CHAPTER 16

Video Components

This chapter presents the requirements and recommendations for display monitors, DVD playback, and video input and capture devices under the Microsoft Windows family of operating systems.

Requirements for graphics adapters and TV output capabilities are defined in the "Graphics Adapters" chapter in Part 4 of this guide. For requirements related to digital cameras and other digital image input devices, see the "Scanners and Digital Cameras" chapter in Part 4 of this guide.

Version 1.1
Includes changes to items 9, 15, 16, 18, 18a, 26, 28, 32, 33, 34, References for Video Components, and Checklist for Video Components, 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: Image FAQs for WHQL Testing of Still and Motion Video on http://www.microsoft.com/hwtest/faqs/faq_image.stm

Contents

Overview for Video Components

This section presents the key design issues for video components under Microsoft Windows. New applications that require MPEG and other video playback for games or advanced graphics applications require high-performance support in the video hardware.

Key design issues for basic video requirements:

- Power management for video devices. Under the OnNow design initiative, specifications are being developed for standard interpretation of the four standard device power states (D0–D4) plus a set of minimum power capabilities for devices in this class. These specifications will cover power consumption, command latency, device functionality, and Wakeup event definitions.
- Connection with consumer-electronics video devices, such as TV, VCR, camcorder, and so on.
- High-quality playback of multiple audio/video source streams:
  - DVD-ROM and CD-ROM movies, games, and applications
  - Digital broadcast satellite input
  - Internet, using ISDN, cable modem, ATM, DVB, and so on
  - Video conferencing

Key design issues for Entertainment PC 97:

- For TV and movie watching, the system must provide full image quality, smooth playback, stereo or surround audio, and synchronized audio and video.

  This also means support for large-screen VGA monitors that offer higher resolution and better image quality than televisions offer. Large-screen VGA monitors will ensure a high-quality user experience for family-oriented and multiplayer computer entertainment applications.
- Non-exclusive operation—that is, other tasks running in the system don't interrupt video. This is necessary for the PC to carry on background management tasks, such as downloading e-mail or handling an incoming telephone call, without impacting TV or movie playback.

  For PCs at Entertainment PC 97 price level, customers expect that software should be capable of multitasking while providing more functionality and dramatically better content. Windows-based PCs can't deliver this if the CPU and PCI bus are overused. Therefore, the end-to-end video subsystem, from input source to rendering, must be capable of sustaining full quality playback and display for complex applications.

System Requirements for Video Components

This section summarizes the requirements for video components for PC 97 system designs.

1. DDC 2.0 Level B-compliant color display with unique EDID identifier

Basic PC 97	*Workstation PC 97*	*Entertainment PC 97*
Required	*Required*	*Required*

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

2. System supports MPEG-1 playback

Basic PC 97	*Workstation PC 97*	*Entertainment PC 97*
Required	*Required*	*Required*

Windows provides operating-system playback support for MPEG-1 through Microsoft ActiveMovie. To support this capability, system manufacturers are required to implement arithmetic stretching and color space conversion in their PC 97 graphics subsystems as defined in the “Graphics Adapters” chapter in Part 4 of this guide. For more information about performance and hardware requirements, see “MPEG-1 Playback Requirements” later in this chapter.

If the device supports MPEG-2 acceleration, the requirements are defined in this chapter as part of the requirements for PC 97 DVD playback.

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

Basic PC 97	*Workstation PC 97*	*Entertainment PC 97*
Required with DVD-Video	*Required with DVD-Video*	*Required*

All PC 97 systems that include DVD-Video support must also provide PC 97 playback support for DVD content, as defined in “DVD Playback Requirements” in this chapter.

4. Video input and capture

Basic PC 97	*Workstation PC 97*	*Entertainment PC 97*
Recommended	*Recommended*	*Recommended*

If implemented in a PC 97 system, video input and capture devices must meet the requirements defined in “Video Capture Requirements” in this chapter. All video input and capture devices must have WDM Imaging minidrivers that have passed WHQL testing.

Video Components Basic Requirements

This section summarizes both the basic hardware design features for video components and the specific features for PC 97.

5. General device requirements
Required

These include the standard requirements for a Plug and Play device identifier, automated software-only settings for device configuration, standard device drivers and Windows-based installation, and icons for external connectors. For more information see the "Basic PC 97" chapter of this guide.

Note To ensure proper connection by the user between VGA monitor, S-Video, and composite cables and connectors, an icon must be added to any external connector, using vendor designs or any appropriate designs provided in Appendix A, "Icons."

PC 97 Design for Video Components

This section summarizes requirements related to the design initiatives for PC 97 defined in Part 1 of this guide.

