

# Monitors

This chapter presents the PC 98 requirements and recommendations for display monitors.

Requirements for graphics adapters and television output capabilities are defined in the “Graphics Adapters” chapter in Part 4 of this guide. For issues related to liquid crystal displays (LCDs), see the “Mobile PC 98” chapter in Part 2 of this guide.

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## Design Note for Dot-Pitch Limits

Dot-pitch requirements are not specified for PC 98 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 based on monitor size.

### 800 × 600 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

## Monitor Basic Features

This section summarizes the basic PC 98 design requirements for mobile, desktop, and entertainment monitors.

### 1. Color monitor is DDC2B-compliant with unique EDID identifier

*Consumer PC 98*

*Office PC 98*

*Entertainment PC 98*

*Required*

*Required*

*Required*

A monitor designed for or included with a PC 98 system must be compliant with *Display Data Channel Standard, Version 2.0*, Level B (DDC2B), which defines the communications channel between the display and host system.

The monitor also must transmit an EDID structure containing unique ID Manufacturer Name and ID Product Code identifiers, plus all required fields as defined in Section 3 of *Extended Display Identification Data Standard, Version 2.0, Revision 1.0* or higher.

## 2. Monitor supports ICC color matching

*Required*

Windows and Windows NT support using color profiles that comply with the International Color Consortium (ICC) Profile Format specification. The Image Color Matching (ICM) APIs and functionality for Windows and Windows NT are described in the Win32 SDK and the Windows NT 5.0 DDK.

For PC 98, color-capable devices such as desktop monitors, printers, scanners, still-image cameras, LCDs, color plasma displays, or other flat-panel devices are required to install one or more ICC profiles for ICC color matching. A monitor color-calibration utility is recommended for generating, editing, and installing ICC profiles. The sRGB profile will be distributed in Windows and Windows NT.

This is also a PC 98 requirement for LCDs, color plasma displays, and other flat-panel devices.

## 3. Monitor meets all PC 98 general device and driver requirements

*Required*

This includes the basic requirements for a Plug and Play device ID, automated software-only settings for device configuration, device drivers and Windows-based installation, and icons for external connectors. For more information, see the “Basic PC 98” chapter in Part 2 of this guide.

The manufacturer does not need to supply a driver if a PC 98-compliant driver provided with the operating system can be used. If the manufacturer supplies a driver, the requirements for the device driver and installation are defined in the “Basic PC 98” chapter in Part 2 of this guide. The PC 98 requirements include driver support for unattended installation and Help file support if special driver parameters are used.

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

## Desktop Monitor Requirements

This section lists the PC 98 hardware requirements and features for desktop monitors.

### **4. Monitor meets 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.

- 14-inch to 15-inch external monitor or built-in mobile PC display =  $800 \times 600$
- 17-inch external monitor or 13-inch to 15-inch LCD =  $1024 \times 768$ , non-interlaced
- 19-inch to 21-inch monitor =  $1280 \times 1024$ , non-interlaced

**Note:** These specific monitor sizes are not listed as recommended or required; they merely show the expected resolution.

### **5. Monitor supports ergonomic timing standards**

*Required*

Recommended: 85 Hz for  $1024 \times 768$ .

The monitor must, at a minimum, support the ergonomic timings documented in *VESA and Industry Standards and Guidelines for Computer Display Monitor Timing Version 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 display for traditional PC computing.

## Entertainment Monitor Requirements

The 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 98, a large-screen monitor that is sold with an Entertainment PC 98 system must meet the requirements defined in this section.

### **6. Large-screen monitor is 20 inches or larger if included with an Entertainment PC system**

*Required*

Recommended: 31 inches or 33 inches, measured on the diagonal.

**7. Large-screen monitor is 16:9 if included with an Entertainment PC system***Recommended*

Recommended: Support 1280 × 720 resolution at 60 Hz.

The 16:9 ratio supports the output capabilities for high-definition television (HDTV) display.

**8. Entertainment monitor supports 800 × 600 at 60 Hz refresh rate***Required*

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

DVD movies and typical satellite digital broadcasts 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 720 × 480 × 30 fps for NTSC and 720 × 576 × 25 fps for PAL. Consequently, 800 × 600 is the optimal resolution.

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 to 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 expressly for 60-Hz television monitors (at a 3:2 ratio), further pulldown to other refresh rates (such as 72 Hz) will introduce unacceptable motion artifacts, such as non-linear screen motion.

**9. Entertainment monitor's host control is DDC2B-compliant, with digitally controlled geometry***Recommended*

The host control of the monitor should be managed using DDC2B-compatible adapters and drivers. This recommendation is based on DDC2B, which defines the communications channel between the display and host system.

Geometry control is necessary for adjustment of PC television images and includes the following controls: skew, pin cushion, size, brightness, contrast, and position. If implemented, 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.

## Plug and Play Design for Monitors

The items in this section summarize PC 98 requirements for Plug and Play.

### **10. External monitor meets DDC2B and EDID standards**

*Required*

This requirement is based on DDC2B, which defines the communications channel between the display and host system, and on the EDID standard, which defines data formats for configuration information. This requirement includes the identification string and other EDID data that the monitor sends to the system.

Use the established standard or (if necessary) detailed timings to indicate the maximum resolution that the monitor will support. Using either the established or standard timings will result in greater flexibility when using detailed timing descriptor blocks.

The following are monitor descriptor definitions:

- **FD (monitor range)**. This information is essential for enabling 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 for a single string, and the blocks must be used in the order in which 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.

## Power Management for Monitors

This section summarizes the specific power management requirements for monitors.

### **11. Monitor complies with device class power management reference specification**

*Required*

The *Display Device Class Power Management Reference Specification, Version 1.0* or higher, 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 wake-up event definitions for the class, if any. Monitors must support the D0, D2, and D3 power states. The D1 power state is optional for monitors.

## Monitors References

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

*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 Monitors

If a recommended feature is implemented, it must meet the PC 98 requirements for that feature as defined in this document.

<b>Consumer PC 98</b>	<b>Office PC 98</b>	<b>Entertainment PC 98</b>
1. Color monitor is DDC2B-compliant with unique EDID identifier <i>Required</i>	<i>Required</i>	<i>Required</i>
2. Monitor supports ICC color matching <i>Required</i>		
3. Monitor meets all PC 98 general device and driver requirements <i>Required</i>		
4. Monitor meets minimum graphics resolution, based on monitor size <i>Required</i>		
5. Monitor supports ergonomic timing standards <i>Required</i>		
6. Large-screen monitor is 20 inches or larger, if included with an Entertainment PC system <i>Required</i>		
7. Large-screen monitor is 16:9, if included with PC system <i>Recommended</i>		
8. Entertainment monitor supports 800 × 600 at 60 Hz refresh rate <i>Required</i>		
9. Entertainment monitor's host control is DDC2B-compliant, with digitally controlled geometry <i>Recommended</i>		
10. External monitor meets DDC2B and EDID standards <i>Required</i>		
11. Monitor complies with device class power management reference specification <i>Required</i>		