Docking station meets all Basic PC 97 requirements for general devices, expansion cards, system bus, and system board <i>Required</i>		
52. Automatic resource assignment and dynamic disable capabilities for mobile/docking station pair <i>Required</i>		
53. Fail-safe docking <i>Required</i>		
Port Replicator Requirements <hr/>		
54. Automatic resource assignment and dynamic disable capabilities for replacement devices <i>Required</i>		
Multimedia PC Guidelines for PC 97 <hr/>		
55. "Multimedia PC" meets PC 97 minimum requirements <i>Required</i>	<i>Required</i>	<i>N/A</i>