Plug and Play and Bus Design for Video Components

The items in this section summarize requirements for Plug and Play and other resource- and bus-related capabilities.

6. Plug and Play device identifier
Required

Each device must have a Plug and Play device identifier as required for the bus it uses, as defined in Part 3 of this guide. For example, a PCI device must comply with PCI v. 2.1 requirements and also provide a Subsystem ID and Subsystem Vendor ID, as defined in the "PCI" chapter in Part 3 of this guide.

7. Conflict resolution and dynamic disable capabilities
Required

The operating system must be capable of automatically assigning, disabling, and relocating the resources used by this device when necessary, using the method required for the related bus class. All configuration settings must be capable of being made through software, with no system reboot required. Changing or adding this device to the PC system must not require changing jumpers or switches on either the adapter or the system board to set resource assignments. In the event of an irreconcilable conflict with other devices on the system, the operating system must be able to disable the device to prevent the system from stalling. The device must not claim any resources while disabled.

8. Dependent MPEG device is not enumerated independently
Required

If an MPEG device is implemented as a dependent device on a multifunction adapter, it must not be enumerated independently. Instead, its parent must be responsible for installing and loading its MPEG driver and updating the registry on its behalf.

Power Management for Display Devices

This section summarizes the specific power management requirements for graphics and display devices.

9. Compliance with Device Class Power Management Reference Specification
Required

The "Device Class Power Management Reference Specification" for the display device class provides definitions of the OnNow device power states (D0–D3) for graphics adapters and monitors. The specification also covers device functionality expected in each power state and the possible Wakeup event definitions for the class, if any.

Version 1.1 Clarification:

As of **July 1, 1997,** the device must meet the requirements defined in the *Default Device Class Power Management Specification* and the *Default Device Class Power Management Specification,* as described in the clarifications to item 5 of the "Basic PC 97" chapter.

10. Support Wakeup Events defined in "Device Class Power Management Reference Specification"
Optional

For PC 97, the ability to cause a Wakeup event as defined in the "Device Class Power Management Reference Specification" for the display device class devices is an optional feature.

Device Driver and Installation for Video Components

This section summarizes the requirements for video components.

11. Device driver and installation meet Windows and Windows NT standards
Required

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 installation include the following:

- All devices and drivers must pass testing by Microsoft WHQL.
- 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-supplied 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 uses the Windows-based methods defined in the Windows 95 and Windows NT DDKs. However, any software applications included with the device can be installed using an alternate Windows-based installation method.
- Driver files provided by the vendor must not use the same file names as used by files included in Microsoft operating systems, unless specifically agreed with Microsoft.
- Only 32-bit protected-mode components are installed. No real-mode or 16-bit protected-mode components are provided in order to operate under Windows.
- Driver supports Plug and Play IRPs (for WDM drivers) or messages (for VxDs).
- If support using WDM drivers is provided in the operating system, the driver supplied by the manufacturer must be a WDM minidriver.

For complete details about standard installation requirements for drivers, see "Basic PC 97" in Part 2 of this guide.

Note Monitor support for Windows is installed using a Monitor INF file, as defined in the Windows 95 and Windows NT DDKs.

12. Applications provided with device meet Windows standards
Required

Any Windows-based applications provided with the device must meet Microsoft requirements for software compatibility as indicated by the "Designed for Microsoft Windows" logo. Applications installed with the device must use a standard Windows-based installation method, as defined in the Win32 SDK.

MPEG-1 Playback Requirements

This section summarizes the minimum requirements for all desktop systems to support MPEG-1 playback.

13. Audio and video decode performance: 30 fps, minimum

Basic PC 97	*Workstation PC 97*	*Entertainment PC 97*
Required	*Required*	*Required*

MPEG-1 audio and video decode performance with ActiveMovie must be greater than or equal to 30 frames per second (fps) as measured by the Average Frame Rate Achieved property of the ActiveMovie Video Renderer.

14. Graphics support for color space conversion and arithmetic stretching

Basic PC 97	*Workstation PC 97*	*Entertainment PC 97*
Required	*Required*	*Required*

To support accelerated software playback of motion video, the graphics subsystem must support the following capabilities:

- Hardware arithmetic stretching.

  For Basic PC 97 and Workstation PC 97, the minimum requirement is linear or better horizontal, up/down arithmetic stretching to any size window.

  For Entertainment PC 97, the minimum requirement is linear or better horizontal and bilinear or better vertical, up/down arithmetic stretching to any size window.

- YUV off-screen surfaces for color space conversion.

For more information about these requirements and other hardware acceleration requirements for the graphics subsystem, see the "Graphics Adapters" chapter in Part 4 of this guide.

Note These capabilities are not required for mobile PCs.

DVD Playback Requirements

The items in this section are requirements related to video and audio playback capabilities for a PC system that includes a DVD-ROM device and software support for DVD-Video playback. For more information about DVD requirements, see the "Storage and Related Peripherals" chapter in Part 4 of this guide.

15. PC 97 DVD playback requirements

Basic PC 97	*Workstation PC 97*	*Entertainment PC 97*
Required with DVD	*Required with DVD*	*Required*

All PC 97 systems that include DVD-ROM drives and support for DVD-Video playback using software or hardware audio/video decodes must provide DVD data format audio/video decoding and rendering using the Microsoft ActiveMovie multimedia architecture, according to the following guidelines:

- **Video requirements.** The system must decode MPEG-2 Main Profile, Main Level video streams, including the following:
  - ISO/IEC 13818-2 (video) specification at Main Profile and Main Level.
  - 10 megabit/second sustained input as the peak rate for DVD-Video content for Basic PC 97 and Workstation PC 97.

    For Entertainment PC 97, the full 15 megabit/second rate specified by the MPEG-2 industry standard is required for forward compatibility with future MPEG-2 streams, such as digital satellite broadcast.

- 720x576x30 (H/V/F) maximum sampling density.
- Test procedures defined by ISO/IEC 13818-4.

- **Audio requirements.** DVD MPEG-2 and Dolby AC-3 audio must be decoded and digitally downmixed to Dolby ProLogic-encoded stereo (2 channels, minimum). Either the original multi-channel streams or the downmixed stereo surround 2-channel streams must be available to software in PCM format. Output can use a digital connection (USB or IEEE 1394) or an analog audio connection.

  DVD audio must be mixed with other PC audio streams. Microsoft recommends digital mixing.

  The system must support MPEG-2 audio decode and output as follows:

  - ISO/IEC 13818-3 (audio) specification at Layer II.
  - 1130 kilobit/second sustained input.
  - Test procedures defined by ISO/IEC 13818-4.

- **Synchronized audio and video.** Audio and video decoders and rendering mechanisms must be in synch, but this requirement does not define whether the solution is implemented in software or hardware. A general broadcast industry guideline is that audio must not be out of synch with video by more than 45 milliseconds late (that is, 1.5 frames at 30 fps) and no more than 20 milliseconds early (0.66 of a frame at 30 fps).
- **Independent audio/video streams supported by decoder subsystem.** This is necessary for support of interactive DVD titles, plus MPEG-2 and AC-3 content from CD-ROM, the Internet, and so on.
- **WDM for MPEG-2 acceleration.** For both Windows 95 and Windows NT, MPEG-2 decode hardware acceleration must be supported using a Win32 Driver Model (WDM) audio/video decoder minidriver.

Version 1.1 Corrections:

- **Video requirements.** The system must provide backward compatibility with MainProfile@Low Level, Simple Profile@Main Level, and MPEG 1. The system must decode MPEG-2 Main Profile@Main Level video streams, including the following:

  - ISO/IEC 13818-2 (video) specification at Main Profile@Main Level.
  - A DVD-ROM device must support sustained input at peak rates of 9.8 megabit/second for all PC 97 system types.
  - Full-frame rate decode of MPEG-2 MP@ML input streams, up to and including the following frame sizes and rates:

720 × 480 at 60 fields per second
720 × 480 at 24 frames per second
720 × 576 at 50 fields per second
720 × 576 at 24 frames per second

Decoded frame rate is measured at the graphics frame buffer.

- All other video-related items remain as specified in this guide.

- **Audio requirements.** DVD MPEG-2, Dolby AC-3 audio, or both must be decoded. The original multi-channel streams, the downmixed stereo surround 2-channel streams, or the Dolby ProLogic-encoded stereo stream must be available to software in PCM format. Output can use a digital connection (USB or IEEE 1394) or an analog audio connection. DVD audio must be mixed with other PC audio streams. Microsoft recommends digital mixing. If MPEG-2 decoding is supported, the system must support MPEG-2 audio decode and output as defined in this guide.

- **Synchronized audio and video and Independent audio/video streams supported by decoder subsystem** as defined in this guide.

- **WDM for MPEG-2 acceleration.** All DVD solutions must support DirectShow 2.0 by **December 1, 1997**. This includes software, hardware-accelerated software (that is, motion compensation graphics hardware), and pure hardware solutions. For hardware MPEG-2 decoders submitted before December 1, 1997, DirectShow support on Windows 95 OSR 2.0/2.1 is not required if future availability of a WDM/DirectShow solution is documented. To ensure forward compatibility and an easy upgrade for end users, all hardware decoder solutions on Windows 95 must support WDM (and DirectShow) by **February 1, 1998**. All Windows 98 solutions must support WDM/DirectShow effective immediately.
  Therefore, the requirements and deadlines are based on logo qualification for Windows 95 versus Windows 98 as follows:

  "Designed for Windows 95" logo requirements:
  - From now until **February 1, 1998**, vendors must meet the performance requirements as defined in PC 97 and the PC 97 FAQ. Vendors can submit existing solutions, with testing to include verification that the solution upgrades smoothly to Windows 98--that is, the user must not lose functionality when Windows 98 is installed.
  - After **February 1, 1998**, Windows 95-based solutions must support DirectShow as described in the PC 97 FAQ.

  "Designed for Windows 98" logo requirements:
  - Solutions must meet the performance requirements as defined in PC 97 and PC 97 FAQ.

- The WDM+DirectShow solution must be tested using the January 1998 WHQL test kit release (no earlier test kits have this test).
- Submissions will be accepted at WHQL for the "Designed for Windows 98" logo beginning **February 1, 1998**.

Important: To get your Windows 98-based solution into the Drivers directory of the Windows 98 product CD (not in the CAB files), the driver must pass WHQL testing by **March 1, 1998**.

(Change dates: October 13, 1997; November 13, 1997)

16. No dropped or duplicated frames

Basic PC 97	*Workstation PC 97*	*Entertainment PC 97*
Recommended	*Recommended*	*Required*

No MPEG-2 video frames can be dropped or duplicated during full-screen playback. This implies that the video frame rate and VGA refresh rate are locked. This requirement guarantees a user experience equivalent to lower cost, dedicated consumer-electronics devices such as DVD players and VCRs.

It is generally accepted in the video broadcast industry that any level of frame slippage will be noticeable to viewers and will be considered an annoyance compared to the smooth viewing experience provided by standard broadcast television, VCRs, and so on.

Version 1.1 Clarification:

In this requirement, “no dropped or duplicated frames” refers to dropping or duplication for synchronization purposes. (Change date: October 13, 1997)

17. Background tasks do not interfere with DVD playback

Basic PC 97	*Workstation PC 97*	*Entertainment PC 97*
Recommended	*Recommended*	*Required*

Normal background tasks that occur during foreground, full-screen DVD playback should not interfere with the audio or video playback. This applies to background tasks initiated by applications included with the PC, such as home control, and so on.

This is a critical requirement for Entertainment PC 97 designs, whose users will rely on the PC to perform normal day-to-day operations simultaneously with non-interactive (linear) movie playback. Some specific examples of operations that must not interfere with DVD playback are the following:

- Answering the telephone to receive voicemail or fax. This applies only to telephony software included with the PC, not third-party software installed by the user. Notice that telephone answering must not be automatically disabled during DVD playback unless explicitly configured by the user.
- Running scheduled communications tasks such as automatic connection using the modem, ISDN, or LAN to transfer e-mail and faxes, download cached Internet content, and so on.

Note Programs that make intensive use of system resources or that are designed for interactive foreground operation are excluded from this requirement. This includes games, video and audio playback, speakerphone, and disk utilities, such as error checking, defragmentation, and virus protection.

18. Subpicture compositing, if DVD drive supports video discs

Required

Because of possible legal requirements to support closed captioning, DVD-Video–enabled PCs must fully support “subpictures” as defined in the DVD specification. This includes the ability to overlay an animated bitmap with the correct pixel aspect ratio onto the decoded active video with alpha blending. This might be implemented with a display adapter that has two overlay surfaces (one of which must be alpha blended), or it might be implemented by compositing in the MPEG decoder subsystem.

Version 1.1 Correction:

This title should be “Subpicture compositing, if system supports DVD-Video discs.” Subpicture streams must be supported as defined in the DVD 1.0 specification. Alpha blending is required. However, until alpha blending of overlay surfaces is implemented in Microsoft DirectDraw® and supported in DirectShow, an acceptable but visually degraded alternative is RGB chroma-keying to simulate alpha blending of subpictures and closed-captioning information appearing over motion video. (Change date: October 13, 1997)

Version 1.1 Addition:

18a. System provides a licensed CSS copyright protection scheme
Required

The system must provide a licensed copy scramble system (CSS) implementation and support for CSS encoded DVD-Video discs to ensure proper protection for content produced in accordance with CSS, including regionalization and analog video protection/analog protection system (APS). For information about CSS or to obtain a CSS license, contact MEI (see http://www.mei.co.ip)), or contact the CSS licensing entity when it is established.

To facilitate the authentication process required by this scheme, software is provided as part of the Windows and Windows NT operating system support for DVD. This allows a DVD-ROM drive to authenticate and transfer keys with a CSS decrypter. Windows and Windows NT operating system software will act as the agent to allow either hardware or software decrypters to be authenticated. (Change date: October 13, 1997)

19. All general device requirements for video components
Required

These are defined in the “Video Components Basic Requirements” and “PC 97 Design for Video Components” sections earlier in this chapter.

Video Capture Requirements

This section summarizes both the basic hardware design features for video capture and the specific features for PC 97. Video capture and playback are not required for PC 97. However, if this feature is implemented, the requirements in this section must be met.

For requirements related to digital cameras and other digital image input devices, see the "Scanners and Digital Cameras" chapter in Part 4 of this guide.

20. Wave audio capture
Recommended
If the video capture device supports wave audio capture, it must support the waveform audio command set defined in the Win32 SDK.

21. Synchronized audio and video capture clocks
Recommended
Genlock capabilities are recommended to prevent problems that occur when there is no clock communication between video and audio cards. Notice that in professional video, the audio clock is usually derived from the video clock.

22. Time code reading
Recommended
Time code is a standard representation of time developed for the video and film industries. Time code is an absolute time format expressed in hours, minutes, seconds, and frames as required by frame-accurate video editing applications.

- For NTSC-based systems, the defining standard for time code is ANSI/SMPTE 12M. Both drop and non-drop frame formats should be supported.
- For PAL-based systems, the defining standard is IEC 461. For film, the defining standard is SMPTE Recommended Practice RP 136.

23. WDM imaging minidriver
Required
Each video input or capture device must have a WDM imaging minidriver that has passed WHQL testing.

24. All general device requirements for video components
Required
These are defined in the "Video Components Basic Requirements" and "PC 97 Design for Video Components" sections earlier in this chapter.

Desktop Monitor Requirements

This section lists the hardware requirements and PC 97 features for desktop monitors.

25. Minimum graphics resolution, based on monitor size
Required

With the following higher resolutions, a larger desktop area can be displayed, more applications can be shown on the display at once, individual windows can be larger, applications can be fully displayed side by side, and so on.

- 7"–10" LCD internal monitor = 640x480
- 14"–15" external monitor or 11"–12" LCD = 800x600
- 17" monitor = 1024x768, non-interlaced
- 19"–21" monitor = 1280x1024, non-interlaced

Note These specific monitor sizes are not listed as recommended or required, but included merely to show the resolution rates expected from various monitor sizes.

26. ICC color matching support
Required; recommended for LCD

The Image Color Matching (ICC) APIs and functionality for Windows 95 are described in the Windows 95 SDK and DDK on MSDN. Windows supports using color profiles that comply with the ICC Profile Format Specification. For information, see the International Color Consortium web site at http://www.color.org.

Minimum implementation of ICC color matching requires one or more ICC profiles to be installed. Providing a monitor color calibration utility is recommended for generating, editing, and installing ICC profiles.

Eastman Kodak, the supplier of the default color matching method for ICM in Windows 95, has a wide array of advanced color management technology and products including device profiles which can be used to optimize your system. For contact information, see the “References for Video Components” section at the end of this chapter.

For PC 97, this is a recommendation for LCD, color plasma displays, or other flat panel devices. This will become a requirement.

Version 1.1 Change:
Implementation of this requirement began **September 1, 1997**. All monitors submitted to WHQL must meet the requirement in order to qualify for the logo.

Each monitor listed in the INF file must install a default image color matching (ICM) profile. Monitors with identical characteristics can share a common default profile. Monitors with unique characteristics must install a unique profile. The

INF file can be used to copy multiple profiles for a monitor, but only one can be installed as the default.

Monitors and related profiles that are received in sufficient time and qualify for the PC 97 logo will be added to the Windows 98 and Windows NT 5.0 products. Vendors are required to provide the INF file and profile in the box with the monitor. OEMs who distribute their monitors bundled with systems can preinstall the INF file and profiles and are not required to include a disk in the box. Monitors that have qualified for the PC 97 logo and are included in Windows 98 and Windows NT 5.0 will not be required to ship a disk in the box.

Information on companies capable of licensing ICC profiles or tools to generate profiles can be found at http://www.color.org. Some companies that provide ICC profile information, services, or tools include: Linotype-Hell; Sonnetech; Kodak; Agfa; Color Solutions, Inc.; Light Source; and Color Savvy Systems. This list is not exhaustive and is provided for informational purposes only. (Change dates: August 6, 1997; November 5, 1997)

27. Ergonomic timing standards: 75 Hz for 1024x768, minimum

Required

Recommended: 85 Hz for 1024x768.

The monitor must, at a minimum, support the ergonomic timings documented in VESA and Industry Standards and Guidelines for Computer Display Monitor Timing v. 1.0, revision 0.6 or higher, for all resolutions supported by the monitor (based on monitor size, as cited earlier in this section). The standards ensure a clear, flicker-free monitor display for traditional PC computing.

28. External monitor meets DDC 2.0 Level B and EDID standards

Required

This requirement is based on the Display Data Channel Standard v. 2.0, Level B (DDC2B), which defines the communication channel between the display and host system, and Extended Display Identification Data Standard 2.0 or higher, which defines data formats for configuration information. This requirement includes the following standards:

- The identification string and other EDID data that the monitor sends to the system.
- The pull-up resistor on the data clock (SCL) line.

Version 1.1 Addition:
The monitor EDID should be based on EDID, Version 1.0, Revision 1.0. Indicate the maximum resolution the monitor supports using established, standard, or (if necessary) detailed timing. If the maximum resolution can be indicated using either the established or standard timings, then you will have more flexibility in use of the detailed timing descriptor blocks.

Use of the following monitor descriptor definitions are recommended:

- **FD (monitor range).** This information is essential to enable the operating system to calculate the optimal refresh rate for any selected resolution.
- **FC (monitor name).** Up to three detailed timing blocks can be used to incorporate the company and model name. These descriptors will be concatenated together for a single string, and the blocks must be used in the order that they are to be concatenated.
- **FF (monitor serial number).** If provided, this information will be placed into the registry for easy access by asset management software.

(Change date: December 18, 1996; June 30, 1997)

29. All general device requirements for video components

Required

These are defined in the “Video Components Basic Requirements” and “PC 97 Design for Video Components” sections earlier in this chapter.

Note Monitor support for Windows is installed using a Monitor INF file, as defined in the Windows 95 and Windows NT DDKs.

Entertainment Monitor Requirements

A large monitor for use with an entertainment PC system requires a picture tube ideal for both PC graphics and television/movie video. This section defines the requirements for large-screen entertainment monitors.

Although an entertainment monitor is not required for Entertainment PC 97, a large (20" or greater) monitor that is sold with an Entertainment PC 97 system must meet the requirements defined in this section.

30. Large-screen monitor size: 20" or larger, if present in PC system
Required

Recommended: 31" or 33" (measured on the diagonal).

31. Support 800x600 at 60 Hz refresh rate
Required
DVD movies and typical satellite digital broadcasters provide main level/main profile MPEG-2 streams, which is the middle level of the five possible levels of MPEG-2–encoded video data. This translates to 720x480x30 fps for NTSC. For PAL, this translates to 720x576x25 fps. Consequently, 800x600 is the optimal resolution.

Recommended refresh rate: An integral multiple of the video frame rate, for any mode in which video is displayed full screen.

For PAL, this is an integral multiple of 25 Hz. For NTSC, this is an integral multiple of 30 Hz, with an ideal rate of 120 Hz to support 24–30 fps content. Because most broadcast video content (such as NTSC or satellite MPEG-2 video and film) is created or adjusted through temporal rescaling or pulldown (at a 3:2 ratio) expressly for 60-Hz television monitors, further pulldown to other refresh rates (such as 72 Hz) will introduce unacceptable motion artifacts, such as non-linear screen motion.

32. Monitor meets current DDC2B and EDID standards
Required
This is the same requirement as for desktop monitors.

Version 1.1 Addition:
The monitor EDID should be based on EDID, Version 1.0, Revision 1.0. Indicate the maximum resolution the monitor supports using established, standard, or (if necessary) detailed timing. If the maximum resolution can be indicated using either the established or standard timings, then you will have more flexibility in use of the detailed timing descriptor blocks.

Use of the following monitor descriptor definitions are recommended:

- **FD (monitor range).** This information is essential to enable the operating system to calculate the optimal refresh rate for any selected resolution.
- **FC (monitor name).** Up to three detailed timing blocks can be used to incorporate the company and model name. These descriptors will be concatenated together for a single string, and the blocks must be used in the order that they are to be concatenated.
- **FF (monitor serial number).** If provided, this information will be placed into the registry for easy access by asset management software.

(Change date: December 18, 1996; June 30, 1997)**33. DDC2B-compliant host control and digitally controlled geometry**
Required
Version 1.1 Change:
Recommended
The host control of the monitor should be managed using DDC2B-compatible adapters and drivers. This requirement is based on the Display Data Channel

Standard 2.0, which defines the communication channel between the display and host system.

Geometry control is necessary for adjustment of PC-TV images, and includes these controls: skew, pin cushion, size, brightness, contrast, and position. Geometry control must be provided through a software application, rather than through dials on the monitor case. Controls must be revealed through a driver with a remote-controllable user interface.

34. ICC color matching support

Required

This is the same requirement as for desktop monitors.

Version 1.1 Change:
Implementation of this requirement began **September 1, 1997**. All monitors submitted to WHQL must meet the requirement in order to qualify for the logo.

Each monitor listed in the INF file must install a default image color matching (ICM) profile. Monitors with identical characteristics can share a common default profile. Monitors with unique characteristics must install a unique profile. The INF file can be used to copy multiple profiles for a monitor, but only one can be installed as the default.

Monitors and related profiles that are received in sufficient time and qualify for the PC 97 logo will be added to the Windows 98 and Windows NT 5.0 products. Vendors are required to provide the INF file and profile in the box with the monitor. OEMs who distribute their monitors bundled with systems can preinstall the INF file and profiles and are not required to include a disk in the box. Monitors that have qualified for the PC 97 logo and are included in Windows 98 and Windows NT 5.0 will not be required to ship a disk in the box.

Information on companies capable of licensing ICC profiles or tools to generate profiles can be found at http://www.color.org. Some companies that provide ICC profile information, services, or tools include: Linotype-Hell; Sonnetech; Kodak; Agfa; Color Solutions, Inc.; Light Source; and Color Savvy Systems. This list is not exhaustive and is provided for informational purposes only. (Change dates: August 6, 1997; November 5, 1997)

Design Note for Dot Pitch Limits

Dot pitch requirements are not specified in this version of PC 97, because dot pitch depends on resolution and size. Also, design features other than dot pitch contribute to usability for PC applications, such as focus and phosphor. However, the following table defines limits depending on monitor size.

Microsoft might add a dot pitch requirement based on image tests in a later version of these specifications.

800x600 Dot Pitch Limits

Monitor size (inches)	Actual size (inches)	Horizontal size (inches)	Vertical size (inches)	Maximum dot pitch (mm)
13.00	11.74	9.39	7.04	0.30
14.00	12.72	10.18	7.63	0.32
15.00	13.70	10.96	8.22	0.35
17.00	15.66	12.53	9.40	0.40
21.00	19.58	15.66	11.75	0.50
25.00	23.50	18.80	14.10	0.60
27.00	25.46	20.37	15.28	0.65
31.00	29.38	23.50	17.63	0.75
33.00	31.34	25.07	18.80	0.80
35.00	33.30	26.64	19.98	0.85
37.00	35.26	28.21	21.16	0.90

References for Video Components

This section lists some of the publications, services, and tools available to help build hardware that works with Windows operating systems.

Windows NT DDK, Windows 95 DDK, and DirectX DDK
Microsoft Developer Network (MSDN)

Display Data Channel Standard 2.0 (includes VBE/DDC)
Extended Display Identification Data Standard 2.0 (or higher)
VESA and Industry Standards and Guidelines for Computer Display Monitor Timing
Video Electronics Standards Association
2150 North First Street, Suite 440
San Jose, CA 95131-2029 USA
Phone: (408) 435-0333
Fax: (408) 435-8225
http://www.vesa.org

International Color Consortium
ICC Profile Format Specification
http://www.color.org

Eastman Kodak, Attn: Color Management Group
164 Lexington Road
Billerica, MA 01821 USA
Phone (North America only): (800) 752-6567

Device Class Power Management Reference Specification
http://www.microsoft.com/hwdev/onnow.htm

Version 1.1 References Update:
Advanced Television Systems Committee (ATSC) standards
National Association of Broadcasters, (800) 368-5644
Society of Motion Picture and Television Engineers, (914) 761-1100
E-mail: mktg@smpte.org
http://www.atsc.org

ANSI/SMPTE 12M
SMPTE Recommended Practice (RP) 136 and time-code standards
Society of Motion Picture and Television Engineers
595 West Hartsdale Avenue
White Plains, NY 10607-1824
http://www.smpte.org/stds/stsubj.html

DirectDraw VPE and kernel-mode video transport white papers
http://www.microsoft.com/hwdev/devdes/

DTV and broadcast architecture white papers
http://www.microsoft.com/hwdev/desinit/bcast1.htm
http://www.microsoft.com/windows/tv/

DVD Specification, Version 1.0, Toshiba Corporation
http://www.toshiba.com

EIA Standard #ANSI/EIA-516-1988: "Joint EIA/CVCC Recommended Practice for Teletext: North American Basic Teletext Specification (NABTS)."
Electronic Industries Association
2500 Wilson Boulevard
Arlington, VA 22201-3834
http://www.eia.org/

IEC Publication 461
http://www.iec.ch/

Matsushita Electronics Incorporated (MEI) test disc
http://www.mei.co.jp

PC Card Standard Guidelines, Volume 10 (PC Card standards)
PCMCIA
2635 North First Street, Suite 209
San Jose, CA 95134 USA
Phone: (408) 433-2273
Fax: (408) 433-9558
E-mail: office@pcmcia.org
http://www.pc-card.com/

SFF 8090 (Mt. Fuji specification) and other SFF specifications
FaxAccess: (408) 741-1600 (fax-back)
Fax: (408) 867-2115
ftp://fission.dt.wdc.com/pub/standards/SFF/specs/

Video Essentials test disc from Joe Kane Productions, Inc.
http://www.videoessentials.com/

WDM driver support white papers
http://www.microsoft.com/hwdev/desinit/

Windows NT DDK, Windows DDK, and DirectX DDK and SDK, including NDIS and broadcast services documentation
MSDN Professional membership

Display Data Channel Standard, Version 2.0, Level B (includes VBE/DDC)
Extended Display Identification Data (EDID) Standard, Version 2.0, Revision 1.0
VESA and Industry Standards and Guidelines for Computer Display Monitor Timing, Version 1.0, Revision 0.6
Video Electronics Standards Association (VESA)
2150 North First Street, Suite 440
San Jose, CA 95131-2029 USA
Phone: (408) 435-0333
Fax: (408) 435-8225
http://www.vesa.org

Display Device Class Power Management Reference Specification, Version 1.0
http://www.microsoft.com/hwdev/onnow.htm

International Color Consortium
ICC Profile Format specification
http://www.color.org

Universal Serial Bus Monitor Control Class Specification, Version 1.0
Phone: (503) 264-0590
Fax: (503) 693-7975
http://www.usb.org

Windows NT DDK, Windows DDK, DirectX DDK, and Win32 SDK
MSDN Professional membership

Checklist for Video Components

Basic PC 97	*Workstation PC 97*	*Entertainment PC 97*
System Requirements for Video Components		
1. DDC 2.0 Level B-compliant color display with unique EDID identifier		
Required	*Required*	*Required*
2. System supports MPEG-1 playback		
Required	*Required*	*Required*
3. PC 97 DVD playback requirements, if PC system includes DVD-Video		
Required with DVD-Video	*Required with DVD-Video*	*Required*
4. Video input and capture		
Recommended	*Recommended*	*Recommended*
Video Components Basic Requirements		
5. General device requirements		
Required		
PC 97 Design for Video Components		
Plug and Play and Bus Design for Video Components		
6. Plug and Play device identifier		
Required		
7. Conflict resolution and dynamic disable capabilities		
Required		
8. Dependent MPEG device is not enumerated independently		
Required		
Power Management for Display Devices		
9. Compliance with Device Class Power Management Reference Specification		
Required		
10. Support Wakeup Events defined in "Device Class Power Management Reference Specification"		
Optional		
Device Driver and Installation for Video Components		
11. Device driver and installation meet Windows and Windows NT standards		
Required		
12. Applications provided with device meet Windows standards		
Required		
MPEG-1 Playback Requirements		
13. Audio and video decode performance: 30 fps, minimum		
Required	*Required*	*Required*
14. Graphics support for color space conversion and arithmetic stretching		
Required	*Required*	*Required*
DVD Playback Requirements		
15. PC 97 DVD playback requirements		
Required with DVD	*Required with DVD*	*Required*
16. No dropped or duplicated frames		
Recommended	*Recommended*	*Required*

Basic PC 97	Workstation PC 97	Entertainment PC 97
17. Background tasks do not interfere with DVD playback		
Recommended	*Recommended*	*Required*
18. Subpicture compositing, if DVD drive supports video discs		
Required		
18a. System provides a licensed CSS copyright protection scheme		
Required		
19. All general device requirements for video components		
Required		
Video Capture Requirements		
20. Wave audio capture		
Recommended		
21. Synchronized audio and video capture clocks		
Recommended		
22. Time code reading		
Recommended		
23. WDM imaging minidriver		
Required		
24. All general device requirements for video components		
Required		
Desktop Monitor Requirements		
25. Minimum graphics resolution, based on monitor size		
Required		
26. ICC color matching support		
Required		
Recommended for LCD		
27. Ergonomic timing standards: 75 Hz for 1024x768, minimum		
Required		
28. External monitor meets DDC 2.0 Level B and EDID standards		
Required		
29. All general device requirements for video components		
Required		
Entertainment Monitor Requirements		
30. Large-screen monitor size: 20" or larger, if present in PC system		
Required		
31. Support 800x600 at 60 Hz refresh rate		
Required		
32. Monitor meets current DDC2B and EDID standards		
Required		
33. DDC2B-compliant host control and digitally controlled geometry		
Recommended		
34. ICC color matching support		
Required		